TM 9-2320-302-20-1

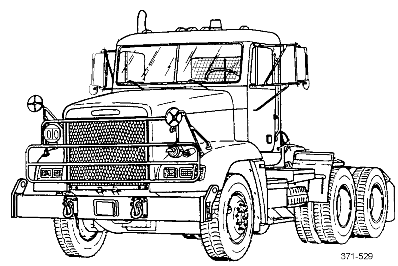
UNIT MAINTENANCE MANUAL

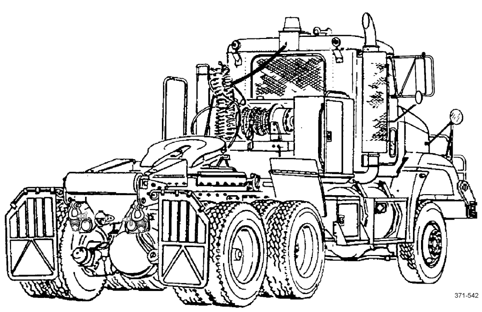
FOR

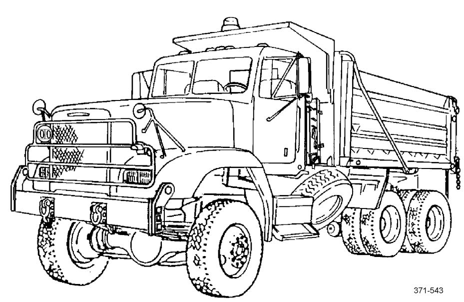
TRUCK, TRACTOR, LINE HAUL:
52,000 GVWR, 6 X 4, M915A3
(NSN 2320-01-432-4847) (EIC: B4L)

TRUCK, TRACTOR, LIGHT EQUIPMENT TRANSPORTER (LET):
68,000 GVWR, 6 X 6, W/WINCH, M916A3
(NSN 2320-01-488-6962) (EIC: B4P)

TRUCK, DUMP, HEAVY, CHASSIS:
68,000 GVWR, 6 X 6, 14 CU YD, ON-OFF HIGHWAY
M917A2 (NSN 3805-01-488-7442) (EIC: BPB)
M917A2 W/MCS (NSN 3805-01-488-6963) (EIC: BA4)







SUPERSEDURE NOTICE - This manual supersedes TM 9-2320-302-20, dated 28 May 2001.

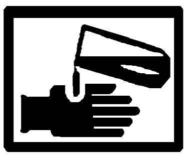
HEADQUARTERS, DEPARTMENT OF THE ARMY

FEBRUARY 2006

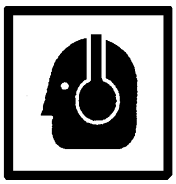
WARNING SUMMARY

This warning summary contains general safety warnings and hazardous materials warnings that must be understood and applied during operation and maintenance of this equipment. Failure to observe these precautions could result in serious injury or death to personnel. Also included are explanations of safety and hazardous materials icons used within the technical manual.

BIOLOGICAL - abstract symbol bug shows that a material may contain bacteria or viruses that present a danger to life or health.

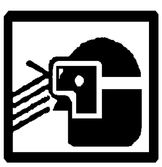


CHEMICAL - drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.



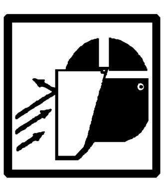
EAR PROTECTION - headphones over ears shows that noise level will harm ears.

ELECTRICAL - electrical wire to arm with electricity symbol running through human body shows that shock hazard is present.



EYE PROTECTION - person with goggles shows that the material will injure the eyes.

FIRE - flame shows that a material may ignite and cause burns.



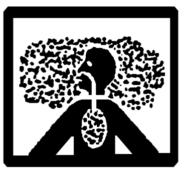
FLYING PARTICLES - arrows bouncing off face with face shield shows that particles flying through the air will harm face.

HEAVY OBJECT - human figure stooping over heavy object shows physical injury potential from improper lifting technique.

HEAVY PARTS - hand with heavy object on top shows that heavy parts can crush and harm.

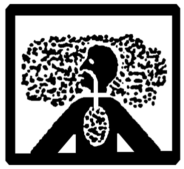
HEAVY PARTS - heavy object on human figure shows that heavy parts present a danger to life or limb.

HOT AREA - hand over object radiating heat shows that part is hot and can burn.



VAPOR - human figure in a cloud shows that material vapors present a danger to life or health.

FOR INFORMATION ON FIRST AID, REFER TO FM 4-25.11.



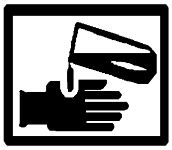
WARNING

CARBON MONOXIDE (EXHAUST GASES) CAN KILL!

- Carbon monoxide is a colorless, odorless, deadly poison which, when breathed, deprives the body of oxygen and causes suffocation. Exposure to air containing carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, and coma. Permanent brain damage or death can result from severe exposure.
- Carbon monoxide occurs in exhaust fumes of internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of inadequate ventilation. The following precautions must be observed to ensure safety of personnel when engine of truck is operated.

1. DO NOT operate vehicle in an enclosed area unless exhaust is vented to outside atmosphere.
2. DO NOT drive truck with inspection plates or cover plates removed.
3. BE ALERT for exhaust poisoning symptoms. They are:
   - Headache
   - Dizziness
   - Sleepiness
   - Loss of muscular control
4. If you see another person with exhaust poisoning symptoms:
   - Remove person from area.
   - Expose to fresh air.
   - Keep person warm.
   - Do not permit physical exercise.
   - Administer cardiopulmonary resuscitation (CPR), if necessary.
   - Notify a medic.
5. BE AWARE. The field protective mask for nuclear-biological-chemical (NBC) protection will not protect you from carbon monoxide poisoning.

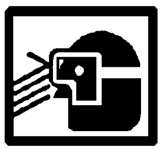
The Best Defense Against Carbon Monoxide Poisoning Is Good Ventilation!

WARNING

ADHESIVES AND SEALING COMPOUNDS

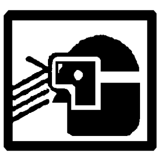
Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound contacts skin or clothing, wash immediately with soap and water.



WARNING

AIR LINES AND FITTINGS

- DO NOT disconnect any air system lines or fittings unless vehicle engine is shut down and air system pressure is relieved. Failure to follow this warning could result in serious injury to personnel.
- Ensure that all air lines and fittings are clear of debris and excess pipe sealing compound does not enter air lines or fittings. Failure to follow this warning could result in injury to personnel and damage to equipment.
- Always wear eye protection when disconnecting air lines. Residual air will be expelled. Failure to follow this warning may result in serious eye injury.

WARNING

BATTERIES

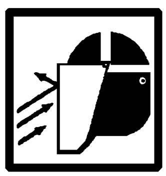
- To avoid eye injury, eye protection is required when working around batteries. DO NOT smoke, use open flame, make sparks or create other ignition sources around batteries. If a battery is giving off gases, it can explode and cause injury to personnel. Remove all jewelry such as rings, ID tags, watches, and bracelets. If jewelry or a tool contacts a battery terminal, a direct short will result in instant heating, injury to personnel, and damage to equipment.
- Sulfuric acid contained in batteries can cause serious burns. Always wear goggles, gloves, and apron. If battery corrosion or electrolyte makes contact with skin, eyes or clothing, take immediate action to stop the corrosive burning effects. Failure to follow these procedures may result in death or serious injury to personnel.

   1. **Eyes.** Flush with cold water for no less than 15 minutes and seek medical attention immediately.
   2. **Skin.** Flush with large amounts of cold water until all acid is removed. Seek medical attention as required.
   3. **Internal.** If corrosion or electrolyte is ingested, drink large amounts of water or milk. Follow with milk of magnesia, beaten egg or vegetable oil. Seek medical attention immediately.
   4. **Clothing/Equipment.** Wash area with large amounts of cold water. Neutralize acid with baking soda or household ammonia.

WARNING

BRAKES

- When caging brakes, block wheels to keep truck from moving when brakes are released. Failure to follow this warning may result in death or injury to personnel or damage to equipment.
- Brake chamber contains spring under great pressure. To prevent personnel injury, never work directly behind chamber. If caging bolt will not engage properly, spring may be broken.
- DO NOT remove clamp ring around spring brake chamber. It is under tension and can cause personnel injury if released.
- When spring brakes are applied, vehicle will stop quickly which could result in injury to personnel. Also, vehicle cannot be driven again until malfunction is repaired and enough air supply is present for operation of service brakes.
- Brakeshoe linings and inside drum friction surface must be free of all oil/grease and other contaminants prior to assembly to ensure maximum braking capability. Oil/grease and other contaminants may compromise braking that could lead to a serious accident resulting in injury and/or death.

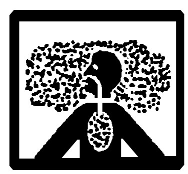


WARNING

COMPRESSED AIR

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

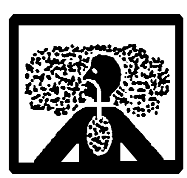
WARNING

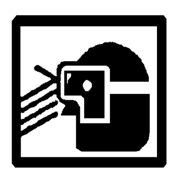


DIESEL FUEL HANDLING

- DO NOT perform fuel system checks, inspections or maintenance while smoking or near fire, flames or sparks. Fuel may ignite, causing injury or death to personnel and damage to vehicle.
- Fuel vapors are toxic. Avoid prolonged exposure or breathing of fumes. Work in a well-ventilated area. Failure to follow this warning could result in serious injury to personnel.
- Personnel must wear fuel-resistant gloves when handling fuels. If exposed to fuel, promptly wash exposed skin and change fuel-soaked clothing.

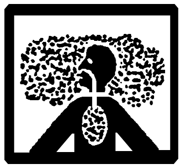
WARNING





ETHER QUICK-START SYSTEM

Ether fuel is extremely flammable and toxic. DO NOT smoke and make sure you are in a well-ventilated area away from heat, open flames or sparks. Wear goggles and chemical resistant gloves. Avoid contact with skin and eyes and avoid breathing vapors. If fluid enters or fumes irritate the eyes, wash immediately with large quantities of clean water for 15 minutes. Seek medical attention immediately if ether is inhaled or causes eye irritation. Failure to follow this warning may cause death or serious injury to personnel.



WARNING

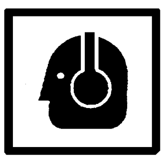
FIRE EXTINGUISHER

Discharging large quantities of dry chemical fire extinguisher in cab may result in temporary breathing difficulty during and immediately after the discharge event. If at all possible, discharge fire extinguisher from outside the cab. Avoid unnecessary contact during use and cleanup. Contact local medical personnel to determine necessary personal protective equipment to wear during cleanup.

WARNING

HAZARDOUS WASTE DISPOSAL

When servicing this vehicle, performing maintenance, or disposing of materials such as engine coolant, transmission fluid, lubricants, battery acids or batteries, and CARC paint, consult your unit/local hazardous waste disposal center or safety office for local regulatory guidance. If further information is needed, please contact The Army Environmental Hotline at 1-800-872-3845.



WARNING

HEARING PROTECTION

Hearing protection is required when operating vehicle at more than 40 mph (64 kph) with windows open for an extended period of time. Hearing protection is also required when personnel are within 5.2 ft (1.57 m) of vehicle when operating at low engine idle (600 rpm) and within 16.5 ft (5 ft) of vehicle when operating at high idle (1600 rpm). Failure to follow this warning may result in hearing damage.

WARNING

NBC EXPOSURE

If NBC exposure is suspected, all air cleaner media should be handled by personnel wearing protective equipment. Consult your NBC Officer or NBC NCO for appropriate handling or disposal procedures.

WARNING

IF NBC EXPOSURE IS SUSPECTED ALL AIR FILTER MEDIA WILL BE HANDLED BY PERSONNEL WEARING FULL NBC PROTECTIVE EQUIPMENT. SEE OPERATOR/ MAINTENANCE MANUAL.

7690-01-114-3702

To order this NBC decal use:

National Stock Number (NSN) - 7690-01-114-3702
Part Number (PN) - 12296626
Commercial and Government Entity Code (CAGEC) - 19207

WARNING

PRESSURIZED COOLING SYSTEM

DO NOT remove radiator cap or drain antifreeze unless engine is cold. Remove radiator cap in two steps. First, place a thick cloth over cap and slowly turn cap left to first stop. Pause and allow pressure to escape. Turn cap further left until it can be removed. This is a pressurized cooling system and escaping steam, hot water or coolant will cause serious burns.

WARNING

R-134A REFRIGERANT

- Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Use care to prevent refrigerant from touching your skin or eyes. Serious injury or blindness may result if you come in contact with refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury.
- DO NOT work in an area where refrigerant may contact an open flame or burning material such as a cigarette. When refrigerant contacts extreme heat, refrigerant breaks down into poisonous phosgene gas which, if breathed, causes severe respiratory irritation. DO NOT breathe fumes from an open flame leak detector.

WARNING

SLAVE STARTING

- When slave starting truck, use NATO slave cable that DOES NOT have loose or missing insulation.
- DO NOT proceed if suitable cable is not available.
- DO NOT use civilian-type jumper cables.
- Failure to follow this warning may result in injury.

WARNING

TIRE CHANGING

Whenever wheel lug nuts require tightening or a wheel has been removed and replaced, lug nuts must be tightened to the required torque. Failure to follow this warning may result in serious injury to personnel and damage to equipment.

WARNING

TOWING

Brakes will be released when air is applied to a disabled vehicle. DO NOT connect air lines to a disabled vehicle without blocking wheels and connecting tow bar between vehicles. Failure to follow this warning could result in death or injury to personnel and damage to equipment.

WARNING

WINCH

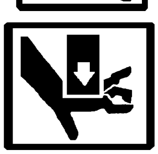
Always wear heavy gloves when handling winch cables. Never allow cable to run through hands; frayed cables can cut.

WARNING

WORK SAFETY

- Hydraulic jack is intended only for lifting truck, not for supporting vehicle to perform maintenance. DO NOT get under truck after it is raised unless it is properly supported with blocks or jackstands. Failure to observe this warning may result in death or injury to personnel.

- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.



- Improper use of lifting equipment and improper attachment of cables to vehicle can result in serious personnel injury and equipment damage. Observe all standard rules of safety.

- ALWAYS install hood prop after opening hood. Failure to follow this warning could result in severe injury to personnel.

LIST OF EFFECTIVE PAGES/WORK PACKAGES

Dates of issue for original and change pages/work packages are:

Original	28 May 2001
Revision	24 February 2006

TOTAL NUMBER OF VOLUMES IS 2. TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 104 AND TOTAL NUMBER OF WORK PACKAGES IS 306 CONSISTING OF THE FOLLOWING:

Page/WP No.	*Change No.
VOLUME I	
Cover (Back Blank)	0
a to h	0
A (B Blank)	0
i to xi (xii Blank)	0
WP 0001 00 to 0020 00	0
Index-1 through Index-4	0
Authentication Page (Back Blank)	0
Sample DA Form 2028	0
DA Form 2028	0
Metric Conversion Chart	0
Back Cover	0
VOLUME II	
Cover (Back Blank)	0
a to h	0
A (B Blank)	0
i to xi (xii Blank)	0
WP 0021 00 to 0306 00	0
Index-1 thru Index-16	0
Foldouts FO-1 thru FO-14	0
Authentication Page (Back Blank)	0
Sample DA Form 2028	0
DA Form 2028	0
Metric Conversion Chart	0
Back Cover	0

* Zero in this column indicates an original page or work package.

TECHNICAL MANUAL
TM 9-2320-302-20-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 24 February 2006

UNIT MAINTENANCE MANUAL

FOR

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TRUCK, TRACTOR, LIGHT EQUIPMENT
TRANSPORTER (LET):
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TRUCK, DUMP, HEAVY, CHASSIS:
68,000 GVWR, 6 X 6, 14 CU YD, ON-OFF HIGHWAY
M917A2 (NSN 3805-01-488-7442) (EIC: BPB)
M917A2 W/MCS (NSN 3805-01-488-6963) (EIC: BA4)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (*Recommended Changes to Equipment Technical Publications*), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is https://aeps.ria.army.mil/. The DA Form 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or e-mail your letter or DA Form 2028 direct to: AMSTA-LC-LPIT/TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The e-mail address is: TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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Table of Contents - Continued

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CHAPTER 2 UNIT TROUBLESHOOTING PROCEDURES

VOLUME II

CHAPTER 3 UNIT MAINTENANCE INSTRUCTIONS

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Electrical - Continued

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Table of Contents - Continued

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Frame and Towing Attachments - Continued

Springs and Shock Absorbers

Body, Cab, and Hood

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Table of Contents - Continued

Page Number

CHAPTER 4 SUPPORTING INFORMATION

HOW TO USE THIS MANUAL

INTRODUCTION

1. This manual is designed to help you maintain the M915 Family of Vehicles.
2. This manual covers the following models:
   a. M915A3 Tractor Truck (Old Model)
   b. M915A3 Tractor Truck (New Model)
   c. M916A3 Tractor Truck
   d. M917A2 Dump Truck
   e. M917A2 w/MCS Dump Truck
3. The terms M915A3 Old Model and M915A3 New Model will be used when model differences must be identified.
   a. M915A3 Old Model = Serial #'s up to H77205 and vehicle J64175 only.
   b. M915A3 New Model = Serial #'s starting with J21548.

FEATURES OF THIS MANUAL:

- A Table of Contents is provided at the beginning of this manual.
- WARNINGs, CAUTIONs, NOTEs, subject headings, and other important information are highlighted in **BOLD** print as a visual aid.

WARNING

A WARNING indicates a hazard which results in death or serious injury.

CAUTION

A CAUTION is a reminder of safety practices or directs attention to usage practices that may result in damage to equipment.

NOTE

A NOTE is a statement containing information that will make the procedures easier to perform.

- Statements and words of particular importance are printed in CAPITAL LETTERS to create emphasis.
- Instructions are located with illustrations that show the specific task on which the mechanic is working.
- Dashed leader lines used in illustrations indicate that called out items are not visible (i.e. they are located within the structure). Dashed leader lines in the Lubrication Chart indicate that lubrication is required on BOTH sides of the equipment.
- Technical instructions include metric units in addition to standard units. A metric conversion chart is provided on the inside back cover.
- An alphabetical index is provided at the end of the manual to assist in locating information not readily found in the Table of Contents.
- Numbers located at lower right corner of art (e.g. 371-529, 371-530, etc.) are art control numbers and are used for tracking purposes. Disregard these numbers.

FOLLOW THESE GUIDELINES WHEN YOU USE THIS MANUAL:

- Read through this manual and become familiar with its contents before attempting to maintain the vehicle.
- A Warning Summary is provided at the beginning of this manual and should be read before attempting to maintain the vehicle.

CHAPTER 1
GENERAL INFORMATION, EQUIPMENT DESCRIPTION, AND THEORY OF OPERATION

GENERAL INFORMATION 0001 00

SCOPE

1. **Type of Manual.**
   a. This manual is for use in performing Unit Maintenance on the M915 Family of Vehicles, to include the chassis of the M917A2 and M917A2 w/MCS (Material Control System) dump truck.
   b. For maintenance of the M917A2 and M917A2 w/MCS dump truck body, refer to TM 5-3805-264-14&P.
2. **Equipment Name and Model Number.**
   a. Truck, Tractor, Line Haul: 52,000 GVWR, 6 X 4, M915A3.
   b. Truck, Tractor, Light Equipment Transporter (LET): 68,000 GVWR, 6 X 6, w/Winch, M916A3.
   c. Truck, Dump, Heavy, Chassis: 68,000 GVWR, 6 X 6, 14 Cu Yd, On-Off Highway, M917A2 and M917A2 w/MCS.
3. **Purpose of Equipment.**
   a. The M915A3 truck tractor is a 6 X 4 prime movers of semitrailers used primarily to transport containers, bulk cargo, and petroleum products over primary and secondary roads under worldwide climatic conditions in a military environment.
   b. The M916A3 truck tractor is a 6 X 6 prime mover of low-bed semitrailers used primarily to transport heavy engineer equipment over primary and secondary roads, and off-road, under worldwide climatic conditions.
   c. The M917A2 and M917A2 w/MCS are 6 X 6 dump trucks used to transport, dump, or spread asphalt, aggregate, dirt, and similar materials over primary and secondary roads and off-road.

MAINTENANCE FORMS, RECORDS, AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, *Functional User's Manual for the Army Maintenance Management System (TAMMS*), as contained in the Maintenance Management Update.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRS)

If your truck needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF Form 368 *(Product Quality Deficiency Report)*. Mail it to us at: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-LMIT, Rock Island, Illinois 61299-7630. We will send you a reply.

CORROSION PREVENTION AND CONTROL (CPC)

1. Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.
2. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of these materials may be a corrosion problem.
3. If a corrosion problem is identified, it can be reported using SF Form 368 *(Product Quality Deficiency Report)*. Use of key words such as "corrosion," "rust," "deterioration," or "cracking" will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA Pam 738-750.

OZONE DEPLETING SUBSTANCES (ODS)

Listing to be provided by requiring activity.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

For destruction of Army materiel to prevent enemy use, refer to TM 750-244-6.

PREPARATION FOR STORAGE OR SHIPMENT

For loading M915A3/M967A2 tractor-trailer combination onto a RO/RO ship, if degree transition exceeds 10 degrees remove fuel tank step assembly (WP 0222 00).

For additional preparation for storage or shipment procedures, refer to TM 740-90-1 and MIL-V-62038E.

WARRANTY INFORMATION

The vehicle is warranted by Freightliner Corporation in accordance with TB 9-2320-302-15. Warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

NOMENCLATURE CROSS-REFERENCE LIST

COMMON NAME	OFFICIAL NOMENCLATURE
Cold Start System	Ether Quick-start System
Engine Coolant	Antifreeze, Ethylene Glycol Mixture
Gladhand	Quick Disconnect Coupling
Jake Brake	Engine Brake
Komfort Loc®	Seat Belt Adjustment
TufTrac	Rear Suspension System

LIST OF ABBREVIATIONS

NOTE

Refer to ASME Y14.38-1999 for standard abbreviations.

ABBREVIATION	DEFINITION
ABS	Anti-lock Brake System
AWD	All-Wheel Drive
C	Centigrade or Celsius
CEL	Check Engine Light
CID	Cubic Inch Displacement
cm	Centimeter
CPU	Central Processing Unit
CWS	Collision Warning System
DDEC	Detroit Diesel Electronic Controlled
DDL	Diagnostic Data Link
DDR	Diagnostic Data Reader
DDU	Driver's Display Unit
DRL	Daytime Running Lights
ECM	Electronic Control Module
ECU	Electronic Control Unit
F	Fahrenheit
GCWR	Gross Combination Weight Rating
GVWR	Gross Vehicle Weight Rating
kg	Kilogram
km	Kilometer

LIST OF ABBREVIATIONS - CONTINUED

ABBREVIATION	DEFINITION
kPa	Kilopascal
kph	Kilometers per Hour
kW	Kilowatt
l	Liter
lb	Pound
lb-ft	Pound foot
lb-in	Pound inch
LED	Light Emitting Diode
lph	Liters per Hour
m	Meter
MCS	Material Control System
mm	Millimeter
MSD	Maintenance Support Device
MTS	Movement Tracking System
Ncm	Newton Centimeter
Nm	Newton Meter
PCU	Pneumatic Control Unit
PMCS	Preventive Maintenance Checks and Services
psi	Pounds per Square Inch
PTO	Power Take-Off
rpm	Revolutions per Minute

END OF WORK PACKAGE

EQUIPMENT DESCRIPTION AND DATA 0002 00

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

1. **Characteristics.**

   a. The M915A3 truck is used to transport M871, M872, and M127 semitrailers, M967/M969 5000 gallon fuel tankers and M1062 7500 gallon fuel tanker on line haul missions. It has a Gross Vehicle Weight Rating (GVWR) of 52,000 lb (23,608 kg) and is equipped with a two-way oscillating, sliding fifth wheel compatible with a two-inch kingpin. Maximum towed load on kingpin is 30,000 lb (13,620 kg).

   b. The M916A3 truck is used to transport M870 and M172A1 semitrailers loaded with heavy engineer equipment and 60PRS and WD6S 6,000 gallon water distributors over primary and secondary roads and trails. It has a GVWR of 68,000 lb (30,872 kg) and is equipped with a 45,000 lb (20,430 kg) winch, a tail roller, and a four-way oscillating, sliding fifth wheel compatible with a 3 1/2-inch kingpin. Maximum towed load on kingpin is 40,000 lb (18,160 kg). It is equipped with a Central Tire Inflation System (CTIS) which allows operation across a wide variety of terrain.

   c. The M917A2 and M917A2 w/MCS dump trucks have a GVWR of 68,000 lb (30,872 kg), a 14 cu yd (10.7 m^3) dump body capacity, and an 18.5 ton (16.8 metric ton) load capability. They are equipped with a CTIS which allows operation across a wide variety of terrain.

2. **Capabilities and Features.**

   a. While operating on Class I roads, a fully loaded M915A3 can maintain a speed of 65 mph (105 kph) on level roads and 25 mph (40 kph) while ascending a 3 percent grade. It has a minimum turning diameter, curb-to-curb, of 53 ft 9 in (16.4 m).

   b. While operating on Class I roads, a fully loaded M916A3 can maintain a speed of 60 mph (96.5 kph) on level roads and 25 mph (40 kph) while ascending a 3 percent grade. It has a transmission-mounted PTO which powers the winch.

   c. While operating on Class I roads, M917A2 and M917A2 w/MCS can maintain a speed of 55 mph (88 kph) on level roads and 25 mph (40 kph) while ascending a 3 percent grade. They have a transmission-mounted PTO which powers the dump body (TM 5-3805-264-14&P).

   d. Average cruising ranges at Gross Combination Weight Rating (GCWR) with a full tank of fuel will vary based on conditions (e.g., varying loads, prolonged idle, PTO usage, off-road driving, and climatic conditions). Cruising range is optimally 400 miles (644 km).

   e. All vehicles are equipped with an instrument panel mounted speedometer and tachometer which register truck ground speed and engine speed.

   f. The following capabilities and features are common to all models:

      (1) air-activated front and rear non-asbestos cam brakes with a four-channel anti-lock brake system (ABS) to provide significantly improved handling and braking during emergency stops;

      (2) operation in temperatures from -25°F (-32°C) to +125°F (+52°C), and to -40°F (-40°C) with arctic kit installed;

      (3) start and climb capability of a 20 percent grade at GCWR in both forward and reverse directions;

      (4) fording capability up to 20 in. (51 cm) deep for 5 minutes without damage or requiring maintenance before operations can continue;

      (5) two-passenger aluminum corrosion-proof cab with a 90 degree tilt-forward hood for service accessibility;

      (6) six cylinder, 12.7 liter, 430 horsepower, in-line diesel engine built by Detroit Diesel.

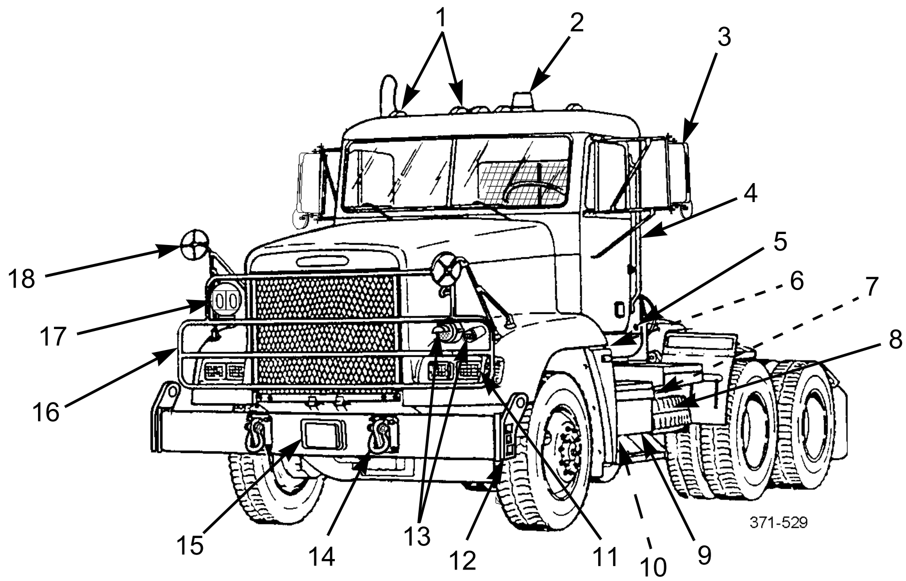
   g. M916A3, M917A2, and M917A2 w/MCS are equipped with Central Tire Inflation System (CTIS).

   h. M915A3 and M916A3 are equipped with a Collision Warning System (CWS) that warns the driver of potentially dangerous driving situations by activating visual and audible alerts.

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES - CONTINUED

i. When operating in arctic conditions, all vehicles can be equipped with an arctic heater mounted under the cab, above the battery box. This provides heat for the cab and engine cooling system. The arctic heater may be operated prior to starting the engine to provide preheating of engine block.

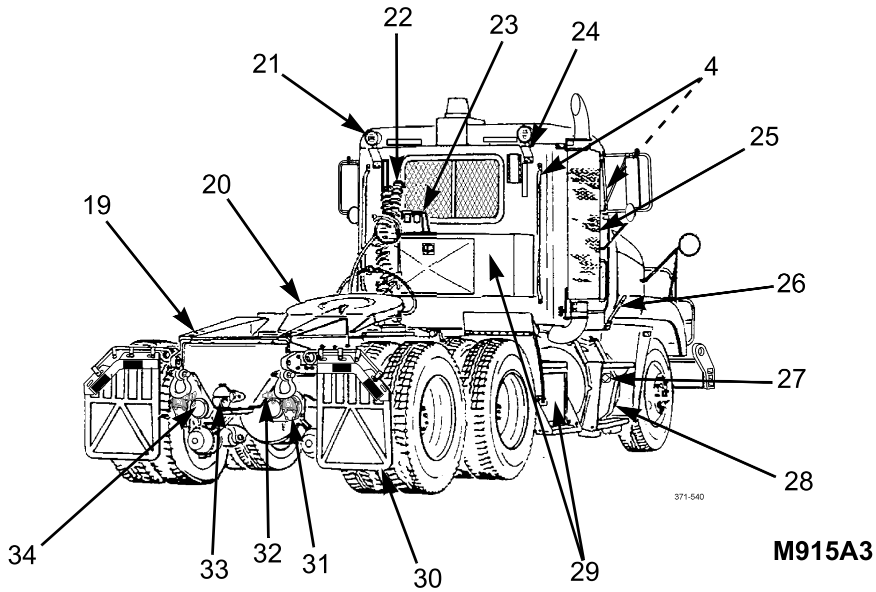
LOCATION AND DESCRIPTION OF MAJOR COMPONENTS



M915A3

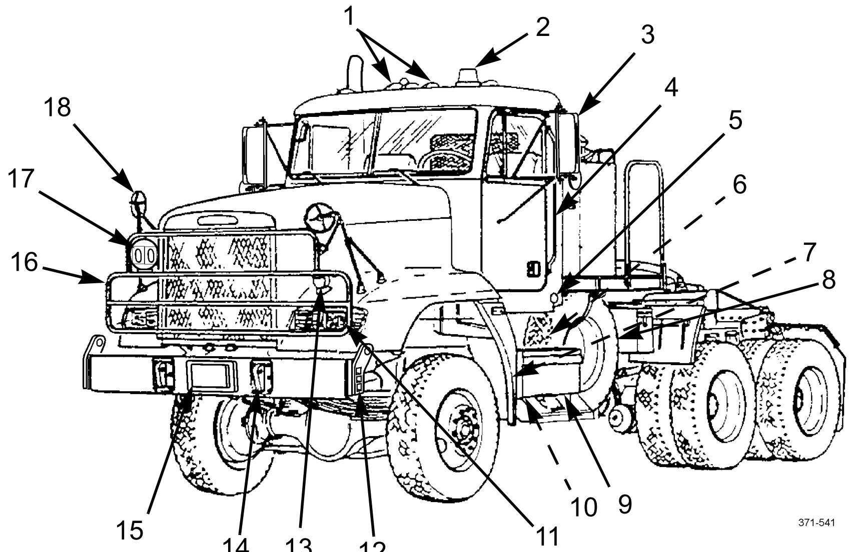
KEY	COMPONENT	DESCRIPTION
1	Marker Clearance Lights	Indicate outline of truck.
2	Beacon Warning Light	Alerts other vehicles of presence of truck.
3	Side Mirrors w/Spotter Mirrors	Provide driver with a view of sides of truck and semitrailer, if towing.
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
5	Utility Power Receptacle	Supplies power for work lights. Located on both sides of truck.
6	Air Horn	Provides an audible alert.
7	Master Battery Switch	Connects batteries to vehicle electrical system.
8	Spare Wheel and Tire	Extra wheel and tire used in case of a flat tire.
9	Battery Box and Steps	Holds vehicle batteries and provides steps to access cab.
10	NATO Slave Receptacle	Provides connection point for NATO cable to slave start vehicle.
11	Front Service Lights	Include headlights, turn signals, and daytime running lights (DRL).
12	Bumper Extensions	Provide adjustable attachment point for overhead sling.
13	Blackout Lights	Used during blackout conditions. Include marker and drive lights.
14	Towing Eyes	Provide attachment points for towing device.
15	CWS Antenna	Forward looking collision warning system antenna.
16	Brush Guard	Protects front of hood and components under hood from damage.
17	Military Classification Sign	Placard used to display military weight classification.
18	Spotting Mirrors	Provide added visibility to right side and front of truck.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



KEY	COMPONENT	DESCRIPTION
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
19	Ramp	Sloped surface serves as an approach to fifth wheel and facilitates coupling of semitrailer.
20	Fifth Wheel	Coupling device for semitrailers with kingpins.
21	Utility Lights	Illuminate area in back of cab. There is one light on each side of cab.
22	Air Lines	Provide air supply for trailer brakes.
23	Intervehicular Receptacles	M915A3 Old Model contains 12-volt, 24-volt, and trailer ABS receptacles. M915A3 New Model contains 12-volt and 24-volt receptacles.
24	Antenna Mount	Mount for radio antenna.
25	Exhaust Muffler	Deadens noise of engine exhaust.
26	Hood Latch	Locks hood closed. Located on both sides of hood.
27	CWS Side Sensor	Side looking collision warning system sensor.
28	Fuel Tank	Holds fuel. Steps mounted to tank provide access to cab.
29	Storage Boxes	Provide stowage area for BII and other items.
30	Mud Flaps	Prevent water and debris from spraying up on passers by or towed semitrailer.
31	Taillights	Contain composite tail, stop, blackout, and turn signal lights.
32	Trailer Gladhands	Provide air supply for pintle-towed trailers.
33	Pintle Hook	Coupling device for trailers with lunettes.
34	Backup Lights	Light comes on when R (Reverse) is selected.

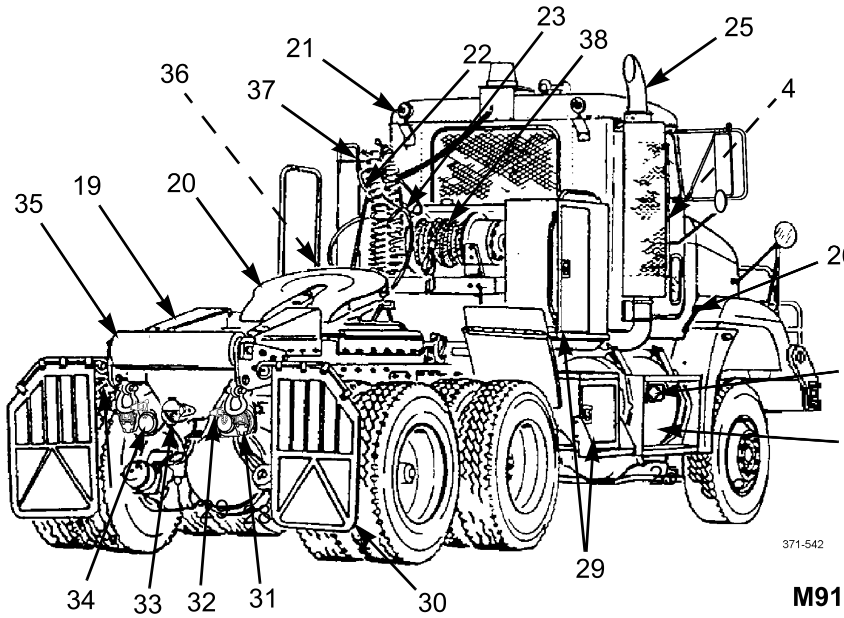
LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



M916A3

KEY	COMPONENT	DESCRIPTION
1	Marker Clearance Lights	Indicate outline of truck.
2	Beacon Warning Light	Alerts other vehicles of presence of truck.
3	Side Mirror w/Spotter Mirrors	Provide driver with a view of sides of truck and semitrailer, if towing.
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
5	Utility Power Receptacle	Supplies power for work lights. Located on both sides of truck.
6	Air Horn	Provides an audible alert.
7	Master Battery Switch	Connects batteries to vehicle electrical system.
8	Spare Wheel and Tire	Extra wheel and tire used in case of a flat tire.
9	Battery Box and Steps	Holds vehicle batteries and provides steps to access cab.
10	NATO Slave Receptacle	Provides connections point for NATO cable to slave start vehicle.
11	Front Service Lights	Include headlights, turn signals, and daytime running lights (DRL).
12	Bumper Extensions	Provide adjustable attachment point for overhead sling.
13	Blackout Lights	Used during blackout conditions. Include marker and drive lights.
14	Towing Eyes	Provide attachment points for towing device.
15	CWS Antenna	Forward looking collision warning system antenna.
16	Brush Guard	Protects front of hood and components under hood from damage.
17	Military Classification Sign	Placard used to display military weight classification.
18	Spotting Mirrors	Provide added visibility to right side and front of truck.

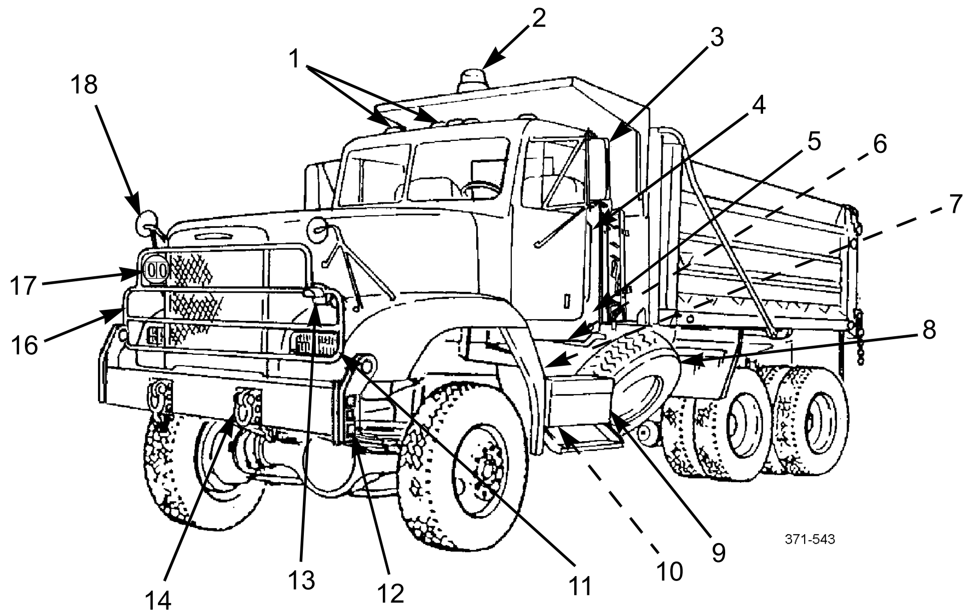
LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



M916A3

KEY	COMPONENT	DESCRIPTION
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
19	Ramp	Sloped surface and roller serves as an approach to fifth wheel and facilitates coupling of semitrailer.
20	Fifth Wheel	Coupling device for semitrailers with kingpins.
21	Utility Lights	Illuminate area in back of cab. There is one light on each side of cab.
22	Air Lines	Provide air supply for trailer brakes.
23	Intervehicular Receptacles	Contains 12-volt and 24-volt receptacles.
25	Exhaust Muffler	Deadens noise of engine exhaust.
26	Hood Latch	Locks hood closed. Located on both sides of hood.
27	CWS Side Sensor	Side looking collision warning system sensor.
28	Fuel Tank	Holds fuel. Steps mounted to tank provide access to cab.
29	Storage Boxes	Provide stowage area for BII and other items.
30	Mud Flaps	Prevent water and debris from spraying up on passers by or towed semitrailer.
31	Taillights	Contain composite tail, stop, blackout, and turn signal lights.
32	Trailer Gladhands	Provide air supply for trailer brakes.
33	Pintle Hook	Coupling device for trailers with lunettes.
34	Backup Lights	Lights come on when R (Reverse) is selected.
35	Roller	Roller serves as an approach to fifth wheel and facilitates coupling of semitrailer.
36	Trailer Hydraulic Couplings	Provide connection points for hydraulic lines between truck and hydraulically equipped trailers.
37	Winch Controls	Operate winch.
38	Hydraulic Winch	Powered by PTO to perform winching operations.

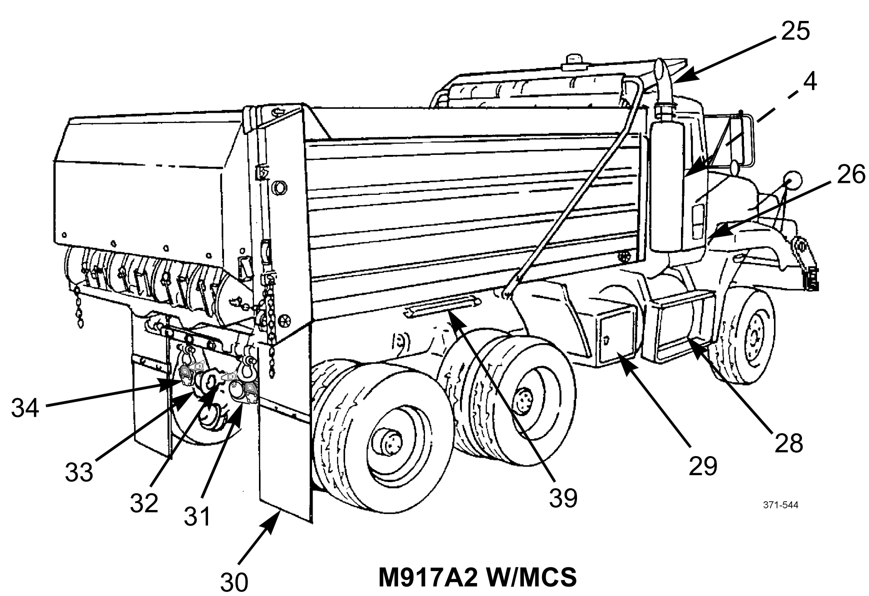
LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



M917A2

KEY	COMPONENT	DESCRIPTION
1	Marker Clearance Lights	Indicate outline of truck.
2	Beacon Warning Light	Alerts other vehicles of presence of truck.
3	Side Mirrors w/Spotter Mirrors	Provide driver with a view of sides of truck and semitrailer, if towing.
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
5	Utility Power Receptacle	Supplies power for work lights. Located on both sides of truck.
6	Air Horn	Provides an audible alert.
7	Master Battery Switch	Connects batteries to vehicle electrical system.
8	Spare Wheel and Tire	Extra wheel and tire used in case of a flat tire.
9	Battery Box and Steps	Holds vehicle batteries and provides steps to access cab.
10	NATO Slave Receptacle	Provides connection point for NATO cable to slave start vehicle.
11	Front Service Lights	Include headlights, turn signals, and daytime running lights (DRL).
12	Bumper Extensions	Provide adjustable attachment point for overhead sling.
13	Blackout Lights	Used during blackout conditions. Include marker and drive lights.
14	Towing Eyes	Provide attachment points for towing device.
16	Brush Guard	Protects front of hood and components under hood from damage.
17	Military Classification Sign	Placard used to display military weight classification.
18	Spotting Mirrors	Provide added visibility to right side and front of truck.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



M917A2 W/MCS

KEY	COMPONENT	DESCRIPTION
4	Grabhandles	Provide a hand hold for personnel climbing on truck.
25	Exhaust Muffler	Deadens noise of engine exhaust.
26	Hood Latch	Locks hood closed. Located on both sides of hood.
28	Fuel Tank	Holds fuel. Steps mounted to tank provide access to cab.
29	Storage Box	Provides stowage area for BII and other items.
30	Mud Flaps	Prevent water and debris from spraying up on passers by or towed semitrailer.
31	Taillights	Contain composite tail, stop, blackout, and turn signal lights.
32	Trailer Gladhands	Provide air supply for trailer brakes.
33	Pintle Hook	Coupling device for trailers with lunettes.
34	Backup Lights	Lights come on when R (Reverse) is selected.
39	Body Prop	Supports dump body in raised position.

DIFFERENCE BETWEEN MODELS

ITEM	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
	VEHICLE MODEL				
Transfer Case			X	X	X
Driving Front Axle			X	X	X
Central Tire Inflation System			X	X	X
2-Way Sliding Fifth Wheel	X	X			
4-Way Oscillating Fifth Wheel			X		
Hydraulic Winch			X		
Air Deflector Bracket	X	X	X		
Collision Warning System	X	X	X		
Mirrors (Heated/ Remote)	Heated Only	X	X	X	X
Propeller Shafts (Prelube)		X	X	X	X
Power Take-Off			X	X	X
Voltage Regulator (Alternator Mounted)		X	X	X	X

EQUIPMENT DATA

ITEM	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
	VEHICLE MODEL				
Manufacturer:	Freightliner	Freightliner	Freightliner	Freightliner	Freightliner
Dimensions:					
Length (Overall)	276.0 in (701 cm)	276.0 in (701 cm)	290 in (736.6 cm)	303.8 in (771.7 cm)	316.25 in (803.3 cm)

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Dimensions - Continued:					
Height (Overall)	118 in (300 cm)	118 in (300 cm)	128 in (325 cm)	128 in (325 cm)	128 in (325 cm)
Width (Overall)	100 in (254 cm)	100 in (254 cm)	102 in (259.1 cm)	102 in (259 cm)	102 in (259 cm)
Wheelbase	162 in (411 cm)	162 in (411 cm)	174 in (442 cm)	179 in (455 cm)	179 in (455 cm)
Ground Clearance	9 in (23 cm)	9 in (23 cm)	9 in (23 cm)	9 in (23 cm)	9 in (23 cm)
Angle of Approach	27 degrees	27 degrees	37.5 degrees	37.5 degrees	37.5 degrees
Weights:					
Curb	19,080 lb (8662 kg)	19,080 lb (8662 kg)	26,900 lb (12212.6 kg)	30,600 lb (13,892.4 kg)	32,618 lb (14,808.6 kg)
GVWR	52,000 lb (23,608 kg)	52,000 lb (23,608 kg)	68,000 lb (30,872 kg)	68,000 lb (30,872 kg)	68,000 lb (30,872 kg)
GCWR	105,000 lb (46,670 kg)	105,000 lb (46,670 kg)	130,000 lb (59,020 kg) (M870/ M870A1/ M870A2/ M870A3) 134,000 lb (60,836 kg)	68,000 lb (30,872 kg)	68,000 lb (30,872 kg)
Front Axle (Loaded)	12,000 lb (5448 kg)	12,000 lb (5448 kg)	16,000 lb (7264 kg)	16,000 lb (7264 kg)	16,000 lb (7264kg)
Rear Axle (Loaded)	40,000 lb (18,160 kg)	40,000 lb (18,160 kg)	52,000 lb (23,608 kg)	52,000 lb (23,608 kg)	52,000 lb (23,608 kg)
Capacities:					
Engine Oil (Refill w/Filters)	41 qt (38.81l)	41 qt (38.81l)	41 qt (38.81l)	41 qt (38.81l)	41 qt (38.81l)
Cooling System	65 qt (61.5 l)	65 qt (61.5 l)	65 qt (61.5 l)	65 qt (61.5 l)	65 qt (61.5 l)
Power Steering Reservoir	2 qt (1.9 l)	2 qt (1.9 l)	2 qt (1.9 l)	2 qt (1.9 l)	2 qt (1.9 l)

EQUIPMENT DATA - CONTINUED

DATA	MODEL M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Capacities - Continued:					
Fuel Tank	100 gal (378.5 l)	100 gal (378.5 l)	100 gal (378.5 l)	100 gal (378.5 l)	100 gal (378.5 l)
Transmission	51 qt (48 l)	51 qt (48 l)	53 qt (49.3 l)	53 qt (49.3 l)	53 qt (49.3 l)
Rear Axle (Forward/Rear)	13/14.5 qt (12.3/13.7 l)	13/14.5 qt (12.3/13.7 l)	22 qt (20.8 l)	22 qt (20.8 l)	22 qt (20.8 l)
Front Drive Axle	N/A	N/A			
Carrier			11.62 qt (10.99 l)	11.62 qt (10.99 l)	11.62 qt (10.99 l)
Wheel End			1.06 qt (1.0 l)	1.06 qt (1.0 l)	1.06 qt (1.0 l)
Transfer Case	N/A	N/A	3.5 qt (3.3 l)	3.5 qt (3.3 l)	3.5 qt (3.3 l)
Winch Reservoir	N/A	N/A	42 gal (159.0 l)	N/A	N/A
Winch Drum	N/A	N/A	5 qt (4.7 l)	N/A	N/A
Engine:					
Manufacturer	Detroit Diesel	Detroit Diesel	Detroit Diesel	Detroit Diesel	Detroit Diesel
Type	4-stroke, in-line turbo-charged diesel	4-stroke, in-line turbo-charged diesel	4-stroke, in-line turbo-charged diesel	4-stroke, in-line turbo-charged diesel	4-stroke, in-line turbo-charged diesel
Model	DDEC IV	DDEC IV	DDEC IV	DDEC IV	DDEC IV
Cylinders	6	6	6	6	6
Displacement	755 CID (12.7 l)	755 CID (12.7 l)	755 CID (12.7 l)	755 CID (12.7 l)	755 CID (12.7 l)
Torque @ 1200 rpm	1450 lb-ft (1966 N.m)	1450 lb-ft (1966 N.m)	1450 lb-ft (1966 N.m)	1450 lb-ft (1966 N.m)	1450 lb-ft (1966 N.m)
Maximum Horsepower @ 2100 rpm	430 (320.6 kW)	430 (320.6 kW)	430 (320.6 kW)	430 (320.6 kW)	430 (320.6 kW)

EQUIPMENT DATA - CONTINUED

DATA	MODEL M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Engine - Continued:					
Maximum Governed Speed	2100 rpm	2100 rpm	2100 rpm	2100 rpm	2100 rpm
Oil Filter Type	2 full flow, replaceable elements	2 full flow, reusable elements	2 full flow, reusable elements	2 full flow, reusable elements	2 full flow, reusable elements
Oil Filter Quantity	2	2	2	2	2
Fuel System:					
Type	diesel fuel injected	diesel fuel injected	diesel fuel injected	diesel fuel injected	diesel fuel injected
Fuel Filter Type	1 primary, 1 secondary, replaceable elements	1 primary, 1 secondary, replaceable elements	1 primary, 1 secondary, replaceable elements	1 primary, 1 secondary, replaceable elements	1 primary, 1 secondary, replaceable elements
Air Cleaner:					
Type	dry element	dry element	dry element	dry element	dry element
Quantity	1	1	1	1	1
Cooling System:					
Radiator Working Pressure	10 psi (69 kPa)	10 psi (69 kPa)	10 psi (69 kPa)	10 psi (69 kPa)	10 psi (69 kPa)
Coolant Inhibitor Filter	1 replaceable element	1 replaceable element	1 replaceable element	1 replaceable element	1 replaceable element
Electrical System:					
Type	dual 12/24 V	dual 12/24 V	dual 12/24 V	dual 12/24 V	dual 12/24 V
Batteries:					
Quantity	4	4	4	4	4
Voltage	12 volt	12 volt	12 volt	12 volt	12 volt

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Transmission:					
Manufacturer	Allison	Allison	Allison	Allison	Allison
Model	HD 4560P	HD 4560P	HD 4070P	HD 4070P	HD 4070P
Type	6-speed automatic	6-speed automatic	7-speed automatic	7-speed automatic	7-speed automatic
Shift Selector	pushbutton	pushbutton	pushbutton	pushbutton	pushbutton
Transfer Case:					
Manufacturer	N/A	N/A	Meritor T-2119D	Meritor T-2119D	Meritor T-2119D
Type			1-speed	1-speed	1-speed
Front Axle:					
Manufacturer	Meritor	Meritor	Meritor	Meritor	Meritor
Type	I-beam, FF961	I-beam, FF961	planetary	planetary	planetary
Rated Capacity	12,000 lb (5448 kg)	12,000 lb (5448 kg)	16,000 lb (7264 kg)	16,000 lb (7264 kg)	16,000 lb (7264 kg)
Maximum Steering Angle	50 degrees	50 degrees	38 degrees	38 degrees	38 degrees
Rear Axle (Tandem):					
Manufacturer	Meritor RT 40-145P	Meritor RT 40-145P	Meritor RT 52-160P	Meritor RT 52-160P	Meritor RT 52-160P
Rated Capacity	40,000 lb (18,160 kg)	40,000 (18,160 kg)	52,000 (23,608 kg)	52,000 (23,608 kg)	52,000 (23,608 kg)
Ratio	5.29:1	4.88:1	4.89:1	4.89:1	4.89:1
Interaxle Differential Traction Control	bevel gear air controlled	bevel gear air controlled	bevel gear air controlled	bevel gear air controlled	bevel gear air controlled

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Brake System:					
Actuation	air-mechanical	air-mechanical	air-mechanical	air-mechanical	air-mechanical
Pressure Range	60-120 psi (414-827 kPa)	60-120 psi (414-827 kPa)	60-120 psi (414-827 kPa)	60-120 psi (414-827 kPa)	60-120 psi (414-827 kPa)
Airbrake Chambers: Service	2 - front axle	2 - front axle	2 - front axle	2 - front axle	2 - front axle
Failsafe (Spring)	4 - forward-rear and rear-rear axles	4 - forward-rear and rear-rear axles	4 - forward-rear and rear-rear axles	4 - forward-rear and rear-rear axles	4 - forward-rear and rear-rear axles
ABS (Anti-Lock Brake System):					
Type	4-channel, Version D	4-channel, Version E	4-channel, Version E	4-channel, Version E	4-channel, Version E
Location	front and rear-rear axle	front and rear-rear axle	front and rear-rear axle	front and rear-rear axle	front and rear-rear axle
Wheels:					
Size:					
Front	22.5 x 8.25 in	22.5 x 8.25 in	22.5 x 9.0 in	22.5 x 12.25 in	22.5 x 12.25 in
Rear/Spare	22.5 x 8.25 in	22.5 x 8.25 in	22.5 x 9.0 in	22.5 x 9.00 in	22.5 x 9.0 in
Number of Studs/Stud Size	10/M22 in	10/M22 in	10/M22 in	10/M22 in	10/M22 in
Tires:					
Type	tubeless radial on-highway	tubeless radial on/off road	tubeless radial on/off road	tubeless radial on/off road	tubeless radial on/off road

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Tires - Continued:					
Size	11R22.5/ XZE	11R22.5/ XZE	Front: 385/ 65R22.5/ XZY 3WB Rear: 315/ 80R22.5/ XDY-3	Front: 385/ 65R22.5/ XZY 3WB Rear: 315/ 80R22.5/ XZY-3	Front: 385/ 65R22.5/ XZY 3WB Rear: 315/ 80R22.5/ XZY-3
Ply Rating	14PR	14PR	20PR	18 ply (Front) 20 ply (Rear)	18 ply (Front) 20 ply (Rear)
Load Range	G	G	L	Front: J Rear: L	Front: J Rear: L
Inflation Pressure (Maximum Load):					
Front	100 psi (690 kPa)	100 psi (690 kPa)	90 psi (621 kPa)	90 psi (621 kPa)	90 psi (621 kPa)
Rear	100 psi (690 kPa)	100 psi (690 kPa)	90 psi (621 kPa)	90 psi (621 kPa)	90 psi (621 kPa)
Spare	100 psi (690 kPa)	100 psi (690 kPa)	90 psi (621 kPa)	90 psi (621 kPa)	90 psi (621 kPa)
Steering:					
Manufacturer	TRW	TRW	TRW	TRW	TRW
Steering Gear Type	TAS 65	TAS 65	TAS 85	TAS 85	TAS 85
Actuation	hydraulic power booster	hydraulic power booster	hydraulic power booster	hydraulic power booster	hydraulic power booster
Power Steering Pump	Eaton B165R	TRW	TRW	TRW	TRW
Turning Diameter	53 ft 9 in (16.4 m)	53 ft 9 in (16.4 m)	59 ft 6 in (18.1 m)	59 ft 6 in (18.1 m)	59 ft 6 in (18.1 m)
Steering Column and Wheel:					
Type	tilt, telescope	tilt, telescope	tilt, telescope	tilt, telescope	tilt, telescope

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Steering - Continued:					
Tilt Range	15 degrees	15 degrees	15 degrees	15 degrees	15 degrees
Telescoping Range	2 5/8 in (67 mm)	2 5/8 in (67 mm)	2 5/8 in (67 mm)	2 5/8 in (67 mm)	2 5/8 in (67 mm)
Suspension:					
Front	Taper-leaf spring w/shock absorbers	Taper-leaf spring w/shock absorbers	Taper-leaf spring w/shock absorbers	Taper-leaf spring w/shock absorbers	Taper-leaf spring w/shock absorbers
Rear	TufTrac w/shock absorbers	TufTrac w/shock absorbers	TufTrac w/shock absorbers	TufTrac w/shock absorbers	TufTrac w/shock absorbers
Towing Attachments:					
Pintle Hook:					
Manufacturer	Holland	Holland	Holland	Holland	Holland
Model	No. 760	No. 760	No. 760	No. 760	No. 760
Rated Capacity	30 tons (27.2 metric tons)	30 tons (27.2 metric tons)	30 tons (27.2 metric tons)	30 tons (27.2 metric tons)	30 tons (27.2 metric tons)
Towing Eyes:					
Quantity	2 front, 2 rear	2 front, 2 rear	2 front, 2 rear	2 front, 2 rear	2 front, 2 rear
Maximum Load Capacity, Each (Up to 45 Angle Front Long. Axis)	60,000 lb (27,240 kg)	60,000 lb (27,240 kg)	60,000 lb (27,240 kg)	60,000 lb (27,240 kg)	60,000 lb (27,240 kg)
Fifth Wheel:					
Manufacturer	Holland	Holland	Holland	N/A	N/A

EQUIPMENT DATA - CONTINUED

DATA	MODEL M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Towing Attachments - Continued:					
Type	36 in (91.4 cm) diameter, 2-way oscillating	36 in (91.4 cm) diameter, 2-way oscillating	36 in (91.4 cm) diameter, 4-way oscillating	N/A	N/A
Capacity	30,000 lb (13,620 kg)	30,000 lb (13,620 kg)	40,000 lb (18,160 kg)	N/A	N/A
Height (Empty)	51 in (129.5 cm)	51 in (129.5 cm)	64 in (162.6 cm)	N/A	N/A
Pitch (Fwd/Aft)	15/10	15/10	15/10	N/A	N/A
Kingpin Size	2 in (5.1 cm)	2 in (5.1 cm)	3.5 in (8.9 cm)	N/A	N/A
Cab:					
Manufacturer	Freightliner	Freightliner	Freightliner	Freightliner	Freightliner
Construction	aluminum	aluminum	aluminum	aluminum	aluminum
Type	2-passenger, tilt-forward hood	2-passenger, tilt-forward hood	2-passenger, tilt-forward hood	2-passenger, tilt-forward hood	2-passenger, tilt-forward hood
Air Deflector (If Equipped)	adjustable	adjustable	adjustable	N/A	N/A
Accessories:					
Utility Light	2 fixed, top rear of cab	2 fixed, top rear of cab	2 fixed, top rear of cab	N/A	N/A
Air Horn	1, under cab	1, under cab	1, under cab	1, under cab	1, under cab
Mirrors	Heated	Heated w/remote control	Heated w/remote control	Heated w/remote control	Heated w/remote control
Military Load Classification:					
Vehicle w/o Trailer	8	8	12	12 (unloaded/ loaded)	12 (unloaded/ loaded)

EQUIPMENT DATA - CONTINUED

DATA	MODEL				
	M915A3 OLD MODEL	M915A3 NEW MODEL	M916A3	M917A2	M917A2 W/MCS
Military Load Classification - Continued:					
Vehicle w/Trailer:					
M871	14/35 (unloaded/ loaded)	14/35	N/A	N/A	N/A
M872	14/46 (unloaded/ loaded)	14/46	N/A	N/A	N/A
M1062	11/34 (unloaded/ loaded)	11/34	N/A	N/A	N/A
M127	N/A	N/A	16/38 (unloaded/ loaded)	N/A	N/A
M870	N/A	N/A	17/54 (unloaded/ loaded)	N/A	N/A
60PRS	N/A	N/A	23 (unloaded/ loaded)	N/A	N/A
WD6S	N/A	N/A	23 (unloaded/ loaded)	N/A	N/A
M967	13/29 (unloaded/ loaded)	13/29 (unloaded/ loaded)			
M969	14/30 (unloaded/ loaded)	14/30 (unloaded/ loaded)			

END OF WORK PACKAGE

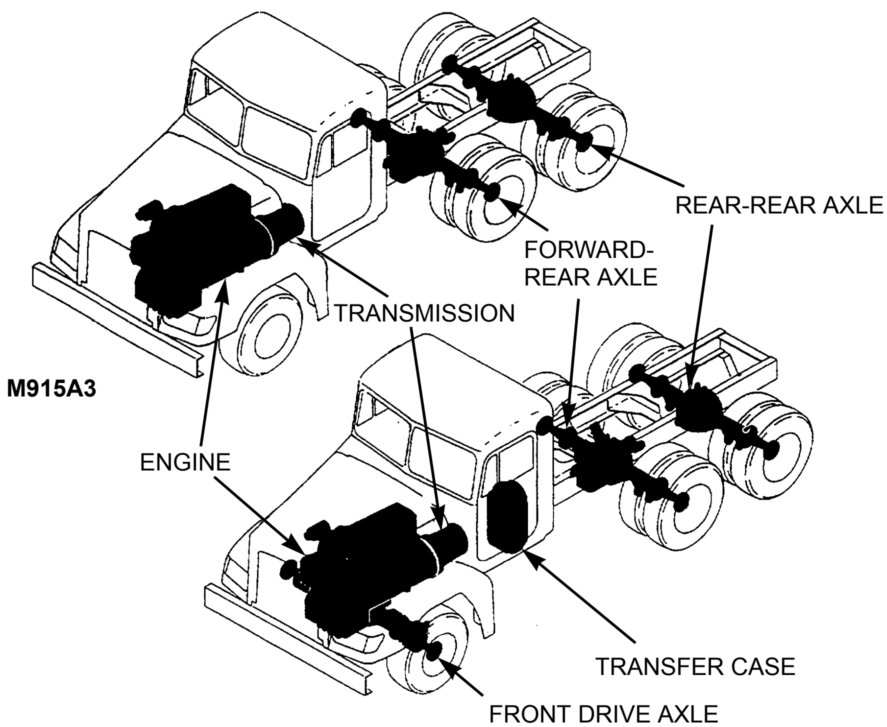
THEORY OF OPERATION 0003 00

INTRODUCTION

1. All vehicles consist of the following functional systems: drive train, fuel system, exhaust system, cooling system, electrical system, air system, brake system, steering system, traction control system, suspension system, and air conditioning system.
2. M915A3 and M916A3 have a Collision Warning System (CWS).
3. M916A3, M917A2, and M917A2 w/MCS have a hydraulic system and Central Tire Inflation System (CTIS).
4. This work package explains how the components and systems of the M915 Family of Vehicles work together. A functional description is provided for each major component and system.

DRIVE TRAIN

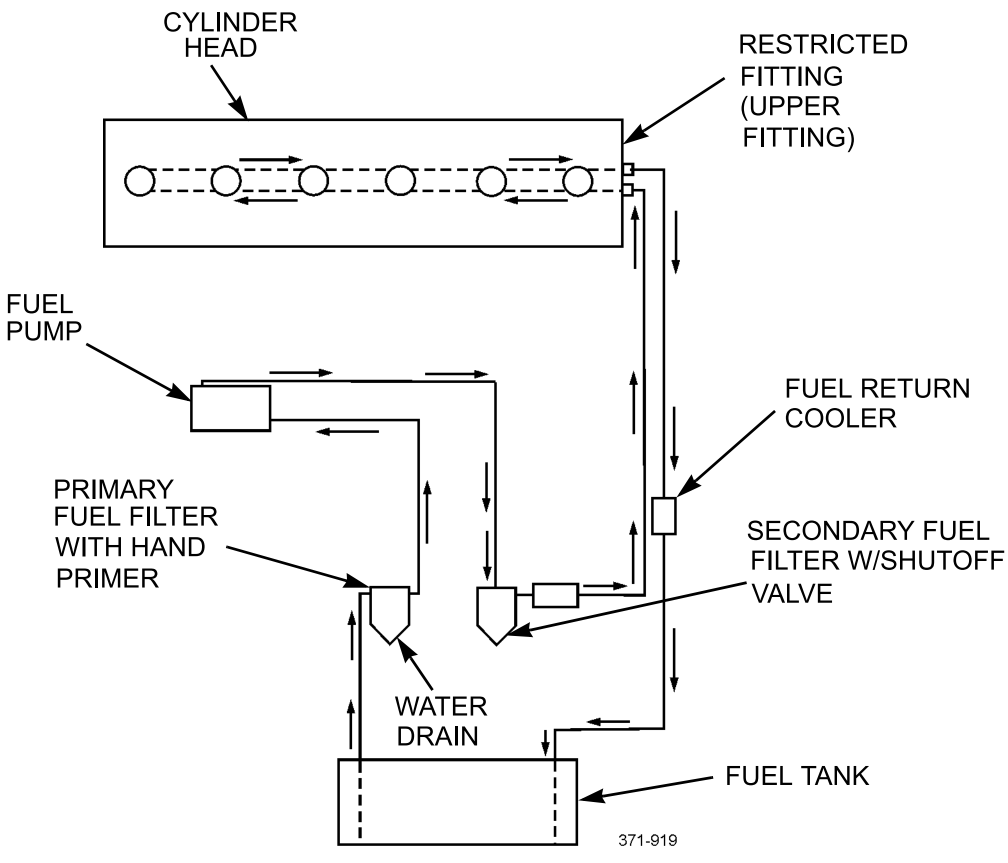
1. The drive trains of the M915A3 consist of a DDEC IV engine and 6-speed automatic transmission connected to RT40-145P rear tandem axles.
2. The M916A3, M917A2, and M917A2 w/MCS consist of a DDEC IV engine and a 7-speed automatic transmission connected thru a T-2119D transfer case to RT52-160P rear tandem axles and a planetary front drive axle. The axles receive power through a transfer case from the transmission and engine. Axles are modified to incorporate CTIS plumbing.



M916A3, M917A2, AND M917A2 W/MCS

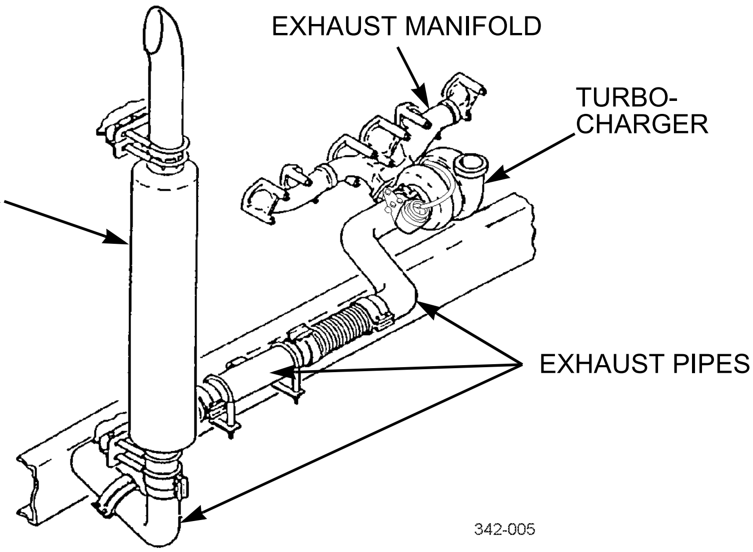
FUEL SYSTEM

1. Fuel to power the engine is pumped out of the fuel tank by an engine-mounted fuel pump. The engine fuel system consists of one electronic unit injector per cylinder, a transfer pump, low-pressure fuel lines, primary and secondary fuel filters, and fuel shutoff valve.
2. The engine is governed by an electronic control system. The system controls idle speed and limits engine maximum speed. The driver controls engine speed through the position of the electronic throttle position sensor (foot pedal).
3. Fuel filters are spin-on types. The primary fuel filter has a hand fuel primer pump and a water drain.
4. Fuel may be drained from the tank through the drain port located on the bottom of the tank.
5. There is a computer-controlled ether quick-start system for use in cold weather.
6. For M916A3 and M917A2, fuel not utilized exits the engine, passes through a fuel return cooler, and is returned to the fuel tank.



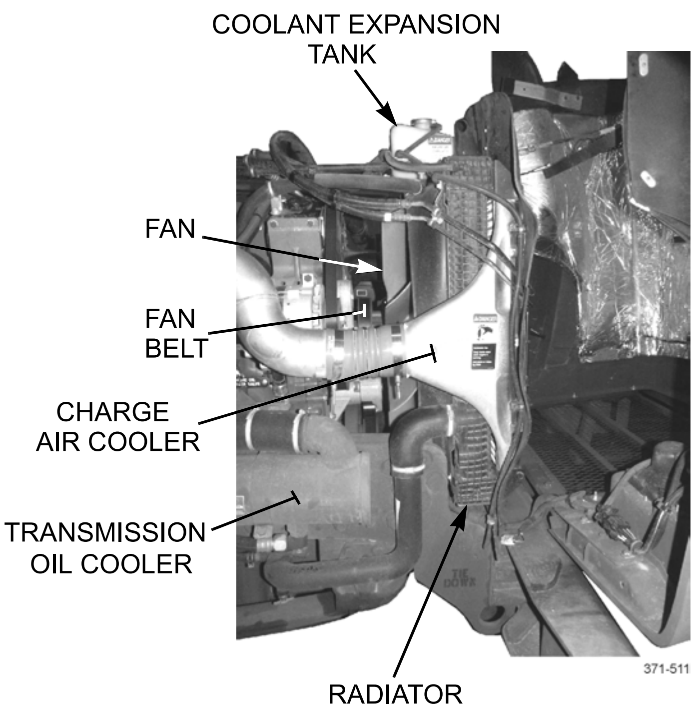
EXHAUST SYSTEM

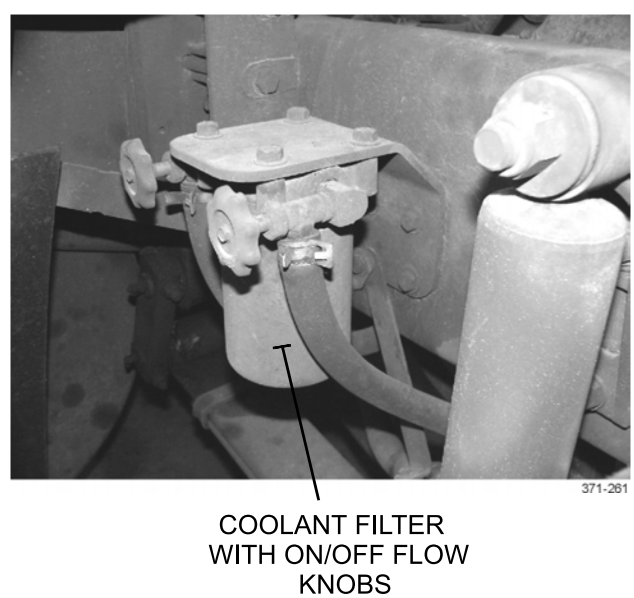
The exhaust system removes exhaust gases from the engine through the exhaust manifold and turbocharger. The gases flow into exhaust pipes and a muffler to the atmosphere above the cab.



COOLING SYSTEM

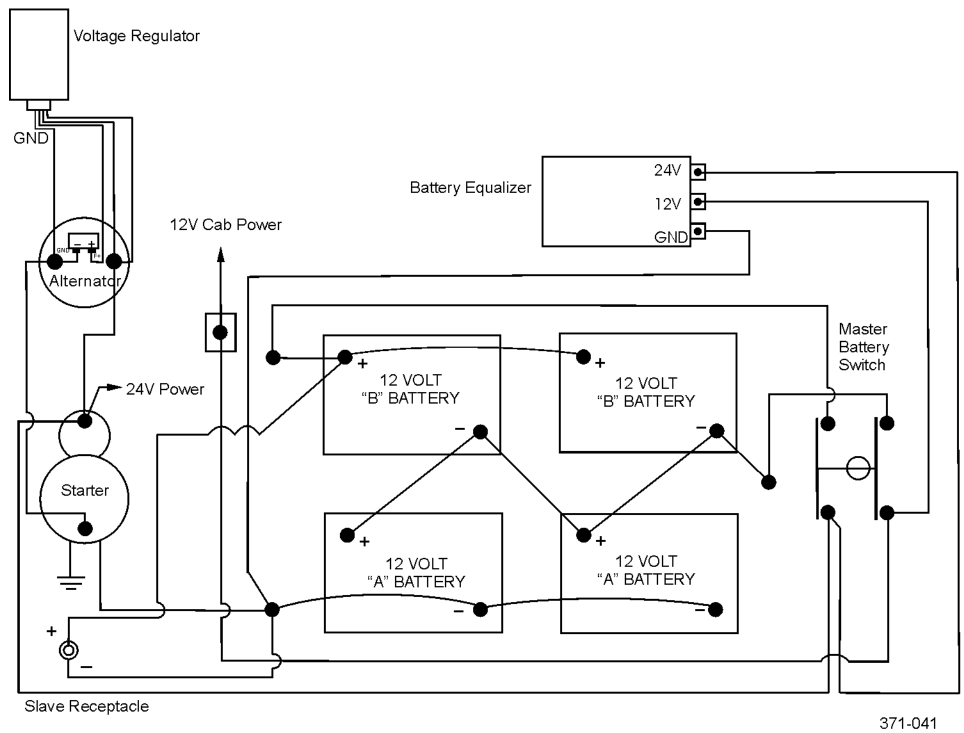
The cooling system consists of one circulating pump, a remote-mounted coolant filter, two 180°F (82°C) thermostats for controlling fluid flow, a transmission oil cooler, a charge air cooler, a radiator, and a belt-driven fan. The cooling system cools the engine by circulating pressurized ethylene glycol based coolant through the engine and radiator.





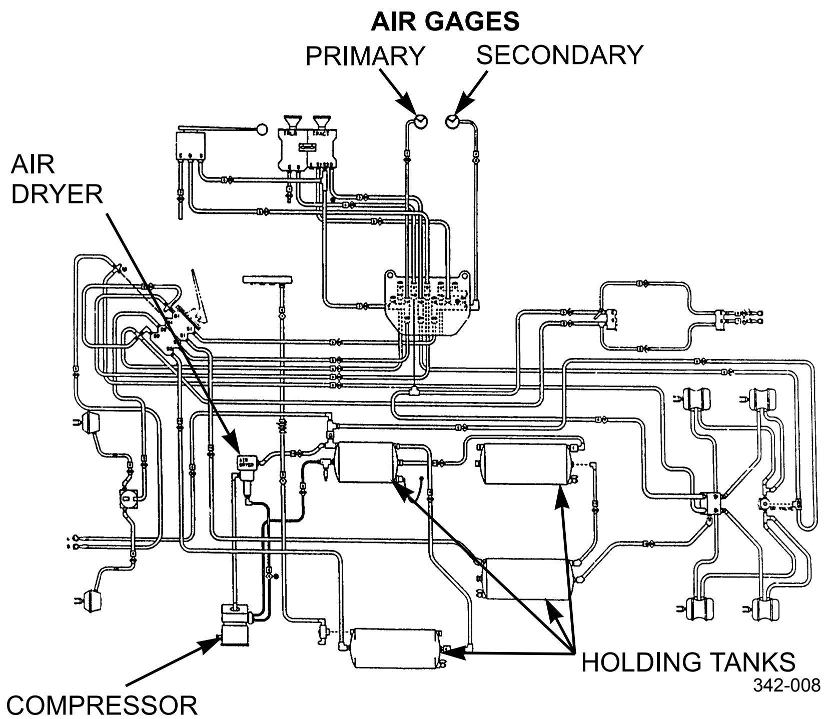
ELECTRICAL SYSTEM

1. Four 12-volt batteries connected in series-parallel supply the 12-volt electrical system and provide 24 volts for the starter motor, blackout lights, accessories, and trailer connectors.
2. A voltage regulator, mounted on the firewall (M915A3 Old Model), or on the alternator (M915A3 New Model, M916A3, M917A2), regulates the system voltage.



AIR SYSTEM

The air system consists of the air compressor, air dryer, air reservoirs, and various air lines. Also included in the air system are air pressure gages, located on the instrument panel, for monitoring air pressure for safe operation of all air-operated components of the vehicle. Each air tank has an automatic air/water evacuation valve. The primary air tank (wet tank) has a pull lanyard attached for manual evacuation.



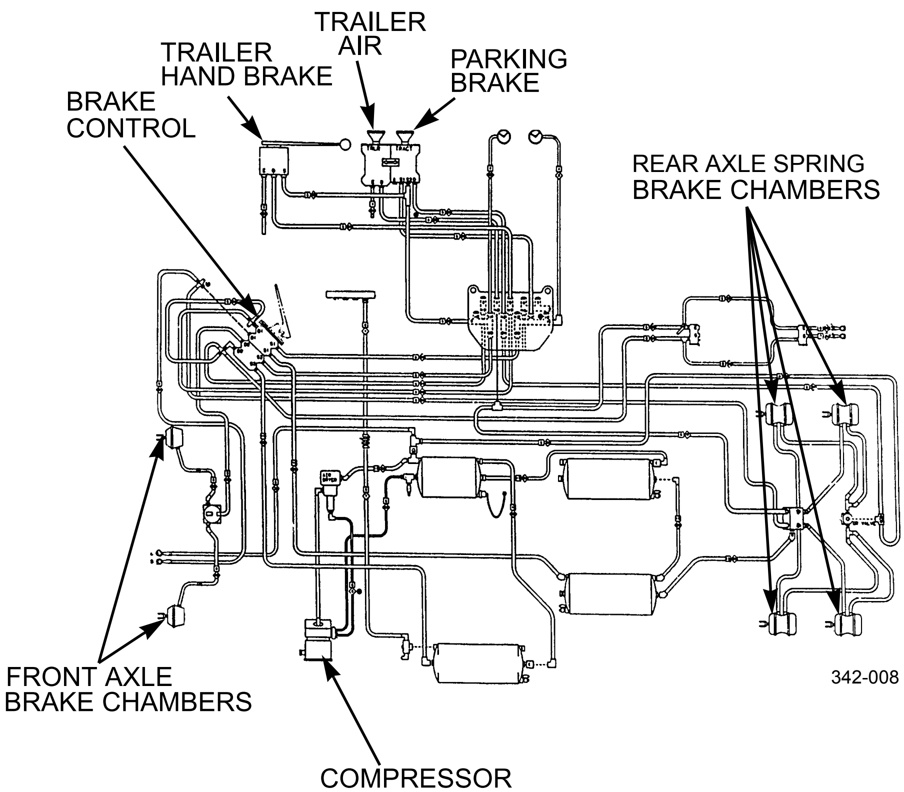
BRAKE SYSTEM

1. The dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoirs, plumbing, and brake chambers. The primary system operates the service brakes on the rear axle and the secondary system operates the service brakes on the front axle. On tractor-trailer configurations, service brake signals from both systems are sent to the trailer.
2. Loss of air pressure in the primary system causes the rear service brakes to become inoperative. Front brakes will continue to be operated by secondary system air pressure. In addition, trailer brakes will be operated by the secondary system. Loss of secondary system air pressure causes the front axle brakes to become inoperative. Rear service brakes and trailer brakes will be operated by the primary system.

BRAKE SYSTEM - CONTINUED

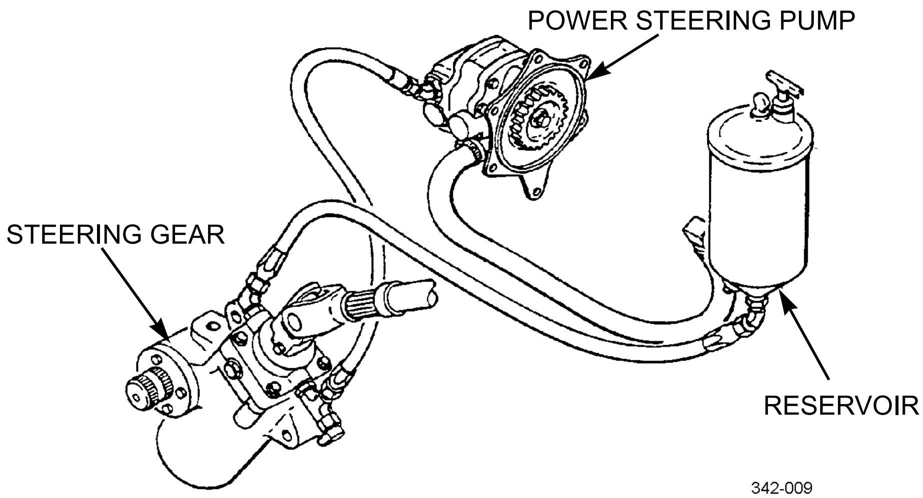
3. The warning light and buzzer inside the cab are activated if air pressure drops below 64 psi (441 kPa) in either brake system. If this happens, check air pressure gages to determine which system has low air pressure. Although vehicle speed can be reduced using the foot brake control pedal, either the front or rear service brakes will not operate, resulting in a longer stopping distance. Bring vehicle to a safe stop and have the air system repaired before continuing.
4. If the primary brake system becomes inoperative, the spring parking brakes automatically apply when air pressure drops to 45-35 psi (310-241 kPa).
5. All vehicles have a four-channel anti-lock brake system (ABS) and cam-operated service brakes with non-asbestos brakeshoes.
6. All vehicles have automatically adjusting slack adjusters. On all axles, brake chambers have a stroke alert indicator which allows the operator to monitor brakeshoe wear.

BRAKE AIR CONTROLS



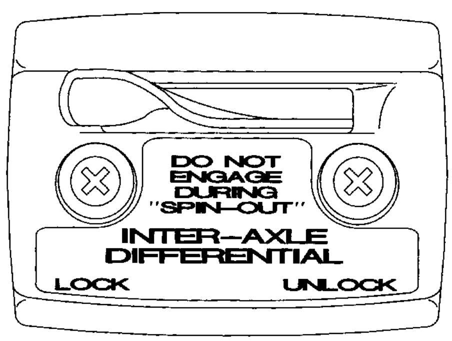
STEERING SYSTEM

1. The power steering system consists of an integral steering gear (which includes a manual steering mechanism and hydraulic control valve), hydraulic hoses, power steering pump, reservoir, and other components.
2. The power steering pump, driven by the engine, provides the power-assist for the steering system.



TRACTION CONTROL SYSTEM

For M915A3, the inter-axle differential lock is controlled by the air operated lever labeled INTER-AXLE DIFFERENTIAL on the driver's instrument panel. Under normal driving conditions, the control lever should be in the UNLOCK position. During poor driving conditions the control lever may be moved to the LOCK position to improve traction. When the inter-axle differential lock is applied, the drive shaft becomes a solid connection between the two rear axles. For M916A3, M917A2, and M917A2 w/MCS, all-wheel drive can be selected on transmission shift tower. This engages front driving axle.

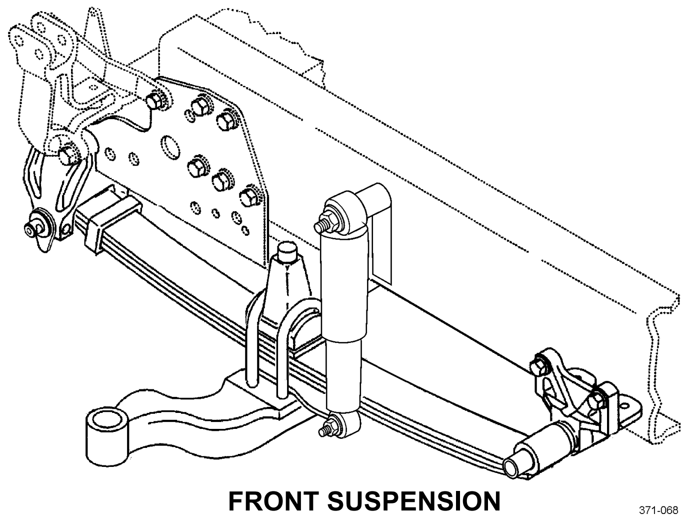


SUSPENSION SYSTEM

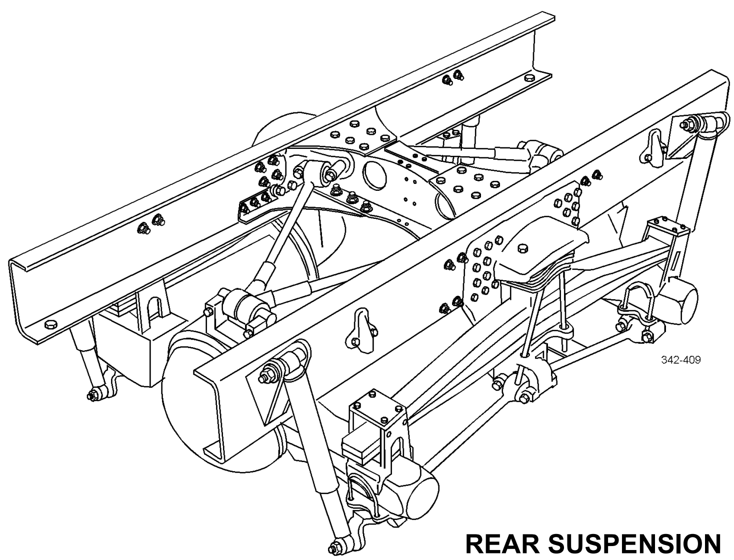
The front suspension system consists of taper-leaf springs and one shock absorber per side.

The rear suspension system consists of parabolic taper-leaf springs and two shock absorbers per side and an arrangement of torque rods.

The suspension system is designed to provide a high degree of ground clearance and articulation while maintaining an equal load over each wheel. Ride characteristics are similar, whether loaded or unloaded.



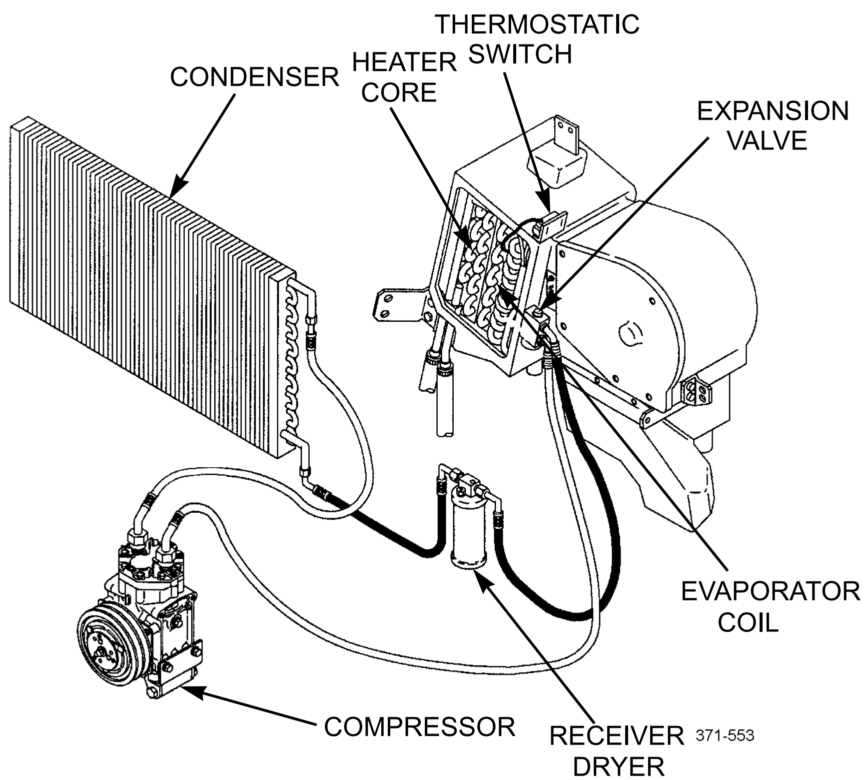
FRONT SUSPENSION



REAR SUSPENSION

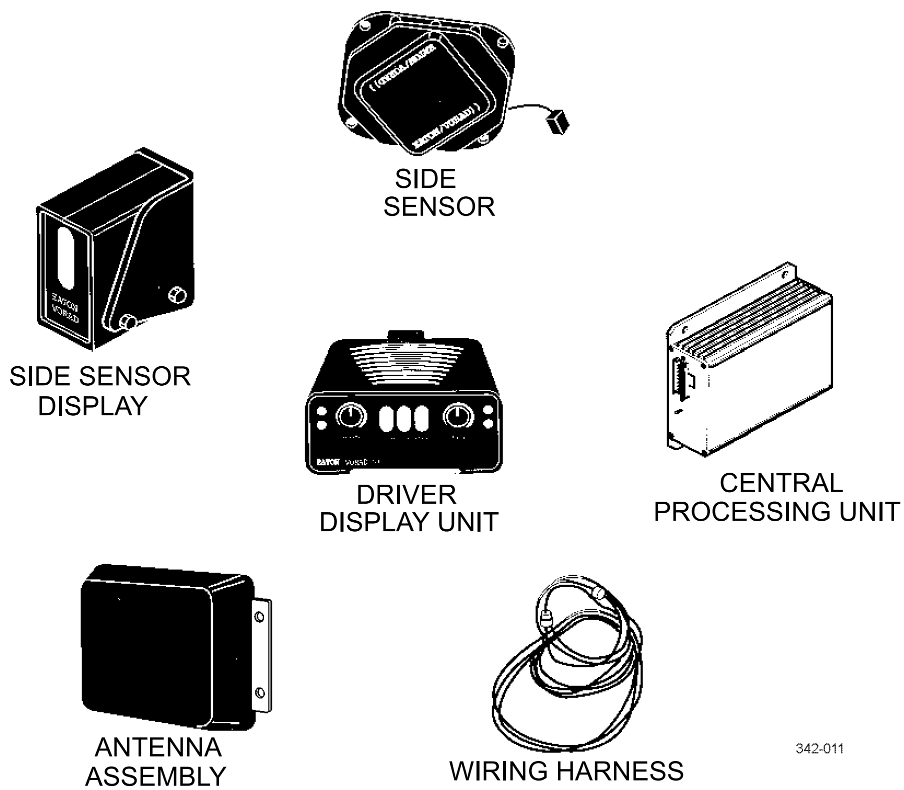
AIR CONDITIONING SYSTEM

1. The air conditioning unit is part of the heater and is mounted under the glove compartment. It is a single unit consisting of a heater core, air conditioning evaporator coil, blower motor, control valves, and air ducts.
2. The system is turned on by the mode control lever on instrument panel in cab. The four-speed blower knob controls air flow rate.
3. An even cab temperature is maintained by controlling the coolant flow through the heater core, or refrigerant flow through the evaporator coil.



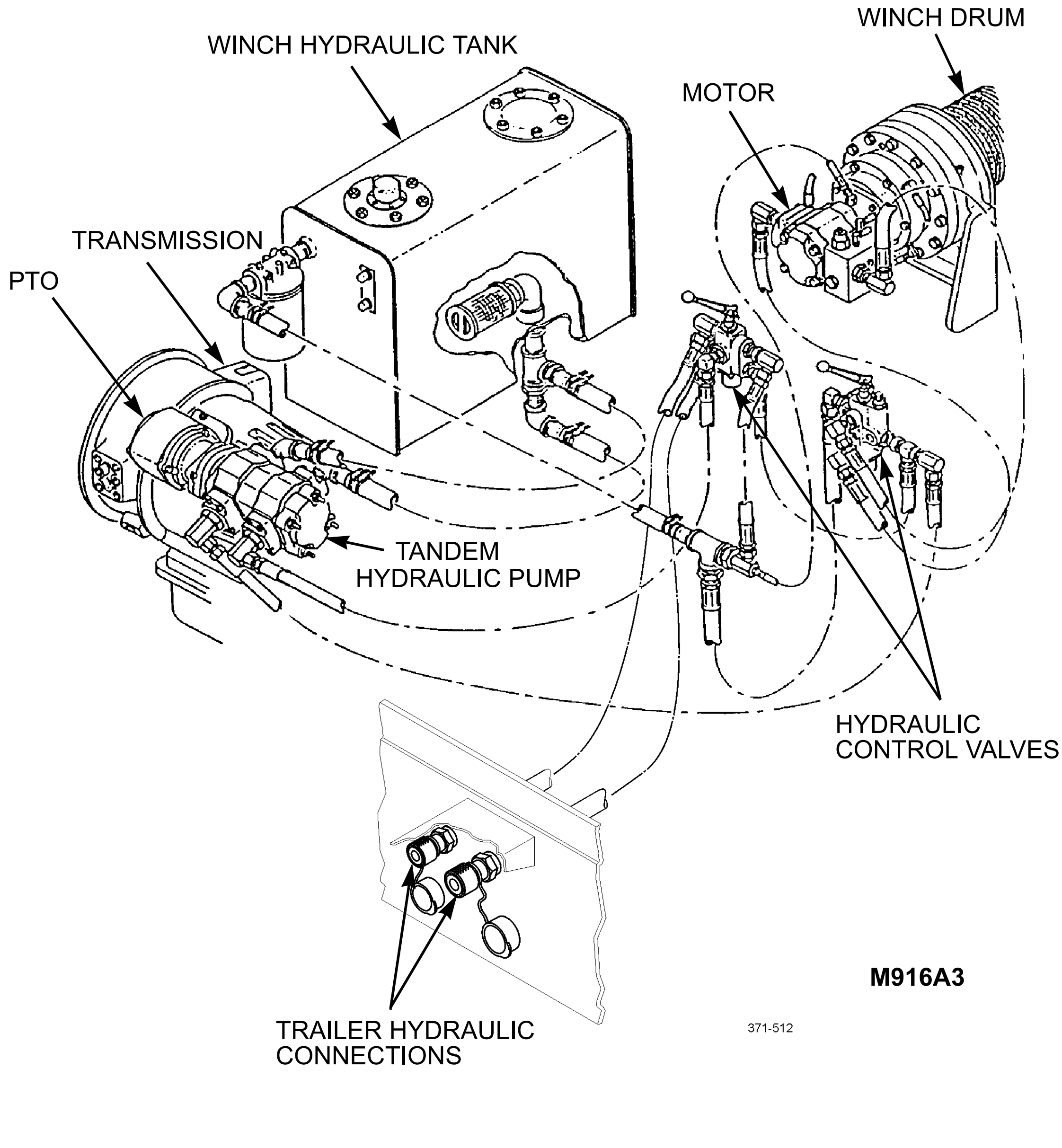
COLLISION WARNING SYSTEM (CWS) (M915A3 AND M916A3)

1. The CWS consists of an antenna assembly, central processing unit, driver display unit, side sensor, side sensor display, and wiring harness.
2. The CWS is a forward and side looking radar system that transmits and receives signals reflected off of objects to the front and side of the tractor.
3. The forward looking antenna assembly determines distance, azimuth, and approximate speed of vehicle forward of the tractor and sends signals through the central processing unit to the driver's display unit.
4. The side sensor detects vehicles or objects from two to ten feet, moving or stationary, alongside the tractor and sends signals through the central processing unit to the side sensor display.

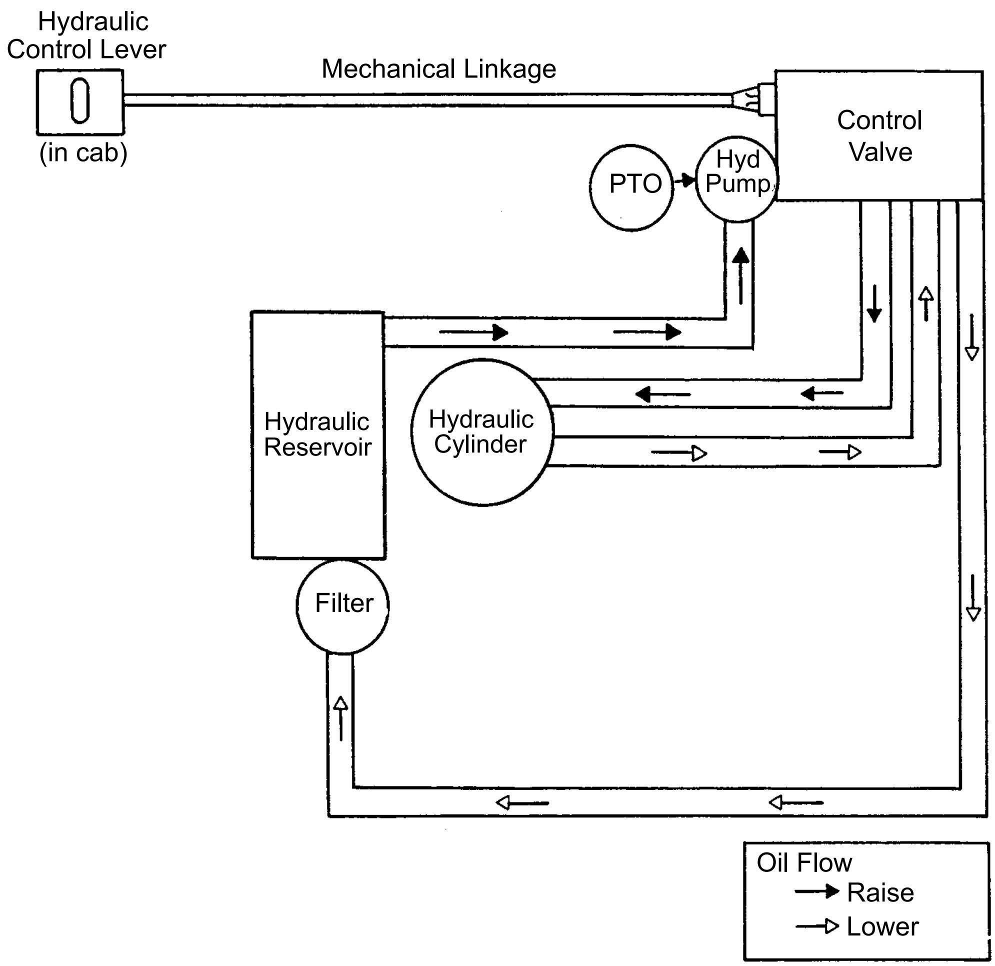


HYDRAULIC SYSTEM (M916A3, M917A2)

1. The M916A3 has a hydraulic system that is used to supply hydraulic power to the winch motor. The hydraulic system is comprised of a 50-gallon frame-mounted tank and a hydraulic pump driven by a transmission-mounted PTO.
2. With the engine running and the PTO engaged, the hydraulic pump takes fluid from the tank and delivers it to the winch control valve bank. The valve bank consists of a speed/auxiliary circuit control valve and a direction control valve.
3. The M917A2 and M917A2 w/MCS hydraulic system is used to raise and lower the dump body (TM 5-3805-264-14&P).
4. With the engine running and the PTO engaged, the hydraulic pump takes fluid from the reservoir and delivers it to the dump body control valve. Depending on the position of the hydraulic control lever, the control valve delivers fluid to the cylinder to raise or lower the dump body.



HYDRAULIC SYSTEM (M916A3, M917A2) - CONTINUED



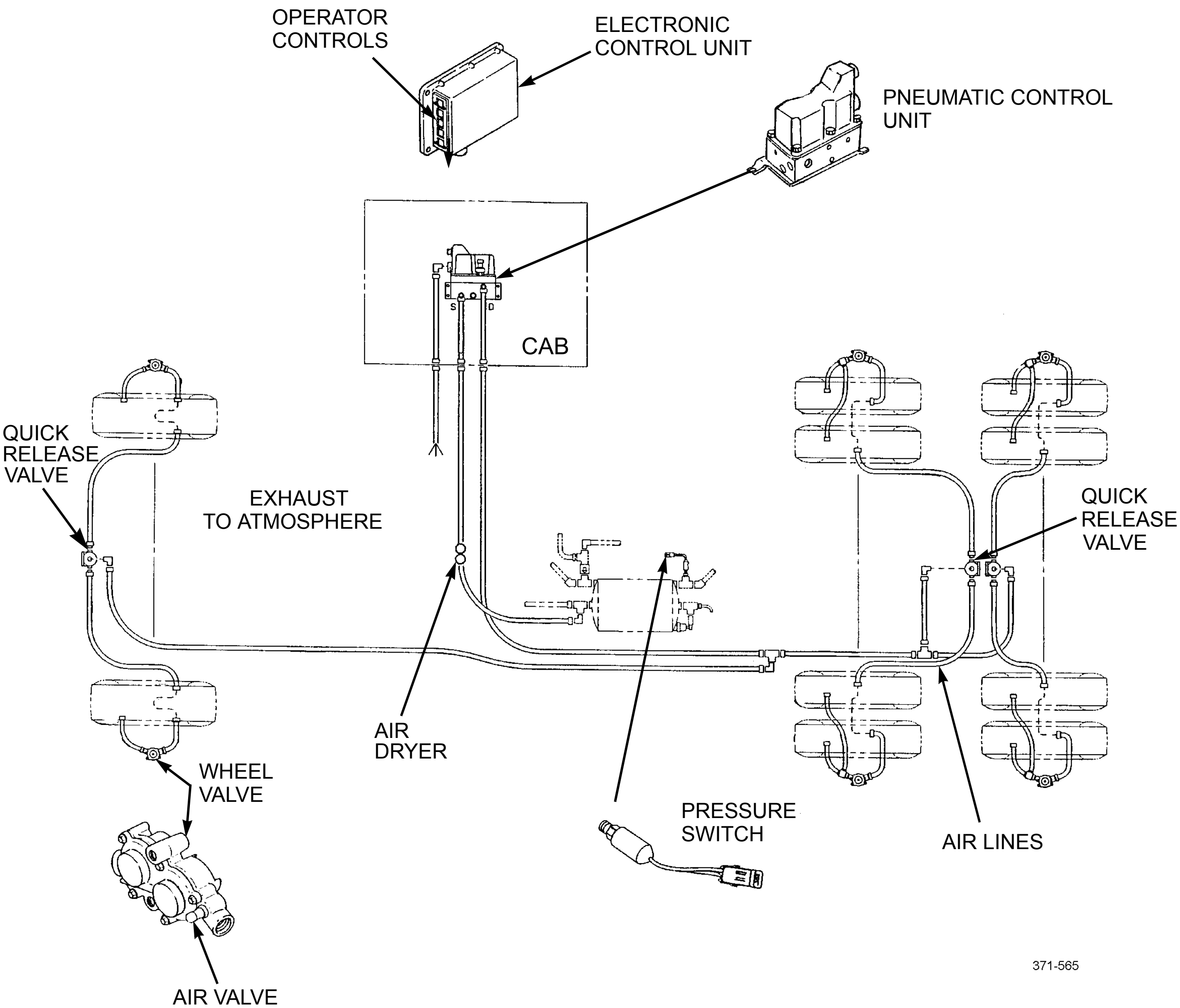
M917A2 AND M917A2 W/MCS

CENTRAL TIRE INFLATION SYSTEM (CTIS) (M916A3, M917A2)

1. The operator uses CTIS to regulate tire pressure at all wheels. This allows operation of the truck on all road surfaces and across a wide variety of terrain, including off-road, when the vehicle is stuck due to extreme conditions (ice, snow, mud), and when a tire has a slow leak due to a minor puncture or other damage.

2. CTIS uses air from the vehicle air system. Air is routed to the wheels via a dedicated pneumatic system plumbed from the vehicle's wet tank.

3. An Electronic Control Unit (ECU) is mounted to the shift tower inside the cab. An operator selector panel is built into the ECU, allowing operator entry of system commands/instructions.



CENTRAL TIRE INFLATION SYSTEM (CTIS) (M916A3, M917A2) - CONTINUED

4. Four terrain settings may be selected: HIGHWAY (HWY); CROSS-COUNTRY (X-C); SAND; EMERGENCY (EMER); and the RUN FLAT mode. If tire damage is minimal (e.g., a minor puncture or slow leak), selecting RUN FLAT causes CTIS to monitor tire pressure every fifteen seconds and re-inflate the tire.
5. Tire pressure can be manually checked and air added to tires through a conventional air valve located at each wheel valve.
6. When a non-CTIS equipped tire is installed, upon vehicle startup, the CTIS will attempt to inflate the tire. The system will recycle every 10 seconds for approximately 60 seconds then shutdown. Existing tire pressure in all CTIS equipped tires will remain the same.
7. Major components of the CTIS are:

COMPONENT	FUNCTION
Electronic Control Unit (ECU)/Operator Selector Panel	Contains microprocessor that controls the system and operator selector panel.
Pneumatic Control Unit	Directs air pressure through air lines to the wheel valves, according to ECU commands.
Air Dryer	Separates moisture and filters impurities from compressed air system before air enters the CTIS.
Pressure Switch	Acts as a brake priority switch by preventing CTIS from consuming air until the air brake system has a minimum of 85 psi (586 kPa) of air.
Speed Sensor	Transmission ECU senses vehicle speed and signals the CTIS ECU to automatically inflate tires when vehicle speed exceeds by 10 mph (16 kph) the top speed setting for the selected mode.
Quick Release Valves	Allow air from PCU to inflate or vent air during deflation.
Wheel Valves	Isolate air pressure in tire during normal operation and for tire removal. Air valve on wheel valve allows for inflation and deflation using standard manual inflation equipment.

END OF WORK PACKAGE

CHAPTER 2
UNIT TROUBLESHOOTING PROCEDURES

TROUBLESHOOTING INTRODUCTION 0004 00

THIS WORK PACKAGE COVERS

Introduction, Preliminary Troubleshooting Procedures, Electrical Troubleshooting, DDEC Engine Troubleshooting, SPORT/MSD Connection and Startup

INTRODUCTION

Troubleshooting procedures are grouped by work packages, containing information you need to fault locate malfunctions on the M915 Family of Vehicles. A troubleshooting symptom index in WP 0005 00 is provided to aid in locating a malfunction or symptom and direct you to the appropriate troubleshooting table (work package) containing a listing of malfunctions, test and inspection procedures, and corrective actions. The corrective action column further directs you to the required corrective maintenance procedure within this manual by work package number. However, if the required maintenance procedure is beyond Unit Maintenance capabilities, the direction is to notify Direct Support Maintenance.

PRELIMINARY TROUBLESHOOTING PROCEDURES

NOTE

Fluid leaks are classified as either Class I, Class II or Class III.

Class I: Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II: Leakage of fluid great enough to form drops, but not enough to cause drops to drip from item being checked/inspected.
Class III: Leakage of fluid great enough to form drops that fall from item being checked/inspected.

Before starting any specific troubleshooting procedures, perform the following:

a. Visually check for ruptured oil hoses or tubes and for Class II or Class III leaks.

b. Check for mechanical jamming or binding caused by rocks or other foreign matter.

c. Check fluid levels in subject area and service as required (WP 0023 00).

ELECTRICAL TROUBLESHOOTING

1. Analyze the symptoms and conditions and use common sense and logic to determine the most likely cause for the problem, then troubleshoot that circuit first. The more information you have concerning the problem, the easier it will be to troubleshoot.
2. Isolate to the subsystem level (in cases where more than one subsystem is involved); next isolate the problem to a single circuit within the subsystem; then, isolate the problem to the faulty component using the troubleshooting symptom index (WP 0005 00).
3. Frayed, broken, loose or corroded wiring is a common source of problems in any electrical circuit. Always make visual inspection before starting detail troubleshooting. Check for loose or damaged ground wires and repair as necessary (WP 0151 00). Observe in particular contacts to ground. Components with case grounds are especially troublesome.

CAUTION

When making continuity checks, make sure the test equipment is isolated from power source.

4. Most of the checks are made by voltage checks. Pay particular attention to the voltages being checked in the procedures. This equipment has a combination of 12 and 24 volt systems. Instructions prior to the step instruct to disconnect at test point from the potential malfunctioning component. Once the check has been made, either repair the component or go to the referenced step. If going to another step, reconnect connection or do as otherwise instructed, such as install jumper wires using Jumper Wire Kit. When ready to make the prescribed check, apply power to the circuit (if required). A helper may be required if the switch or power source is out of reach. Release the power function prior to going on, to avoid damage to equipment.

DDEC ENGINE TROUBLESHOOTING

1. Troubleshooting the DDEC engine and related systems is preformed by locating the malfunction within the troubleshooting symptom index (WP 0005 00), then referring to WP 0006 00 or WP 0007 00 for the required test or inspection steps. The troubleshooting table in WP 0006 00 contains general procedures to identify and correct an engine or engine related malfunction. The table also references the use of Check Engine Light (CEL) and SHUTDOWN Light flash codes to identify a problem. The information to utilize a Diagnostic Data Reader is also provided to aid in identifying a malfunction.
2. Also available to troubleshoot the DDEC engine is the Detroit Diesel Data Link diagnostic CD Rom, used with a PC or the SPORT/MSD computer.

SPORT CONNECTION AND STARTUP

1. Connect AC cable to battery pack and AC power source.
2. Connect battery pack cable to SPORT/MSD computer.
3. From SPORT/MSD storage container, remove DPA adapter, J1939 9-pin cable, and SPORT/DPA cable.
4. Connect J1939 cable to DPA adapter.
5. Connect SPORT/MSD/DPA cable (labels next to each connector) to DPA adapter and SPORT.
6. Connect J1939 cable to J1939 diagnostic connector under dashboard.
7. Turn SPORT/MSD to ON.
8. Allow SPORT/MSD to boot up.
9. Enter password or press ESC.
10. Click on EMS-2 VIEWER icon.
11. Click on OPTIONS, then HARDWARE CONFIGURATION, then CONFIGURE INTERFACE HARDWARE.
12. On EMS-2 Application screen, click on OK.
13. On EMS-2 Application screen, select CUSTOM, then J1939 Interface DPA, then click on OK.
14. On SELECT MANUAL TO OPEN menu, select desired manual and press ENTER.
15. On SELECT MANUAL TO OPEN menu, select desired vehicle model and press ENTER.
16. Enter PIN, and press NEXT.
17. Enter PIN, DODACC, and ADMIN info and press OK.
18. Selected manual is presented.
19. Select TROUBLESHOOTING and press ENTER.
20. Follow instructions on screen (ignition ON and perform hardware test).
21. SELECT SYSTEM menu will appear. Ensure DDEC engine listed is DDEC engine for your vehicle.
22. Select desired system.

END OF WORK PACKAGE

TROUBLESHOOTING SYMPTOM INDEX 0005 00

Malfunction/Symptom Page Number

COLLISION WARNING SYSTEM (M915A3, M916A3) - CONTINUED

HYDRAULIC SYSTEM (M916A3, M917A2)

Power Take-Off Circuits

Hydraulic System

CENTRAL TIRE INFLATION SYSTEM (CTIS) (M916A3, M917A2)

END OF WORK PACKAGE

ENGINE TROUBLESHOOTING 0006 00

THIS WORK PACKAGE COVERS

Engine Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

DDEC III/IV PC Card, Pro-link (Item 7, WP 0306 00)

Tester, Pro-link, diagnostic reader (Item 46, WP 0306 00)

Tools and Special Tools - Continued

Diagnostic set, DDEC (Item 8, WP 0306 00)

SPORT (Item 43, WP 0306 00)

MSD (Item 27, WP 0306 00)

Table 1. Engine Troubleshooting Procedures .

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Engine Fails to Crank or Cranks Slowly.	1. Check for damaged or loose battery connections.	Tighten or repair battery connections as required (WP 0145 00 or WP 0146 00).
	2. Check battery voltage. 22-26 volts are required.	If voltage is below 22 volts, service batteries (TM 9-6140-200-14).
	3. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 4 and read Active Flash Codes. b. If CEL comes on for up to five seconds and then turns off, perform step 4 and read Inactive Flash Codes. c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 0007 00).
	4. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system diagnostic troubleshooting. Refer to section number that matches flash code logged (WP 0007 00).
2. Engine Does Not Crank.	1. Check for damaged or loose battery cable connections.	Tighten or repair battery cable connections as required (WP 0145 00 or WP 0146 00).
	2. Check battery voltage. 22-26 volts are required.	If voltage is below 22 volts, service batteries (see TM 9-6140-200-14).

Table 1. Engine Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Engine Does Not Crank - Continued.	3. Check electrical connections at the starter motor.	Tighten or repair connections as required (WP 0067 00 or WP 0068 00).
	4. Check TRANS ECU fuse F6.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	5. Open battery box and check transmission ECU 15A fuse.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	6. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 5 and read Active Flash Codes. b. If CEL comes on for up to five seconds and then turns off, perform step 5 and read Inactive Flash Codes. c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00). d. If a NO FAULT code is present, proceed to step 7.
	7. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system diagnostic troubleshooting. Refer to section number that matches flash code logged (WP 07 00).
	8. Check for damage/continuity to engine start button.	If button is damaged or continuity is not present, replace button (WP 0077 00). If button is okay, proceed.
	9. Check NEUTRAL START L/O relay M1.	Replace defective relay (WP 0084 00).
3. Engine Cranks, But Does Not Start.	1. Check position of fuel shutoff valve.	If closed, open valve (WP 0034 00).
	2. Check ENGINE ECU 10A fuse F7.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Open battery box and check engine ECU 15A fuse.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	4. Check fuel lines and hoses for leaks and damage.	Tighten or replace fuel lines and hoses as necessary (WP 0034 00).
	5. Check for clogged fuel/water separator and clogged secondary fuel filter.	Service or replace fuel filters (WP 0034 00).
	6. Confirm fuel system is primed.	Using fuel/water separator primer pump, prime system (TM 9-2320-302-10).
	7. Check for clogged or restricted air cleaner element.	Service air cleaner (WP 0040 00).

Table 1. Engine Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
3. Engine Cranks, But Does Not Start - Continued.	8. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 7 and read Active Flash Codes. b. If CEL comes on for up to five seconds and then turns off, perform step 7 and read Inactive Flash Codes. c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00).
	9. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system troubleshooting. Refer to section number that matches flash code logged (WP 07 00).
4. Engine Stops, But Is Not Seized.	1. Check for clogged fuel/water separator and clogged secondary fuel filter.	Service or replace fuel filters (WP 0034 00).
	2. Check fuel lines and hoses for leaks and damage.	Tighten or replace fuel lines and hoses as necessary (WP 0032 00 or WP 0033 00).
	3. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 4 and read Active Flash Codes. b. If CEL comes on for up to five seconds and then turns off, perform step 4 and read Inactive Flash Codes. c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00)
	4. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system diagnostic troubleshooting by referring to the section number that matches the flash code logged (WP 07 00).
5. Erratic Engine Operation.	1. Check fuel lines and hoses for leaks and damage.	Tighten or replace fuel lines and hoses as necessary (WP 0032 00 or WP 0033 00).
	2. Check for clogged fuel/water separator and clogged secondary fuel filter.	Service or replace fuel filters (WP 0034 00).

Table 1. Engine Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
5. Erratic Engine Operation - Continued.	3. Confirm fuel system is primed.	Using fuel/water separator primer pump, prime fuel system (TM 9-2320-302-10).
	4. Check for clogged or restricted air cleaner element.	Service air cleaner (WP 0040 00).
	5. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 6 and read Active Codes.
		b. If CEL comes on for up to five seconds and then turns off, perform step 6 and read Inactive Flash Codes.
		c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00).
	6. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system troubleshooting. Refer to section number that matches flash code logged (WP 07 00).
6. Excessive Exhaust Smoke.	1. Check for clogged or restricted air cleaner element.	Service air cleaner (WP 0040 00).
	2. Check for clogged fuel/water separator and clogged secondary fuel filter.	Service or replace fuel filters (WP 0034 00).
	3. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 4 and read Active Flash Codes.
		b. If CEL comes on for five seconds and then turns off, perform step 4 and read Inactive Flash Codes.
		c. If CEL comes on, but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00).
	4. Connect Diagnostic Data Reader (DDR) to Diagnostic Data Link (DDL) connector.	Perform DDEC system troubleshooting. Refer to section number that matches flash code logged (WP 07 00).
7. Low Oil Pressure.	1. Check engine oil level.	Fill to proper level (TM 9-2320-302-10).

Table 1. Engine Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
7. Low Oil Pressure - Continued.	2. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 3 and read Active Flash Codes.
		b. If CEL comes on for up to five seconds and then turns off, perform step 3 and read Inactive Flash Codes.
		c. If CEL comes on but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00).
	3. Connect Diagnostic Data Reader (DDR) to Diagnostic Data Link (DDL) connector.	Perform DDEC system troubleshooting. Refer to section number that matches flash code logged (WP 07 00).
8. High Oil Consumption.	1. Check for overfilled crankcase.	Drain oil to proper level (TM 9-2320-302-10).
	2. Check for oil in air reservoir tanks.	If oil is found in air reservoirs, replace air compressor assembly (WP 0031 00).
	3. Check for indications of oil at turbocharger outlet and inlet.	If oil is found, notify Direct Support Maintenance.
9. Engine Overheats.	1. Check coolant level.	Fill coolant to proper level (TM 9-2320-302-10).
	2. Check for loose (M915A3 Old Model) or missing fan belts.	Adjust (M915A3 Old Model) or replace fan belts as required (WP 0053 00 or WP 0063 00).
	3. Check radiator clamps and hoses for leaks.	Replace or tighten radiator clamps and hoses as necessary (WP 0047 00 or WP 0048 00).
	4. Remove and test thermostats.	Replace failed thermostats (WP 0049 00).
	5. Visually check radiator for signs of clogged fins, leaks, and damage.	If radiator fins are clogged, remove obstructions. Replace leaking or damaged radiator (WP 0052 00).
	6. With ignition ON and engine OFF, press Check Engine Button and observe Check Engine Light (CEL).	a. If CEL comes on and stays on, perform step 6 and read Active Flash Codes.
		b. If CEL comes on for up to five seconds and then turns off, perform step 6 and read Inactive Flash Codes.

Table 1. Engine Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
9. Engine Overheats - Continued.		c. If CEL comes on but is erratic or intermittent, refer to DDEC Engine Troubleshooting (WP 07 00).
	7. Connect test set to Diagnostic Data Link (DDL) connector.	Perform DDEC system diagnostic troubleshooting. Refer to section number that matches flash code logged (WP 07 00).

END OF WORK PACKAGE

DDEC ENGINE TROUBLESHOOTING 0007 00

THIS WORK PACKAGE COVERS

Introduction, DDEC Engine Troubleshooting and Flash Code Index

INITIAL SETUP

Tools and Special Tools

Adapter, electrical (Item 1, WP 0306 00)

Cable assembly, special (Item 4, WP 0306 00)

DDEC III/IV PC card, Pro-link (Item 7, WP 0306 00)

Tester, Pro-link, diagnostic reader (Item 46, WP 0306 00)

Tools and Special Tools - Continued

Diagnostic set, DDEC (Item 8, WP 0306 00)

SPORT/ICE (Item 43, WP 0306 00)

MSD (Item 27, WP 0306 00)

INTRODUCTION

1. The DDEC Troubleshooting Manual is provided in its entirety as part of this work package. For ease of use, this manual retains its original format and page numbering.
2. A DDEC Engine Troubleshooting Index has been developed to assist the user in finding general information on DDEC troubleshooting and locating specific diagnostic flash codes.
3. Note that the flash codes in the index are electronically linked to the flash codes within the DDEC Troubleshooting Manual.

DDEC ENGINE TROUBLESHOOTING AND FLASH CODE INDEX

DDEC ENGINE TROUBLESHOOTING AND FLASH CODE INDEX - CONTINUED

DDEC ENGINE TROUBLESHOOTING AND FLASH CODE INDEX - CONTINUED

DDEC ENGINE TROUBLESHOOTING AND FLASH CODE INDEX - CONTINUED

END OF WORK PACKAGE

ENGINE EXHAUST

Consider the following before servicing engines:

CAUTION:

Engine exhaust may be harmful to your health if inhaled.

Please note this caution and remember:

- ☐ Always start and operate the engine in a well ventilated area.
- ☐ If in an enclosed area, vent the exhaust to the outside.
- ☐ Do not modify or tamper with the exhaust system.

GENERAL INFORMATION

Section **Page**

ABSTRACT

This manual provides instruction for troubleshooting the Detroit Diesel Electronic Controlled (DDEC®) engines, with two or three (multiple) ECMs.

Specifically covered in this manual are troubleshooting and repair steps that apply to the DDEC III and DDEC IV systems.

CAUTION:

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed. Proper service and repair are important to the safety of the service technician and the safe, reliable operation of the engine. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part number. Do not use a replacement part of lesser quality. The service procedures recommended and described in this manual are effective methods of performing repair. Some of these procedures require the use of specially designed tools. Accordingly, anyone who intends to use a replacement part, procedure or tool which is not recommended, must first determine that neither personal safety nor the safe operation of the engine will be jeopardized by the replacement part, procedure or tool selected. It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during repair, or the possibility that improper repair may damage the engine or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is impossible to warn personnel of the possible hazardous consequences that might result from failure to follow these instructions.

1 INTRODUCTION

1.1 INTRODUCTION

Detroit Diesel Corporation is the world leader in diesel engine electronics. DDC has made technological leaps in engine performance and fuel economy. Today, we build the most dependable electronically controlled diesel engine in the industry.

Our goal at Detroit Diesel is to be the most customer focused and most responsive engine manufacturer in the world.

1.2 TROUBLESHOOTING INFORMATION

Troubleshooting of the DDEC III system and the DDEC IV system is identical. At the time of this printing, the available features are the same in both systems. The DDEC IV system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable.

Instructions for repair in this manual are generic. For example, "Repair Open" is used to advise the technician that a particular wire has been determined to be broken. In some cases it may not be best to try and locate the open. It may be that the best repair technique is to replace a complete harness. The technician should make the determination of the proper repair, with the best interest of the customer in mind.

Instructions to "Contact Detroit Diesel Technical Service" indicate that at the time of this publication, all known troubleshooting checks have been included. Review any recent Service Information Bulletins (SIB) or Service Information letters before calling.

It is also suggested that other DDC outlets be contacted. e.g. if you are a dealer or user, contact your closest DDC Distributor.

Ensure you have the engine serial number when you call. The FAX number for Detroit Diesel Technical Service is 313-592-7888.

Instructions in this manual may suggest replacing a non DDC component. It may be required to contact the supplier of the component, e.g. truck manufacturer for a TPS concern, to obtain approval to replace the component.

Instructions to check terminals and connectors should include checking for proper contact tension. Using a mating terminal, a modest force should be required to remove a terminal from its mate. Replace terminals with poor tension.

After completing any repair, always clear fault codes that may have been generated during the troubleshooting process.

Important:

To ensure you receive updates to this manual should the need arise, you must fill out the Information Card in the front of this manual.

NOTE:
Be aware that troubleshooting in this manual is mostly concerned with DDEC related codes. Codes associated with other components, e.g. construction and industrial, EDM and AIM, can be found in the related publication. Refer to section 2.4.

2 (CHG) OPERATION

2.1 DDEC BENEFITS

CHANGES NEEDED. All Detroit Diesel On-Highway engines come standard with Detroit Diesel Electronic Controls (DDEC®). The state of the art Electronic Control Module (ECM) allows precise control of the engine management system that provides:

- ☐ Excellent engine performance
- ☐ Optimum fuel economy
- ☐ Emissions to meet current laws without after treatment
- ☐ Engine diagnostics
- ☐ Simple programming

2.2 FEATURES

The following features are part of the DDEC system:

- ☐ Engine Protection System
- ☐ Cruise Control
- ☐ Cruise Power
- ☐ Cruise Control Automatic Resume
- ☐ Progressive Engine Braking In Cruise Control
- ☐ Fan Controls
- ☐ Engine Fan Braking
- ☐ Progressive Shifting
- ☐ Vehicle Speed Limiting
- ☐ Vehicle Overspeed Diagnostics
- ☐ Vehicle ID Number
- ☐ Pressure Governor
- ☐ Starter Lockout
- ☐ Remote Throttle - PTO - Control
- ☐ High Idle Controls
- ☐ DDEC Ether Start
- ☐ Optimized Idle
- ☐ Idle Adjustment
- ☐ Idle Timer Shutdown
- ☐ Air Temperature Shutdown
- ☐ Auxiliary Engine Protection
- ☐ Customer Password
- ☐ Rating Security
- ☐ Maximum Security
- ☐ Low DDEC Voltage Light
- ☐ Low Coolant Light
- ☐ Low Oil Pressure Light
- ☐ High Oil Temperature Light
- ☐ High Coolant Temperature Light
- ☐ De-acceleration Light
- ☐ 12-volt or 24-volt ECM
- ☐ Communications Links SAE J1587, J1922, J1939

2.3 DDEC SYSTEM--HOW IT WORKS

The major components of the DDEC system consist of the electronic control module (ECM), the electronic unit injectors (EUI) and the various system sensors. The purpose of the sensors is to provide information to the ECM regarding various engine performance characteristics. The information sent to the ECM is used to instantaneously regulate engine and vehicle performance.

2.3.1 Electronic Unit Injector

An electronic unit injector incorporates a solenoid operated poppet valve which performs the injection timing and metering functions. When the solenoid valve is closed, pressurization and fuel injection is initiated. Opening the solenoid valve releases injection pressure, ending injection. The duration of valve closure determines the quantity of fuel injected. See Figure 2-1.

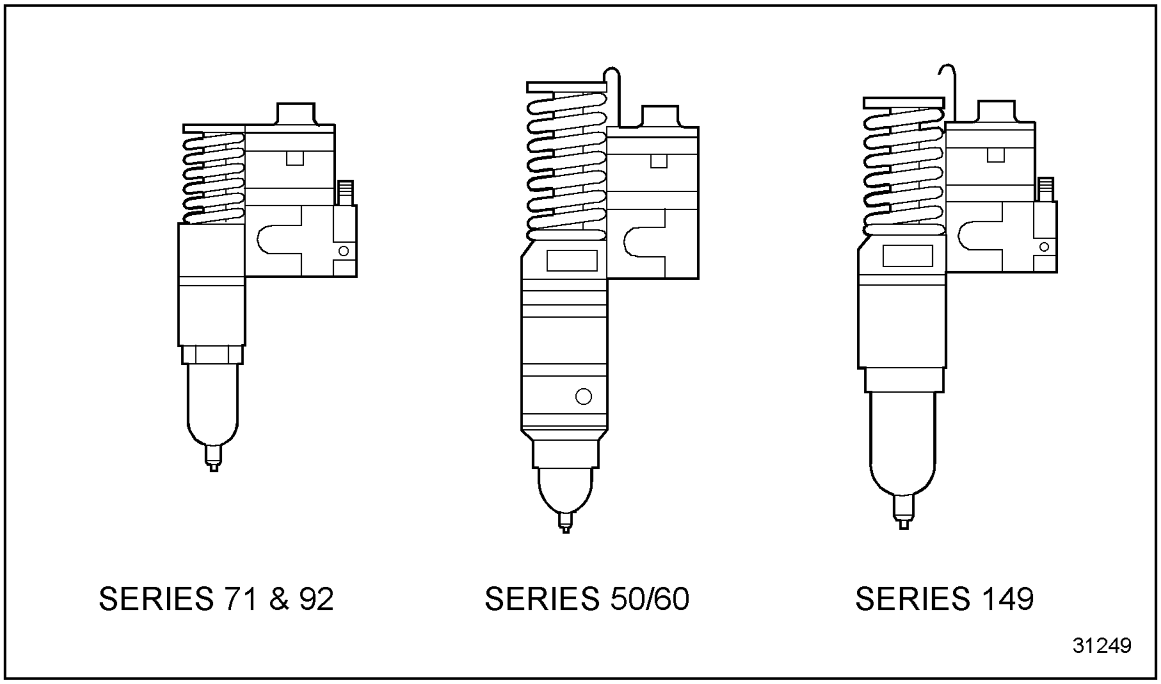


Figure 2-1 Electronic Unit Injector

2.3.2 Electrical Connectors

Provide water-tight connections for the harnesses between the sensors and the ECM.

2.3.3 Air Temperature Sensor

The air temperature sensor is located in the air intake manifold and monitors the air temperature entering the engine. The ECM adjusts the engine timing to reduce white smoke, improve cold starts, and provide engine protection. See Figure 2-2.

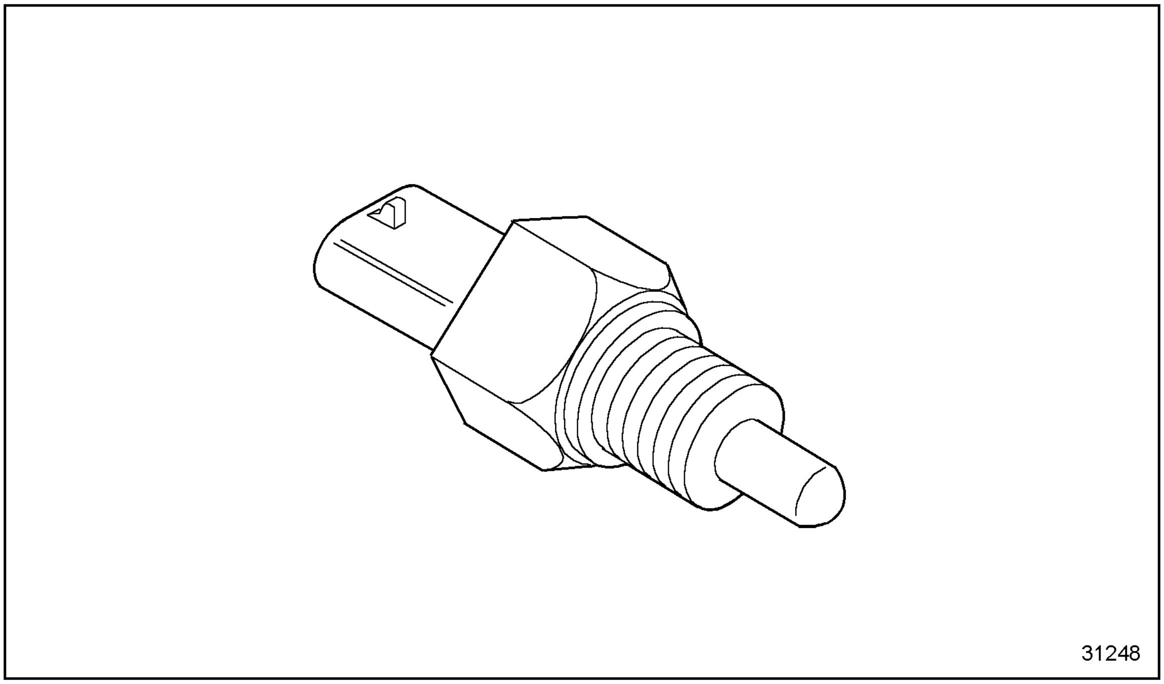


Figure 2-2 Air Temperature Sensor

2.3.4 Coolant Temperature Sensor

The coolant temperature sensor is located on the right side of the engine. The engine protection feature will be triggered if the coolant temperature exceeds the specified limits. See Figure 2-3.

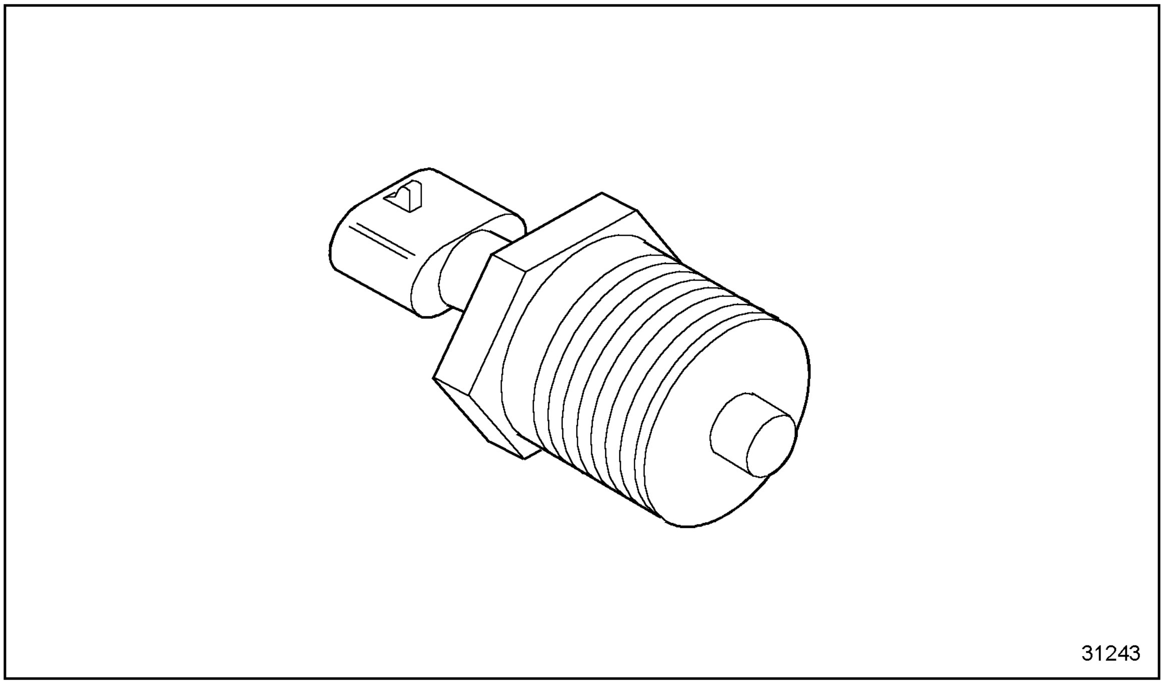


Figure 2-3 Coolant Temperature Sensor

2.3.5 Fire Truck Pump Pressure Sensor

The fire truck pump pressure sensor is used to monitor water pressure for the Pressure Governor System in the DDEC system. The signal back to the ECM changes r/min which allows the fire truck water pump to maintain a steady water pressure during pumping operation in fire trucks. See Figure 2-4.

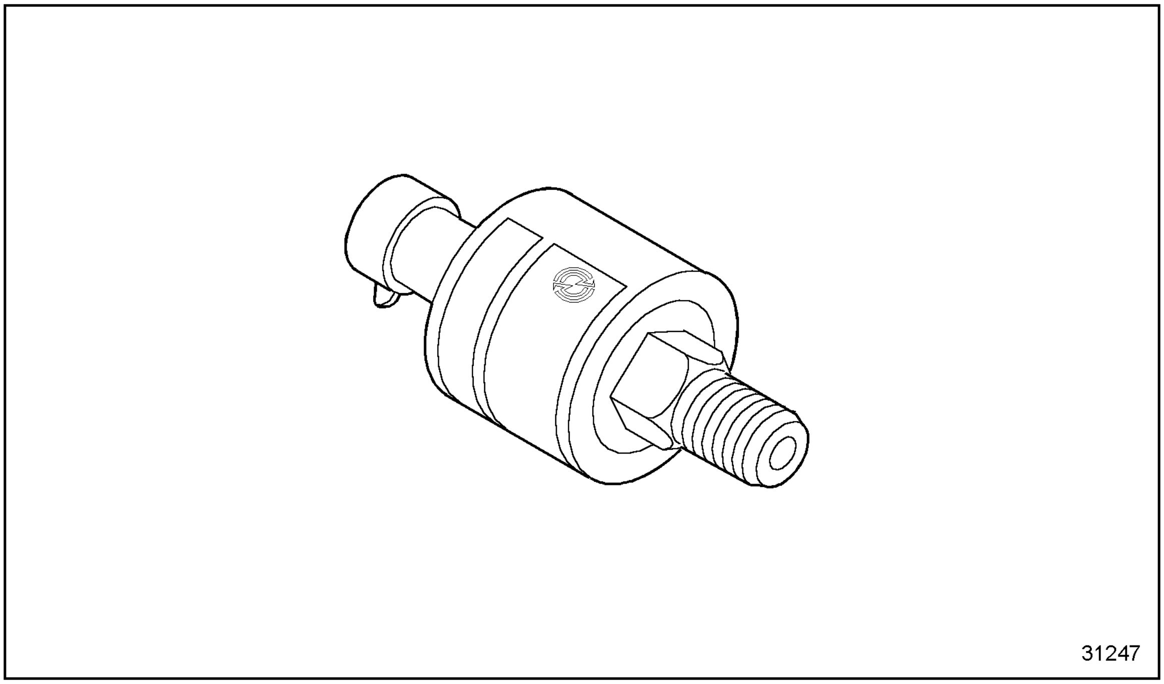


Figure 2-4 Fire Truck Pump Pressure Sensor

2.3.6 The Synchronous Reference Sensor and Timing Reference Sensor

These sensors control the timing of the engine. The SRS sensor provides a "once per cam revolution" signal and the TRS sensor provides a "36 per crankshaft revolution" signal. Working together, these sensors tell the ECM which cylinder is at top-dead-center for cylinder firing. Precise monitoring of piston position allows for optimum injection timing, resulting in excellent fuel economy and performance with low emissions. See Figure 2-5 for the SRS and the TRS.

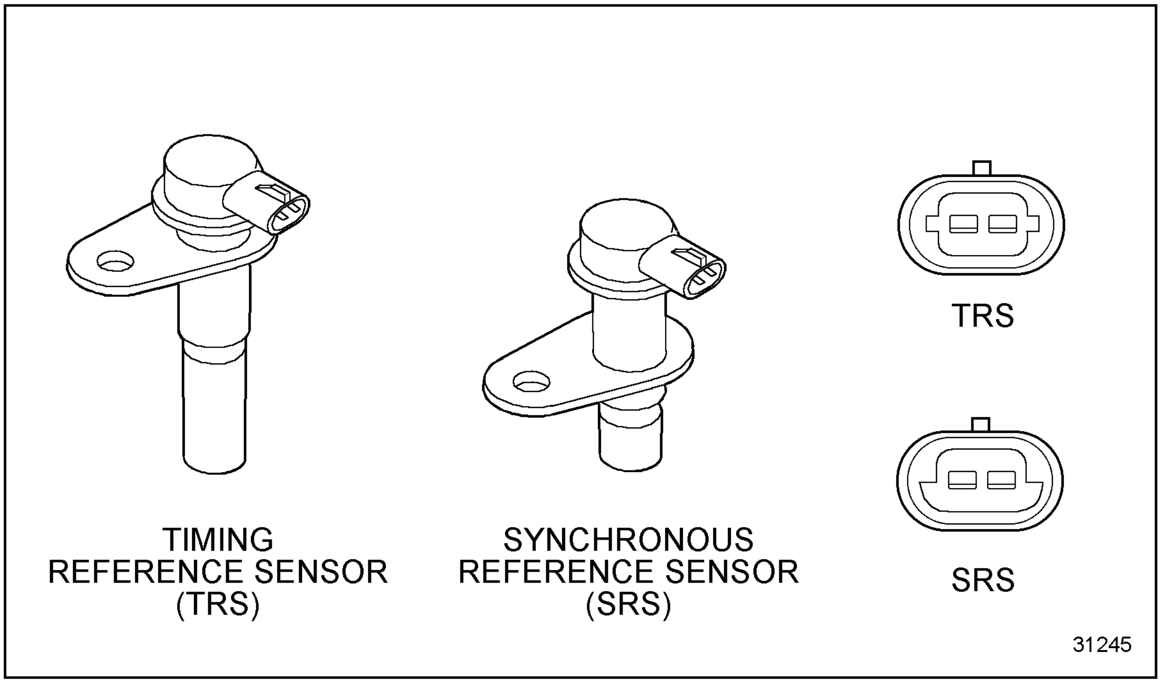


Figure 2-5 Timing Reference Sensor and Synchronous Reference Sensor

2.3.7 Oil and Fuel Temperature Sensors

The oil temperature sensor optimizes idle speed and injection timing to improve cold startability and reduce white smoke. This sensor will activate the engine protection system if the oil temperature is higher than normal.

The fuel temperature sensor provides a signal to the ECM. The ECM utilizes the fuel temperature signal to adjust the fueling for changes in the fuel density as a function of temperature to maintain horsepower. See Figure 2-6.

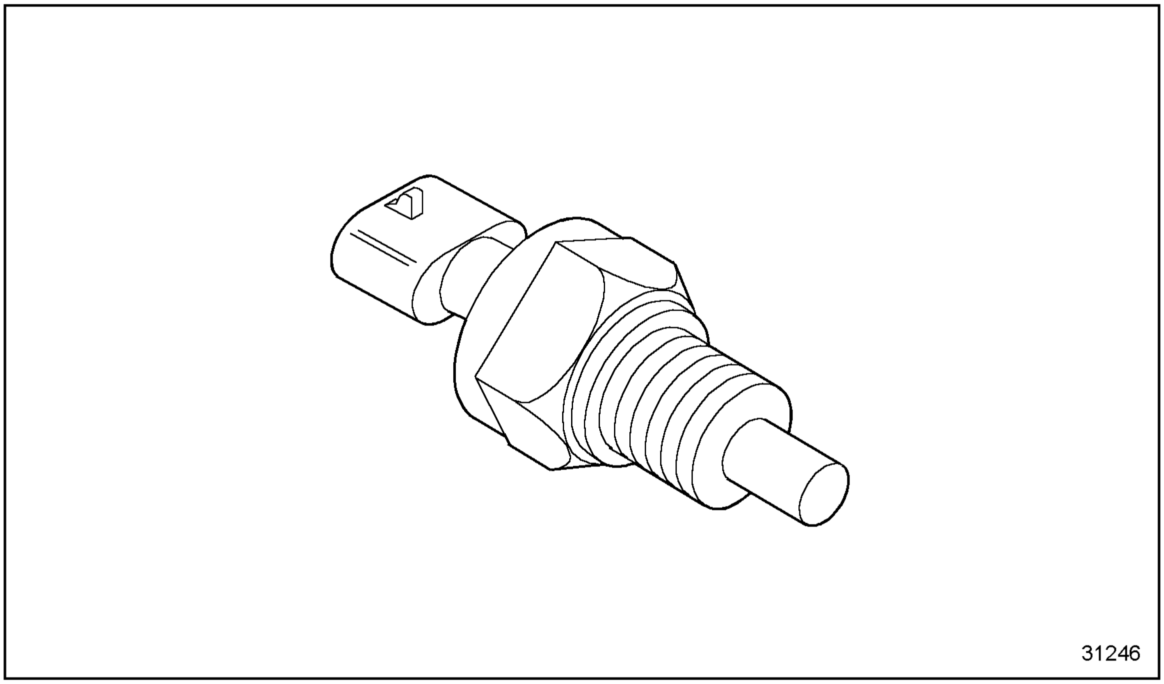


Figure 2-6 Oil and Fuel Temperature Sensors

2.3.8 Electronic Control Module

The ECM is the brain of the computer system, receiving electronic inputs from the operator as well as from the engine and vehicle mounted sensors. See Figure 2-7.

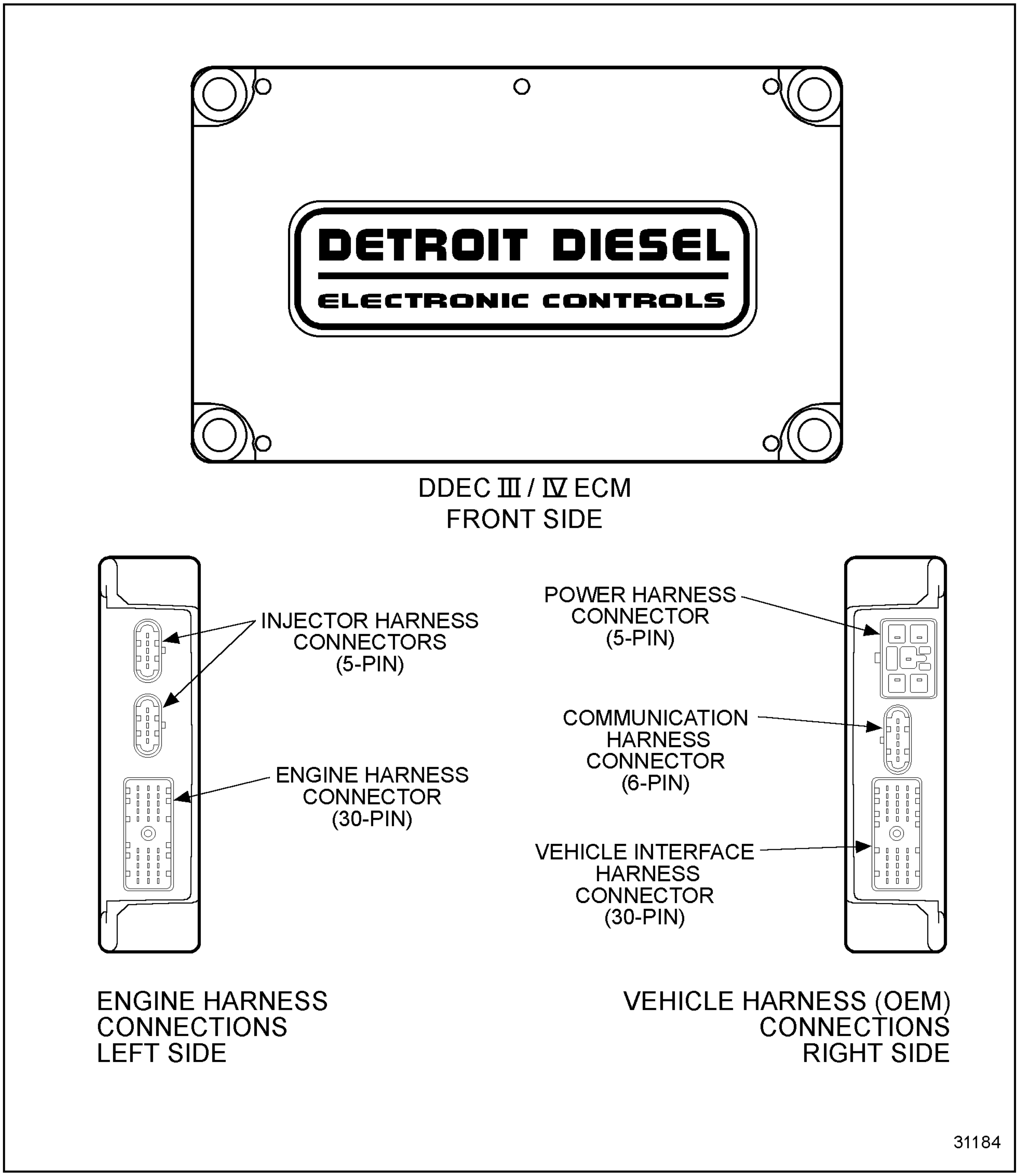


Figure 2-7 Electronic Control Module

2.3.9 Coolant Level Sensor

The engine protection feature will be triggered if the coolant level sensor detects a low coolant level. See Figure 2-8.

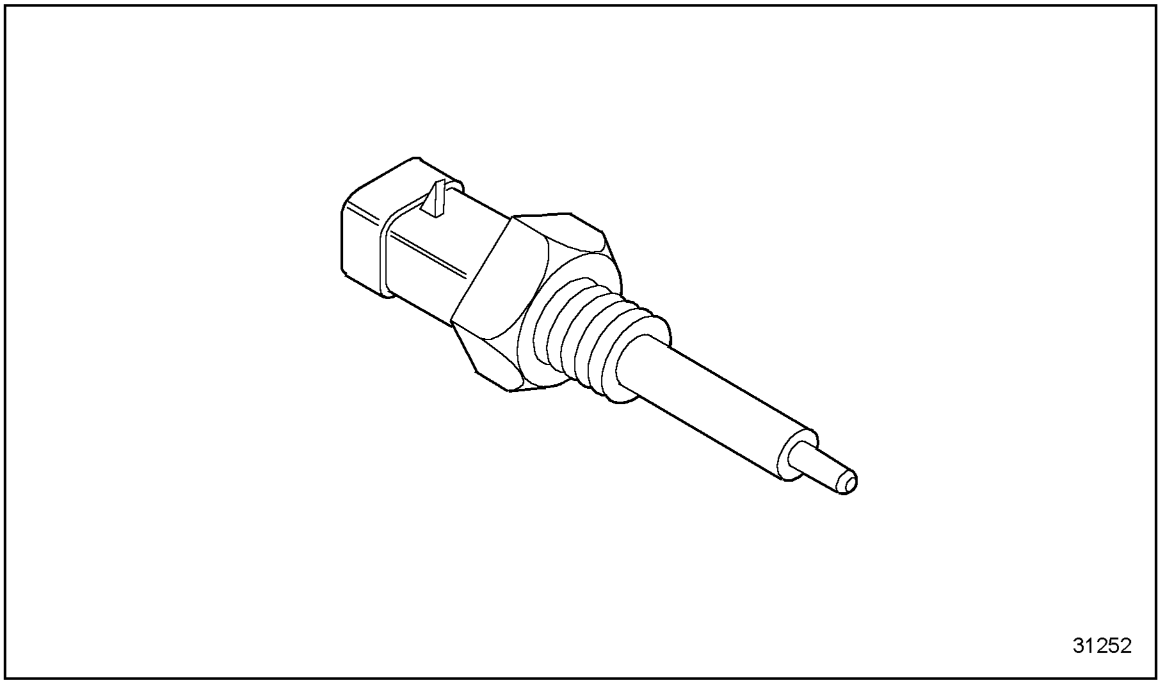


Figure 2-8 Coolant Level Sensor

2.3.10 Throttle Position Sensor

The electronic foot pedal assembly instantaneously converts the operator's throttle input into a signal to the ECM. The throttle response is fast and accurate. This sensor is self-calibrated, and requires no maintenance. See Figure 2-9.

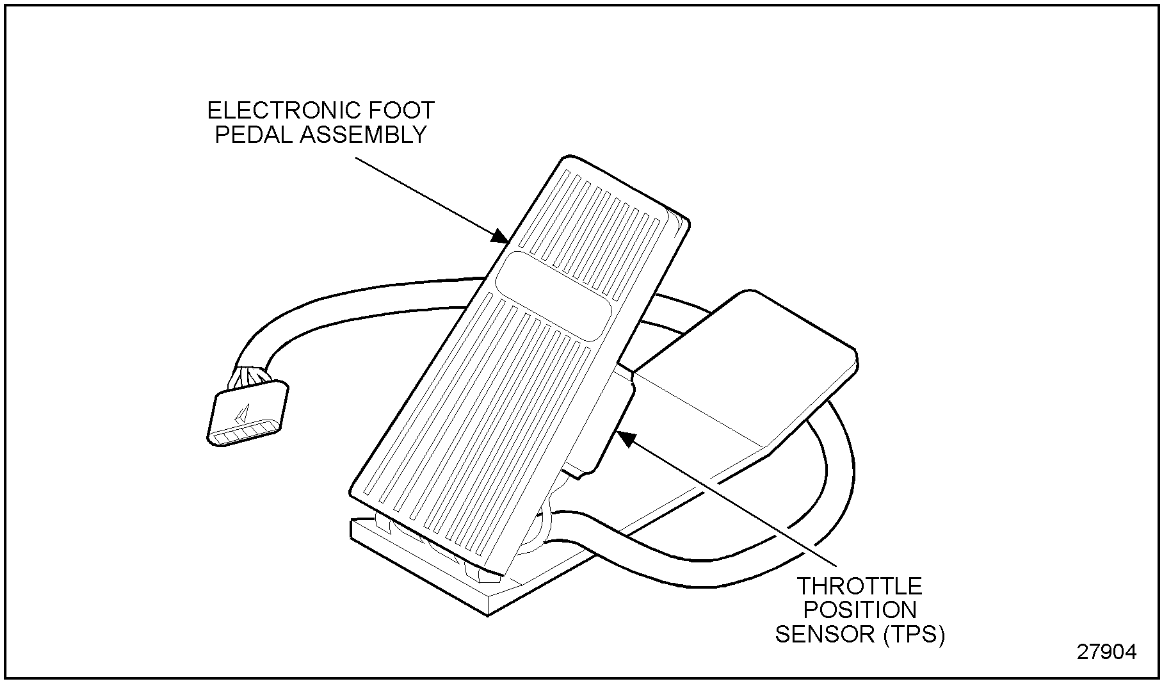


Figure 2-9 Throttle Position Sensor

2.3.11 Vehicle Speed Sensor

The vehicle speed sensor provides the ECM with the vehicle road speed for use with cruise control, vehicle speed limiting, and progressive shifting. See Figure 2-10.

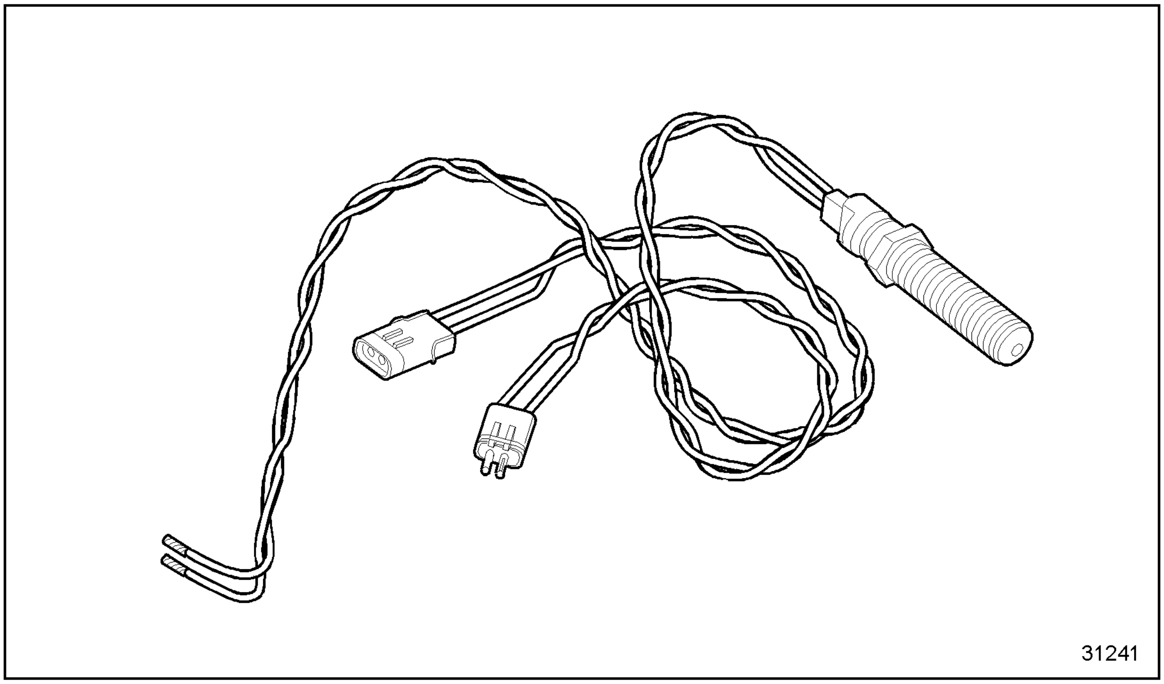


Figure 2-10 Vehicle Speed Sensor

2.3.12 Turbo Boost Sensor

In monitoring turbocharger compressor discharge, the turbo boost sensor provides air pressure data to the ECM for smoke control during engine acceleration. See Figure 2-11.

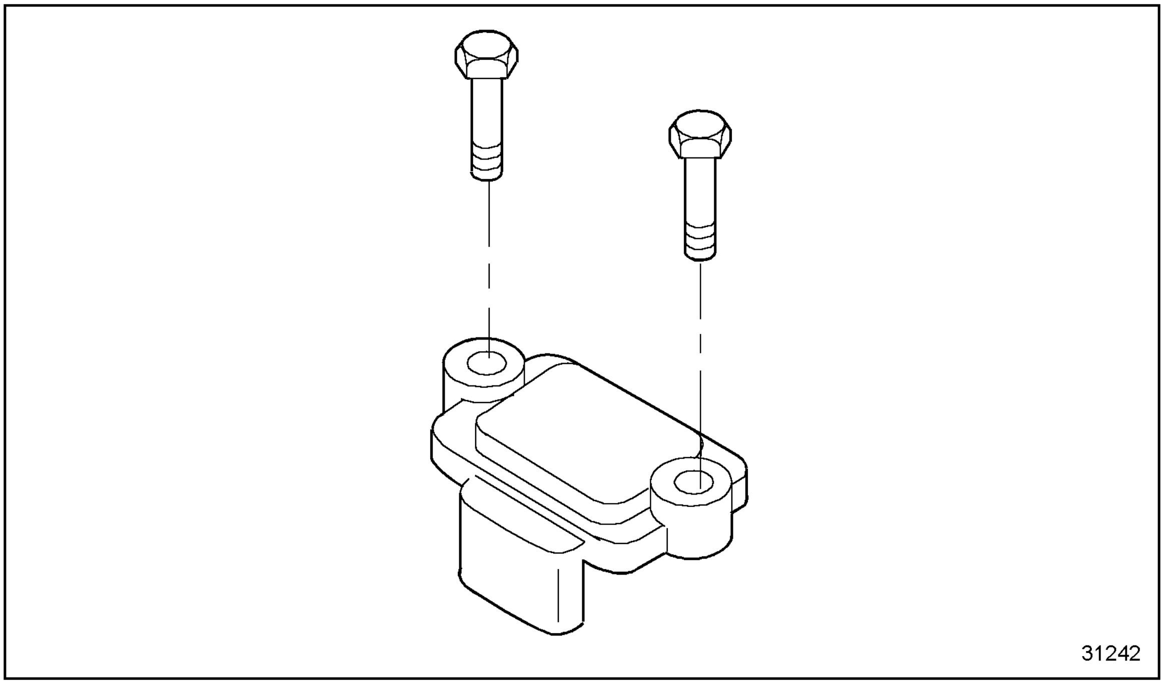


Figure 2-11 Turbo Boost Sensor

2.3.13 Oil Pressure Sensor

The oil pressure sensor will activate the engine protection system when the oil pressure falls below a normal oil pressure at a given engine r/min. See Figure 2-12.

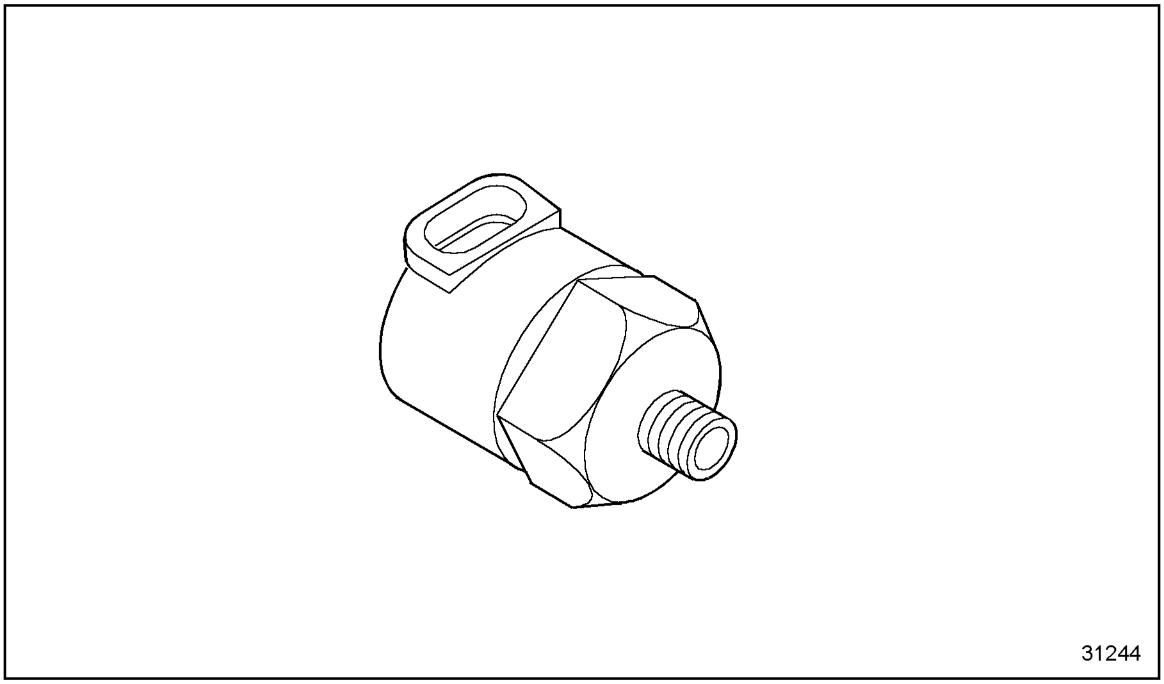


Figure 2-12 Oil Pressure Sensor

2.3.14 Fuel Pressure Sensor

The fuel pressure sensor monitors fuel pressure to warn the operator of impending power loss. This feature is optional. It is not used in international applications. See Figure 2-13.

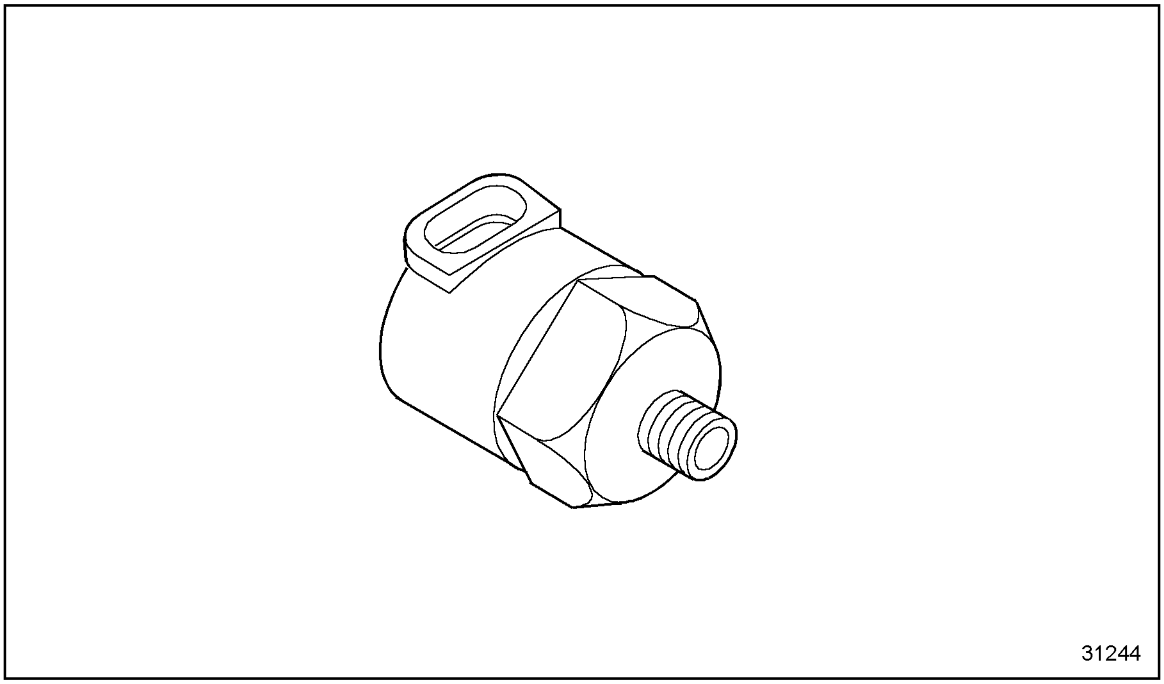


Figure 2-13 Fuel Pressure Sensor

2.4 DDEC RELATED PUBLICATIONS

The following manuals, listed in Table 2-1, should be used for reference when troubleshooting DDEC components.

Publication	Number
DDEC III Application and Installation manual	7SA800
Optimized Idle Installation and Troubleshooting	7SA734
Optimized Idle User Manual	6SE518
Optimized Idle Troubleshooting and Reprogramming	18SA366
Engine Synchro Shift (ESS) Troubleshooting Manual	6SE498
Construction and Industrial EDM and AIM Installation and Troubleshooting	7SA801
Construction and Industrial EDM and AIM User Manual	6SE710
DDC Ether Start	7SA727
Series 50G Application and Installation Engineering Guidelines, Bulletin 53	18SA365
DDEC III Automotive Code Chart, 3 color, 8.5 x 11	7SE444
DDEC III Codes, Reference Pamphlet	7SE414
DDEC II Troubleshooting Manual	6SE489
DDEC II Application and Installation manual	7SA707
Series 60 Driving Tips (includes VHS video)	25STV0161

Table 2-1 DDEC Related Publications

3 (CHG) ECM AND SENSOR LOCATIONS

3.1 ECM AND SENSOR LOCATIONS

For the DDEC system ECM see Figure 3-1.

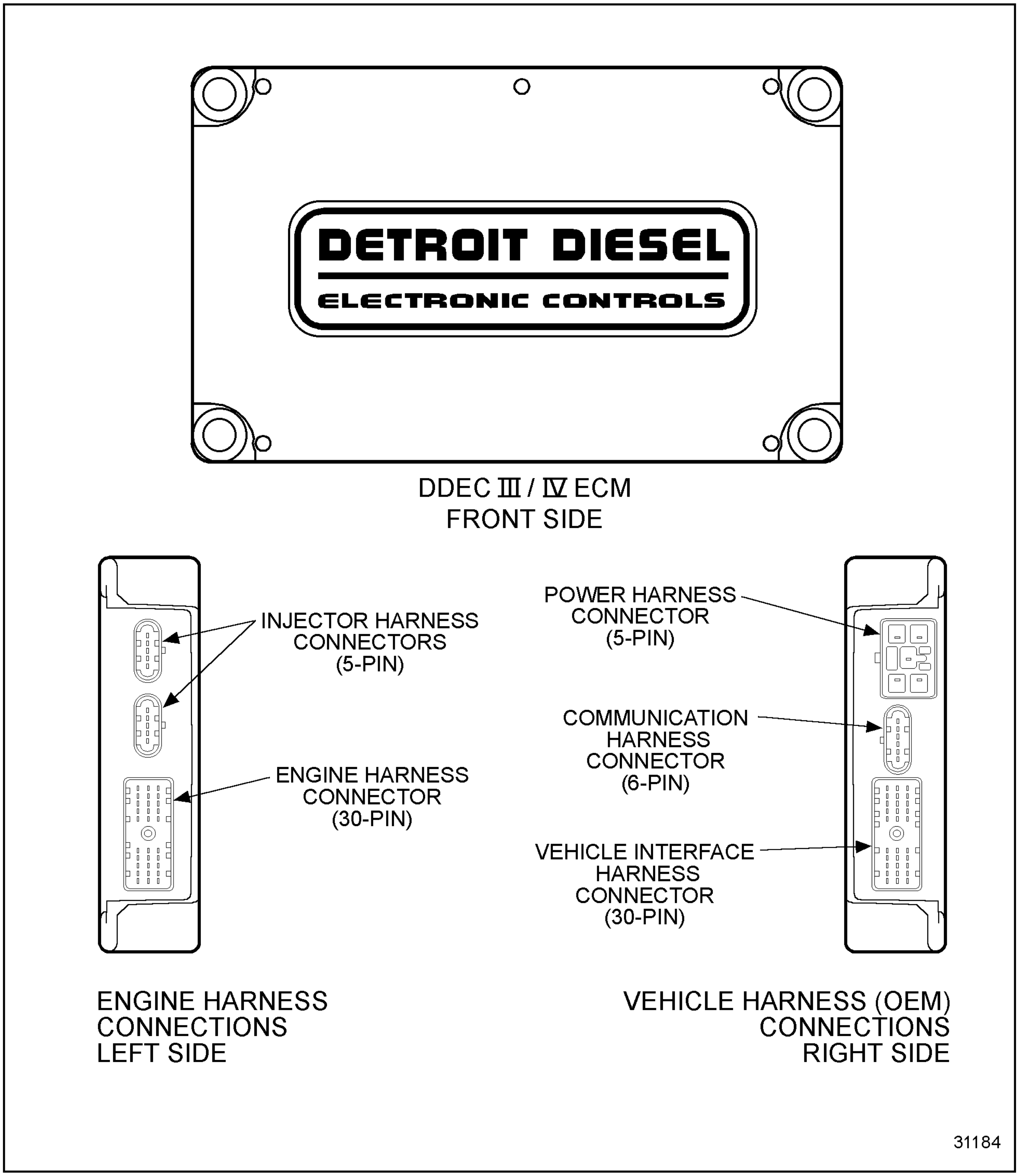


Figure 3-1 DDEC System ECM

For the Series 60® sensor locations, see Figure 3-2.

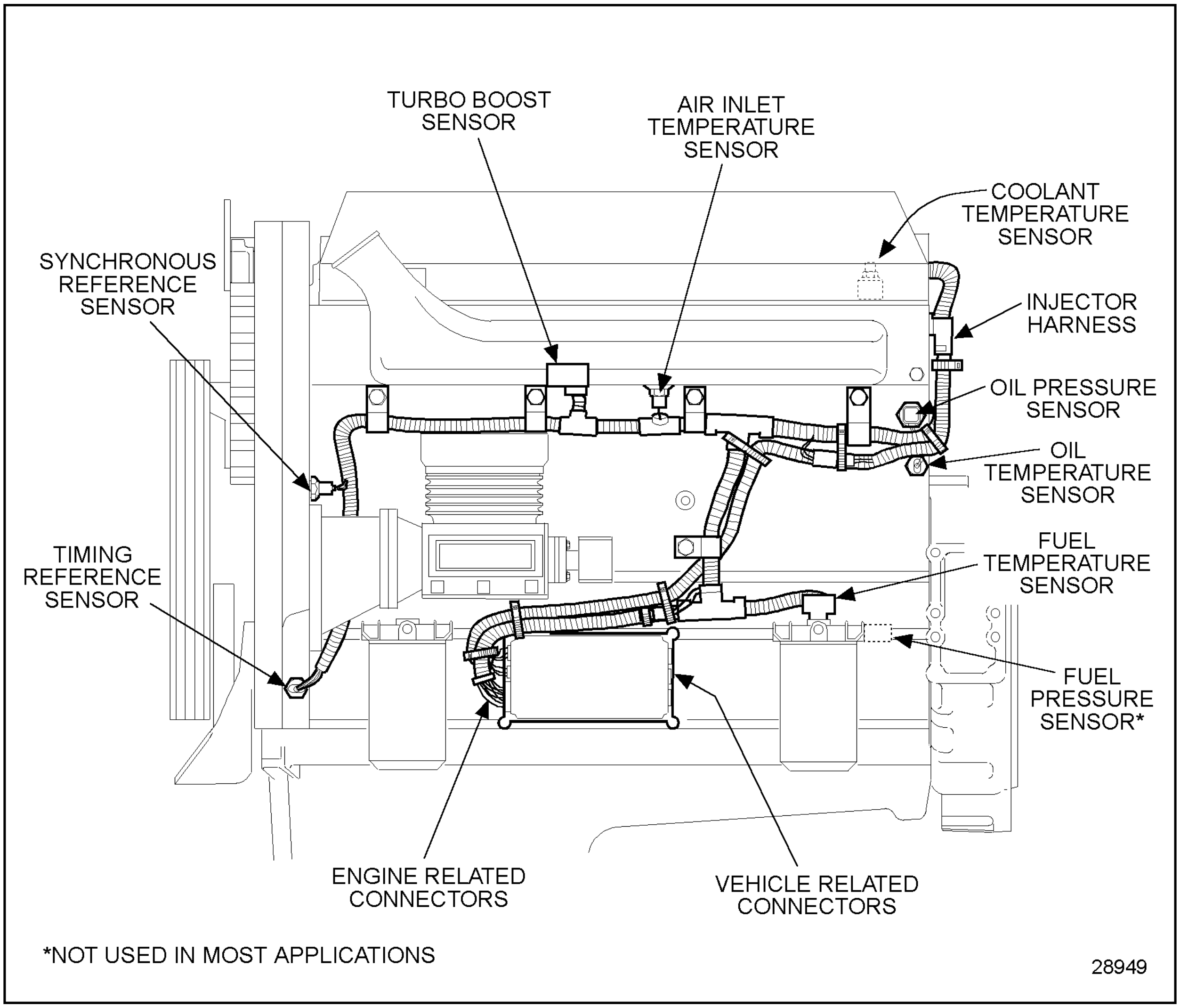
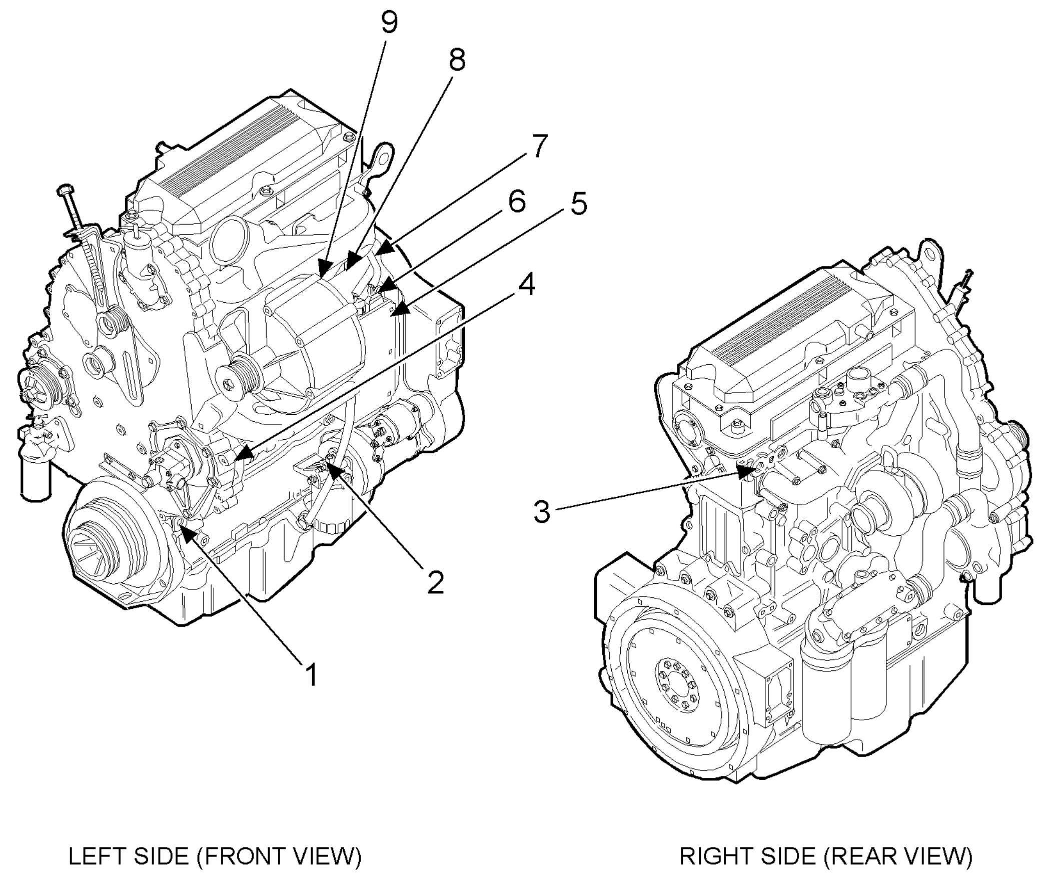


Figure 3-2 Series 60 Diesel ECM and Sensor Locations

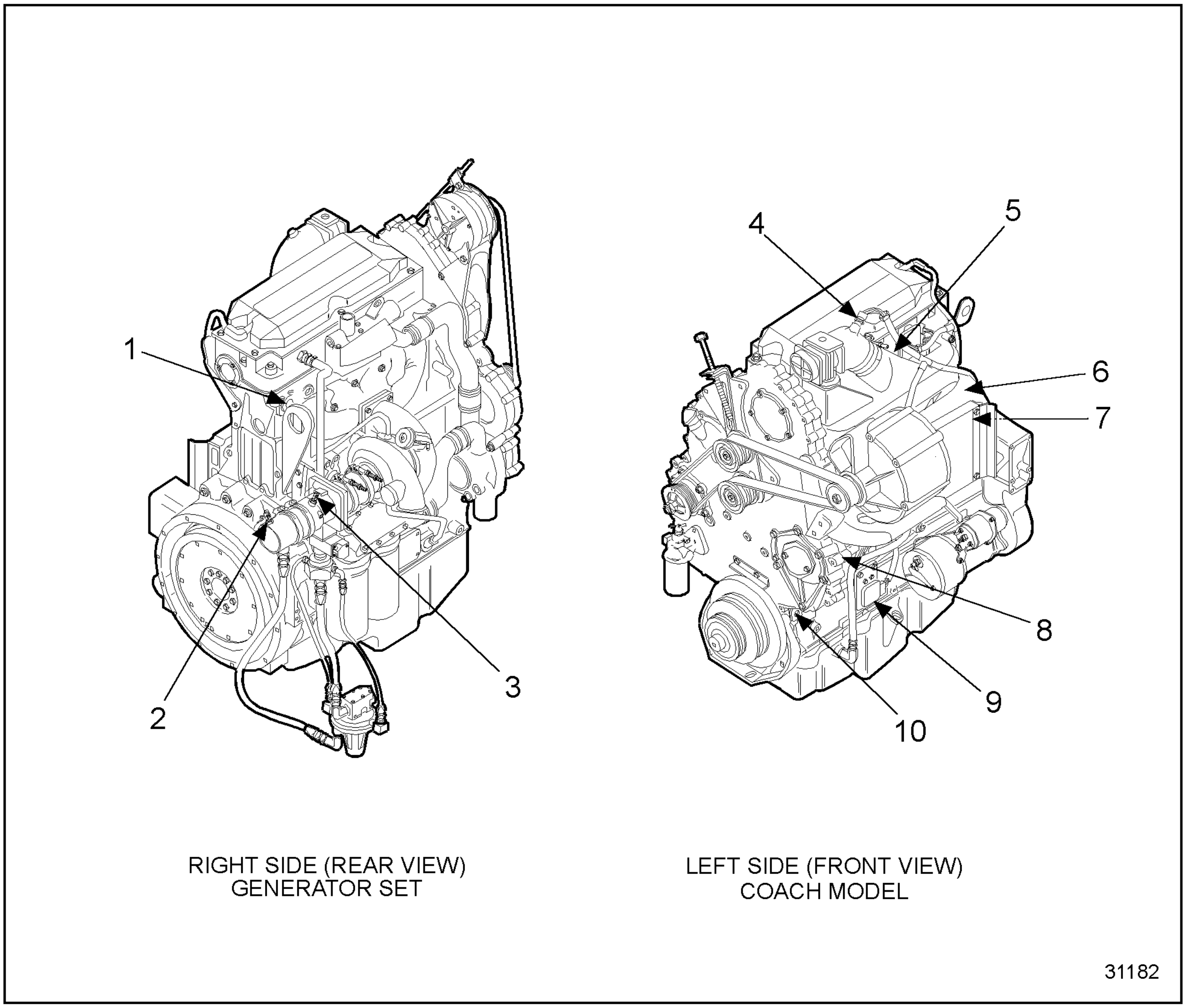
For the Series 50® diesel engine sensor locations, see Figure 3-3.



1. Timing Reference Sensor
2. Fuel Temperature Sensor
3. Coolant Temperature Sensor
4. Synchronous Reference Sensor
5. ECM
6. Oil Temperature Sensor
7. Oil Pressure Sensor
8. Turbo Boost Sensor
9. Air Inlet Temperature Sensor

Figure 3-3 Series 50 Diesel ECM and Sensor Locations

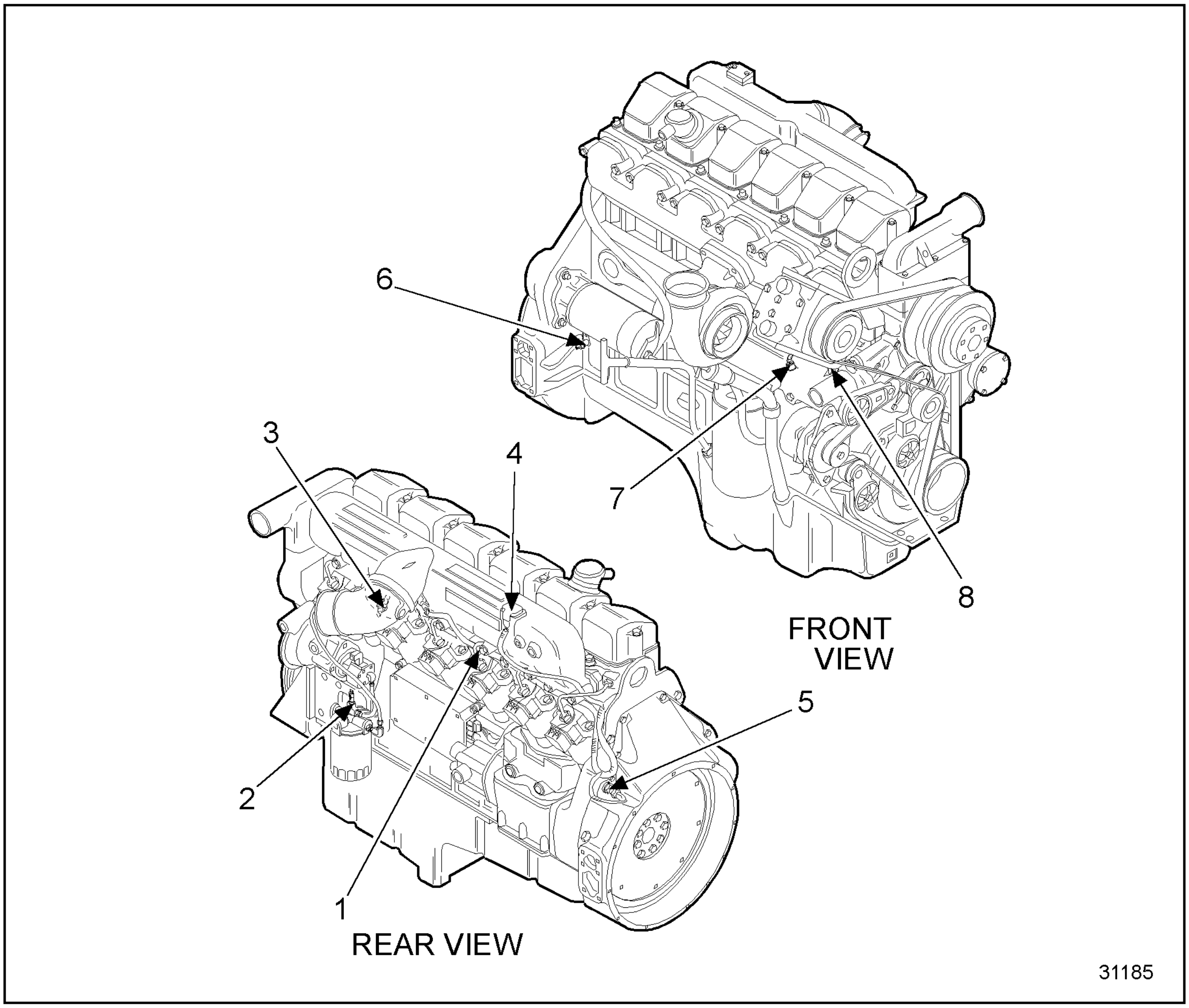
For the Series 50® gas engine sensor locations, see Figure 3-4.



1. Coolant Temperature Sensor
2. Air Temperature Sensor
3. Fuel Temperature Sensor
4. Manifold Air Pressure (MAP) Sensor
5. Knock Sensor
6. Oil Temperature Sensor
7. Oil Pressure Sensor
8. Synchronous Reference Sensor
9. SNEF Module
10. Timing Reference Sensor

Figure 3-4 Series 50 Gas ECM and Sensor Locations

For the Series 55™ engine sensor locations, see Figure 3-5.



1. Coolant Temperature Sensor
2. Fuel Temperature Sensor
3. Air Inlet Temperature Sensor
4. Turbo Boost Sensor
5. Synchronous Reference Sensor
6. Timing Reference Sensor
7. Oil Temperature Sensor
8. Oil Pressure Sensor

Figure 3-5 Series 55 Engine Sensor Locations

4 BASIC KNOWLEDGE REQUIRED

4.1 DDEC DIAGNOSTIC CODE

Troubleshooting of the DDEC III system and the DDEC IV system is identical. At the time of this printing, the available features are the same in both systems. The DDEC IV system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable.

A diagnostic code indicates a problem in a given circuit (i.e. diagnostic Code 14 indicates a problem in the oil or coolant temperature sensor circuit). This includes the oil or coolant temperature sensor, connector, harness, and Electronic Control Module (ECM). The procedure for finding the problem can be found in Flash Code 14, refer to section 14.3. Similar sections are provided for each code. Remember, diagnosis should always begin at the start of the section. For an oil or coolant temperature sensor problem, it will quickly lead you to section 14, but first you verify the code or symptom.

Since the self-diagnostics do not detect all possible faults, the absence of a code does not mean there are not problems in the system. If a DDEC problem is suspected, even in the absence of a code, refer to section 9.1, anyway. This section can lead you to other sections that can aid in the troubleshooting process - where DDEC problems may occur, but do not generate a code. Basic mechanical checks are not covered in this manual.

4.2 GENERAL DIAGNOSTIC INFORMATION

As a bulb and system check, the Check Engine Light (CEL) and Stop Engine Light (SEL) will come on for five seconds when the ignition switch is first turned on. If the unit is programmed for the cruise control feature, the "Cruise Active" light (if equipped) will also turn on for five seconds.

If the CEL comes on during vehicle operation, it indicates the self diagnostic system has detected a fault.

When the diagnostic request switch is held, the diagnostic system will flash the yellow or red light located on the dash of the vehicle. The light will be flashing the code(s) indicating the problem areas. If the SEL comes on during vehicle operation, it indicates the DDEC System has detected a potential engine damaging condition. The engine should be shut down immediately and checked for the problem.

Active codes will be flashed on the SEL in numerical flash code order. If there are no active codes, a code 25 will be flashed.

Inactive codes will be flashed on the CEL in most recent to least recent order. If there are no inactive codes, a Code 25 will be flashed.

4.3 READING CODES WITH DIAGNOSTIC DATA READER

Flash codes are used for operator convenience to advise of an engine fault or sensor failure. SAE specific codes are read with the Diagnostic Data Reader (DDR). In some cases, one flash code may be used to cover more than one component fault. For this reason the DDR (or Diagnostic Data Link, DDL) must be used to identify the specific code.

The Diagnostic Code Menu selections are defined as follows.

- ☐ Active codes
- ☐ Inactive codes
- ☐ Clear codes

To read codes, start with the Menu Selection screen.

1. To call up active codes:
   [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
   [a] Select ENGINE and ENTER twice.
   [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
   [a] Select ENGINE and push ENTER twice.
   [b] Go down and select CLEAR CODES and ENTER.
   [c] Left to YES, and ENTER.
   [d] Wait and then push FUNC three times.
   [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

4.3.1 Active Codes

Active codes are conditions that are presently occurring and causing the CEL to be illuminated. All current active codes will be displayed for the entire system, including single, dual and triple ECM applications. The display for each code is as follows:

Line 1: ## MID: XXX XXXXXXXX

Line 2: PID Description

Line 3: FMI Description

Line 4: ↑ A## PID: XXX FMI: XX ↓

Explanation:

##: Indicates the DDC diagnostic flash code number

MID: Message Identification Character

PID: Parameter Identification Character

FMI: Failure Mode Identifier

A##: Numerical count of active codes

↑↓: Indicates additional codes are stored in ECM memory

4.3.2 Inactive Codes

Inactive codes are faults that have occurred previously. All current inactive codes will be displayed for the entire system, including single, dual, and triple ECM applications. The display for each code is as follows:

SCREEN #1; SCREEN #2

Line 1: ## MID: XXX XXXXXX XX ; Line 5: 1st: Last:

Line 2: PID Description; Line 6: Total#:

Line 3: FMI Description; Line 7: Total Time:

Line 4: ↑ |## PID: XXX FMI: XX ↓; Line 8: Min/Max:

Explanation:

##: Indicates the DDC diagnostic flash code number

|##: Numerical Count of inactive codes

1st: First occurrence of the diagnostic code in engine hours

Last: Last occurrence of the diagnostic code in engine hours

Total#: Total number of occurrences

Total Time: Total engine seconds that the diagnostic code was active

Min/Max: Minimum/Maximum value recorded during diagnostic condition

4.3.3 Clear Codes

This feature allows diagnostic codes stored in the ECMs to be erased. An audit trail of when the codes were last erased will be displayed in engine hours.

Engine Hours of Last Clear Codes: XXXX

4.3.4 Message Identification Descriptions

MID: 128 ENGINE, Single ECM applications

MID: 175 ENGINE, R1 Dual ECM application - engine #2 with first receiver ECM

MID: 183 ENGINE, R2 Triple ECM application - engine #3 w/second receiver ECM

MID: 184 PING, Pilot Injection Natural Gas ECM application

Diagnostic codes with Subsystem Identification Characters (SIDs) that reference Auxiliary Outputs # 1-8 (SIDs: 26, 40, 51, 52, 53, 54, 55, 56) will look up the parameter text description in a table to identify the function assigned to the auxiliary output channel.

Diagnostic codes with SIDs that reference PWM Outputs #1 through #4 (SIDs: 57, 58, 59 & 60) will look up the parameter text description in a table to identify the function assigned to the PWM output channel.

Injector Response Time Codes Long and Injector Response Time Codes Short will use a table of injector numbering to identify the appropriate engine cylinder number.

4.4 ELECTRICAL CIRCUITS

Before using this manual, you should understand the theory of electricity and know the meaning of voltage and ohms. You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

You should be able to use jumper wires to make circuit checks.

4.5 USE OF DIGITAL VOLT-OHM METER

Before using this manual, you should be familiar with the digital volt-ohm meter (VOM). You should be able to measure voltage and resistance. You should be familiar with the controls of the meter and how to use it correctly.

For use of a typical digital volt-ohm meter, refer to section 4.5.1, refer to section 4.5.2, and refer to section 4.5.3.

4.5.1 Resistance Measurements

Perform the following steps to measure resistance:

1. Connect the red test lead to the V- Ω (Volt-Ohm) input connector and the black lead to the com input connector on the meter.
2. Set the function/range switch to the desired Ω position. If the magnitude of the resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained.
3. If the resistance being measured is connected to a circuit, turn off the power to the circuit being tested. Turn off the ignition.
4. Connect the test leads to the circuit being measured. When measuring high resistance, be careful not to contact adjacent points, even if they are insulated. Some insulators have a relatively low insulation resistance which can affect the resulting measurement.
5. Read the resistance value on the digital display.

4.5.2 Continuity Checks

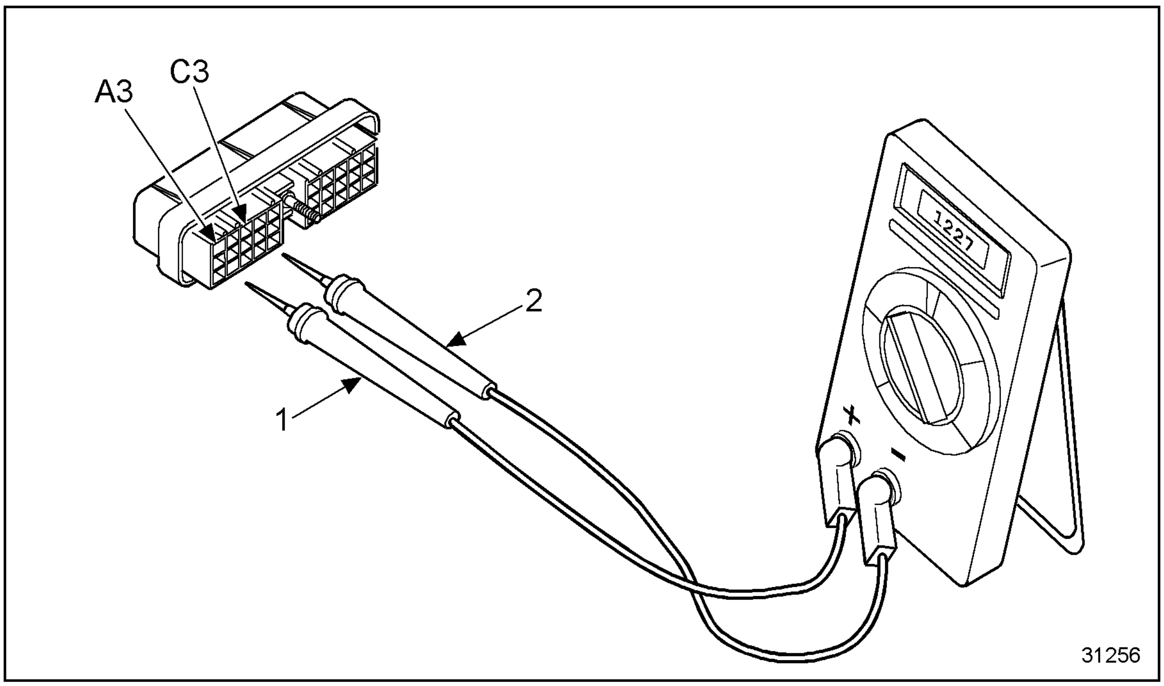
In addition to measuring the specific resistance value of a circuit, some meters will also register if a continuous electrical path exists. If a path exists, the circuit is said to have continuity. (This continuity check can be used in any section of this troubleshooting guide where the test is looking for greater than, less than, or equal to 5 ohms.) An open circuit (broken electrical path) would have ∞ resistance and would not have continuity. To utilize the continuity feature of certain meters:

1. Place the function/range switch in any Ω range.
2. Connect the red lead to the V- Ω connector and the black lead to the com connector on the meter. With the test leads separated or measuring an out-of-range resistance, the digital display will indicate OL (over limit) Some meters show "1 +, 1, or ↑."
3. Put one test probe at one end of the wire or circuit to be tested. Use the other test lead to trace the circuit. When continuity is established, an ohm (Ω) symbol will display in the upper left corner of the digital display. If contact in the wire is maintained long enough (about 1/4 second), the OL will disappear and the resistance value of the wire or circuit will display next to the symbol.
4. If your VOM does not work in the manner described above, you must know how your VOM operates in order to use this troubleshooting guide.

4.5.3 Voltage Measurements

Perform the following steps to measure voltage.

1. Connect the red test lead to the V- Ω connector and the black lead to the com input on the meter. If a DC-AC switch is present, ensure it is switched to the DC position.
2. Set the function range/switch to the desired volts position. If the magnitude of the voltage is not known, set the switch to a range that will be able to read most voltages seen on a vehicle. Typically, a 20V range will do. Then, reduce the range until a satisfactory reading is obtained.
3. Connect the test leads to the circuit being measured. In the DDEC system diagnostic procedures, voltage measurements are always given as being taken at pins, sockets, battery +, or ground. Following the voltage measurement point, the color test lead to be used is given in parenthesis (red is the V- Ω connection, and black is the com connection). Example: If the procedure displays, "Take voltage reading at socket A3 (red lead) to socket C3 (black lead)", see Figure 4-1 for the hook-up.



1.Red Lead 2.Black Lead

Figure 4-1 Voltage Measurement Hook-up

4.6 IMPORTANT INFORMATION

The following items must be read and thoroughly understood before using this manual.

1. The engine and ignition should always be off before the harness connectors are disconnected or reconnected.
2. When disconnecting harness connectors, ensure the pulling force is applied to the connectors themselves and not the wires extending from them.

NOTICE:
To avoid damage to the harness connectors, ensure the pulling force is applied to the connections themselves and not the wires extending from them.

3. After harness connectors are reconnected to the DDEC system, the codes logged should be ignored and cleared.
4. In most all areas of repair/troubleshooting, a DDR will be required.
5. In diagnosing an intermittent problem, wiggling wires or harnesses may allow the fault to be repeated. This may allow a technician to better isolate the problem area.

4.7 EXPLANATION OF ABBREVIATIONS AND TERMS

The following abbreviations and terms listed in Table 4-1, will be used throughout the electrical flowcharts.

Abbreviations	Terms
A/C	Air Conditioning
ACG	Air Compressor Governor
A/D	Analog to Digital: The computer inside the ECM uses an A/D converter to convert a sensor voltage into a number with which the computer can work.
ASR	Anti-Skid Regulation: Data supplied by the ECM for use with ABS (anti-lock braking system).
ATI	Auxiliary Timed Input
ATS	Air Temperature Sensor: Monitors engine air temperature.
BAT	Battery
BOI	Beginning of Injection: The number of crank angle degrees, before top-dead-center (TDC), where the ECM is requesting the injectors be turned on.
BPS	Bypass Position Sensor
CAN	Controller Area Network: J 1939 high speed control data link.
CCM	Crankcase Monitor Sensor: Monitors crankcase pressure (currently on 149 engines only).
CCPS	Crankcase Pressure Sensor
CEL	* Check Engine Light: Typically mounted on the instrument panel. The CEL has two functions:1. It is used as a warning lamp to inform the operator of the vehicle that a fault has occurred and the unit should be taken in for service as soon as possible.2. It is used by the operator or technician to "flash out inactive trouble codes to help diagnose a problem.
CKT	Circuit
CLS	Coolant Level Sensor: Monitors coolant level at the radiator top tank or heat exchanger.
COM	Common
CPS	Coolant Pressure Sensor: Monitors coolant presssure.
CTS	Coolant Temperature Sensor: Monitors coolant temperature.
DDEC	Detroit Diesel Electronic Controls
DDEC III	Third generation Detroit Diesel Electronic Controls
DDEC IV	Fourth generation Detroit Diesel Electronic Controls

Abbreviations	Terms
DDL	Diagnostic Data Link: The lines (wires) over which the ECM transmits information that can be read by a Diagnostic Data Reader.
DDL+	Data Link, positive side: J 1587 data link.
DDL-	Data Link, negative side: J 1587 data link.
DDR	Diagnostic Data Reader: The hand held tool used for troubleshooting the DDEC system. MPSI PRO-LINK 9000.
ECM	Electronic Control Module: The controller of DDEC system. It reads the engine and vehicle inputs, sensors and switches, calculates injector firing and duration, and fires injectors at appropriate times.
EEPROM	Electrically Erasable Programmable Read Only Memory.
EFC	Electronic Fire Commander
EFPA	Electronic Foot Pedal Assembly: Contains the throttle position sensor.
EOP	Engine Over-temperature Protection
ESH	Engine Sensor Harness
ESS	Engine Synchro Shift
EUI	Electronic Unit Injector
FEI	Fuel Economy Incentive
FPS	Fuel Pressure Sensor: Monitors fuel pressure.
FTS	Fuel Temperature Sensor: Monitors fuel temperature.
GND	Ground
INJ	Injector (fuel)
ISD	Idle Shutdown: Programmable feature of the DDEC system.
IVS	Idle Validation Switch: A switch used to establish the idle speed position.
LSG	Limiting Speed Governor.
MPG	Miles Per Gallon
N/A	Not Applicable.
OEM	Original Equipment Manufacturer
OI	Optimized Idle
OLS	Oil Level Sensor: Monitors oil level.
OPS	Oil Pressure Sensor: Monitors oil pressure.
OTS	Oil Temperature Sensor: Monitors oil temperature.
PGS	Pressure Governor System: Regulates engine speed to maintain a selected external pump pressure.

Abbreviations	Terms
PTO	Power Take-Off. Also, referred to as VSG (Variable Speed Governor).
PW	Pulsewidth
PWM	Pulsewidth Modulated: Modulated signal provided by the DDEC system.
RES/ACCEL	Resume/Accelerate Switch used for cruise control.
SEL	† Stop Engine Light: Typically mounted on the instrument panel. It has two functions:1.It is used as warning to the operator that a potential engine damaging condition has been detected. If the DDEC system is programmed for shutdown, the engine will shutdown on its own within 30 seconds. The engine should not be run until the condition is corrected.2.It is used by the operator or technician to "flash" out active trouble codes.
SEO	Stop Engine Override: Allows the stop engine condition to be overridden in case it is required.
SET/COAST	Set/Coast Switch: Used in cruise control.
SRS	Synchronous Reference Sensor: Indicates a specific cylinder in the firing order.
TBS	Turbocharger Boost Sensor: Monitors turbo boost.
TBD	To be determined.
TD	Tachometer Driver: An output from the ECM for electronic tachometers and or data loggers.
TPS	Throttle Position Sensor: Used to detect throttle request (a component of the EFPA). Also, referred to as LSG.
TRS	Timing Reference Sensor: Used to detect whenever any cylinder is about to be fired.
VIH	Vehicle Interface Harness (OEM Wiring)
VIN	Vehicle Identification Number
VSG	Variable Speed Governor. Also, referred to as PTO (Power Take-Off).
VSS	Vehicle Speed Sensor: Used to detect vehicle speed.
VSS OC	Vehicle Speed Sensor Open Collector: An ECM input which must be used in addition to the VSS positive input when certain types of vehicle speed sensors are used. Refer to the Application and Installation manual for installation.

* As a light bulb check and system check, the check engine light will come on for about 5 seconds when the ignition is turned on. If the CEL remains on, or comes back on, the self diagnostic system has detected a problem. If the problem goes away, the light will go out, but a trouble code will be stored in the ECM as an inactive code.

† As a light bulb check and system check, the stop engine light will come on for about 5 seconds when the ignition is turned on.

Table 4-1 Abbreviations and Terms

5 (CHG) FLASH CODES VS SAE CODES

5.1 READING THE DIAGNOSTIC CODES - FLASH METHOD

The following steps describe the flash method to interpret diagnostic codes:

NOTE:
If you are here to begin diagnosis of a problem and already know how to read codes, as well as understand active and inactive codes, refer to section 9.1.

1. Active versus Inactive codes:
   [a] Active codes are the codes which are currently keeping the "Check or Stop Engine" light on. Active codes are flashed via the Stop Engine Light (SEL).
   [b] Inactive codes are all the codes previously logged in the ECM. These codes can be cleared by using the DDR. Inactive codes are flashed via the Check Engine Light (CEL).

NOTE:
The Diagnostic Request Switch reads codes on the CEL and SEL when an DDR is not available. The following steps will enable you to obtain codes.

2. Turn vehicle ignition switch ON.
3. Depress and hold the diagnostic request switch.
   [a] As an example, observe Code 13 (active) and Code 21 (inactive) flashing out on the CEL and SEL; see Figure 5-1.
   [b] If input used is SEO/Diagnostic Request, press and release the switch.

[c] If input used is Diagnostic Request, press and hold switch.

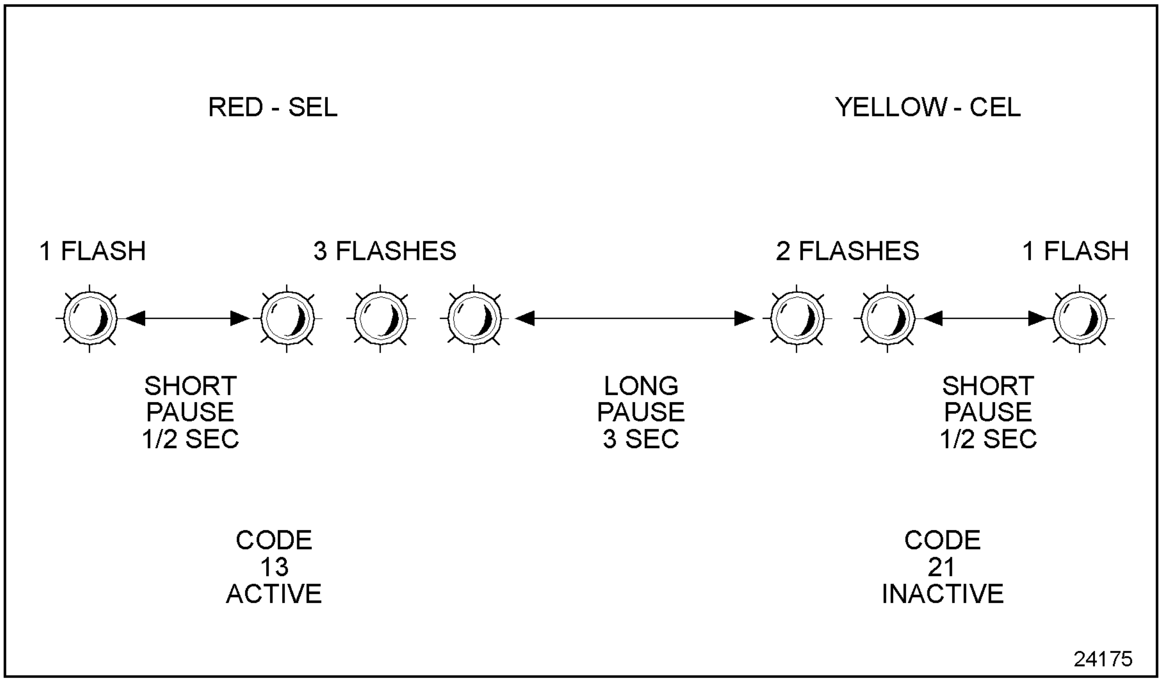


Figure 5-1 Flash Code Method

5.1.1 Clearing Codes

Fault codes can only be cleared using the DDR.

NOTE:
Removing the battery cables will not clear codes.

5.2 READING CODES

For instructions for using the DDR or Pro-Link 9000 ®, (see Figure 5-2), refer to the Pro-Link Users Manual. For a list of Flash Codes and SAE Fault Codes, refer to section 5.3. Refer to flowchart.

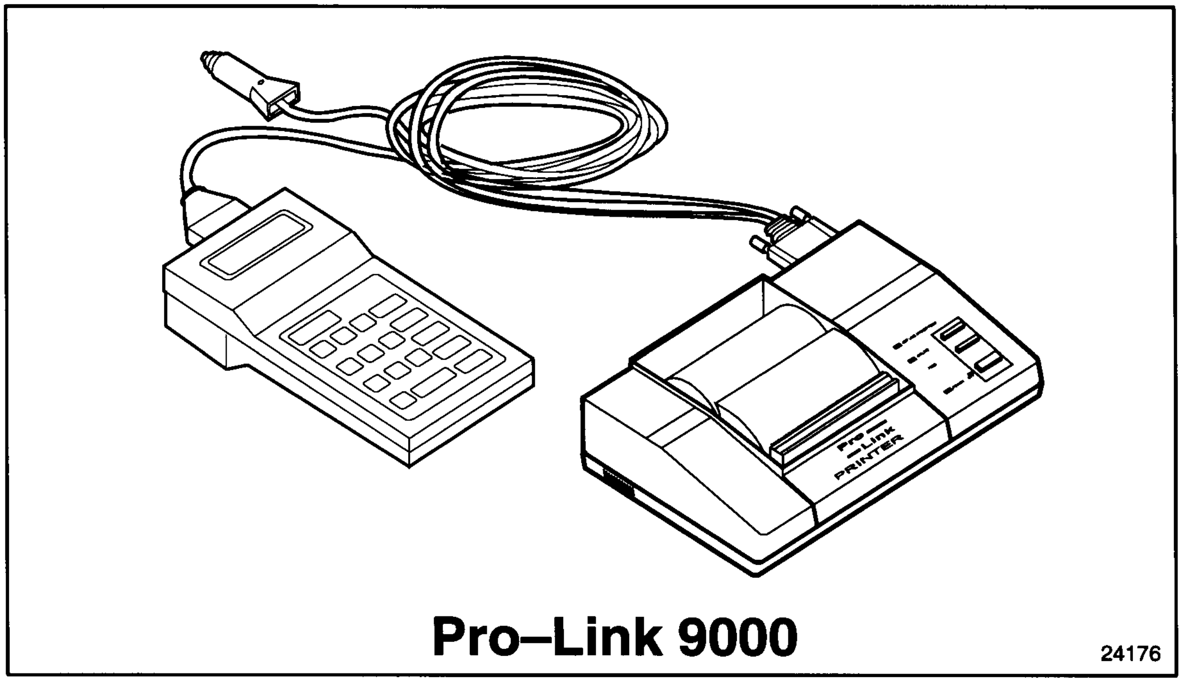


Figure 5-2 Pro-Link 9000

NOTE:
Active codes are flashed in ascending numerical flash code order. Inactive codes are flashed in most recent to least recent order.

5.3 DDEC DESCRIPTIONS

To read codes, use the diagnostic data reader or depress and hold the diagnostic request switch with the ignition ON, engine at idle or not running. Active codes will be flashed on the SEL. Inactive codes will be flashed on the CEL. The cycle will repeat until the operator releases the diagnostic request switch. Flash codes and descriptions are listed in Table 5-1.

Flash Codes	DDEC Description
11	VSG sensor input voltage low
12	VSG sensor input voltage high
13	Coolant level sensor input voltage low
14	Oil, coolant, or intercooler, temperature sensor input voltage high
15	Oil, coolant, or intercooler, temperature sensor input voltage low
16	Coolant level sensor input voltage high
17	Bypass or throttle, valve position sensor input voltage high
18	Bypass or throttle, valve position sensor input voltage low
21	TPS input voltage high
22	TPS input voltage low
23	Fuel temperature sensor input voltage high
24	Fuel temperature sensor input voltage low
25	No active codes
26	Auxiliary shutdown #1, or #2, input active
27	Air inlet or intake air, temperature sensor input voltage high
28	Air inlet or intake air, temperature sensor input voltage low
31	Auxiliary high side output open circuit or short to ground
32	CEL or SEL short to battery (+) or open circuit
33	Turbo boost sensor input voltage high
34	Turbo boost sensor input voltage low
35	Oil pressure sensor input voltage high
36	Oil pressure sensor input voltage low
37	Fuel pressure sensor input voltage high
38	Fuel pressure sensor input voltage low
41	Too many SRS (missing TRS)
42	Too many SRS (missing SRS)
43	Coolant level low
44	Oil, coolant, intercooler or intake air, temperature high
45	Oil pressure low

Flash Codes	DDEC Description
46	ECM battery voltage low
47	Fuel, air inlet, or turbo boost, pressure high
48	Fuel or air inlet pressure low
52	ECM A/D conversion fault
53	ECM non volatile memory fault
54	Vehicle speed sensor fault
55	J1939 data link fault
56	J1587 data link fault
57	J1922 data link fault
58	Torque overload
61	Injector response time long
62	Auxiliary output short to battery (+) or open circuit, or mechanical fault
63	PWM drive short to battery (+) or open circuit
64	Turbo speed sensor input fault
65	Throttle valve position input fault
66	Engine knock sensor input fault
67	Coolant or air inlet, pressure sensor input voltage fault
68	TPS idle validation switch open circuit or short to ground
71	Injector response time short
72	Vehicle overspeed
73	Gas valve position input fault or ESS fault
74	Optimized idle safety loop short to ground
75	ECM battery voltage high
76	Engine overspeed with engine brake
77	Fuel temperature high
81	Oil level, crankcase pressure, dual fuel BOI, or exhaust temperature voltage high
82	Oil level, crankcase pressure, dual fuel BOI, or exhaust temperature voltage low
83	Oil level, crankcase pressure, exhaust temperature, or external pump pressure high
84	Oil level or crankcase pressure low
85	Engine overspeed
86	External pump or barometer pressure sensor input voltage high

Flash Codes	DDEC Description
87	External pump or barometer pressure sensor input voltage low
88	Coolant pressure low

Table 5-1 Flash Codes and Description

SAE faults and flash codes with descriptions are listed in Table 5-2.

SAE Faults	Flash Code	DDEC Description
p051 0	65	Throttle valve position above normal range
p051 1	65	Throttle valve position below normal range
p051 3	17	Throttle valve input voltage high
p051 4	18	Throttle valve input voltage low
p051 7	65	Throttle valve not responding
p052 0	44	Intercooler temperature high
p052 3	14	Intercooler sensor input voltage high
p052 4	15	Intercooler sensor input voltage low
p070 4	74	Optimized idle safety loop short to ground
p072 3	17	Bypass position sensor input voltage high
p072 4	18	Bypass position sensor input voltage low
p073 0	83	External pump pressure high
p073 3	86	Pump pressure sensor input voltage high
p073 4	87	Pump pressure sensor input voltage low
p084 0	72	Vehicle overspeed (fueled)
p084 11	72	Vehicle overspeed (absolute)
p084 12	54	Vehicle speed sensor failure
p091 3	21	Throttle position sensor input voltage high
p091 4	22	Throttle position sensor input voltage low
p092 0	58	Torque overload
p094 0	47	Fuel pressure high
p094 1	48	Fuel pressure low

SAE Faults	Flash Code	DDEC Description
p094 3	37	Fuel pressure sensor input voltage high
p094 4	38	Fuel pressure sensor input voltage low
p098 0	83	Oil level high
p098 1	84	Oil level low
p098 3	81	Oil level sensor input voltage high
p098 4	82	Oil level sensor input voltage low
p100 1	45	Oil pressure low
p100 3	35	Oil pressure sensor input voltage high
p100 4	36	Oil pressure sensor input voltage low
p101 0	83	Crankcase pressure high
p101 1	84	Crankcase pressure low
p101 3	81	Crankcase pressure sensor input voltage high
p101 4	82	Crankcase pressure sensor input voltage low
p102 0	47	Turbo boost pressure high
p102 3	33	Turbo boost pressure sensor input voltage high
p102 4	34	Turbo boost pressure sensor input voltage low
p103 8	64	Turbo speed sensor input failure
p105 0	44	Intake air temperature high
p105 3	27	Intake air temperature sensor input voltage high
p105 4	28	Intake air temperature sensor input voltage low
p106 0	47	Air inlet pressure high
p106 1	48	Air inlet pressure low
p106 3	67	Air inlet pressure sensor input voltage high
p106 4	67	Air inlet pressure sensor input voltage low
p108 3	86	Barometer pressure sensor input voltage high
p108 4	87	Barometer pressure sensor input voltage low
p109 1	88	Coolant pressure low

SAE Faults	Flash Code	DDEC Description
p109 3	67	Coolant pressure sensor input voltage high
p109 4	67	Coolant pressure sensor input voltage low
p110 0	44	Coolant temperature high
p110 3	14	Coolant temperature sensor input voltage high
p110 4	15	Coolant temperature sensor input voltage low
p111 1	43	Coolant level low
p111 3	16	Coolant level sensor input voltage high
p111 4	13	Coolant level sensor input voltage low
p121 0	76	Engine overspeed with engine brake
p168 0	75	ECM battery voltage high
p168 1	46	ECM battery voltage low
p172 3	27	Air temperature sensor input voltage high
p172 4	28	Air temperature sensor input voltage low
p173 0	83	Exhaust temperature high
p173 3	83	Exhaust temperature sensor input voltage high
p173 4	83	Exhaust temperature sensor input voltage low
p174 0	77	Fuel temperature high
p174 3	23	Fuel temperature sensor input voltage high
p174 4	24	Fuel temperature sensor input voltage low
p175 0	44	Oil temperature high
p175 3	14	Oil temperature sensor input voltage high
p175 4	15	Oil temperature sensor input voltage low
p187 3	12	VSG sensor input voltage high
p187 4	11	VSG sensor input voltage low
p187 7	11	VSG switch system not responding
p190 0	85	Engine overspeed
p251 10	-	Clock module abnormal rate

SAE Faults	Flash Code	DDEC Description
p251 13	-	Clock module fault
s001 0	61	Injector #1 response time long
s001 1	71	Injector #1 response time short
s002 0	61	Injector #2 response time long
s002 1	71	Injector #2 response time short
s003 0	61	Injector #3 response time long
s003 1	71	Injector #3 response time short
d004 0	61	Injector #4 response time long
s004 1	71	Injector #4 response time short
s005 0	61	Injector #5 response time long
s005 1	71	Injector #5 response time short
s006 0	61	Injector #6 response time long
s006 1	71	Injector #6 response time short
d007 0	61	Injector #7 response time long
s007 1	71	Injector #7 response time short
s008 0	61	Injector #8 response time long
s008 1	71	Injector #8 response time short
s009 0	61	Injector #9 response time long
s009 1	71	Injector #9 response time short
s010 0	61	Injector #10 response time long
s010 1	71	Injector #10 response time short
s011 0	61	Injector #11 response time long
s011 1	71	Injector #11 response time short
s012 0	61	Injector #12 response time long
s012 1	71	Injector #12 response time short
s013 0	61	Injector #13 response time long
s013 1	71	Injector #13 response time short
s014 0	61	Injector #14 response time long
s014 1	71	Injector #14 response time short
s015 0	61	Injector #15 response time long
s015 1	71	Injector #15 response time short
s016 0	61	Injector #16 response time long
s016 1	71	Injector #16 response time short
s020 3	81	Dual fuel BOI input voltage high
s020 4	82	Dual fuel BOI input voltage low
s021 0	41	Too many SRS (missing TRS)

SAE Faults	Flash Code	DDEC Description
s021 1	42	Too few SRS (missing SRS)
s025 11	26	Auxiliary engine shutdown #1 input active
s026 3	62	Auxiliary output #1 short to battery (+)
s026 4	62	Auxiliary output #1 open circuit
s026 7	62	Auxiliary output #1 mechanical system not responding properly
s040 3	62	Auxiliary output #2 short to battery (+)
s040 4	62	Auxiliary output #2 open circuit
s 040 7	62	Auxiliary output #2 mechanical system not responding properly
s047 0	61	Injector #17 response time long
s047 1	71	Injector #17 response time short
s048 0	61	Injector #18 response time long
s048 1	71	Injector #18 response time short
s049 0	61	Injector #19 response time long
s049 1	71	Injector #19 response time short
s050 0	61	Injector #20 response time long
s050 1	71	Injector #20 response time short
s051 3	31	Auxiliary output #3 open circuit
s051 4	31	Auxiliary output #3 short to ground
s052 3	31	Auxiliary output #4 open circuit
s052 4	31	Auxiliary output #4 short to ground
s053 3	62	Auxiliary output #5 short to battery (+)
s053 4	62	Auxiliary output #5 open circuit
s053 7	62	Auxiliary output #5 mechanical system not responding properly
s054 3	62	Auxiliary output #6 short to battery (+)
s054 4	62	Auxiliary output #6 open circuit
s054 7	62	Auxiliary output #6 mechanical system not responding properly
s055 3	62	Auxiliary output #7 short to battery (+)
s055 4	62	Auxiliary output #7 open circuit
s055 7	62	Auxiliary output #7 mechanical system not responding properly
s056 3	62	Auxiliary output #8 short to battery (+)
s056 4	62	Auxiliary output #8 open circuit
s056 7	62	Auxiliary output #8 mechanical system not responding properly

SAE Faults	Flash Code	DDEC Description
s057 3	63	PWM driver #1 short to battery (+)
s057 4	63	PWM driver #1 open circuit
s058 3	63	PWM driver #2 short to battery (+)
s058 4	63	PWM driver #2 open circuit
s059 3	63	PWM driver #3 short to battery (+)
s059 4	63	PWM driver #3 open circuit
s060 3	63	PWM driver #4 short to battery (+)
s060 4	63	PWM driver #4 open circuit
s061 11	26	Auxiliary engine shutdown #2 input active
s072 0	61	#21 injector response time long
s072 1	71	#21 injector response time short
s073 0	61	#22 injector response time long
s073 1	71	#22 injector response time short
s074 0	61	#23 injector response time long
s074 1	71	#23 injector response time short
s075 0	61	#24 injector response time long
s075 1	71	#24 injector response time short
s076 0	66	Engine knock level above normal range
s076 3	66	Engine knock sensor input voltage high
s076 4	66	Engine knock sensor input voltage low
s076 7	66	Engine knock sensor torque reduction
s077 0	73	Gas valve position above normal range
s077 1	73	Gas valve position below normal range
s077 3	73	Gas valve position input voltage high
s077 4	73	Gas valve position input voltage low
s151 14	73	System Diagnostic Code #1 (ESS)
s226 11	73	Transmission Neutral Switch (ESS)
s227 4	73	Auxiliary analog input #1 voltage low (ESS)
s227 3	73	Auxiliary analog input #1 voltage high (ESS)
s227 2	73	Auxiliary analog input #1 data erratic, intermittent or incorrect (ESS)

SAE Faults	Flash Code	DDEC Description
s230 5	68	TPS idle validation switch open circuit
s230 6	68	TPS idle validation switch short to ground
s231 12	55	J1939 data link fault
s238 3	32	SEL short to battery (+)
s238 4	32	SEL open circuit
s239 3	32	CEL short to battery (+)
s239 4	32	CEL open circuit
s240 2	-	Fram checksum incorrect
s248 8	55	Proprietary data link fault (master)
s248 9	55	Proprietary data link fault (slave)
s249 12	57	J1922 data link fault
s250 12	56	J1587 data link fault
s253 2	53	Non volatile memory data incorrect
s253 12	53	Non volatile memory fault
s253 13	-	Incompatible calibration version
s254 0	-	External failed RAM
s254 1	-	Internal failed RAM
s254 6	-	Entered boot via switches
s254 12	52	ECM A/D conversion fail

Table 5-2 SAE Faults and Flash Codes

6 (CHG) TESTING / SERVICE TOOLS / TIPS

6.1 BASICS

CHANGES NEEDED. The following listed items should be checked prior to starting any troubleshooting:

- ☐ Ensure engine serial number on the ECM matches the serial number on the cylinder block.
- ☐ Walk around the vehicle. Look for obvious problems such as leaks (air or liquid).
- ☐ Inspect ECM for worn isolators, debris or bolts lodged between ECM and cylinder block.
- ☐ Broken wiring connectors.
- ☐ Fuel Supply - Full on.
- ☐ Fuel tank level.
- ☐ Vehicle damage.
- ☐ Investigate into any prior repairs, if applicable.
- ☐ Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
- ☐ Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
- ☐ Electrical system interference caused by a defective relay, ECM driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
- ☐ Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
- ☐ Wiggle wires and harnesses to try to make the problem active, or re-occur.

6.1.1 ECM Programming

The following label is attached to the ECM. See Figure 6-1.

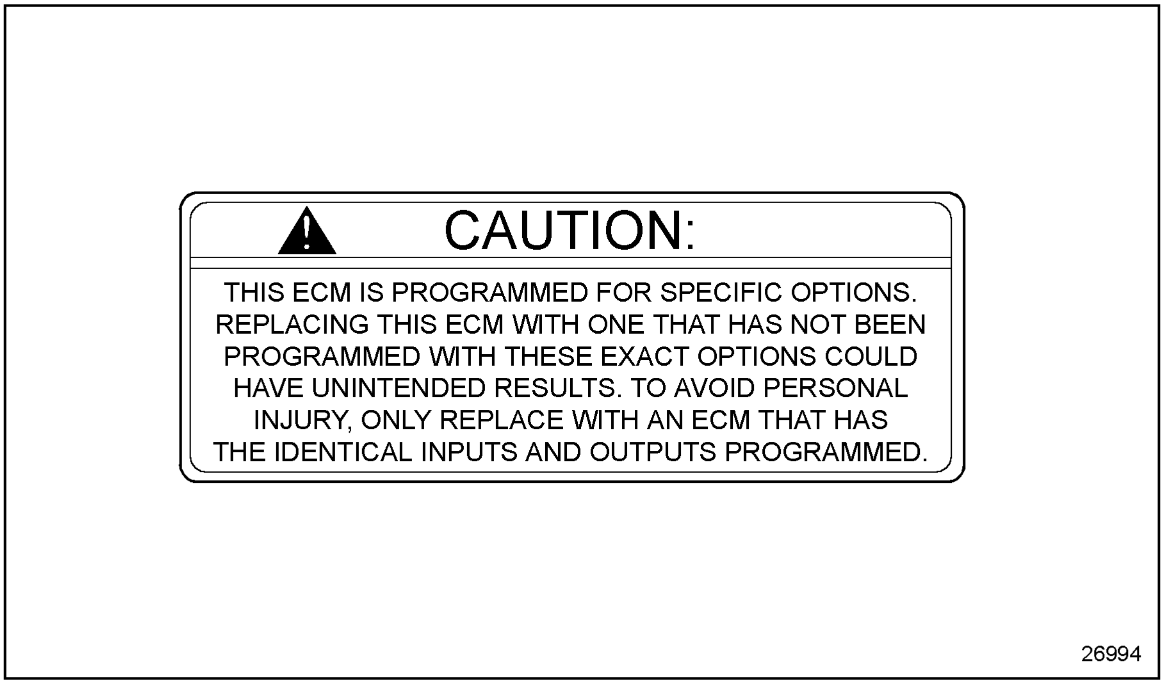


Figure 6-1 ECM Label

- Every DDEC system engine serial number has its own file in the DDC Mainframe.

NOTICE:
Failure to match the serial number on the engine with the ECM programming may result in incorrect calibration results and engine damage.

- ECM programming must be done to match the serial number you are currently working on. Failure to do so may result in incorrect calibration and engine damage.
- Programming a DDEC III ECM must be done with an engine file set up for the DDEC III system.
- Programming a DDEC IV ECM must be done with an engine file set up for the DDEC IV system.
- For a summary of features and how to change them, refer to section 7.

6.2 OPERATOR INFORMATION

This section should serve as a guideline for the technician:

- ☐ Intermittent Problems - Talk to the operator/driver. Be specific!
- ☐ Develop your own Driver Questionnaire. Refer to section 6.2.1.

6.2.1 Driver Questionnaire

Ask the driver to answer the following questions before attempting to repair an intermittent problem, or a problem with symptoms but no diagnostic codes. Use this and the response guideline to these questions.

1. How often does the problem occur? Can you and the driver take the vehicle and demonstrate the problem in a short time?
2. Has the vehicle been to other shops for the same problem? If so, what was done there?
3. Did the radio, dash gages, or lights momentarily turn OFF when the problem occurred?
4. Does the problem occur only at specific operating conditions? If so, at what load? Is it light, medium, or heavy?
5. Does the problem occur at a specific engine operating temperature? If so, at what engine temperature?
6. Does the problem occur only when above or below specific outside temperatures? In what temperature range?
7. Does the problem occur during other conditions e.g. during or after rain, spray washing, snow?
8. Did the problem occur at a specific vehicle speed? If so, at what vehicle speed?
9. Does the problem occur at specific engine r/min? If so, at what engine r/min?

6.2.2 Questionnaire Response Guideline

The following are typical responses to the Driver Questionnaire:

1. If the problem is repeatable, take the vehicle for a drive with the DDR connected and note the conditions when the problem occurs. Be prepared to take snapshot data using the DDR. Ensure you operate the vehicle after correcting the problem and duplicate the operating conditions before releasing the unit, to verify the problem is corrected.
2. If the vehicle has been to other shops for the same problem, call the other shops and find out what has been done. Avoid replacing the same components again unless absolutely sure they are the problem! It is unlikely a component will fail again following a recent replacement.
3. If other vehicle devices are affected, this indicates there may be something wrong with the ignition wiring. Refer to section 91.2 for information on inspecting the ECM battery connections.

4. Operate the engine under similar load conditions. Check the fuel system for restrictions, primary filter, and fuel tanks for foreign objects blocking the fuel supply. Also, check the air system. Utilize the DDR snapshot feature.
5. Operate the engine at this temperature while attempting to duplicate the problem. Use the snapshot feature on the DDR.
6. If possible, troubleshoot the problem in this temperature range.
7. If the problem seems to occur during or after the engine is subjected to rain/spray washing, thoroughly inspect the connectors for moisture entry.
8. If the problem occurs at a specific vehicle speed, check the parameters affecting vehicle speed to verify they are programmed close to the vehicle speed where the problem occurs. Check Vehicle Speed and watch the DDR (snapshot) for changes to see if the pulse wheel (VSS signal) is loose.
9. If the problem occurs at a specific engine r/min, unplug the oil, coolant, and air temperature sensors, and note any changes to the problem. Gather this data and contact Detroit Diesel Technical Service.

6.3 SERVICE TOOLS

Listed in Table 6-1 are the service tools required to perform troubleshooting procedures for the DDEC-equipped engine.

Tool Number	Tool Name
J 39299	Volt-Ohm Meter; see Figure 6-2.
J 38500	Pro-Link ® Diagnostic Data Reader; see Figure 6-3.
J 41005	DDEC III Vehicle Interface Module; see Figure 6-4.
J 38480	Pro-Link Printer; see Figure 6-5.
J 38852 or J 39848	Crimping Tools; see Figure 6-6
23516937	Digital Diesel Sensor Simulator; see Figure 6-7 (Optional Tool)
J 35751	Jumper Wire Kit

Table 6-1 Service Tools

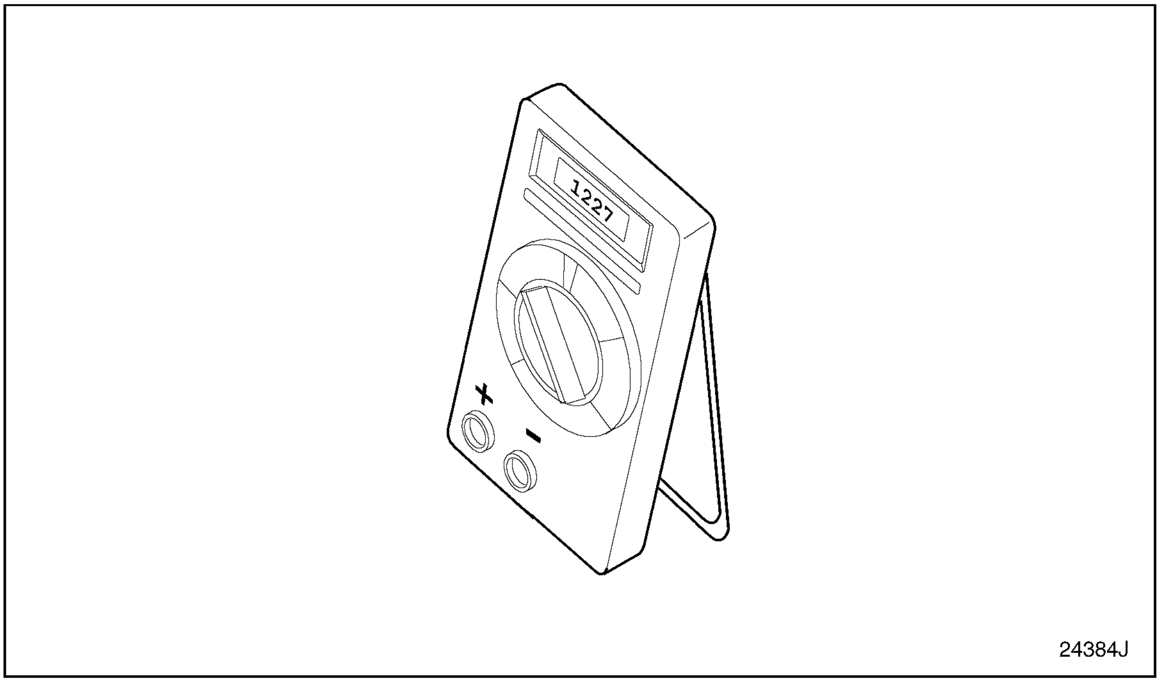


Figure 6-2 Volt-Ohm Meter, J 39299

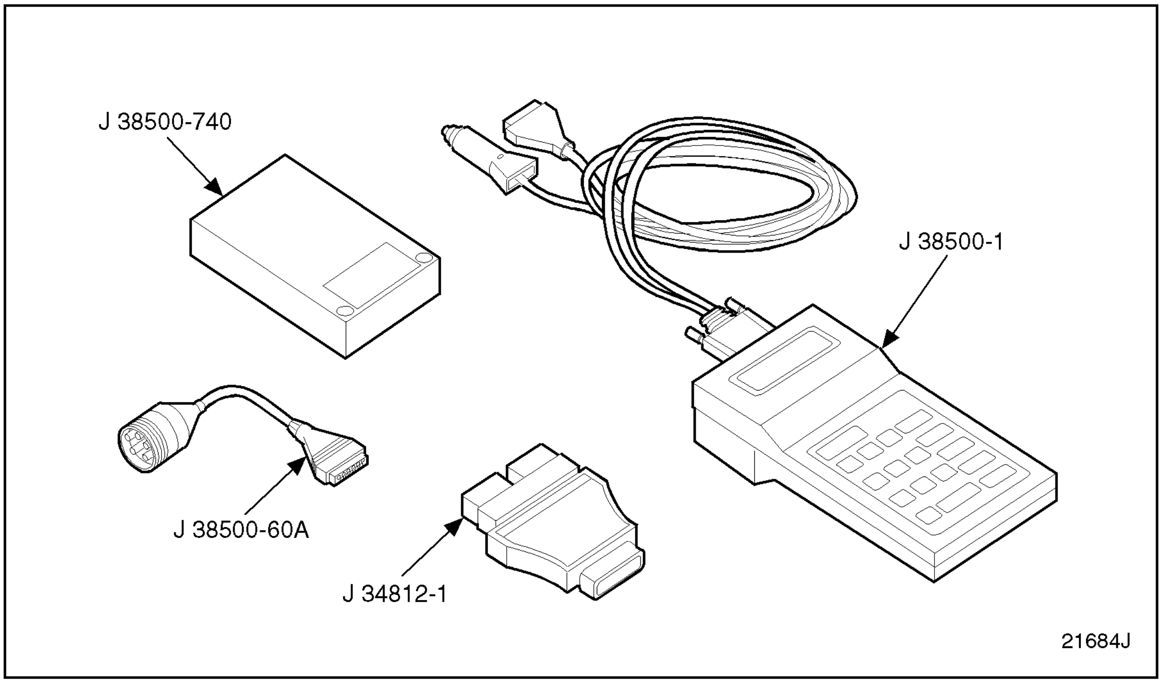
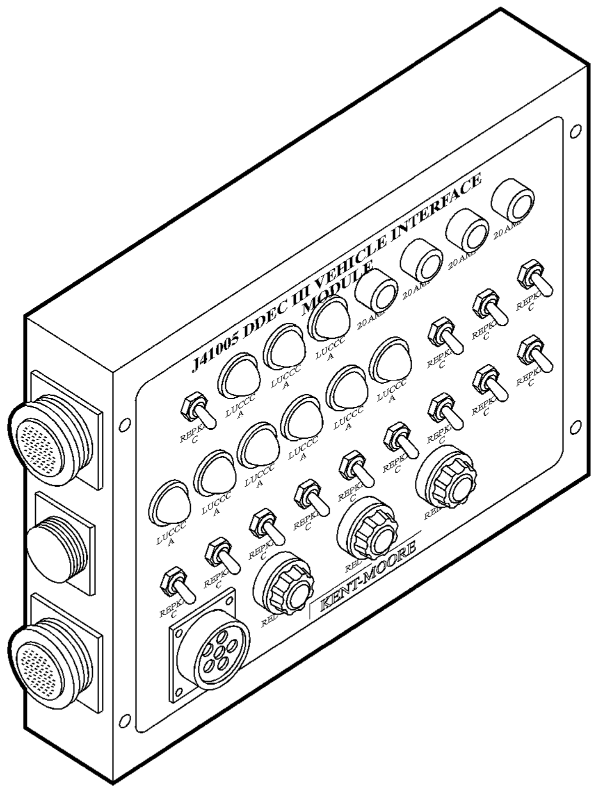


Figure 6-3 Pro-Link Diagnostic Data Reader, J 38500



21655J

Figure 6-4 DDEC III Vehicle Interface Module, J 41005 (Will Operate DDEC IV Also)

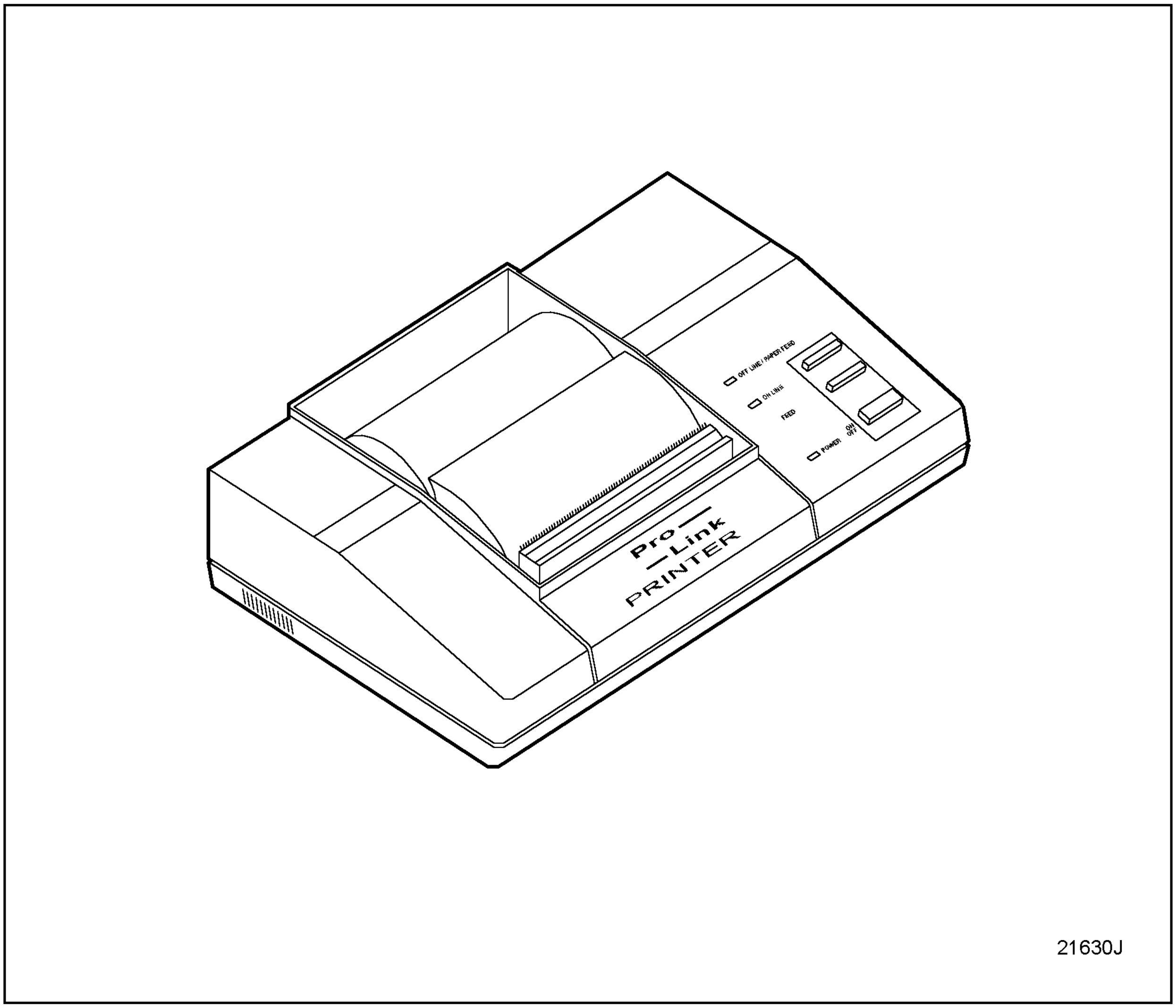


Figure 6-5 Pro-Link 9000 Printer, J 38480

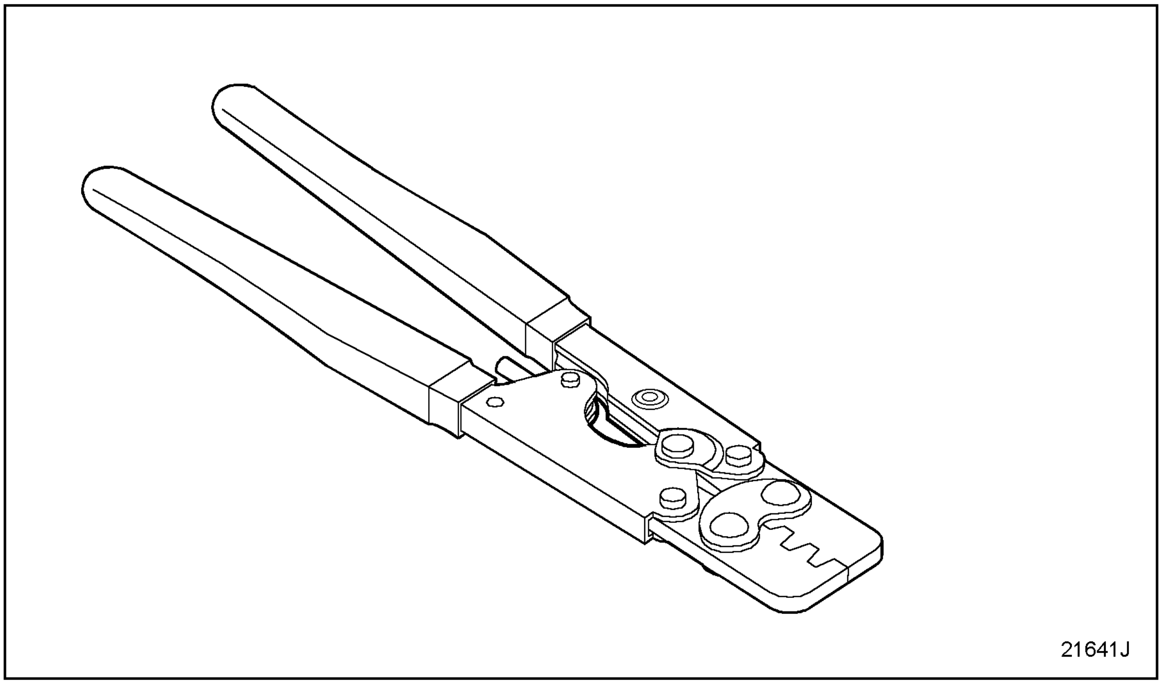
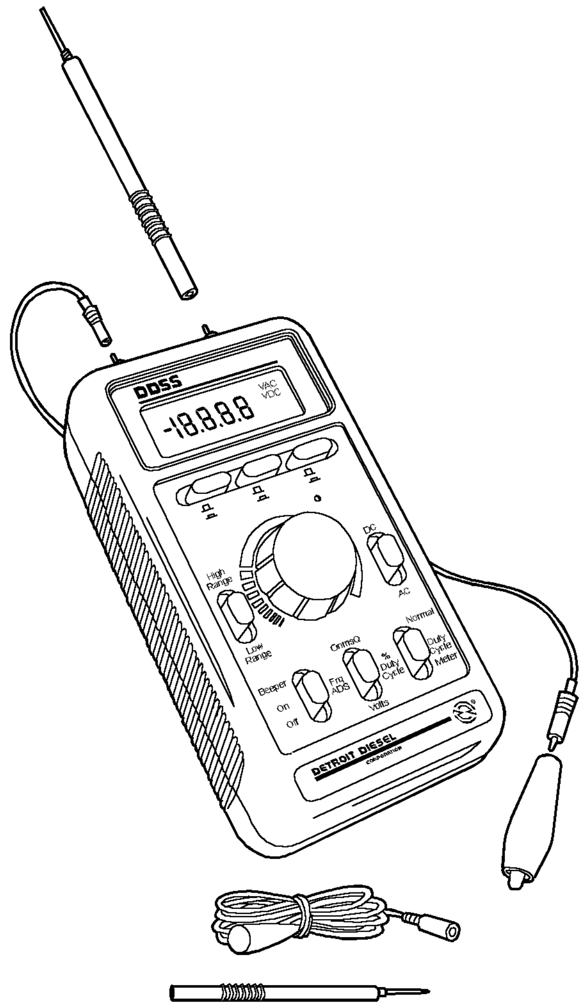


Figure 6-6 Crimping Tool, J 38852 or J 39848



31158

Figure 6-7 Digital Diesel Sensor Stimulator, P/N: 23516937

7 (CHG) DDEC ECM SOFTWARE FEATURES

7.1 DDEC ECM SOFTWARE FEATURES

This section is a brief description of DDEC system ECM software features and what is required to activate the feature (DDR, PC, etc.).

NOTE:
For a complete description of features, refer to publication 7SA800, *DDEC III Application and Installation* manual.

7.1.1 Air Compressor Governor System

The air compressor governor system can be set on the mainframe only. This system is similar to the pressure governor system, but for air compressor applications. 6N4C change adjusts the engine speed to compensate for air pressure loads. ECM Software 4.01 is required.

7.1.2 Cruise Control

Cruise control can be set with the DDR or programming station.

- ☐ Auto Resume
  - ☐ Yes or No. Will re-engage cruise if clutch switch is used to disable. Second press of clutch must be done within 3 seconds of the disengage and cruise will resume at the previously set speed.
- ☐ Minimum Cruise Speed
  - ☐ Can be set with the DDR or programming station. Normally 20 mph, newer ECM software may allow setting to as low as 10 mph.
- ☐ Maximum Cruise Speed
  - ☐ Can be set with the DDR or programming station. Limited to the calculated gear bound vehicle speed at rated engine r/min, or if progressive shift = yes, then max cruise speed is limited to high gear r/min. Also limited to vehicle speed limit (if set).
- ☐ Engine Brake Cruise
  - ☐ Can be set with the DDR or programming station. Refer to engine brake information. Refer to section 7.1.5.

7.1.3 Cruise Switch Variable Speed Governor

The cruise switch can be set with the DDR or programming station. Requires Vehicle Speed Sensor (VSS) set to Yes.

- ☐ Initial r/min= 1000 r/min default, initial r/min to ramp up to when set.
- ☐ R/min incr= 25 r/min default, r/min increase when res/accl switch is enabled.

7.1.4 Data Pages

Enable data pages on the mainframe (up to 7.00 ECM software). This is automatic with ECM software level 20.xx or higher.

7.1.5 Engine Brake (Jake Brake)

Enabling the engine brake is done on the mainframe. Once turned on, output cavities S3 and T3 are automatically configured to provide voltage to the brake solenoids when the ECM calibrated parameters are met allowing activation.

Also requires two inputs, engine brake low and engine brake med.

Several options are available (programming station or DDR set) relative to engine brake operations:

- Dynamic Fan Braking
  - Enables the cooling fan whenever the engine brake is in high mode. This feature is able to be configured with the programming station or DDR. (DDR software level 2.0 or higher.)
- Engine Brake / Service Brake
  - This feature forces the operator to, in addition to the normal requirements, press the service brake in order to initiate the engine brake(s). Can be set with the DDR or programming station.
- Engine Brake Minimum MPH
  - This feature allows the customer to set a minimum mph to allow the engine brake to activate. Can be set with the DDR or programming station.
- Engine Brake Cruise
  - Allows engine brakes to activate to programmed levels automatically based on vehicle speed increases. Initial speed is low. The speed of the increments is medium, then high. Level (high, med, low) is limited by dash position switch.
  - Can be set with the DDR or programming station.

7.1.6 Engine Protection Features

Engine protection features can be set with the DDR or programming station. Three features are available:

- Shutdown
- Rampdown
- Warning

7.1.7 Engine Synchro Shift

Engine Synchro Shift ™ (ESS) can be set with the programming station. ESS is a joint development between DDC and Rockwell.

The ESS system automatically synchronizes the transmission by matching the engine r/min speed to the road speed of the vehicle, eliminating the need to use the clutch pedal for shifting gears. Refer to publication number 6SE498, *Engine Synchro Shift (ESS) Troubleshooting Manual* .

Requires an ESS transmission type, two inputs (in gear and in neutral), and two outputs (high range solenoid and low range solenoid).

7.1.8 Ether Start

Ether start can be set with the programming station only. Requires ECM software level to be greater than 3.00, and enable output for Ether Start. Refer to *Ether Start* manual, 7SA727.

7.1.9 Fan Controls

Fan type is set in the mainframe; None; Single; Dual; Two Speed; are the allowed types. The correct inputs (if any are needed or desired) and outputs must be configured to an available cavity with the programming station.

- ☐ Required Outputs: Configure to any output cavity
  - ☐ Fan control #1 for Single
  - ☐ Fan control #1 and Fan control #2 for Dual or Two-Speed types
- ☐ Inputs are optional: Configure to any input cavity with the programming station
  - ☐ Auxiliary Fan Control
  - ☐ Fan Override

7.1.10 Fuel Economy Incentive

Fuel Economy Incentive (FEI) can be set with the DDR or programming station.

FEI is a DDEC feature that allows vehicle owners to set driver goals of fuel economy while offering the driver an incentive which is a result of his/her good driving habits. The FEI will automatically allow a higher vehicle speed (speed increase is dependent on the customer selected settings) than is set in the road speed limiting area of the ECM. FEI was released with ECM software level 5.00.

There are four items relative to FEI:

- ☐ Minimum MPG (MIN MPG)
  - ☐ This would be defined as the customer's minimum fuel economy goal. Any fuel economy obtained by the driver greater than this figure would result in a allowed speed increase. Each increase of 0.1 mpg will provide the speed increase dictated by the Conversion factor (or Scaler MPH/MPG).
- ☐ Maximum MPH (MAX MPH)
  - ☐ This would be the absolute maximum speed increase to which the customer wants the vehicle limited. The value is an increase above the vehicle speed limit. The allowed values are 0 to 20. A value of 0 disables the FEI feature. A value of 1 to 20 enables the FEI feature.
- ☐ Conversion Factor (Scaler MPH/MPG)
  - ☐ The miles per hour you want to allow for each full mile per gallon above the minimum mpg. Example: a value of 10 will allow the driver to go 10 mph above the road speed limit for each full (1) mile per gallon above the minimum mpg. If the minimum mpg is 7.0, and the driver is getting 7.1 mpg, then the system will allow one additional mile per hour increase, etc. The unit will still be limited to the maximum MPH.
- ☐ Calculation Type (CALC TYPE)

- Two choices can be found under this item; FILTERED, or TRIP. This is what you want the FEI to use to base its calculations. Filtered bases the calculations on the fuel information, by periodic sampling of fuel consumption, recorded in the ECM. Trip bases the calculations on the *trip* portion of the fuel usage information.

FEI is only able to be set by the customer or service outlet and only with the DDR or programming station. Requires MPSI DDR version 5.0 or higher.

7.1.11 Fuel Pressure Sensor

Fuel pressure sensing is currently only configured for some industrial engines. It is not available on all series. The fuel pressure sensor used is the same as the oil pressure sensor.

7.1.12 Full Power Continuous Override

Full Power Continuous Override allows the operator to override the shutdown protection and maintain full power rather than ramp down to a reduced performance. This is set on the mainframe.

7.1.13 Function Lockout

Function Lockout was added to the release of 4.00 ECM and DDR software.

The purpose of this new option is to allow users to have a selected area or areas of the customer parameters password protected. For example, a customer can now function lockout the cruise control parameters with a user entered password, and still have the other areas accessible with the DDR with no (four zeros) password.

The function lockout parameters are able to be selected and customized to the customers request. The areas that are able to be protected by function lockout are:

- Idle Shutdown
- VSG Configuration
- Engine Protection
- Cruise Control
- Progressive Shift
- Engine Droop
- Engine/Vehicle Options
- Air Compressor
- ESS Transmission

When making changes with the DDR under the Reprogram Calibration section, you will already have entered a password to get past this step. If any of the functions in the selection list are function lockout protected, the DDR will ask for the function lockout password after that selection is made.

7.1.14 Half Engine Enable

Half engine enable can be set with the DDR for ECMs with 7.00 ECM software or higher. A current DDR is required. Half engine options are:

- ☐ No half engine - (OFF)
- ☐ Half engine when cold air inlet temperature is less than 12.5°C (55°F), with parking brake set - (IF COLD)
- ☐ Half engine all the time, whenever park brake is set - (ON)
- ☐ N/A is displayed when changing half engine with the DDR or laptop is not allowed in the engine calibration. The engine may have half engine program as part of that engine calibration. View "Diagnostic Data List" to see if the engine is currently operating in half engine mode.

7.1.15 Idle Shutdown

Idle shutdown can be set with the DDR or programming station.

- ☐ Enabled: Yes/No
- ☐ Time: 01 - 99 minutes
- ☐ Enabled on VSG: Yes/No; this determines if you want the idle timer to shut the engine down during idle only
  - ☐ No
  - ☐ Yes (Idle and High Idle)
- ☐ Override:
  - ☐ Yes/No, will flash the CEL 90 seconds before shutdown to allow the driver to press the pedal that will cancel the idle shutdown, and run until the key is cycled or by pressing the pedal again.
  - ☐ Ambient Air Temp disallows override: Can be set with the DDR or programming station. (Override Temp Disable) Lower Limit = XX; Upper Limit =XX. (When upper and lower limits are set, the operator will only be able to override ISD if the calculated ambient air temperature is above or below these temperatures. Upper and lower limit both set to 167°F=disables the feature.
- ☐ Adding Ambient Temp Sensor: DDC offers an *actual* ambient temperature sensor.

NOTE:
If the override temperature disable function is wanted by a customer, it is recommended that this be added (Kit P/N: 23518521, with instructions 18SP397).

7.1.16 Idle Speed

Idle speed can be set on the mainframe for some industrial applications to a maximum of 1000 r/min. It is a fixed speed for on-highway engines.

7.1.17 Idle Speed Offset

The Idle Speed Offset is read by the DDR as Idle Adjust.

Idle speed offset can be adjusted from + 100 r/min, to - 25 r/min using the DDR. Maximum combined speed for automatic transmission applications is 700 r/min. (Some special applications allow 750 r/min.)

7.1.18 Injector Calibration Codes

Injector calibration codes can be set with the DDR or programming station only. Codes are password protected. Allowed range is 01 - 99.

7.1.19 Input Functions

DDEC has twelve digital input ports listed in Table 7-1, located on the Vehicle Interface Harness. These digital inputs can be configured for various functions, listed in Table 7-2. These functions can be ordered at the time of engine order. Any digital input function is able to be customized by programming the ECM with a the programming station.

Input Cavities	Input Cavities
E1#451	G2#543
F1#542	H2#524
G1#528	J2#531
H1#523	K2#583
J1#541	G3#545
F2#544	K3#979

Table 7-1 Input Cavities

Functions	Functions	Functions
None	Limiting Torque Curve	Trans Retarder Status
Engine Brake Low	Diagnostic Request	Dual Throttle (LSG)
Engine Brake Med	Alt Min VSG/Fast Idle	A/C Fan Status
Aux Shutdown #1	Service Brake Release	Aux CLS
Aux Shutdown #2	Clutch Released	Fan Control Override
Park Brake / ISD	Set Coast OFF DDEC II	VSG Station Change
Idle Validation	Set / Coast ON	VSG Station Complement
Pressure / RPM Mode	Resume/Accel OFF DDEC II	Air Load Switch
Throttle Inhibit	Resume / Accel ON	In Neutral Switch
RPM Sync (Marine)	Cruise Enable	In Gear Switch
RPM Freeze (Marine)	PGS System Enable	KD Brake
Rating Switch #1	SEO / DIAG Request	Gas Valve Diagnostic
Rating Switch #2	Engine Brake Disable	-

Table 7-2 Available Input Functions

7.1.20 Jake Brake (See Engine Brake)

For information on the Jake Brake®, refer to section 7.1.5.

7.1.21 Optimized Idle Feature

The Optimized Idle ® feature can be set with the mainframe. Refer to the *Optimized Idle Installation and Troubleshooting Manual* , 7SA734, for all required information.

7.1.22 Output Functions

The DDEC system has three digital output ports located on the vehicle interface harness and three digital output ports located on a pigtail off the engine sensor harness. These digital outputs can be configured for various functions. The digital output cavities are listed in Table 7-3. These functions can be ordered at the time of engine order. The digital output functions available are listed in Table 7-4. Any digital output function can be customized by programming the ECM with the programming station.

Output Cavities	Output Cavities
VIH	ESH
A1 #988	W3 #563
A2 #555	X3 #564
F3 #499	Y3 #565

Table 7-3 Output Cavities

Functions	Functions	Functions
No Function	Fan Control #2	Turbo Recirc Valve
Low DDEC Volt	Deceleration Light	Optimized Idle Active
RPM Sync Active	Engine Brake Active	Low Range Solenoid (ESS)
PGS Active Light	VSG Active Indication	High Range Solenoid (ESS)
Vehicle Power Down	Oil Pressure Low Light	Shift Solenoid (Top2)
Starter Lockout	Oil Temp High Light	Shift Lockout (Top2)
Ext Brake Enable	Coolant Temp High Light	Gas Throttle Actuator
Trans Retarder Enable	Air Comp Solenoid	Fuel Supply Solenoid
Coolant Level Low Light	Crankcase Pressure High	KD Brake Solenoid
Cruise Active Light	Coolant Pressure Low	-
Fan Control #1	Ether Start	-

Table 7-4 Available Output Functions

7.1.23 Passwords

DDEC ECMs have the ability to have unique and separate passwords in the following areas:

- ☐ Update customer calibration (calibration change)
- ☐ Rating change

- ☐ Function lockout (4.00 or higher ECM software function)
- ☐ Injector calibration (Only the DDR will change this password)

7.1.23.1 Changing Passwords Using the Diagnostic Data Reader

DDR software level **must** be 2.00 or higher.

1. In the event a customer loses or forgets his/her password, contact a Detroit Diesel Regional Office, or the Detroit Diesel Technical Service Department with the engine serial number. These contacts can provide an alternate (backdoor) password. You should also ensure that there is not any "maximum" or "rating" security enabled on the mainframe for that unit.
2. Using the DDR select the Password Change option in the area that you need to change. Password changing for Customer Password can be found in the "ENGINE" section, under "Calibration Change". Changing the password for engine rating and function lockout is found under their respective headings under the "Reprogram Cal" menu. Changing the injector password is found in the "ENGINE" section, under "Fuel Injector Information".
3. Enter the alternate password as the current password. The alternate password is a six character alpha numeric code. Enter alpha characters with the DDR by using the up or down arrow keys, that scroll you through the alphabet. Use the side arrow keys to move the cursor to the next position, or to back up to correct an entry.
4. Once all six positions are filled press the enter key.
5. Enter the new password you wish to enter (maximum four positions). Press enter.
6. Depending on the area you are changing, you will get a message that the password is successfully changed, or prompt you to confirm that this is what you really want to do.
7. Turn the ignition off, unplug the DDR.

7.1.24 Pressure Governor System (Fire Truck)

The pressure governor system allows the engine speed to fluctuate to maintain a steady water pump outlet pressure.

NOTE:
This system can be set on the mainframe only (Fire Truck Applications 6N4C change).

The system requires the mainframe to be set to enable the feature. A pressure transducer is required.

NOTE:
The same transducer is used for DDEC II systems and III systems.

Control of the system can be done with switches/Mastermind for DDEC II systems or with Switches/Mastermind or Electronic Fire Commander (EFC) for DDEC III systems. Basic operation is the same for all systems.

The mastermind part number differs for DDEC II systems vs. DDEC III systems.

7.1.25 Progressive Shift Configuration

Progressive shift configuration can be set with the DDR or programming station and can be used to force shifting. It is also useful to limit engine r/min in certain gears, to force shifting to a higher gear. Use Spec Manager to determine values to enter.

7.1.26 Rating Selections

Ratings can be selected with DDR or programming station. Selections are limited to ratings available within the 6N4D group.

7.1.27 Top 2 (Eaton)

Top 2 can be set with the programming station. Two outputs are required - shift solenoid and shift lockout. The transmission type is manual.

7.1.28 Transmission Type

Transmission type can be set with the programming station only. Choices at time of print (may be limited by the application code) are listed in Table 7-5.

Transmission	Transmission	Transmission
00 Manual	14 Other Automatic	20 Rockwell RSX9-R
01 Allison Hydraulic	15 GE Statex III	21 Rockwell RS10
03 Voith	16 Autoshift / J1939	22 Rockwell RSX10
04 Z-F Ecomat	17 Rockwell RS9	23 Reserved - RSX10-C
09 Allison Electronic	18 Rockwell RSX9-A	-
12 Allison WT	19 Rockwell RSX9-B	-

Table 7-5 Available Transmission Selections

7.1.29 Vehicle Overspeed Parameters

Vehicle overspeed parameters can be set with the DDR or programming station. Customer decided parameters log vehicle overspeed codes. The parameter is typically set for +3 mph and +5 mph greater than the current vehicle speed limit; e.g. vehicle speed limit 65. Maximum overspeed limit is 68 and maximum speed no fuel is 70. Setting both to zero disables the function.

NOTE:
Remember to review these figures if Fuel Economy Incentive is activated.

7.1.30 Vehicle Speed Limiting

Vehicle speed limiting can be set with the DDR or programming station. Requires VSS set to Yes.

Vehicle Speed Limit = Yes/No; Maximum speed = XX mph. Limited to the calculated gear bound vehicle speed at rated engine r/min, or if progressive shift = yes, then max cruise speed is limited to high gear r/min. (XX refers to customer selections.)

7.1.31 Variable Speed Governor or Limited Speed Governor Vehicle Speed Limiting Diagnostics

If low side diagnostics need to be enabled or disabled, this is set on the mainframe.

Low side diagnostics refers to throttle position sensor (TPS) or variable speed governor (VSG) "low volt" codes. This occurs when an ECM is configured to be looking for a signal at one of these items, but nothing is wired to it.

7.1.32 Vehicle Speed Sensor Anti-Tamper

Vehicle Speed Sensor (VSS) anti-tamper can be set with the DDR, or special ECM software available via parts.

Once set, VSS anti-tamper requires 5.0 level DDR or higher to disable.

7.2 DDEC FEATURE SUMMARY

The "x" in a column indicates that this feature has always been available. The numbers indicate the software release that the feature was introduced. A number in the DDR column represents the ECM software release that made the feature available, or able to be changed with the tool listed in the comments column. Parameters that are configured in the Application Code Only are listed in Table 7-6.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
Air Compressor Governor System	4	-	-	-	-
Air Temp Sensor	x	-	-	-	-
Air Temp Torque Reduction	3	-	-	-	-
Barometric Pressure Sensor	x	-	-	-	-
Coolant Level Sensor	x	-	-	-	-
Coolant Pressure Sensor	x	-	-	-	-
Crankcase Pressure Sensor	x	-	-	-	-
Cruise MIN r/min	x	-	-	-	Typically 1100 r/min
Disable EOP on VSG	x	-	-	-	Typically fire trucks only
Dual Fuel BOI	x	-	-	-	Methanol engines; replaces fuel pressure sensor
Enable Engine Brakes	x	-	-	-	May be Jakes, KD (S55) or DVB (S55) beginning w/R4
Engine Overtemp Protection	x	-	-	-	Engine power limiting based on high engine temps OTS, CTS, ICTS
Engine Protection Configuration	x	-	-	-	Temp limits F & amt of power/speed reduction
Engine Sync	x	-	-	-	-
Engine Sync Pulses	x	-	-	-	Typically 12
Fan Control Configuration	x	-	-	-	Includes activation temps
Fuel Pressure Sensor	x	-	-	-	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
Glow Plugs	x	-	-	-	Methanol engines
Idle Operation at Zero VSG	x	-	-	-	Typically set for on-highway applications
Intercooler Temp Sensor	x	-	-	-	-
LSG Low Side Diagnostics (Code 22)	x	-	-	-	-
LSG Override VSG	x	-	-	-	-
Oil Pressure Sensor	x	-	-	-	-
Oil Temp Sensor	x	-	-	-	-
Pressure Governor System	x	-	-	-	Fire truck applications
PWM Fan Control	3	-	-	-	Assigned to PWM4 w/R3; can be programmed for PWM2 or PWM4 w/R4*
PWM Fan Control Configuration	3	-	-	-	Includes duty cycle levels and temperatures
VSG	x	-	-	-	-
VSG Low Side Diagnostics (Code 11)	x	-	-	-	Typically not set for on-highway applications
VSG Operation at Higher Vehicle Speeds	5	-	-	-	Typically set to 3 mph
VSG Using Foot Pedal	x	-	-	-	Changes scale of r/min per count

* Typically PWM2 for S149; PWM4 for S50/S60

Table 7-6 Parameters That Are Configured in Application Code Only

The parameters that are configured in the mainframe screens only are listed in Table 7-7.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Program Station	DDR/DDL	Comments
6N4C Group	-	x	-	-	-
6N4D Group	-	x	-	-	-
ATI Port	-	4	-	-	None or TURBO SPD or NAT GAS or VSG FREQ (Pin X-1)
Digital Torque Limiting	-	5	-	-	Utilizes selection of a predefined torque curve and/or speed
Fan Type (Digital Output)	-	x	-	-	-
Full Power Continuous Override	-	x	-	-	-
Hot Idle Speed	-	x	-	-	Some industrial only max 1400 r/min
Max Cold Idle Speed	-	3	-	-	Restricted for automatic trans to 700 r/min
Maximum Security	-	x	-	-	-
Override CCPS Faults	-	3	-	-	Intended for EMD
Override OPS Low Faults	-	3	-	-	Intended for EMD
Rating Security	-	x	-	-	-
Starter Lockout Speed Settings	-	5	-	-	Allows use of this out-put for other functions
VSG is Primary	-	x	-	-	-

Table 7-7 Parameters that are Configured in the Mainframe Screens Only

Parameters that can be configured by the OEM, programming station, and/or the DDR are listed in Table 7-8.

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
ACG Integral Gain	-	4	4	-	Air Compressor Gov
ACG Pressure Increment	-	4	4	-	-
ACG Proportional Gain	-	4	4	-	-
Engine Sensor Harness Outputs (3)	-	x	x	-	-
Fan A/C Timer	-	5	5	-	Typically set to 180 seconds (3 minutes)
PGS Cavitation Time Out	-	x	x	-	-
PGS Engine Speed Increment	-	x	x	-	-
PGS Integral Gain	-	x	x	-	-
PGS Proportional Gain	-	x	x	-	-
PGS Pump Pressure Increment	-	x	x	-	-
Vehicle Interface Harness Inputs (12)	-	x	x	-	-
Vehicle Interface Harness Outputs (3)	-	x	x	-	-
ACG Delta Pressure to Load	-	4	4	4	Air Compressor Gov
ACG Delta Pressure to Unload	-	4	4	4	-
ACG Maximum Pressure - 1,2,3	-	4	4	4	-
ACG Minimum Pressure - 1.2.3	-	4	4	4	-
Auxiliary Stop 1 or 2 Protection Level	-	x	x	x	-
Coolant Level Protection Level	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
Crankcase Pressure Protection Level	-	x	x	x	-
Cruise Auto Resume	-	x	x	x	-
Cruise Control Enable	-	x	x	x	-
Cruise Maximum Speed	-	x	x	x	-
Cruise Minimum Speed	-	x	x	x	-
Dynamic Fan Braking	-	x	2	2	-
Engine Brake Cruise	-	x	x	x	-
Engine Brake Increment	-	x	x	x	-
Engine Brake Low	-	x	x	x	-
Engine Brake-Svc Brake Activation	-	-	5	5	When set requires tap of svc brake to activate Jakes
Engine Brake - Minimum mph	-	-	5	5	Allows deactivation of Jakes below a vehicle speed
FEI - Calculation Type	-	5	5	5	Fuel Economy Incentive
FEI Conversion Factor, mph per mpg	-	5	5	5	-
FEI - Maximum mph	-	5	5	5	-
FEI - Minimum mpg	-	5	5	5	-
Feature Password Protection	-		5	4	(Function Lockout)
Half Engine Enable	-	-	-	7	Enable/disable Half engine idle, Off, If Cold, On, N/A
Idle Shutdown Override	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
Idle Speed Offset	-	-	-	x	Idle Adjust Normal +100 to -25 rpm
Idle Timer	-	x	x	x	-
Idle Timer Operates ON	-	x	x	x	Idle Gov only, or Idle and VSG Governor
Idle Timer Override Defeat, max temp	-	2	2	2	-
Idle Timer Override Defeat, min temp	-	2	2	2	-
Idle Timer Shutdown	-	x	x	x	-
Injector Calibration Codes	-	-	-	x	-
Intercooler Temp Protection Level	-	x	x	x	-
LSG Droop	-	x	x	x	-
Max Vehicle Overspeed with Fuel	-	x	x	x	-
Max Vehicle Overspeed w/o Fuel	-	x	x	x	-
Oil Pressure Protection Level	-	x	x	x	-
Oil Temp Protection Level	-	x	x	x	-
Progressive Shift Configuration	-	x	x	x	-
Rating Selection (Rating Override)	-	6N4M	x	x	-
Transmission Type (PWM #1)	-	x	x	x	-
Unit Number	-	-	-	4	-
Vehicle Speed Limiting	-	x	x	x	-
Vehicle Speed Max	-	x	x	x	-
Vehicle Speed Sensor	-	x	x	x	-

Parameter Name	APPL Code 6N4C Only	Mainframe Only	Prog Station	DDR/DDL	Comments
VIN	-	-	x	x	-
VSG Alt Min RPM	-	x	x	x	-
VSG Cruise Init Speed	-	x	x	x	-
VSG Cruise RPM Increment	-	x	x	x	-
VSG Droop	-	x	x	x	-
VSG Maximum RPM	-	x	x	x	-
VSG Minimum RPM	-	x	x	x	-
VSG Using Cruise Switch	-	x	x	x	-
VSS Anti Tamper	-	-	7	5	-
VSS Axle Ratio	-	x	x	x	-
VSS Final Gear Ratio	-	x	x	x	-
VSS Number of Teeth	-	x	x	x	-
VSS Sensor Type	-	x	x	x	Typically tailshaft; also wheel or J1939
VSS Signal Type	-	2	2	2	Typically magnetic; also open-collector/switch
VSS Tire Revolutions	-	x	x	x	-

Table 7-8 Parameters that can be Configured by the OEM, Programming Station, and/or the DDR

DDEC Features, code 6N5, are listed in Table 7-9.

Parameter Name	Code	Mainframe Only	Program Station	DDR	Comments
No DDEC Feature	6N5-NONE	-	-	-	-
ECM Data Pages Only	6N5-0001	-	-	-	-
Optimized Idle Only	6N5-0002	-	-	-	-
Data Pages and Optimized Idle	6N5-0003	-	-	-	-

Table 7-9 6N5 - DDEC Features

8 (UPDATE) CONNECTORS, TERMINALS, AND SPLICING

8.1 CRIMP AND REMOVAL TOOLS

Crimp tools and connector removing tools can be purchased from Kent-Moore. The part and associated part numbers are listed in Table 8-1.

Connector	Tool	Part Number
Metri-Pack 150	Removing	J 35689
	Crimp	J 35123
Weather Pack	Removing	J 36400-5
	Crimp	J 35606
Metri-Pack 280	Removing (18 AWG)	J 33095
	Crimp (18 AWG)	J 38125-6
	Removing (12 AWG - Used for power harness)	J 33095
	Crimp (12 AWG - Used for power harness)	J 39848
Deutsch	Removing (12 AWG)	J 37451
	Removing (16-18 AWG)	J 34513
	Crimp	J 34182

Table 8-1 Crimp and Removal Tools

8.2 METRI-PACK 150 CONNECTORS

Metri-Pack 150 series connectors are "pull-to-seat" connectors. Each wire must be pushed through the connector prior to crimping the terminal. Cable seals are inserted into the shell of the connector and hold many wires. Metri-Pack 150 connectors are listed in Table 8-2.

ECM Engine Harness		**ECM Vehicle Interface Harness**	
Connector	P/N: 12034400	Connector	P/N: 12034398
Terminal	P/N: 12103881	Terminal	P/N: 12103881
Seal	In Connector	Seal	In Connector
Plug	P/N: 12034413	Plug	P/N: 12034413
ECM Communication Harness Connector		**Temperature Sensor Harness**	
Connector	P/N: 12066317	Connector	P/N: 12162193
Terminal	P/N: 12103881	Terminal	P/N: 12103881
Seal	In Connector	Seal	In Connector
Plug	P/N: 12034413	Plug	P/N: Not Applicable
Pressure Sensor Harness		**Fire Truck Pressure Sensor (PGS)**	
Connector	P/N: 12047909	Connector	P/N: 12065287
Terminal	P/N: 12103881	Terminal	P/N: 12103881
Seal	In Connector	Seal	In Connector
Plug	P/N: Not Applicable	Plug	P/N: Not Applicable
SRS Harness		**TRS Harness**	
Connector	P/N: 12162193	Connector	P/N: 12162197
Terminal	P/N: 12103881	Terminal	P/N: 12103881
Seal	In Connector	Seal	In Connector
Plug	P/N: Not Applicable	Plug	P/N: Not Applicable
Injector (Gray)		**Injector (Black)**	
Connector	P/N: 12162830	Connector	P/N: 12040947
Terminal	P/N: 12103881	Terminal	P/N: 12103881
Seal	P/N: Not Applicable	Seal	P/N: Not Applicable
Plug	P/N: 12034413	Plug	P/N: 12034413

Table 8-2 Metri-Pack 150 Connector Part Numbers

8.2.1 Installation

Metri-Pack 150 connectors are of the "pull-to-seat" design. The cable is pushed through the seal and correct cavity of the connector before crimping the terminal to the cable. It should be stripped of insulation *after* it is placed through the seal and connector body. Use the following instructions for terminal installation:

1. Position the cable through the seal and correct cavity of the connector. See Figure 8-1.

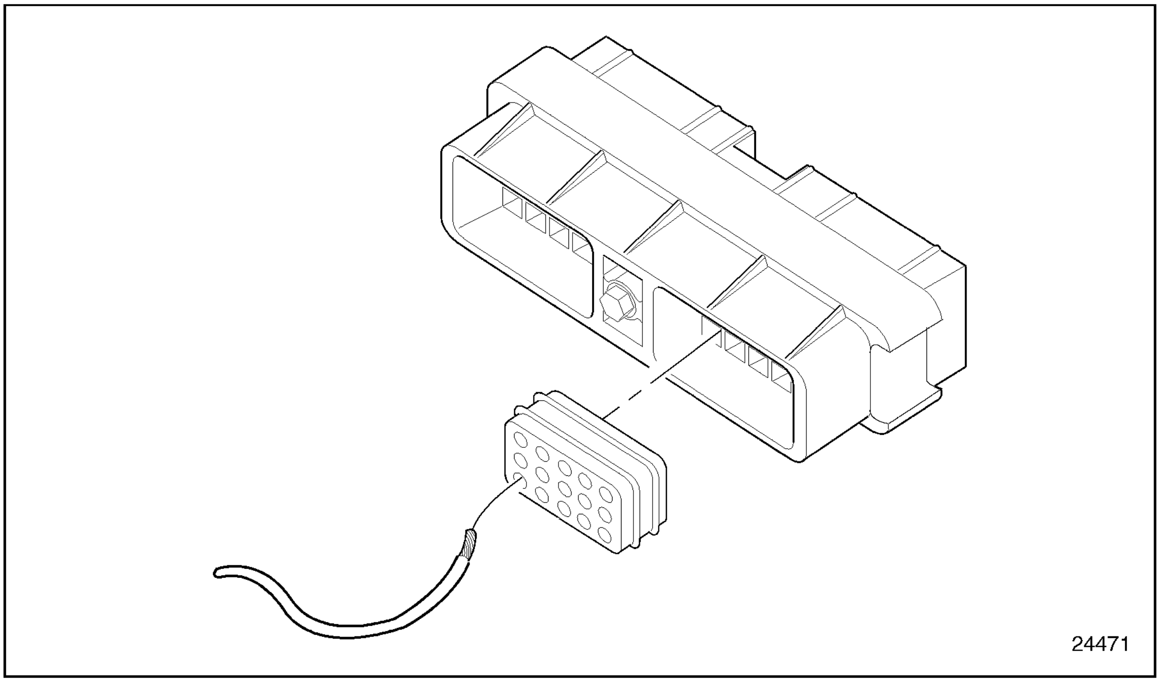


Figure 8-1 Inserting Wire in Connector

2. Strip the end of the cable using wire strippers to leave 5.0 ± 0.5 mm (0.2 ± 0.02 in.) of bare conductor.
3. Squeeze the handles of the crimping tool together firmly to cause the jaws to automatically open.
4. Hold the "wire side" facing you.
5. Push the terminal holder to the open position and insert the terminal until the wire attaching portion of the terminal rests on the 20-22 anvil. Be sure the wire core wings and

the insulation wings of the terminal are pointing toward the upper jaw of the crimping tool. See Figure 8-2.

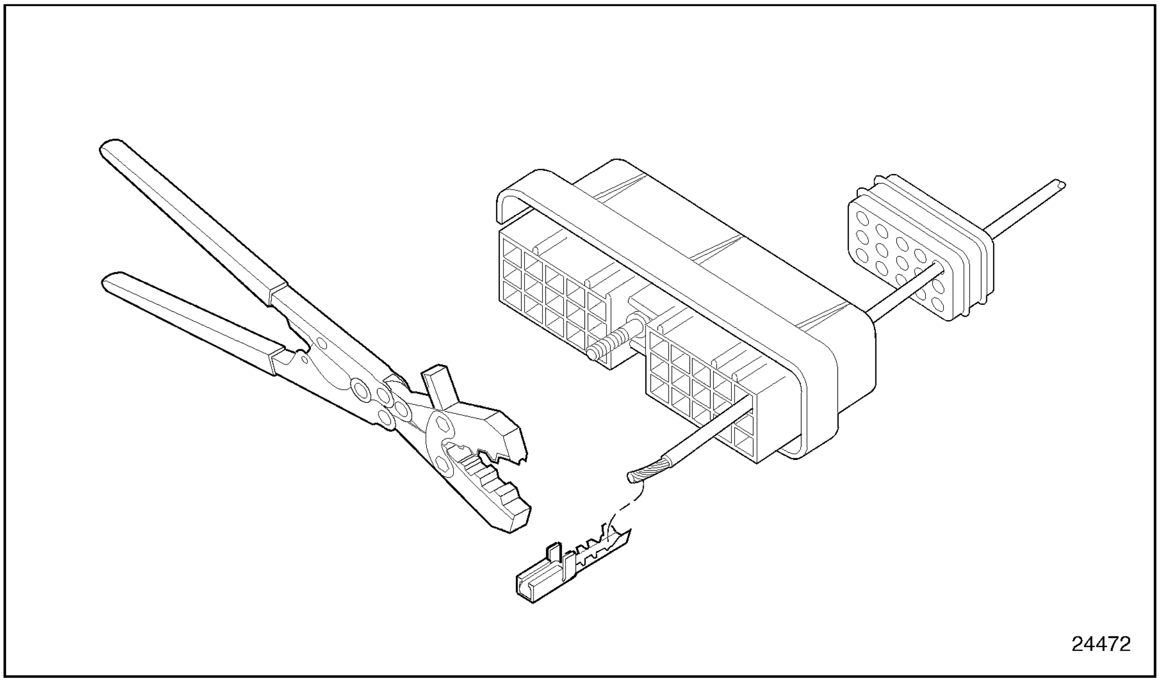


Figure 8-2 Terminal and Crimping Tool Position

6. Insert the cable into the terminal until the stripped portion is positioned in the wire core wings, and the insulation portion ends just forward of the insulation wings. See Figure 8-3.

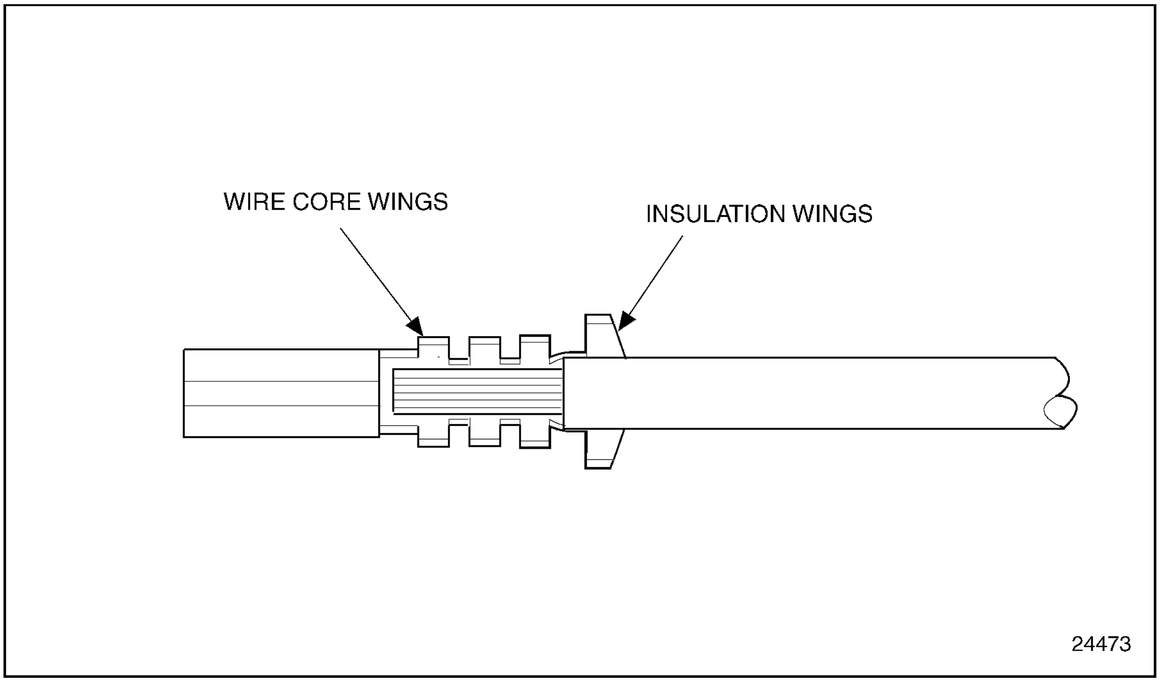


Figure 8-3 Cable to Terminal Alignment

7. Compress the handles of the crimping tool until the ratchet automatically releases and the crimp is complete.

NOTE:
For faster, more efficient crimping operation, a bracket or bench rest may be used to cradle one handle of the tool. The operator can apply the terminals by grasping and actuating only one handle of the tool. See Figure 8-4.

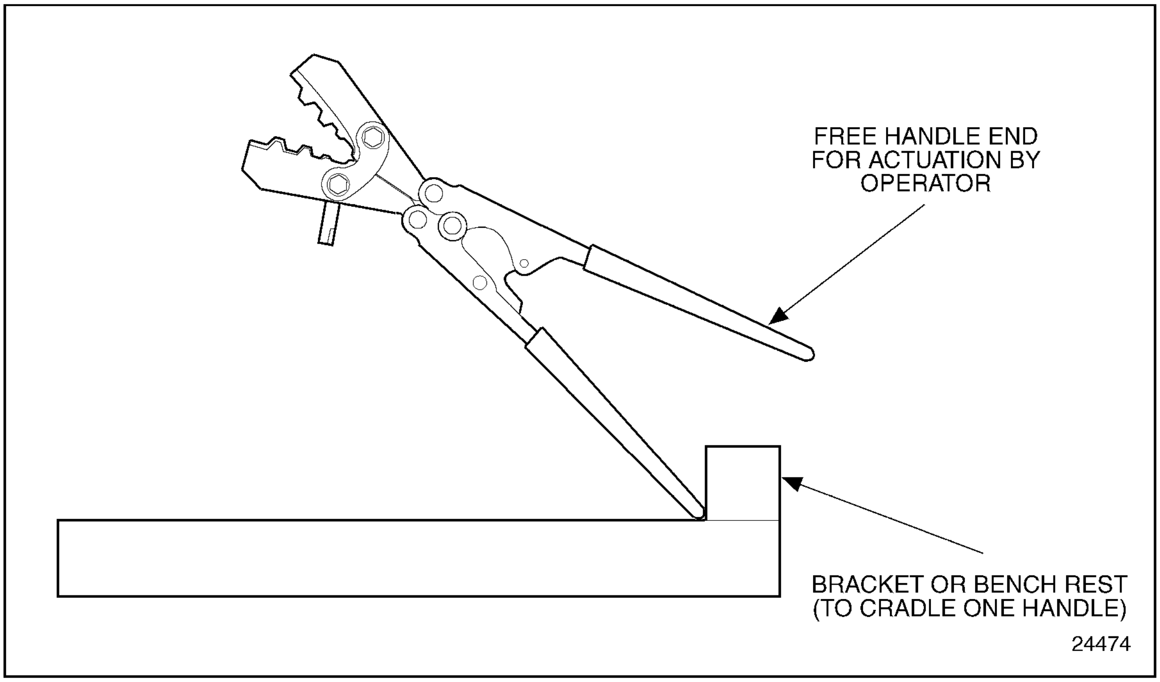


Figure 8-4 Crimping Operation

8. Release the crimping tool with the lock lever located between the handles, in case of jamming.
9. Align the locking tang of the terminal with the lettered side of the connector.

10. Pull the cable back through the connector until a click is heard.See Figure 8-5. Position the seal into the connector.

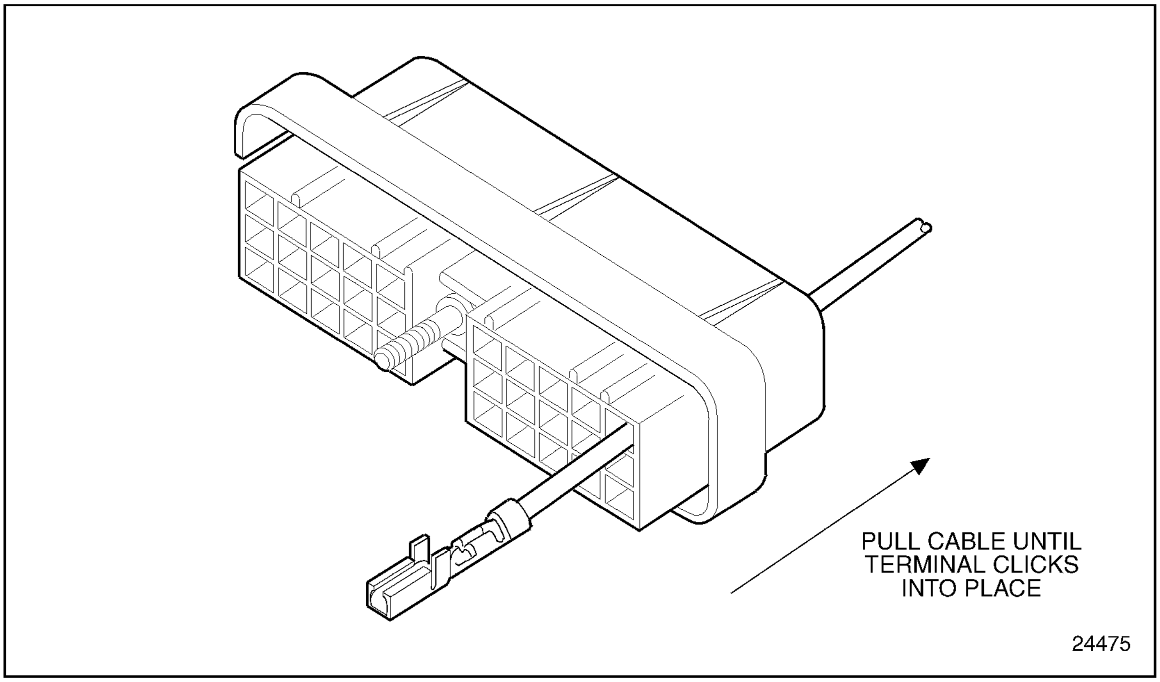


Figure 8-5 Pulling the Terminal to Seat

NOTE:
For ECM 30-pin connectors, put locking tang opposite lettered side.

8.2.2 Removal and Repair

A tang on the terminal locks into a tab molded into the plastic connector to retain the cable assembly. Remove Metri-Pack 150 terminals using the following instructions.

1. Insert the removal tool into the cavity of the connector, placing the tip of the tool between the locking tang of the terminal and the wall of the cavity. See Figure 8-6.

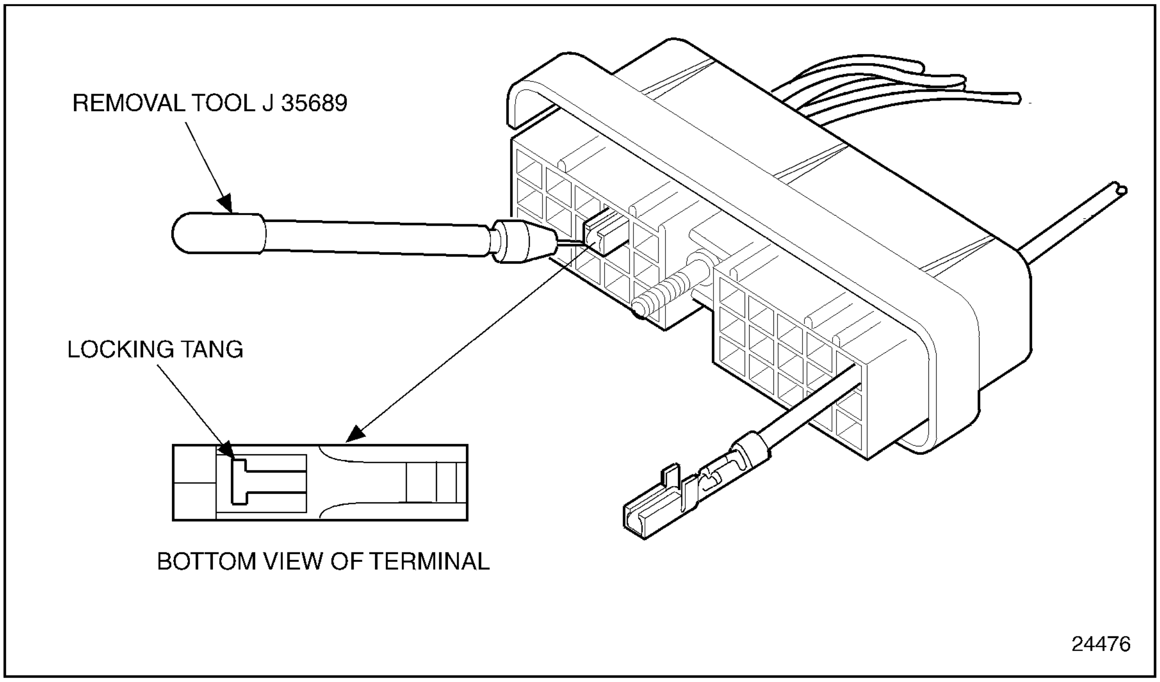


Figure 8-6 Terminal Removal

2. Depress the tang of the terminal to release it from the connector.
3. Push the cable forward through the terminal until the complete crimp is exposed.
4. Cut the cable immediately behind the damaged terminal to repair it.
5. Follow the installation instructions for crimping the terminal and inserting it into the connector.

8.3 WEATHER PACK AND METRI-PACK 280 CONNECTORS

Weather Pack and Metri-Pack 280 series connectors are push-to-seat. The terminal is crimped onto each wire before it is inserted into the connector. A cable seal is crimped on each wire at the same time the terminal is crimped onto the wire. Weather Pack connectors use a secondary lock on both male and female connector bodies and the lock snaps into place over the cable seals after installation. Some Metri-Pack connectors have secondary locks as well. Weather Pack connectors and their associated part numbers are listed in Table 8-3. Metri-Pack 280 connectors and their associated part numbers are listed in Table 8-4.

Turbo Boost Pressure Sensor Harness		Engine Brake Connector, Series 60	
Connector	P/N: 12015384	Connector	P/N: 12010973 / 12162000
Terminal	P/N: 12089040	Terminal	P/N: 12048074 / 12045773
Seal	P/N: 12015323	-	-
Throttle Position Sensor Harness Side		**Throttle Position Sensor Sensor Side**	
Connector	P/N: 12015793	Connector	P/N: 12010717
Terminal	P/N: 12089188	Terminal	P/N: 12089040
Seal	P/N: 12015323	Seal	P/N: 12015323
Plug	P/N: Not Applicable	Plug	P/N: Not Applicable
Ignition Connector Power Harness Side		**Ignition Connector Vehicle Interface Harness Side**	
Connector	P/N: 12034074	Connector	P/N: 12015378
Terminal	P/N: 12089040	Terminal	P/N: 12089188
Allison Interface Module		**Allison Interface Module Maximum Feature**	
Connector	P/N: 12015791	Connector	P/N: 12015799
Terminal	P/N: 12089188	Terminal	P/N: 12089188
Seal	P/N: 12015323	Seal	P/N: 12015323
		Plug	P/N: 12010300

Table 8-3 Weather Pack Connectors and Part Numbers

Coolant Level Sensor Connector		Power Harness	
Connector	P/N: 15300027	Connector	P/N: 12124634
Terminal	P/N: 12077411	Terminal	P/N: 12077413
Seal	P/N: 12015323	Seal	P/N: 12015193
Secondary Lock	P/N: 15300014	Secondary Lock	P/N: 12052816
Plug	P/N: Not Applicable	Plug	P/N: Not Applicable

Table 8-4 Metri-Pack 280 Connectors and Part Numbers

8.3.1 Installation

Use the following instructions for terminal installation:

1. Insert the terminal into the locating hole of the crimping tool using the proper hole according to the gage of the cable to be used. See Figure 8-7.

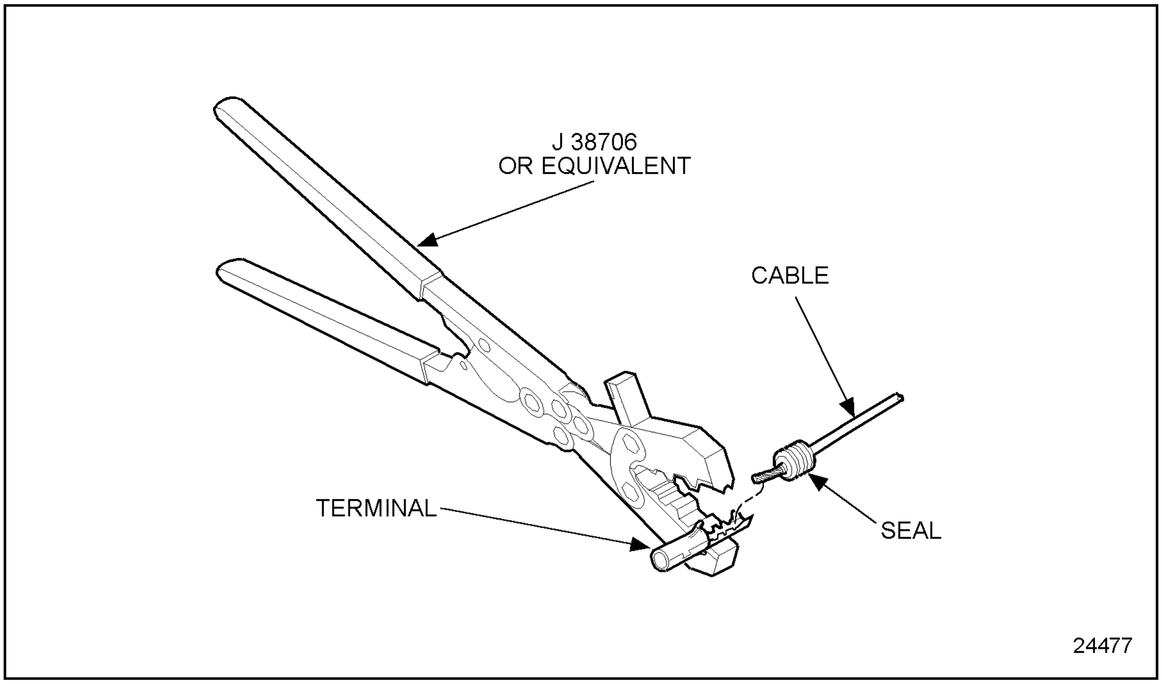


Figure 8-7 Terminal Position

2. Insert the cable into the terminal until the stripped portion is positioned in the cable core wings, and the seal and insulated portion of the cable are in the insulation wings. See Figure 8-8.

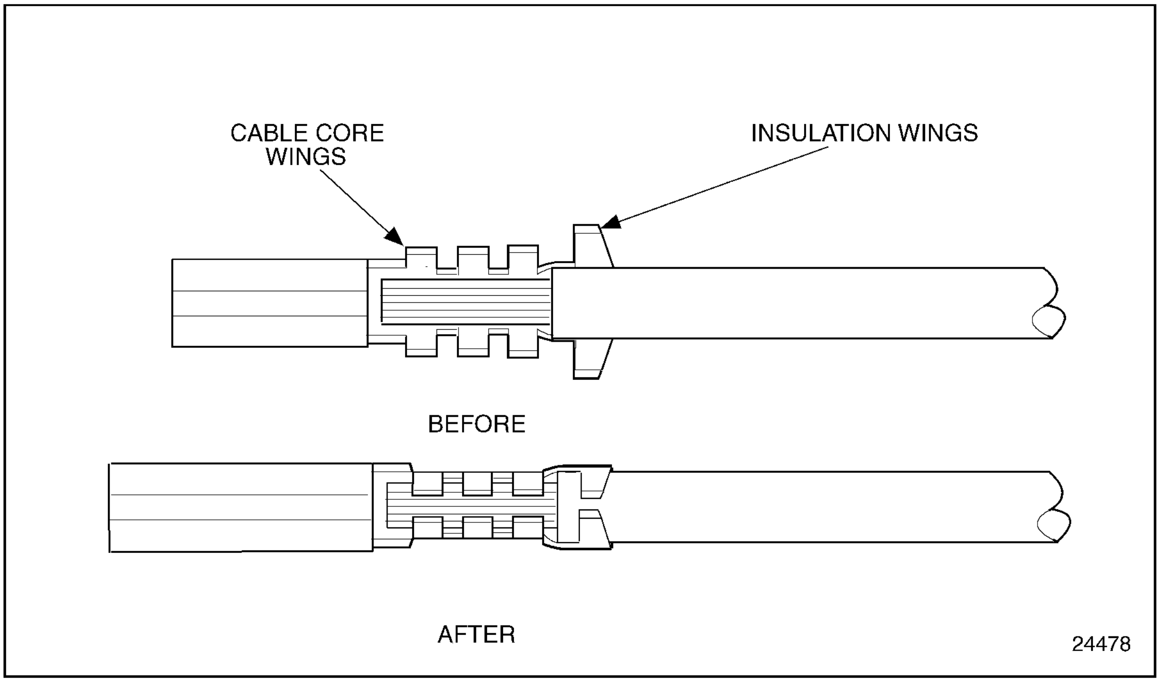


Figure 8-8 Cable and Terminal Position Before and After Crimping

3. Compress the handles of the crimping tool until the ratchet automatically releases and the crimp is complete. A properly crimped terminal is shown. See Figure 8-8.
4. Release the crimping tool with the lock lever located between the handles, in case of jamming.

5. Push the crimped terminal into the connector until it clicks into place. Gently tug on the cable to make sure it is secure. See Figure 8-9.

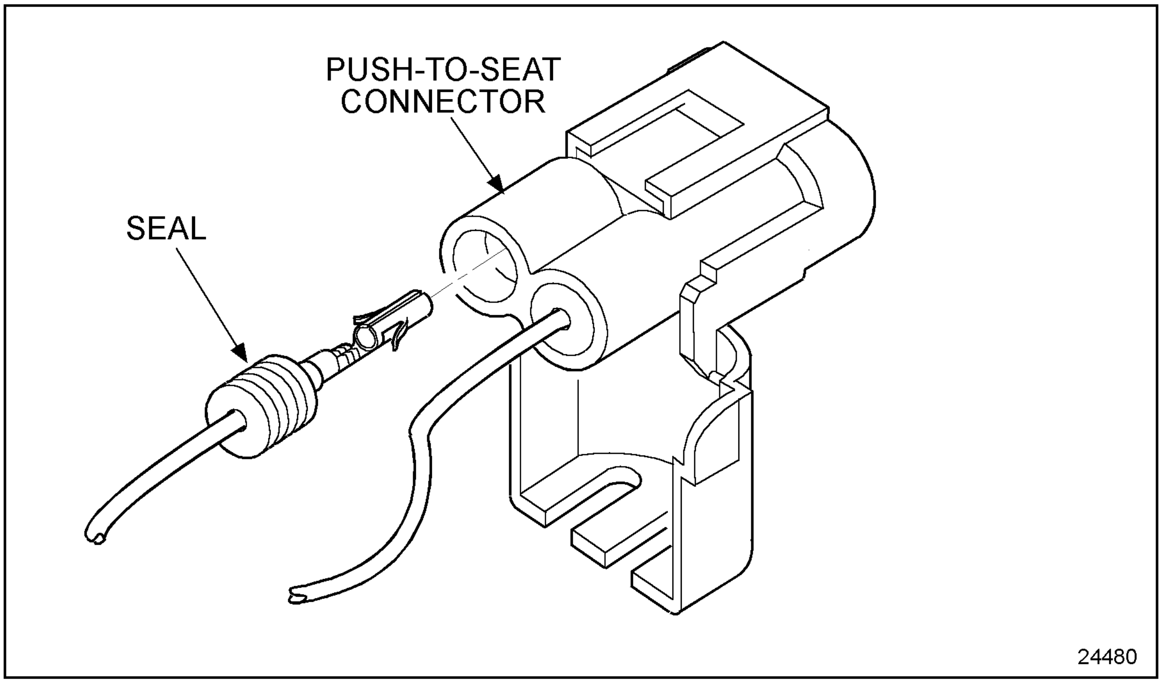


Figure 8-9 Inserting Terminal in Connector

8.3.2 Removal and Repair

Two locking tangs are used on the terminals to secure them to the connector body. Use the following instructions for removing terminals from the connector body.

1. Disengage the locking tang, securing the connector bodies to each other. Grasp one half of the connector in each hand and gently pull apart.

2. Unlatch and open the secondary lock on the connector. See Figure 8-10.

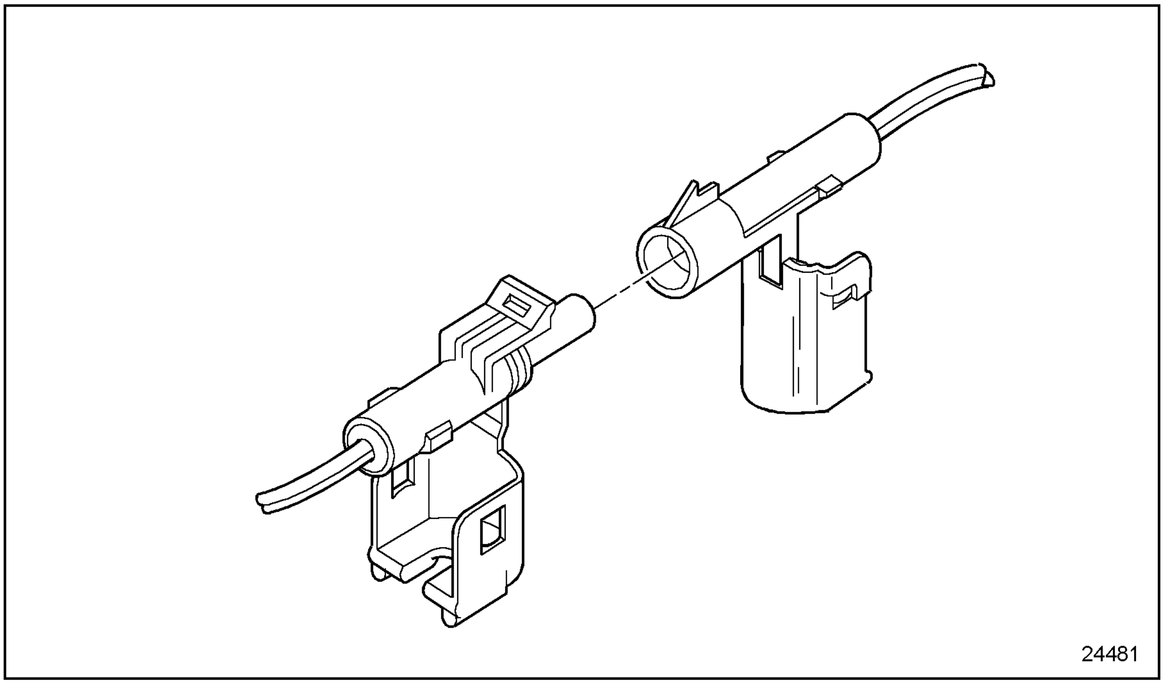


Figure 8-10 Unlatched Secondary Lock

3. Grasp the cable to be removed and push the terminal to the forward position.
4. Insert the removal tool straight into the front of the connector cavity until it resists on the cavity shoulder.

5. Grasp the cable and push it forward through the connector cavity into the tool while holding the tool securely in place. See Figure 8-11.

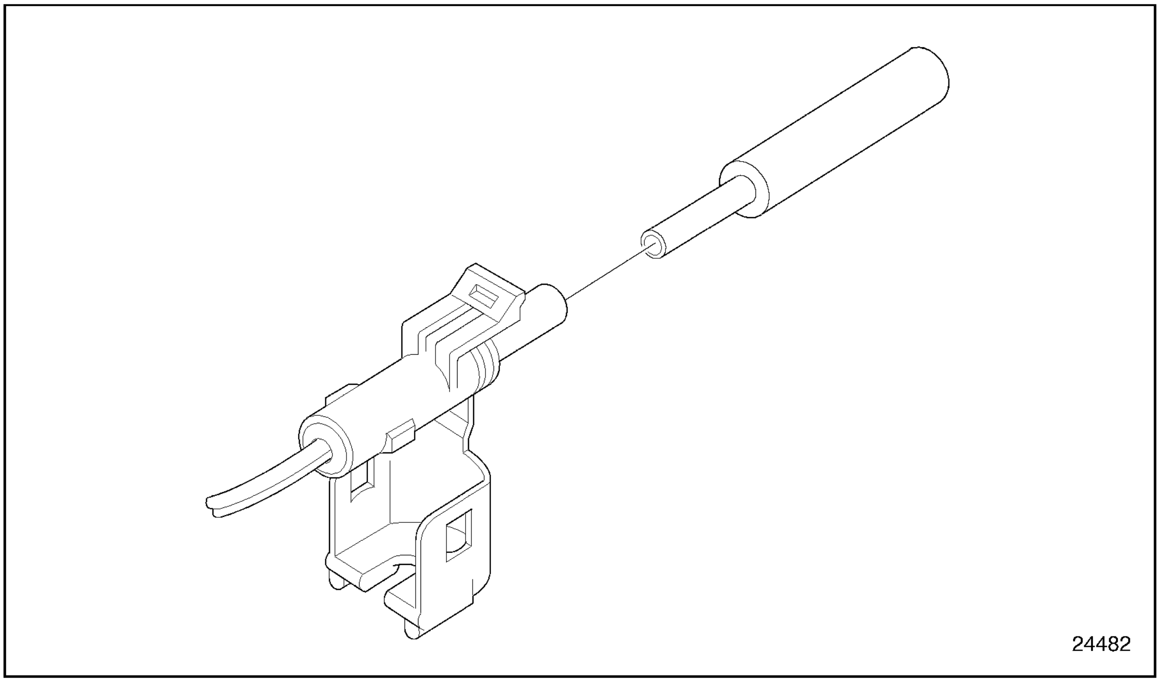


Figure 8-11 Removal Tool Procedure

6. The tool will press the locking tangs of the terminal. Pull the cable rearward (back through the connector). Remove the tool from the connector cavity.
7. Cut the wire immediately behind the cable seat and slip the new cable seal onto the wire.

8. Strip the end of the cable using strippers to leave 5.0 ± 0.5 mm (0.2 ± 0.02 in.) of bare conductor. Position cable seal as shown. See Figure 8-12.

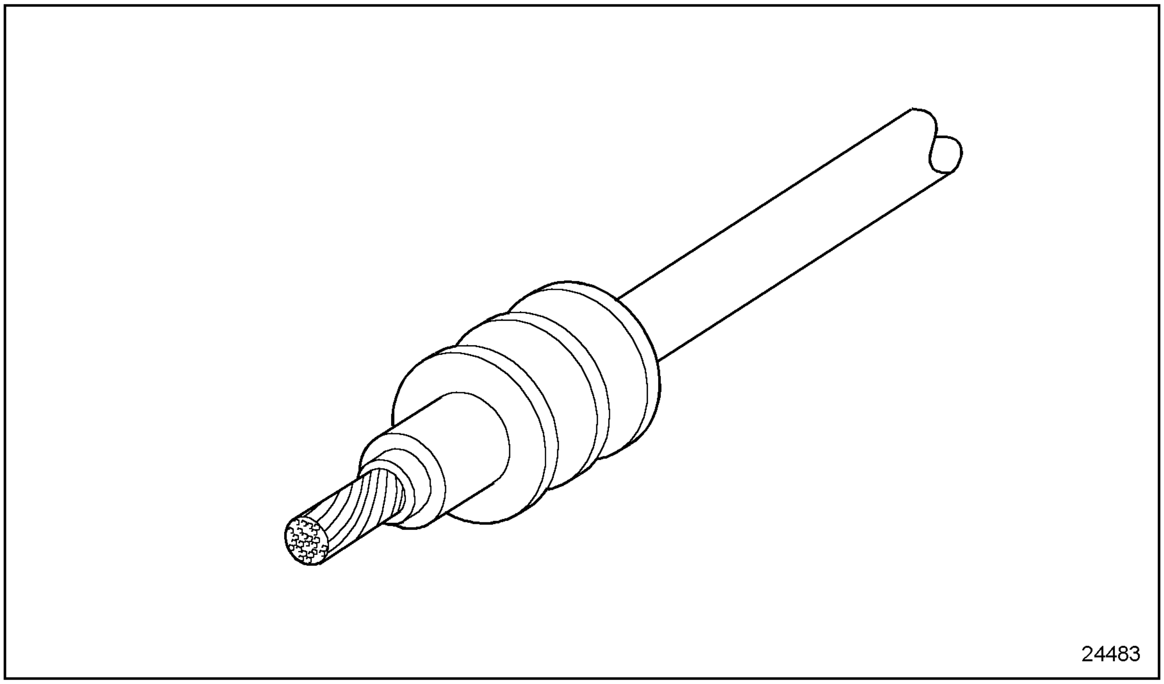


Figure 8-12 Proper Cable Seal Position

9. Crimp new terminal onto wire using the crimp tool. See Figure 8-13.

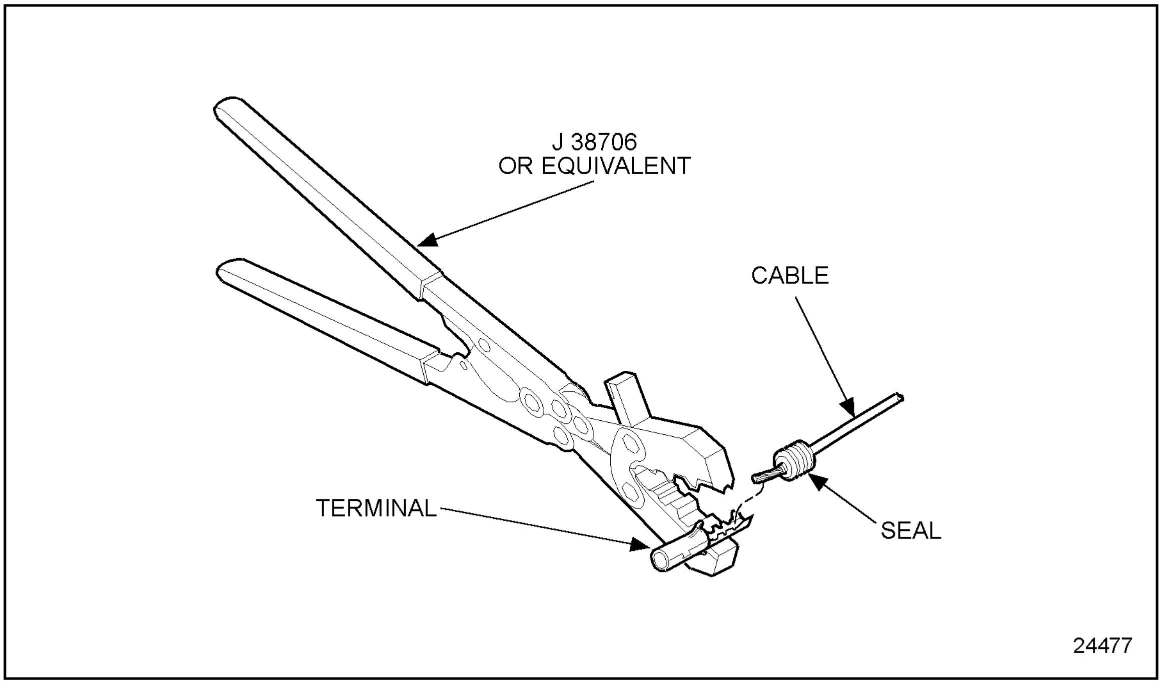


Figure 8-13 Crimping Procedure

8.4 DEUTSCH CONNECTORS

Deutsch connectors have cable seals molded into the connector. These connectors are push to seat connectors with cylindrical terminals. The diagnostic connector terminals are gold plated for clarity. Deutsch connectors and their associated part numbers are listed in Table 8-5.

Diagnostic Connector	
Connector	P/N: 23513052
Terminal	P/N: 23513053
Protective Cap	P/N: 23413054
Plug	P/N: 23507136
Engine Minder	
Connector	P/N: 23512222
Terminal	P/N: 23507132
Plug	P/N: 23507136
Mastermind - Power and Communication Link	
Connector	P/N: 23512221
Terminal	P/N: 23507132
Plug	P/N: 23507136
Mastermind - Inputs and Outputs	
Connector	P/N: 23512223
Terminal	P/N: 23507066
Plug	P/N: 23507136

Table 8-5 Deutsch Connectors and Part Numbers

8.4.1 Installation

Use the following instructions for installation:

1. Strip approximately $\frac{1}{4}$ in.(6 mm) of insulation from the cable.
2. Remove the lock clip, raise the wire gage selector, and rotate the knob to the number matching the gage wire that is being used.
3. Lower the selector and insert the lock clip.

4. Position the contact so that the crimp barrel is 1/32 of an inch above the four indenters. See Figure 8-14. Crimp the cable.

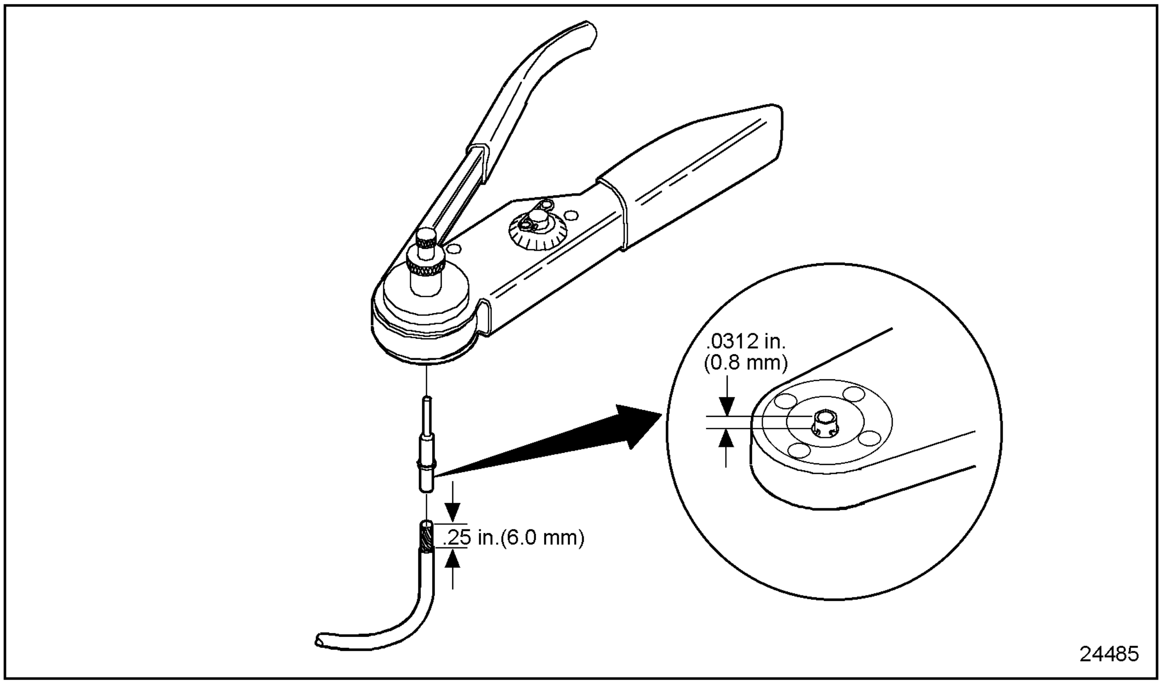


Figure 8-14 Setting Wire Gage Selector and Positioning the Contact

5. Grasp the contact approximately one inch behind the contact crimp barrel.

6. Hold the connector with the rear grommet facing you. See Figure 8-15.

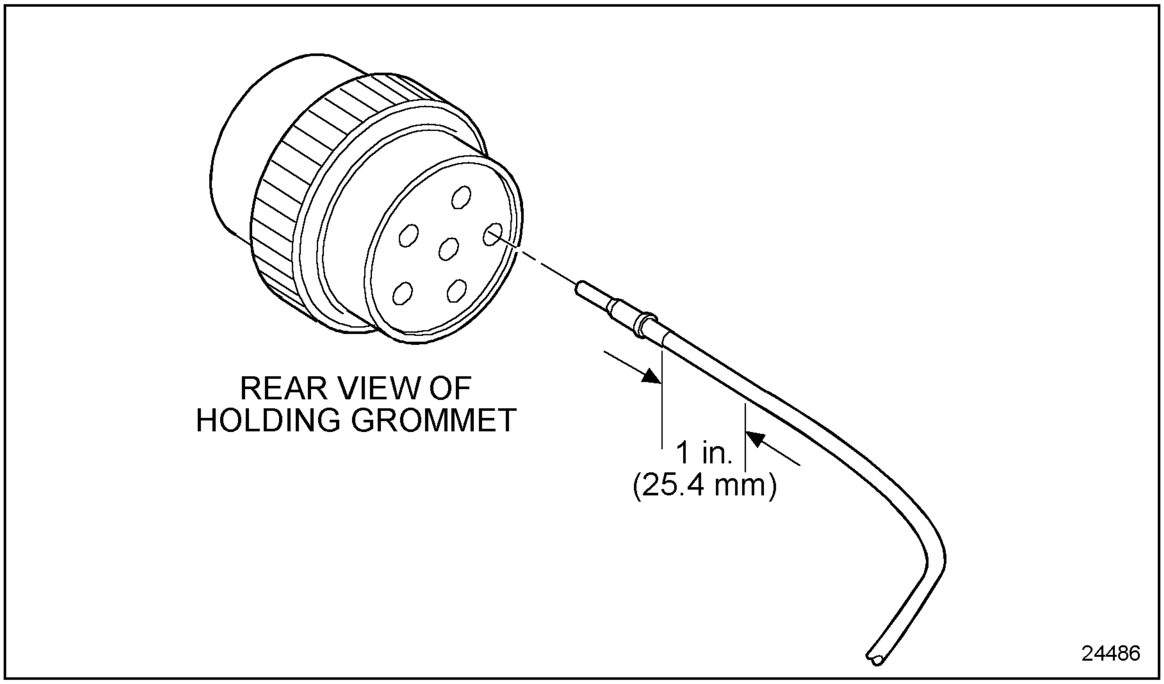


Figure 8-15 Pushing Contact Into Grommet

7. Push the contact into the grommet until a positive stop is felt. See Figure 8-15. A slight tug will confirm that it is properly locked into place. See Figure 8-16.

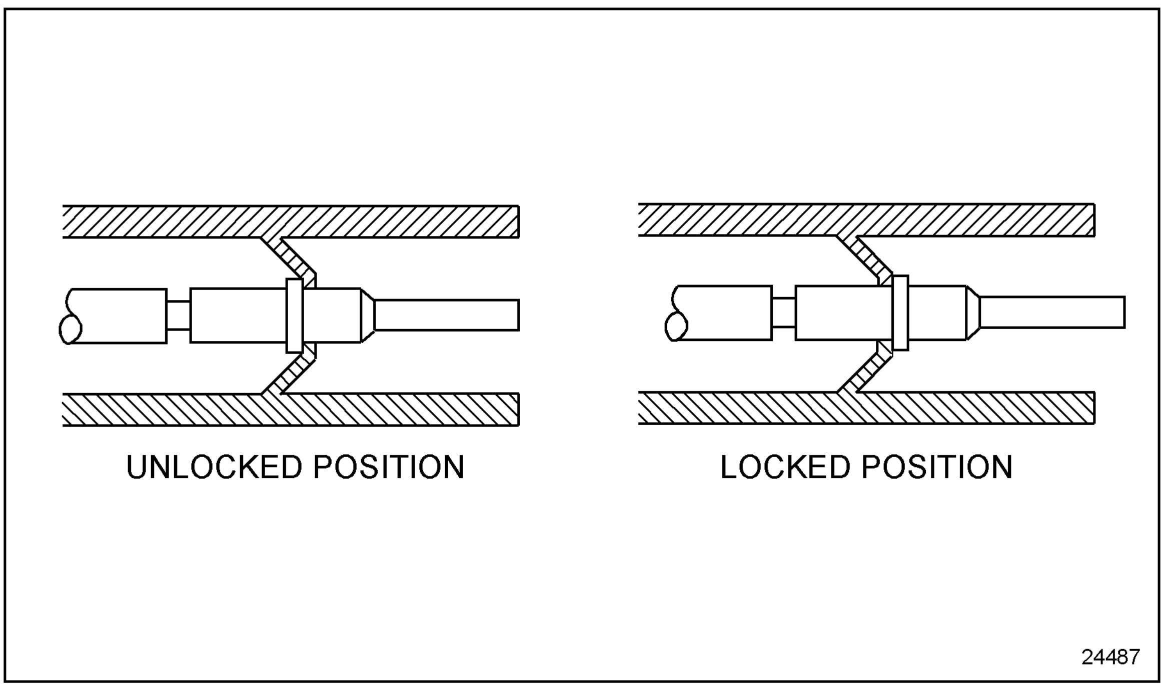


Figure 8-16 Locking Terminal Into Connector

8.4.2 Removal

The appropriate size removal tool should be used when removing cables from connectors. The proper removal tool size is listed in Table 8-1.

1. With the rear insert toward you, snap the appropriate size remover tool over the cable of contact to be removed. See Figure 8-17.

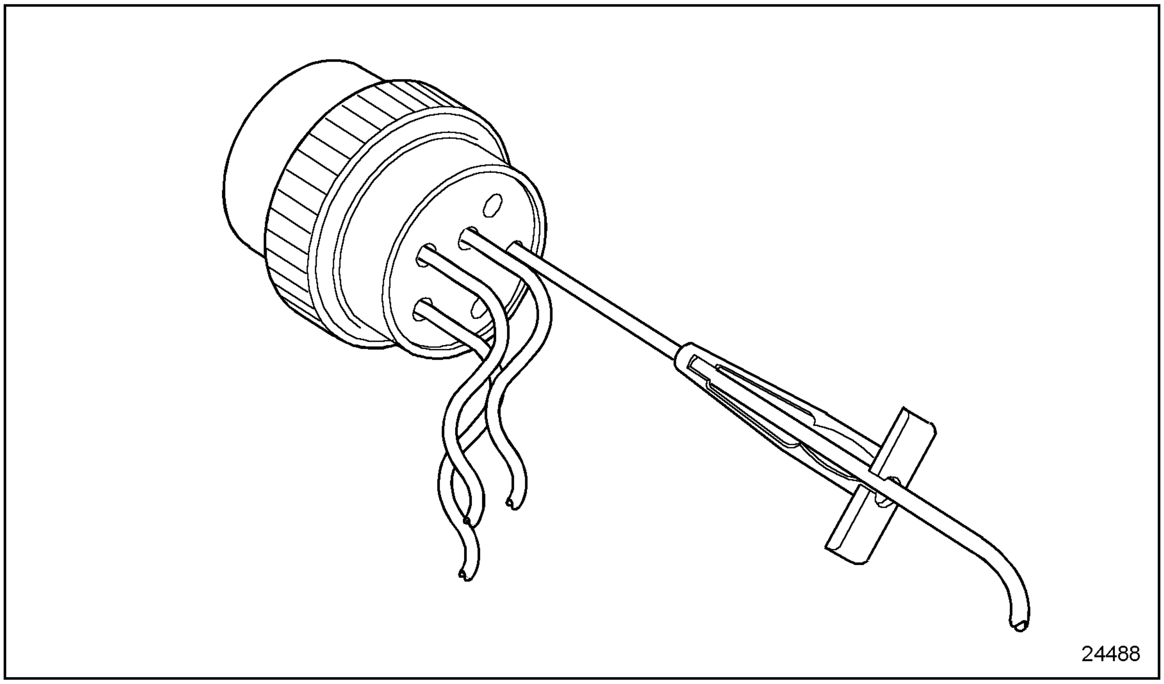


Figure 8-17 Removal Tool Position

2. Slide the tool along the cable into the insert cavity until it engages and resistance is felt. Do not twist or insert tool at an angle. See Figure 8-18.

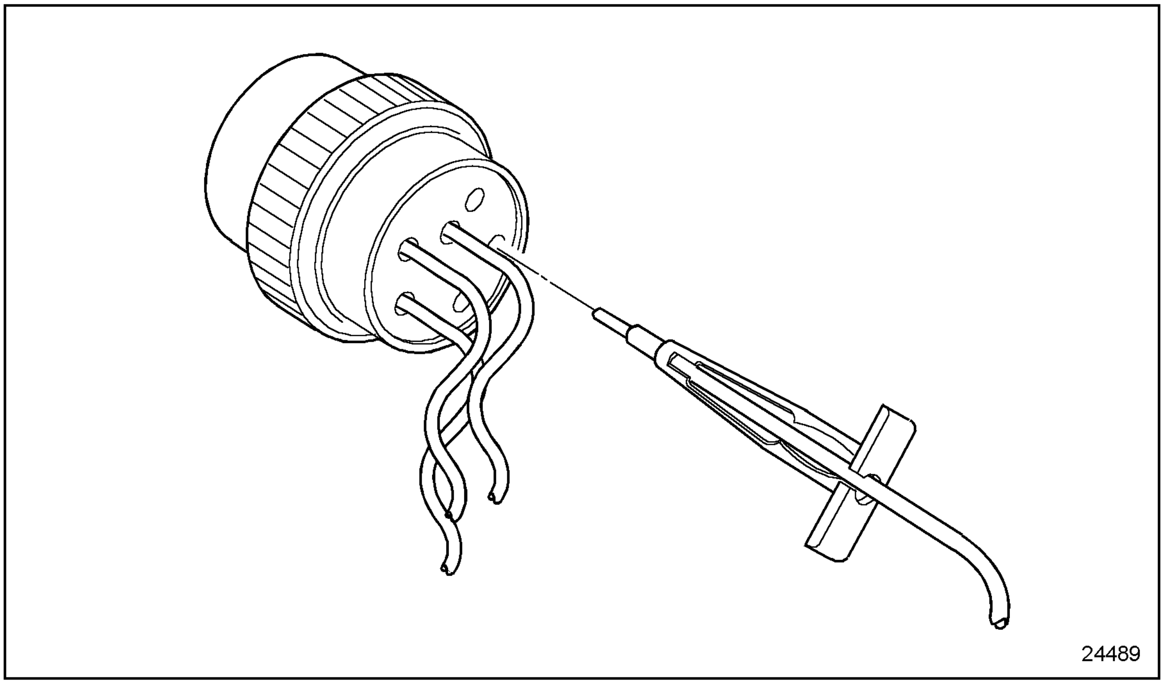


Figure 8-18 Removal Tool Insertion

3. Pull contact cable assembly out of the connector. Keep reverse tension on the cable and forward tension on the tool.

8.5 SPLICING GUIDELINES

The following are guidelines which may be used for splices. The methods described are not the only acceptable methods. Any method should produce a high quality, tight splice with durable insulation which can be expected to last the life of the vehicle.

The selection of crimpers and splice connectors is optional. Select a high quality crimper equivalent to the Kent-Moore tool, J 38706, and commercially available splice clips.

8.5.1 Tools Required

The following is a list of tools required for splicing wires:

- ☐ Soldering iron
- ☐ Rosin core solder
- ☐ Wire strippers
- ☐ Heat shrink tubing
- ☐ Splice clips
- ☐ Crimp pliers

8.6 STRAIGHT LEADS

To splice straight leads:

1. Locate broken wire.
2. Remove insulation as required; be sure exposed wire is clean and not corroded.
3. Slide a sleeve of shrink wrap on the wire long enough to cover the splice and overlap the wire insulation, about $\frac{1}{4}$ in. on both sides.
4. Insert one wire into splice clip (P/N: 0597428 or equivalent) and crimp.
5. Insert the other wire into splice and crimp. See Figure 8-19.

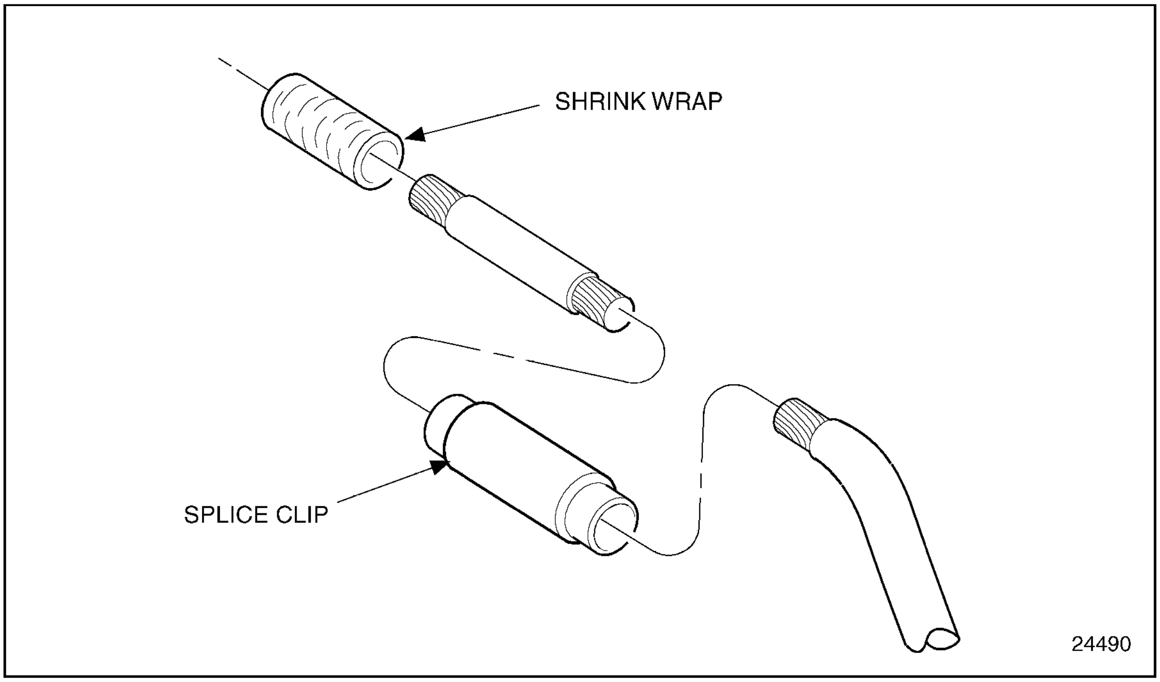


Figure 8-19 Spliced Wire

8.7 SOLDER

Soldering splice connectors is optional. To solder splice connectors:

1. You *must* use rosin core solder.
2. Check the exposed wire before the splice is crimped in its connector. The exposed wire *must* be clean before the splice is crimped.
3. Use a suitable electronic soldering iron to heat the wires. Apply the solder to the heated wire (not to the soldering iron) allowing sufficient solder flow into the splice joint.
4. Pull on connection to assure crimping and soldering integrity.

8.8 SHRINK WRAP

Shrink wrap is required. Alpha FIT-300, Raychem TAT-125 or any equivalent heat shrink dual wall epoxy encapsulating adhesive polyolefin is required.

Alpha Wire Corp 711 Lidgerwood Ave, P.O. Box 711 Elizabeth; New Jersey 07207-0711; 1-800-52ALPHA

Raychem Corporation, Thermofit Div 300 Constitution Drive, Bldg. B; Menlo Park, CA 94025; 415-361-3860

To heat shrink wrap a splice:

1. Select the correct diameter to allow a tight wrap when heated. The heat shrink wrap *must* be long enough to overlap the wire insulation about $\frac{1}{4}$ in. on both sides of the splice.
2. Heat the shrink wrap with a heat gun; do not concentrate the heat in one location, but play the heat over the entire length of shrink wrap until the joint is complete.

8.9 MULTIPLE BROKEN WIRES

To splice multiple broken wires:

1. Stagger the position of each splice as illustrated. See Figure 8-20.
2. You *must* stagger positions to prevent a large bulge in the harness and to prevent the wires from chafing against each other.

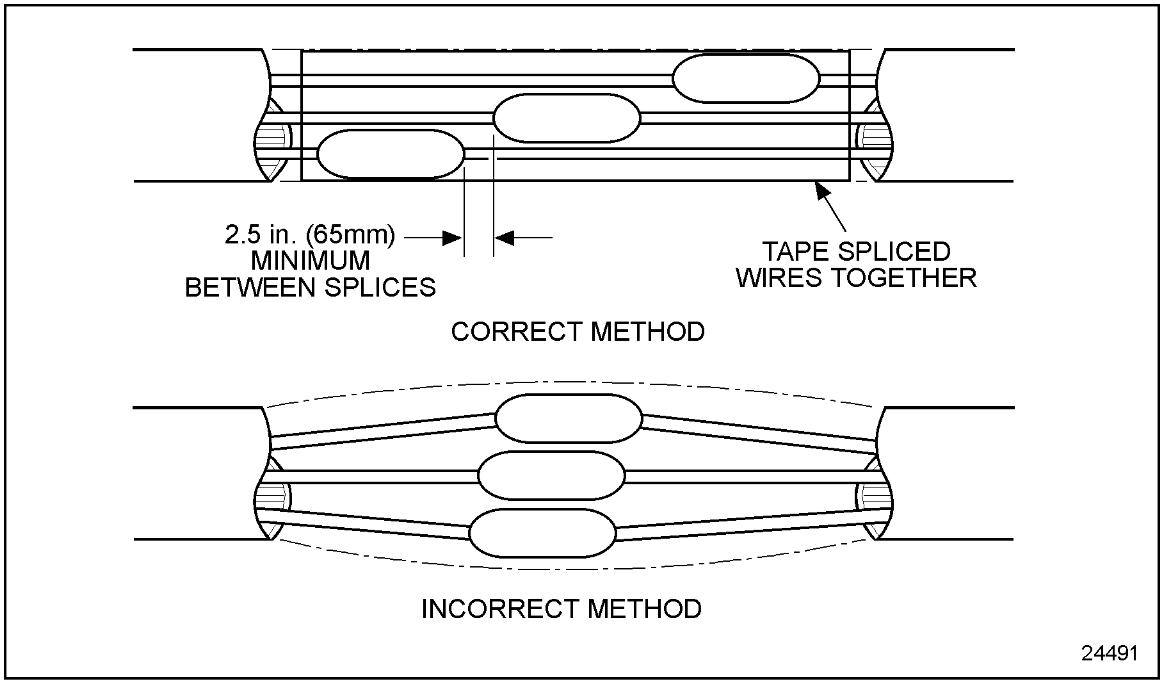


Figure 8-20 Multiple Splices

8.10 THREE-WIRE SPLICE

Three-way splice connectors are commercially available to accommodate three-wire splices. The technique is the same as a single butt splice connector. See Figure 8-21.

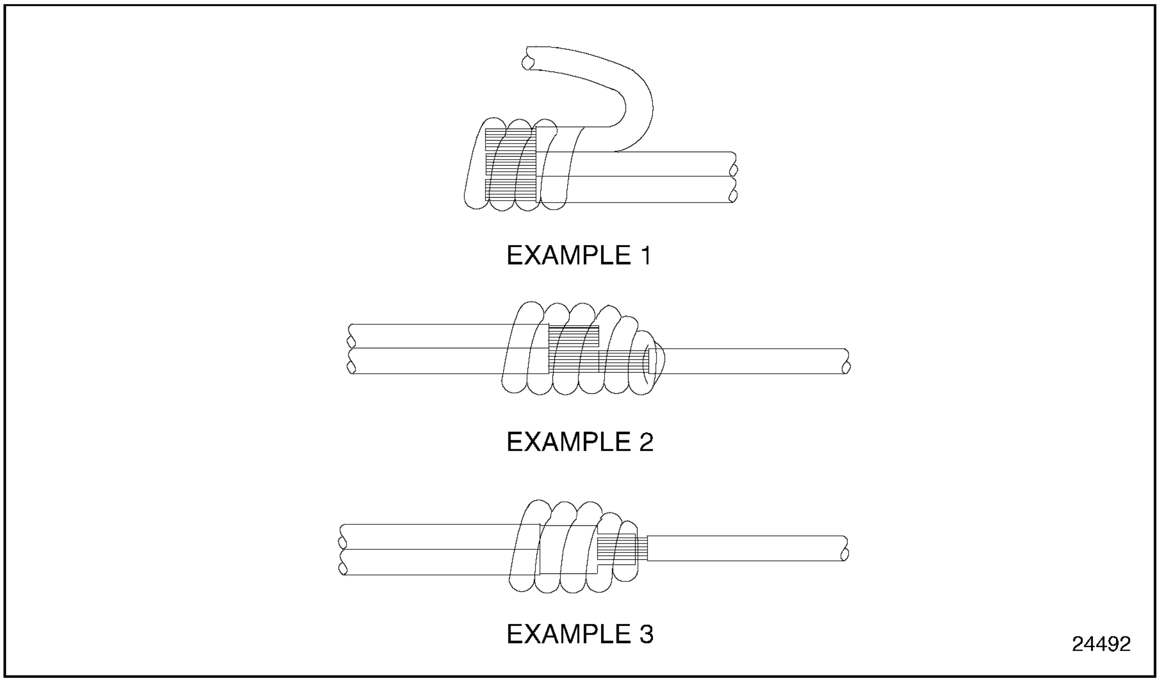


Figure 8-21 Three-Way Splice

9 (CHG) DIAGNOSING A DDEC SYSTEM FAULT

9.1 FIRST STEP FOR DIAGNOSING A FAULT WITHIN THE DDEC SYSTEM

The following procedure is the starting point for diagnosing DDEC codes using the Diagnostic Data Reader (DDR).

9.1.1 Check Engine Light

Perform the following steps to check the Check Engine Light (CEL):

1. Turn the ignition on while at the same time observing the Check/Stop Engine light (engine not running).
   - [a] If the CEL comes on and stays on, refer to section 9.1.2.
   - [b] If the CEL comes on for up to five seconds, and then turns off, refer to section 9.1.3.
   - [c] If the CEL does come on, but the condition of light is erratic or intermittent, refer to section 10.4.
   - [d] If the CEL does not come on, refer to section 10.4.

9.1.2 Read Active Codes

Perform the following steps to read the active codes.

1. Turn ignition on. Plug DDR into DDL connector. See Figure 9-1.

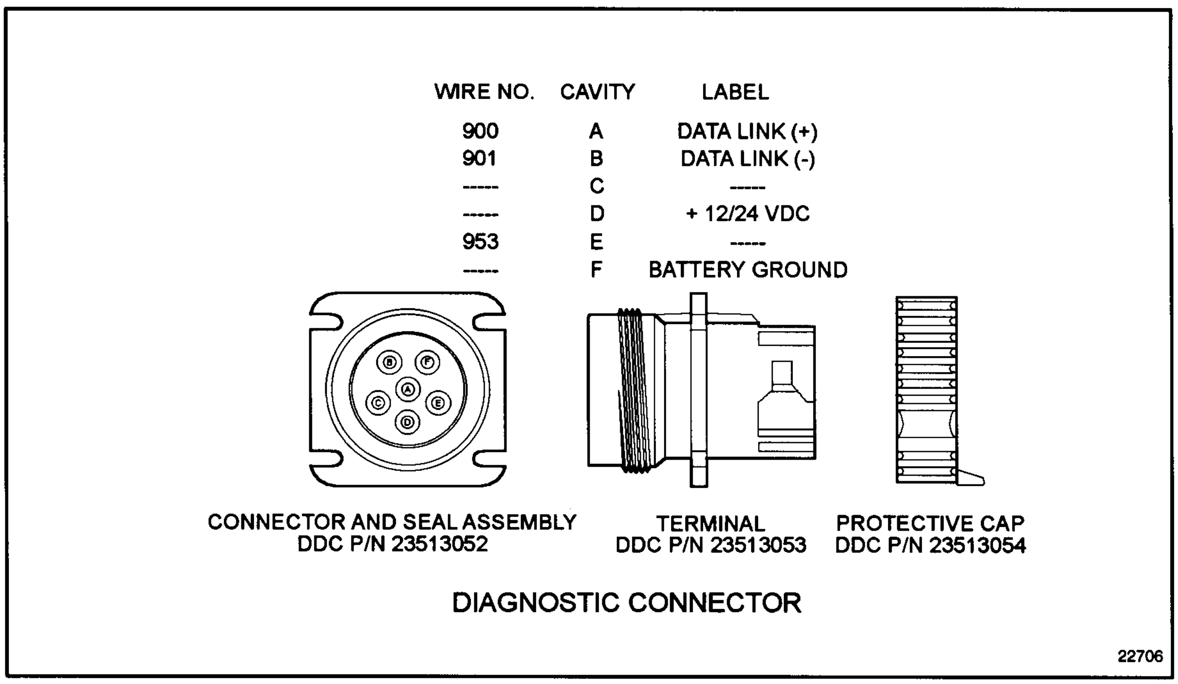


Figure 9-1 Diagnostic Connector

2. Read active codes by selecting the DIAGNOSTIC CODE MENU (ACTIVE CODES) on the DDR.
   - [a] If active codes are displayed on the DDR, follow the appropriate diagnostic procedures for the codes received. Refer to the section number that is the same as the Flash Code number.
   - [b] If the DDR display is blank or random, refer to section 10.5.
   - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 10.8.
   - [d] If the DDR display reads "No Active Codes", refer to section 10.8.

9.1.3 Read Inactive Codes

Perform the following steps to read inactive codes.

1. Plug DDR into the DDL connector.
2. Read inactive codes. (Select inactive codes on the DDR.)
   - [a] If DDR displays no inactive codes, the problem may be intermittent. Refer to section 10.1.
   - [b] If DDR display is blank or random, refer to section 10.5.
   - [c] If DDR displays NO DATA or DDEC Info not available, refer to section 10.5.
   - [d] If the DDR displays any inactive codes, clear the codes and refer to section 9.1.4.

9.1.4 Attempt to Make Codes Active

Perform the following steps to make codes active.

1. Start and run the engine for eight minutes. Warm the engine. Coolant/oil temperature must be greater than 140 ° F (60 ° C).
2. If required, perform road test with an assistant.
   - [a] If CEL or SEL illuminate, read codes and refer to the section number that matches the flash code number logged.
   - [b] If CEL or SEL do not illuminate and no codes log, return to service.
   - [c] If CEL or SEL do not illuminate but symptom occurs, refer to section 10.1, and Diagnosis by Symptom.

10 (CHG) INTERMITTENT FAULT

10.1 INTERMITTENT CODE OR A SYMPTOM AND NO CODES

The following procedure will diagnose an intermittent code or symptom.

10.1.1 Diagnosis by Symptom

Perform the following steps to diagnose an intermittent code or symptom.

NOTE:
Do not use any other procedures (except for the suggestions listed in this manual) when trying to solve an intermittent problem. Use of any other procedures for this type of problem can result in the replacement of non-defective parts.

Many intermittent problems are caused by faulty electrical connectors or wiring. Diagnosis must include a careful inspection of the indicated circuit wiring and connectors. For example, an intermittent code 35 (Oil Pressure Sensor High Voltage) would indicate a problem in the following areas associated with the Oil Pressure Sensor.

- ☐ Wires #530 (signal line), #416 (+5 volt line), or #452 (ground line)
- ☐ The Oil Pressure Sensor connector or ECM connector
- ☐ An intermittent problem in the Oil Pressure Sensor (least likely)

Use the following checklist:

1. Check for poor mating of the connector halves or terminals not fully seated in the connector body (backed out terminals).
2. Look for improperly formed or damaged terminals. All connector terminals in the problem circuit should be carefully inspected to determine proper contact tension. Use a mating terminal to test the contact tension.
3. Electrical system interference caused by a defective relay, ECM driven solenoid, or a switch causing an electrical surge. Look for problems with the charging system (alternator, etc.). In certain cases, the problem can be made to occur when the faulty component is operated as in the case of a relay.
4. Verify alternator grounds are clean and making good contact. Disconnect the alternator belt to test.
5. Wiggle wires and harnesses to try to make the problem active, or re-occur.

10.1.2 Verify Repairs

Perform the following steps to verify repairs.

1. Clear codes.
2. Confirm the CEL does not come on (except for the five second ignition ON bulb check).
3. Run the engine for one minute.
4. If the CEL stays ON, refer to section 9.1.2.

10.2 ENGINE CRANKS BUT WILL NOT START

The following procedures will diagnose engine cranks but will not start.

10.2.1 Check Engine Light

Perform the following steps to check the CEL:

1. Turn ignition on while observing the Check/Stop Engine Light.
   - [a] If the light comes on and stays on, refer to section 9.1.
   - [b] If the light comes on for up to five seconds, and then goes off, refer to section 10.2.2.
   - [c] If the lights are off, refer to section 10.2.14.

10.2.2 Fuel Check

Perform the following steps to check the fuel supply:

1. Disconnect the fuel return line.
2. Check for fuel flow while cranking the engine.
   - [a] If fuel flow is okay, refer to section 10.2.3.
   - [b] If fuel supply is not okay, refuel the vehicle. The system may need to be re-primed. Refer to the appropriate engine service manual.

10.2.3 White Smoke Check

Perform the following steps to check for white smoke:

1. Reconnect fuel return line.
2. Look for white smoke coming out of the exhaust stack while cranking the engine.
   - [a] If white smoke is present, refer to section 10.2.4.
   - [b] If white smoke is not present, refer to section 10.2.28.

10.2.4 Check Timing Reference Sensor Status

Perform the following steps to check the TRS status via a r/min readout:

1. Select engine speed and active codes on the DDR.
2. Crank the engine for ten seconds while observing DDR display. A battery voltage surge while cranking with electric starters may blank or reset the DDR.
   - [a] If the display reads greater than or equal to 60 r/min, refer to section 10.2.9.
   - [b] If the display reads less than 60 r/min or constantly reads 60 r/min, refer to section 10.2.5.

[c] If code 41 is displayed, refer to section 41.3.1.

[d] If code 42 is displayed, refer to section 42.3.1.

10.2.5 Check Timing Reference Sensor

Perform the following steps to check the TRS:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Measure resistance between sockets T1 and T2 at the engine harness connector.

   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.3.

   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.2.

   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 10.2.6.

10.2.6 Check Synchronous Reference Sensor / Timing Reference Sensor Mounting

Perform the following steps to check the SRS/TRS mounting and the bracket:

1. Inspect SRS/TRS mounting.

   [a] If the sensor and mount are secure, refer to section 10.2.7.

   [b] If the sensor and mount are not secure, tighten the bolt or replace if necessary. Refer to section 10.2.27.

10.2.7 Check Pulse Wheel

Perform the following steps to check the pulse wheel:

1. Inspect DDEC ® pulse wheel for loose wheel or chipped or missing teeth.

   [a] If the pulse wheel is damaged, repair or replace as necessary. Refer to section 10.2.27.

   [b] If the pulse wheel is not damaged, refer to section 10.2.8.

10.2.8 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Turn vehicle ignition OFF.
2. Disconnect all connectors at the ECM.
3. Check terminals at all ECM connectors (both the ECM and harness side) for damaged, bent, corroded or unseated pins or sockets.

   [a] If the terminals and connectors are damaged, repair them. Refer to section 10.2.27.

[b] If the terminals and connectors are not damaged, replace the ECM. Refer to section 10.2.27. (Try a test ECM first.)

10.2.9 Check for Good Synchronous Reference Sensor Signal

Perform the following steps to check for a good SRS signal:

1. Select engine data list on DDR.
2. Crank engine while observing DDR display of SRS received. Battery voltage surges while cranking with electric starters may blank or reset the DDR.
   [a] If the SRS RECEIVED signal is YES, refer to section 10.2.11.
   [b] If the SRS RECEIVED signal is NO, refer to section 10.2.10.

10.2.10 Check Synchronous Reference Sensor

Perform the following steps to check the SRS:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Measure resistance between sockets S1 and S2 at the engine harness connector.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.3.
   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.2.
   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 10.2.6.

10.2.11 Check for Open

Perform the following steps to check if the injector return wires are open:

1. Turn ignition OFF.
2. Disconnect the 5-way injector harness connector at the ECM.
3. Measure resistance between the injector return pin and all the power driver pins on both harness connectors.
   [a] If the resistance measurement is greater than 5 Ω on any reading, an open exists in one of the injector power driver or return wires. Repair the open. Refer to section 10.2.27.
   [b] If the resistance measurement is less than or equal to 5 Ω on any reading, refer to section 10.2.12.

10.2.12 Short to Ground

Perform the following steps to check if the injector lines are shorted to the ground:

1. Disconnect the 5-way injector harness connector at the ECM.

2. Measure resistance between socket D of the 5-way power harness connector to the following sockets on the injector harness connector: A, B, C, D, E, G, H, J, K and L.
   - [a] If the resistance measurement is greater than or equal to 10,000 Ω or open on all readings, refer to section 10.2.13.
   - [b] If the resistance measurement is less than 10,000 Ω on any reading, there is a short to ground on the wire where resistance was less than 10,000 Ω. Repair the short and refer to section 10.2.27.

10.2.13 Injector Drive Pulses

Perform the following steps to check the injector drive pulses:

1. Turn ignition OFF.
2. Reconnect all ECM connectors. See Figure 10-1.
3. Remove rocker covers.
4. Disconnect return wire #619 or #620 from one injector.
5. Place a 6-volt test light across the previously disconnected injector return side and a good ground.
6. Crank engine and note the test light to see if it lights (flashes).
7. Reconnect the return wire.
8. Repeat the above procedure with all other injectors until all have been tested or until one test fails.
   - [a] If all tests pass, the problem does not appear to be in the DDEC system.
   - [b] If all tests do not pass and the test light is flashing for one or more tests, check for proper parts (e.g. bull gear) then try a test ECM. Refer to section 10.2.27.

[c] If all tests do not pass and the test light is not flashing for one or more tests, refer to section 10.2.8.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N	
CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816

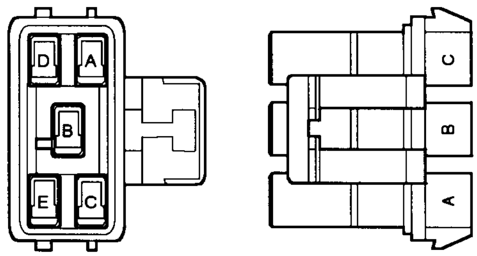


Figure 10-1 5-Way ECM Power Harness Connector

10.2.14 Check DDEC Fuses

Perform the following steps to check the DDEC fuses:

1. Check both ECM power fuses or circuit breakers.
   [a] If both fuses are okay, refer to section 10.2.15.
   [b] If either fuse is not okay, refer to section 10.2.25.

10.2.15 Battery Volts Check

Perform the following steps to check for battery volts at the 5-way connector:

NOTE:
A high resistance in these wires may prevent engine starting but measure correct voltage. Proper resistance based on wire length and size is listed in Table 46-2.

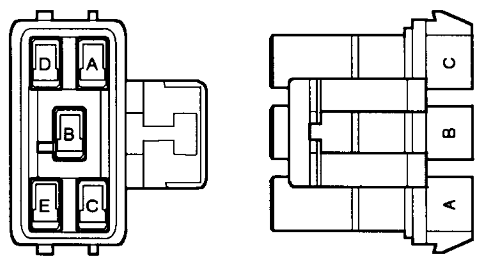
1. Turn ignition OFF.
2. Disconnect the 5-way power harness connector at the ECM. See Figure 10-2.
3. Measure voltage from socket A (red lead) of 5-way power harness connector to a good ground.

4. Measure voltage from socket C (red lead) of 5-way power harness connector to a good ground.
   - [a] If the voltage measurement is greater than 11.5 volts on all readings, refer to section 10.2.18.
   - [b] If the voltage measurement is less than 11.5 volts on any readings, refer to section 10.2.16.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

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Figure 10-2 5-Way ECM Power Harness Connector

10.2.16 ECM Power Line Check

Perform the following steps to check if the ECM power lines are open:

1. Measure voltage between battery side of one ECM fuse or circuit breaker (red lead) and a good ground (black lead).
2. Measure voltage at other ECM fuse or circuit breaker. Note that battery side does not contain #240 or #241 wires. See Figure 10-3.
   - [a] If the voltage measurement is less than 11.5 volts on any reading, refer to section 10.2.17.

[b] If the voltage measurement is greater than 11.5 volts on all readings, an open exists in either power wire (#240 or #241). Repair the open; refer to section 10.2.27.

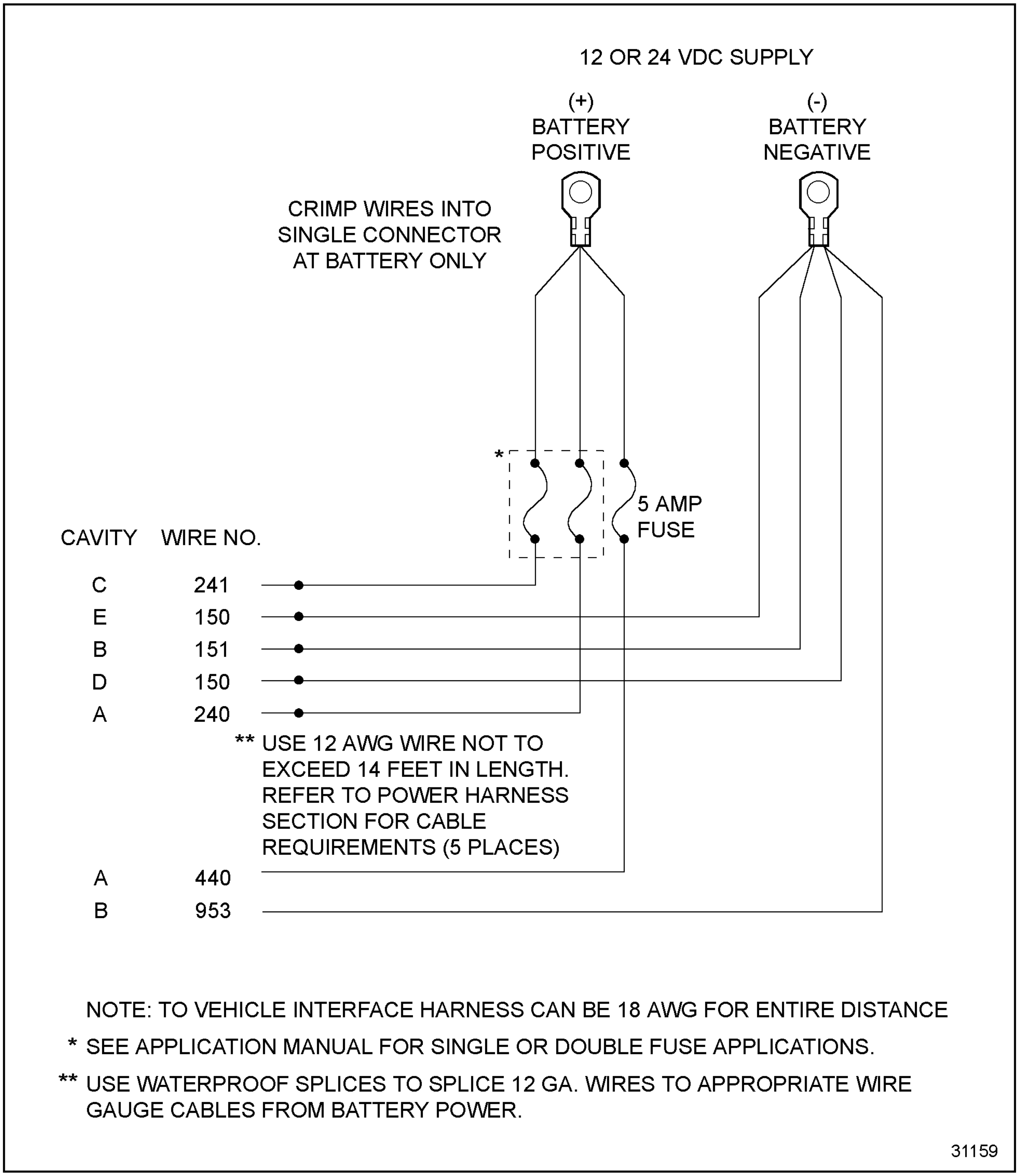


Figure 10-3 Power Harness Diagram

10.2.17 Check Battery

Perform the following steps to check the battery:

1. Connect all connectors.
2. Turn ignition ON.
3. Measure voltage at battery (+) terminal (red lead) to the battery (-) terminal (black lead).
   [a] If the voltage reading is less than 11.5 volts, service the discharged battery. Refer to section 10.2.27.
   [b] If the voltage reading is greater than or equal to 11.5 volts, an open or short to ground exists in the battery (+) line. Repair the open. Refer to section 10.2.27.

10.2.18 Check Volts at Ignition Wire

Perform the following steps to check for +12 or +24 volts at the ignition wire:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. For vehicle harness schematic, see Figure 10-4.
3. Turn ignition ON.
4. Measure voltage between socket B3 on the vehicle harness connector (red lead) and a good ground (black lead).
   [a] If the voltage measurement is greater than or equal to 11.5 volts, refer to section 10.2.19.

[b] If the voltage measurement is less than 11.5 volts, refer to section 10.2.20.

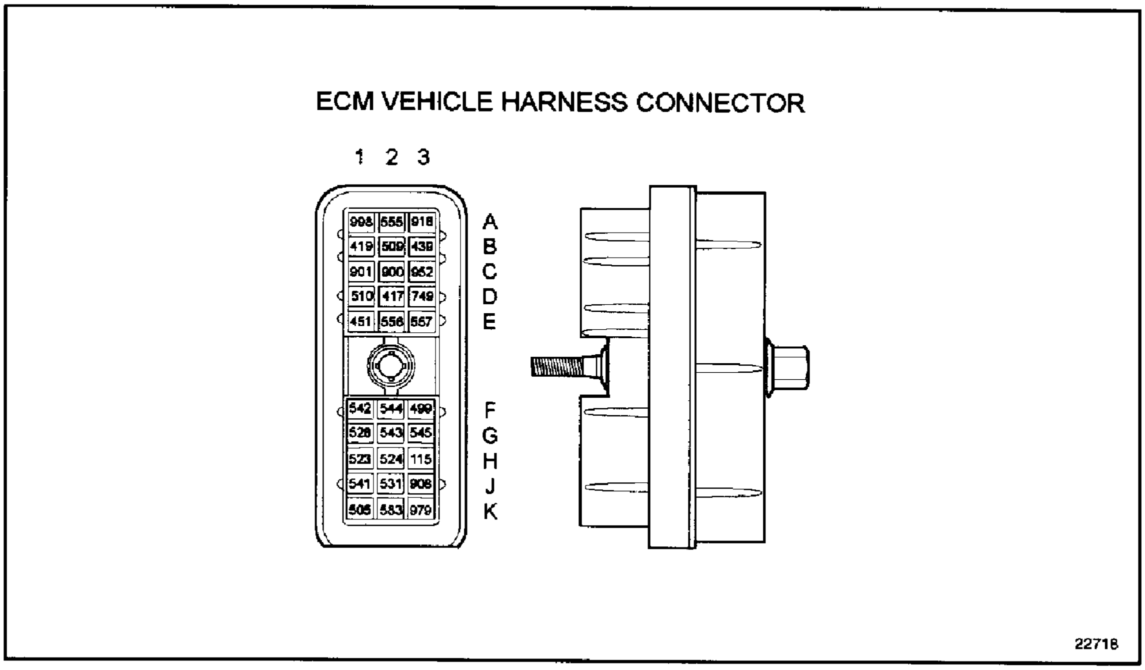


Figure 10-4 ECM Vehicle Harness Connector

10.2.19 Ground Wire Check

Perform the following steps to check for a good ground wire:

1. Measure voltage between socket B3 on the vehicle harness connector (red lead) and sockets D and E of the 5-way power harness connector. For 5-way ECM power harness schematic, see Figure 10-5.

   [a] If the voltage measurement is greater than or equal to 11.5 volts, refer to section 10.2.8.

[b] If the voltage measurement is less than 11.5 volts, the ECM ground wire (ck#150) is open or has a poor connection. Repair open; refer to section 10.2.27.

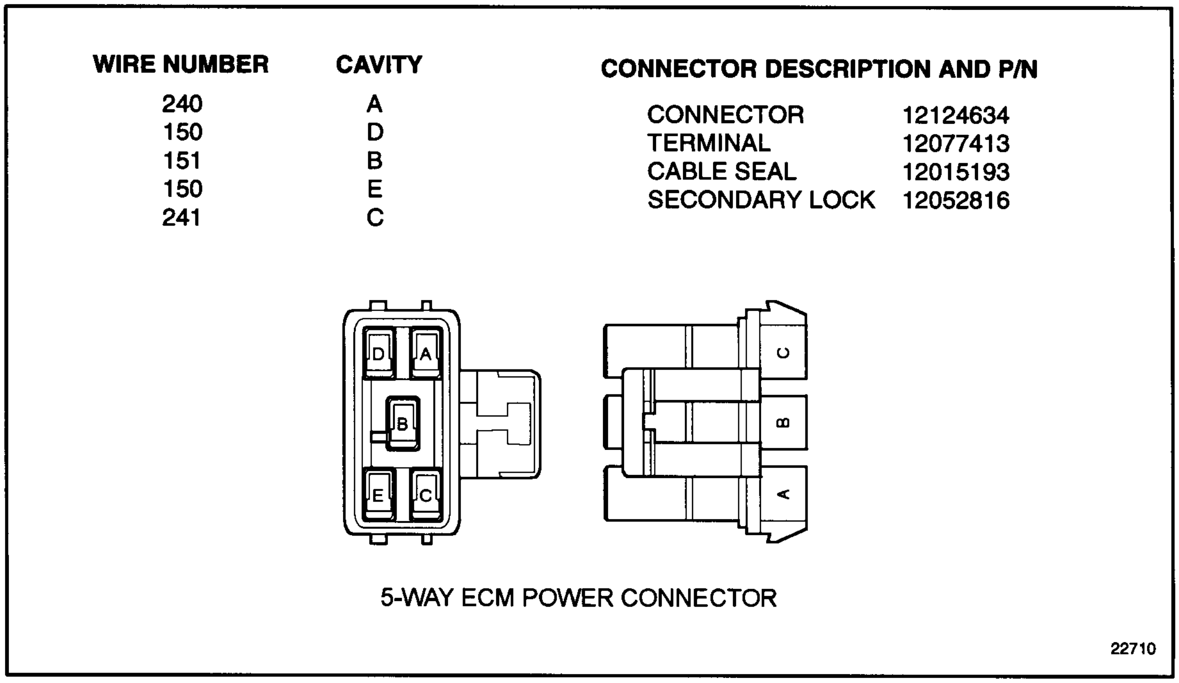


Figure 10-5 5-Way ECM Power Harness Connector

10.2.20 Check Ignition Fuse

Perform the following steps to check the ignition fuse:

1. Turn ignition OFF.
2. Check 5-amp ignition fuse or circuit breaker.
   [a] If both the fuse and circuit breaker are okay, refer to section 10.2.21.
   [b] If the fuse or circuit breaker are not okay, refer to section 10.2.22.

10.2.21 Check for Open

Perform the following steps to check if the ignition wire is open:

1. Measure voltage between battery side (hot side) of the 5-amp ignition fuse (red lead) and a good ground (black lead).
   [a] If the voltage measurement is less than 11.5 volts, refer to section 10.2.24.
   [b] If the voltage measurement is greater than or equal to 11.5 volts, the ignition line (circuit #439) is open. Repair the open; refer to section 10.2.27.

10.2.22 Check for Ground

Perform the following steps to check if the ignition wire is shorted to ground:

1. Replace blown fuse or reset open circuit breaker.
2. Turn ignition ON for ten seconds.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check 5-amp ignition fuse or circuit breaker again.
   [a] If both the fuse and circuit breaker are okay, refer to section 10.2.23.
   [b] If the fuse and circuit breaker are not okay, the ignition line (circuit #439) is shorted to ground. Repair the short; refer to section 10.2.27.

10.2.23 Check Fuse or Circuit Breaker

Perform the following steps to check if the ignition fuse or breaker is okay:

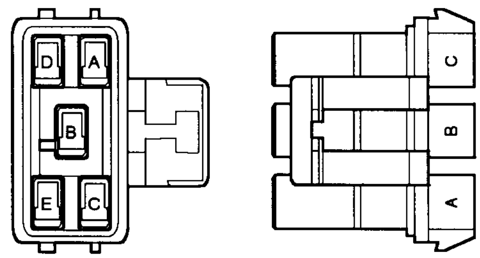
1. Reconnect all harness connectors at the ECM.
2. Start the engine.
3. Run engine for one minute.
4. Turn ignition OFF.
5. Check 5-amp ignition fuse or circuit breaker again. For 5-way ECM power harness schematic, see Figure 10-6.
   [a] If both the fuse and circuit breaker are okay, no short is currently present. Be warned of an intermittent short that could shut down the engine or blow a fuse due to reverse voltage at the battery. Refer to section 10.2.27.

[b] If the fuse or circuit breaker are not okay, refer to section 10.2.8.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

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Figure 10-6 5-Way ECM Power Harness Connector

10.2.24 Check Battery

Perform the following steps to check the battery:

1. Disconnect the battery cables at the battery.
2. Measure voltage at the battery (+) terminal (red lead) to the battery (-) terminal (black lead).

   [a] If the voltage measurement is less than 11.5 volts, service the discharged battery. Refer to section 10.2.27.

   [b] If the voltage measurement is greater than or equal to 11.5 volts, an open or short to ground exists in unfused ignition line. Repair the open. Refer to section 10.2.27.

10.2.25 Check for Blown Fuses

Perform the following steps to check for blown fuses:

1. Turn ignition OFF.
2. Disconnect the 5-way power harness connector at the ECM.
3. Replace blown fuse(s) or reset the circuit breaker(s).
4. Wait ten seconds.
5. Check whether fuse(s) or circuit breaker(s) have blown or opened up again.

[a] If the fuse and circuit breaker are okay, refer to section 10.2.23.

[b] If the fuse or circuit breaker are not okay, refer to section 10.2.26.

10.2.26 Check for Short to Ground

Perform the following steps to check for a short to ground:

1. Disconnect the batteries.
2. Measure resistance between #240 and a good ground (black lead).
3. Measure resistance between #241 and a good ground (black lead).

   [a] If the resistance measurement is greater than or equal to 10,000 Ω on all readings, refer to section 10.2.8.

   [b] If the resistance measurement is less than 10,000 Ω on any readings, a short to ground exists. Repair the short. Refer to section 10.2.27.

10.2.27 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop the engine.
7. Read inactive codes.

   [a] If the engine starts and no codes are displayed, troubleshooting is complete.

   [b] If the engine does not start, refer to section 10.2.1.

   [c] If the engine starts and codes display, refer to section 9.1.

10.2.28 Check Fuel Filters

Perform the following steps to check fuel filters:

1. Turn ignition OFF.
2. Check primary and secondary fuel filters to be sure they are not clogged and they are filled with clean fuel.

   [a] If the fuel filters are clean, refer to section 10.2.4.

   [b] If the fuel filters are not clean, replace the filters. Prime the system if required. Refer to section 10.2.27.

NOTE:
For information concerning Fuel Filters, refer to section 29.4.11 in the appropriate service manual. For information concerning Fuel Filter Replacement, refer to section 18 in the appropriate service manual.

10.3 ERRATIC PERFORMANCE AND NO CODES

The following troubleshooting chart resolves erratic performance and no codes displayed. For troubleshooting procedures, refer to the appropriate engine service manual.

10.3.1 Erratic Performance and No Codes

Check the following symptoms to determine possible fault, listed in Table 10-1.

Symptom	Possible Fault
Cannot get full power.	Plugged fuel filters. Hose not connected to Turbo Boost Sensor. Verify injector calibration(s) are correct.
Cannot get full throttle.	Mis-calibrated Throttle Position Sensor.
Runs rough; misses and occasionally stalls.	Improper gapping of Timing Reference and Synchronous Reference Sensor. Fuel leaks. Loose battery power, ignition or ground wires Injector failure. Vehicle speed sensor failure. Injector harness failure.
Engine idles high after warm-up or hangs.	Incorrect calibration of Throttle Position Sensor. TPS linkage or pedal problem. VSG signal wire shorted to voltage source.
Low road speed.	Determine road speed specifications for vehicle manufacturer data. If road speed is less than specified and all mechanical checks are correct, then cruise control calibration is suspected.
Vehicle surges or bucks.	VSS may be supplying incorrect data to the ECM.

Table 10-1 Troubleshooting Erratic Performance and No Code

10.4 CHECK ENGINE LIGHT AND STOP ENGINE LIGHT FAULT

The following steps will troubleshoot a fault with the check engine or stop engine lights. These lights are used to alert the operator of engine faults; flash any trouble codes stored in the ECM; and illuminate for five seconds and then go out during a start sequence, as a bulb check.

10.4.1 Determine Fault

Perform the following to determine fault:

1. If the CEL or SEL is always on, refer to section 10.4.2.
2. If the CEL or SEL never lights, refer to section 10.4.5.

10.4.2 Display ECM Light Status

Perform the following steps to display light status:

1. While the light is lit, plug in the DDR (ignition ON).
2. Select switch light status.
3. View the displayed status for the problem light.
   [a] If status reads OFF, refer to section 10.4.4.
   [b] If status reads ON, refer to section 10.4.3.

10.4.3 Determine Reason for ECM Request

Perform the following steps to determine the reason the ECM is requesting the light to be ON:

1. Verify the diagnostic request is not ON.
   [a] If the diagnostic request is ON, refer to section 10.10.
   [b] If the diagnostic request is not ON, refer to section 9.1, (troubleshoot code).

10.4.4 Check for Grounded Wire

Perform the following steps to check for a grounded wire:

1. Turn ignition OFF.
2. Unplug VIH 30-pin connector.
3. Turn ignition ON.
   [a] If the light stays on, drive (#509 or #419) wire is shorted to the ground. Repair or replace the wire. Refer to section 10.4.9.
   [b] If the light goes off, clean the connectors of the VIH 30-pin and assemble again. Then, refer to section 10.4.9.

10.4.5 Activate Light With Diagnostic Data Reader

Perform the following steps to activate the light with the DDR:

1. Turn ignition ON.
2. Plug in DDR.
3. Select Activate Outputs.
4. Activate affected light; watch status.
   [a] If the light stays off. Refer to section 10.4.6.
   [b] If the light illuminates, the problem no longer exists. Refer to *DDEC III Application and Installation* manual, 7SA800, to review the light operation.

10.4.6 Check Bulb

Perform the following steps to check the bulb:

1. Turn ignition OFF.
2. Refer to OEM recommendations for checking bulb.
   [a] If the bulb is bad, replace the bulb and refer to section 10.4.9.
   [b] If the bulb is okay, refer to section 10.4.7.

10.4.7 Check for Voltage Supply

Perform the following steps to check the voltage supply:

1. Disconnect the power supply to the light.
2. Turn ignition ON.
3. Measure voltage between the removed connection and battery ground.
   [a] If the voltage is correct based on the system of the vehicle (12/24V), refer to section 10.4.8.
   [b] If the voltage is too low to expect the bulb to light, refer to the OEM recommendations to resolve the problem. Refer to section 10.4.9.

10.4.8 Check for Open Output Wire

Perform the following steps to check for an open output wire:

1. Measure the resistance between the ground side of the connector of the light and the battery ground.
   [a] If the measured resistance is 45,000 to 48,000 Ω, clean the connections. Refer to section 10.4.9.

[b] If the measured resistance is less than 45,000 Ω or greater than 48,000 Ω, the wire is shorted to voltage, or is opened. Repair wire. Refer to section 10.4.9.

10.4.9 Verify Repairs

Perform the following steps to verify repairs.

1. Ensure all removed connections are installed.
2. Turn ignition ON.

[a] If the light comes on for five seconds, then goes out, troubleshooting is complete.

[b] If the light comes on and stays on, refer to section 10.4.1.

[c] If the light does not turn on, all troubleshooting is complete. Review this section and contact Detroit Diesel Technical Service.

10.5 NO DATA TO DIAGNOSTIC DATA READER

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.5.1 Read Codes on the Check Engine Light

Perform the following steps to read the codes on the CEL or SEL:

1. Unplug the DDR.
2. Ignition should be ON; engine not running.
3. Enable diagnostic request switch.
4. Read codes flashing on the CEL and SEL.
   [a] If codes are flashing out, refer to section 10.5.4.

NOTE:
If you wish to bypass diagnosis of a potential data line of the DDR problem for now, diagnose the active code by referring to the section that matches the code number.

   [b] If CEL and SEL are not flashing out codes, refer to section 10.5.2.

10.5.2 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Ensure ignition is ON.
2. Plug in DDR.
3. Select Calibration Configuration.
4. Determine port assigned to Diagnostic Request on the ECM input switches.
5. Go to switch light status.
6. Depress and hold the diagnostic request switch.
7. Read status of diagnostic request.
   [a] If the switch reads OFF, the diagnostic request circuit (#528) is open or the ground is poor or open. Repair the open wire or the bad ground. Refer to section 10.5.8.
   [b] If the switch reads ON, refer to section 10.5.3.

10.5.3 Check ECM Connectors

Follow this procedure to check the ECM connectors:

1. Check the terminals at the vehicle harness and 5-way power harness connectors (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 10-7.
   [a] If terminals and connectors are okay, replace the ECM. Refer to section 10.5.8.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 10.5.8.

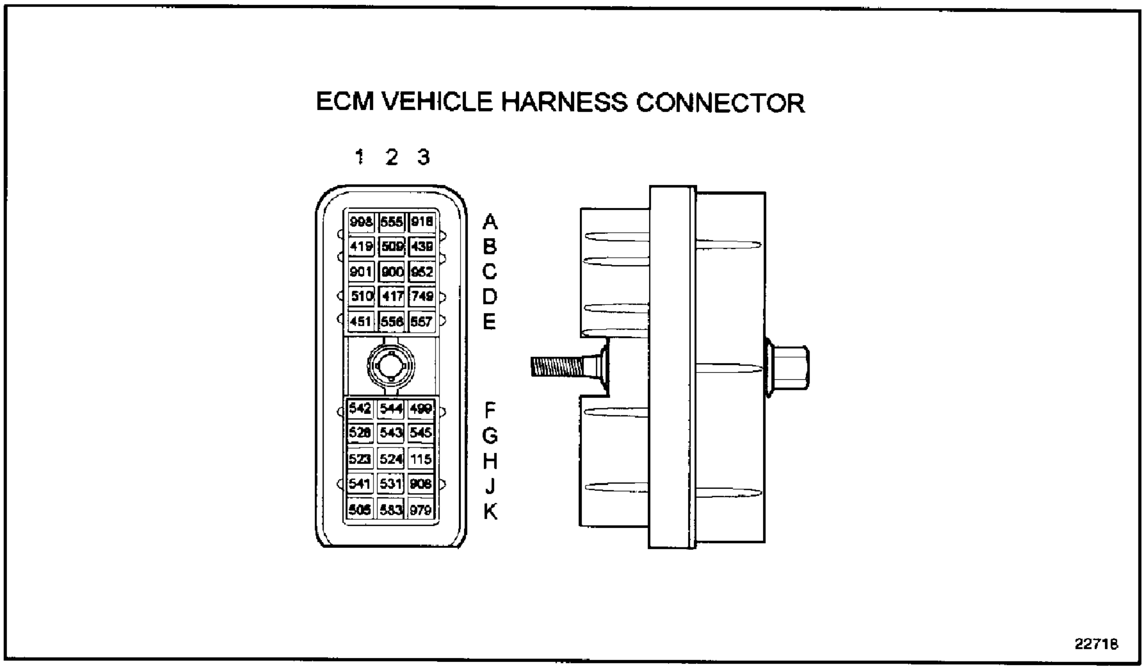


Figure 10-7 ECM Vehicle Harness Connector

10.5.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Place a jumper wire across pins A (#900) and B (#901) of the DDL connector. Unplug the vehicle harness connector and measure resistance between sockets C1 and C2.
3. Turn ignition ON, and again measure resistance between sockets C1 and C2. See Figure 10-8.
   [a] If both readings are greater than 5 Ω , one or both data wires (circuit #900 or #901) are open. Repair the open and refer to section 10.5.8.

[b] If either reading is less than 5 Ω, refer to section 10.5.5.

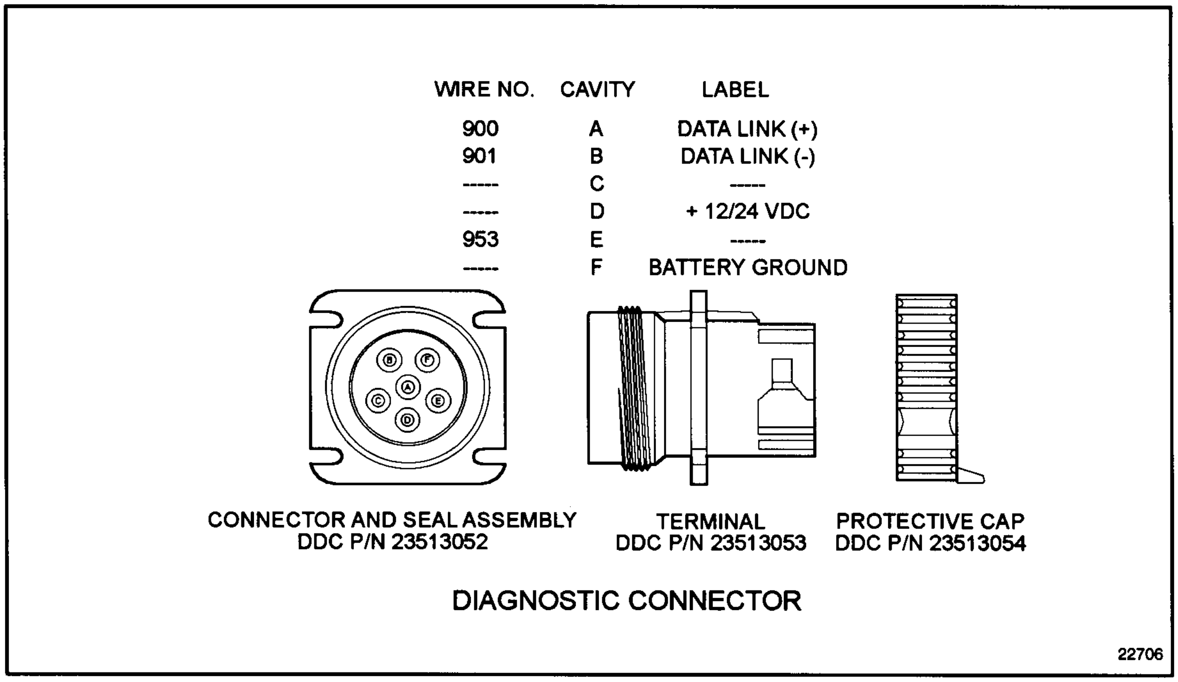


Figure 10-8 Diagnostic Connector

10.5.5 Check for Short

Perform the following steps to check for a short:

1. Remove the jumper wire from the DDL connector.
2. Measure resistance between sockets C1 (#901) and C2 (#900) of the vehicle harness connector.
   [a] If the resistance measurement is less than 5 Ω, two data wires (circuit #900 or #901) are shorted together. Repair the short and refer to section 10.5.8.
   [b] If the measured resistance is greater than 5 Ω, refer to section 10.5.6.

10.5.6 Check for Short to Ignition and Ground

Perform the following steps to check for a short to ignition and ground:

1. Remove all jumpers for the DDL connector.
2. Measure resistance between sockets A (#900) and C (ignition switch), A (#900) and E (ground), B (#901) and E (ground), and B (#901) and C (ignition switch) of the DDL connector.
   [a] If the measured resistance is less than 5 Ω on any reading, a short exists between the data wires and ignition or ground. Repair the short and refer to section 10.5.8.
   [b] If the measured resistance is greater than 5 Ω, refer to section 10.5.7.

10.5.7 Check Diagnostic Data Reader on Another Engine

Follow this procedure to check the DDR on another engine:

1. Connect the DDR to another engine and read any parameter in the menu.
   [a] If the procedure worked okay, refer to section 10.5.8.
   [b] If the procedure did not work, the DDR is probably defective. Refer to the DDR instruction manual for repair.

10.5.8 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Turn ignition OFF.
6. Turn ignition ON.
7. Note status of CEL.
8. Start and run the engine for one minute.
9. Read inactive codes.
   [a] If the DDR display reads NO DATA BEING RECEIVED FROM DATA LINK or DDEC SYSTEM NOT RESPONDING, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 10.5.1.
   [b] If the engine starts and no codes are read on the DDR, repairs are complete.
   [c] If the engine starts and code displays, refer to section 9.1.

10.6 DIAGNOSTIC REQUEST SWITCH INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.6.1 Check Diagnostic Request Circuit

Perform the following steps to check the diagnostic request circuit:

1. Turn ignition ON; engine not running.
2. Plug in DDR.
3. Select Switch/Light Status.
4. Depress and hold diagnostic request switch.
5. Observe the Diagnostic Request Status on the DDR.
   - [a] If the display reads ON, refer to section 10.6.2.
   - [b] If the display reads OFF, the diagnostic request line (#528) is open, or is not being grounded when the switch is depressed. Check the #528 wire and ground for diagnostic request switch. Repair the problem; refer to section 10.6.4.
   - [c] If no diagnostic request on the DDR input list, the ECM is not configured for diagnostic request operation. Refer to the *DDEC Application and Installation* manual, 7SA800.

10.6.2 Check Stop Engine Light and Check Engine Light Bulbs

Perform the following steps to check the SEL and CEL bulbs:

1. Turn ignition OFF.
2. Remove CEL and SEL bulbs. Check to see if either is burned out or damaged.
   - [a] If the bulbs are okay, refer to section 10.6.3.
   - [b] If the bulbs are defective, replace the bulbs. Refer to section 10.6.4.

10.6.3 Check 12 / 24V Ignition Line

Perform the following steps to check the 12/24V ignition line:

1. Turn ignition ON.
2. Disconnect vehicle harness connector at ECM.
3. Measure voltage at cavity B3 (#439).
   - [a] If voltage measurement is less than 11.5V, the 5 amp fuse or circuit breaker is blown, and the ignition line could be open or shorted to ground.

[b] If the voltage measurement is greater than 11.5V, the circuit #419 or #509 is open. Repair the open. Refer to section 10.6.4.

10.6.4 Verify Repairs

Perform the following steps to verify repairs:

1. Reconnect all connectors.
2. Turn ignition ON.
3. Press diagnostic request switch.
   [a] If codes flash, the system is working. Repairs are complete. If any other problems exist, refer to section 9.1.
   [b] If the system does not function, all system diagnostics are complete. Review this section to find the error. Refer to section 10.6.1.

10.7 CRUISE CONTROL INOPERATIVE

Before using this procedure, all basic mechanical checks and physical inspections should have been performed with no problem found. Also the diagnosis of the DDEC system in Section 9 referred you to this section.

10.7.1 Determine Type of Cruise Control System

Perform the following to determine the type of cruise control system:

1. Check that this is a DDEC cruise control system.
2. Turn ignition ON.
3. Plug DDR into DDL connector.
4. Select calibration configuration (cruise control).
5. Is cruise control enabled?
   - [a] If cruise control is enabled, refer to section 10.7.3.
   - [b] If cruise is not enabled, refer to *DDEC III Installation and Application* manual, 7SA800, for requirements of installing cruise control.

10.7.2 Check ECM Connectors

Perform the following to check the ECM connectors:

1. Disconnect the vehicle harness connector at the ECM.
2. Check the terminals at the ECM vehicle harness connector (both ECM and harness side) for damaged, corroded, or unseated pin or sockets.
   - [a] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 10.7.16.
   - [b] If the terminals or connectors are damaged, repair them. Refer to section 10.7.16.

10.7.3 Check Pin Assignments

Perform the following to check pin assignments:

1. Turn ignition ON.
2. Plug in the DDR.
3. Select calibration configuration (ECM Ins/Outs).
4. Write/print pin assignments.

[a] An example listed in Table 10-2 shows pins, wires and functions. Refer to section 10.7.4.

Pin	Wire	Function
J1	#541	set/coast on
F2	#544	cruise enable
G2	#543	svc brk rel
J2	#531	clutch rel
G3	#545	res/accel on

Table 10-2 Pin Assignments

[b] If the functions are not assigned, reprogram the ECM. Refer to section 10.7.16.

10.7.4 Checking Out of Cruise Control Switch and Wiring

To speed up the checking out of cruise control switches, quick check tables have been developed. These tests are to be run with the ignition ON, and the engine not running. A DDR must be plugged into the connector. All three quick check tables must be gone through to completely check out the cruise control wiring and switches.

For Example: Listed in Table 10-3, step 2, you would do the following:

1. Ignition ON; engine not running; DDR plugged in.
2. Turn the cruise enable switch to ON.
3. Select switch/light status on the DDR.
4. Note the DDR display; if ON, check out brake and clutch switch as listed in Table 10-4.

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	Off	Off	Off	Cruise Enable	OffOn	YesNo	Refer to step 2 Refer to section 10.7.5
2.	On	Off	Off	Cruise Enable	OffOn	NoYes	Refer to section 10.7.6Listed in Table 10-4, step 1

Table 10-3 Cruise Control Quick Check Table I, Check Out Cruise Enable Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Brake Pedal	Clutch Pedal	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	On	Released	Released	Service Brake Release	On Off	Yes No	Refer to step 2 Refer to section 10.7.7
2.	On	Depressed	Released	Service Brake Release	On Off	No Yes	Refer to section 10.7.8 Refer to step 3
3.	On	Released	Released	Clutch Release	On Off	Yes No	Refer to step 4 Refer to section 10.7.9
4.	On	Released	Depressed	Clutch Release	On Off	No Yes	Refer to section 10.7.10Listed in Table 10-5, step 1

Table 10-4 Cruise Control Quick Check Table II, Check Out Brake and Clutch Switch and Wiring (Ignition ON Not Running)

Step	Cruise Enable Switch	Set / Coast Switch	Res / Accel Switch	DDR Readout Being Looked At	DDR Display	Okay	Go To
1.	On	Off	Off	Set/Coast On	Off On	Yes No	Refer to step 2 Refer to section 10.7.11
2.	On	On	Off	Set/Coast On	Off On	No Yes	Refer to section 10.7.12 Refer to step 3
3.	On	Off	Off	Res/Ac-celOn	Off On	Yes No	Refer to step 4 Refer to section 10.7.13
4.	On	Off	On	Res/Accel On	Off On	No Yes	Refer to section 10.7.14Refer to section 10.7.15

Table 10-5 Cruise Control Quick Check Table III, Check Out Set/Coast and Resume/Accel Switches and Wiring (Ignition ON Not Running)

10.7.5 Check for Short at the Cruise Enable Circuit

Perform the following steps to check for a short at the cruise enable circuit:

1. Turn ignition ON.
2. Turn cruise engage switch to off.
3. Disconnect the vehicle harness connector at the ECM.
4. Measure resistance between the cruise enable cavity (i.e. F2) on the vehicle harness connector and a good ground.

   [a] If the resistance measurement is less than or equal to 10,000 Ω, reconnect the vehicle harness. Turn the ignition on. Then run steps listed in Table 10-4; and listed in Table 10-5. If any DDR display received is not okay, refer to the indicated step. If all steps listed in Table 10-4 and listed in Table 10-5, pass, then the cruise engage wire is shorted to the ground. Repair the short, or replace the switch. Refer to section 10.7.16.

   [b] If the resistance measurement is greater than 10,000 Ω, refer to section 10.7.2.

10.7.6 Check for Open at the Cruise Enable Circuit

Perform the following steps to check for an open at the cruise enable circuit:

1. Turn ignition ON.
2. Disconnect the vehicle harness connector at the ECM.
3. Turn cruise enable switch to ON.
4. Measure resistance between the cruise enable cavity (i.e. F2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the cruise engage switch is bad, circuit #953 is open or the cruise enable wire is open. Repair the open or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.7 Check for Open or Miswired Brake Switch

Perform the following steps to check for an open or miswired brake switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Ensure the service brake is not engaged.
4. Measure resistance between the service brake cavity (i.e. G2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the brake switch is miswired or faulty, circuit #953 is open or the ground is bad. Repair the open, rewire or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.8 Check for Short at the Brake Switch or Circuit

Perform the following steps to check for a short at the brake switch or circuit:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Engage the service brake.
4. Measure resistance between the service brake cavity (i.e. G2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is less than or equal to 10,000 Ω, the brake switch is miswired or the service brake circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is greater than 10,000 Ω, or open, refer to section 10.7.2.

10.7.9 Check for Open or Miswired Clutch Switch

Perform the following steps to check for an open or miswired clutch switch:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Ensure the clutch is not engaged.
4. Measure resistance between the clutch cavity (i.e. J2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is greater than 5 Ω, or open, the clutch switch is miswired or faulty, circuit #953 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.10 Check for Short at the Clutch Service/Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Engage the clutch.
4. Measure resistance between the clutch cavity (i.e. J2) on the vehicle harness connector and a good ground.
   - [a] If the resistance measurement is less than or equal to 100 Ω, the clutch switch is miswired or faulty, or the clutch circuit is shorted to ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is greater than 100 Ω, or open, refer to section 10.7.2.

10.7.11 Check for Short at the Set/Coast Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between the set/coast cavity (i.e. J2) and a good ground.
   - [a] If the resistance measurement is less than or equal to 100 Ω, the set/coast switch is shorted, or a short to ground exists in the set/coast circuit (i.e. #541). Repair the short or replace the switch. Refer to section 10.7.16.
   - [b] If the resistance measurement is greater than 100 Ω, refer to section 10.7.2.

10.7.12 Check for Open at the Set/Coast Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.

2. Disconnect the vehicle harness connector at the ECM.
3. Find a means to press and hold the set/coast switch.
4. Measure resistance between the set/coast cavity (i.e. J1) and a good ground.
   [a] If the resistance measurement is greater than 5 Ω, or open, the set/coast switch is open or miswired, circuit #953 is open, or there is a bad battery ground. Rewire, repair the short or replace the switch. Refer to section 10.7.16.
   [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.13 Check for Short at the Res/Accel Circuit

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between the Res/Accel cavity (i.e. G3) and a good ground.
   [a] If the resistance measurement is less than or equal to 100 Ω, the Res/Accel switch is shorted, or a short to ground exists in the Res/Accel circuit (i.e. #541). Repair the short or replace the switch. Refer to section 10.7.16.
   [b] If the resistance measurement is greater than 100 Ω, refer to section 10.7.2.

10.7.14 Check for Open at the Res/Accel Circuit

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Find a means to press and hold the Res/Accel switch.
4. Measure resistance between the Res/Accel cavity (i.e. G3) and a good ground.
   [a] If the resistance measurement is greater than 5 Ω, or open, the Res/Accel switch is open or miswired, circuit #953 is open or the battery ground is bad. Repair the short, replace the switch, or rewire. Refer to section 10.7.16.
   [b] If the resistance measurement is less than or equal to 5 Ω, refer to section 10.7.2.

10.7.15 Verify Problem Still Exists

Perform the following steps to verify the problem still exists:

1. If you were referred to this step, you have completed the switch checkout process without detecting a fault.
2. Take the vehicle for a road test and check the cruise control operation.

[a] If the cruise control operates correctly, the problem no longer exists. If any other problems exist, refer to section 9.1.

[b] If the cruise control does not operate correctly, check the vehicle speed sensor. Refer to section 54.1.

10.7.16 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Road test the vehicle.

[a] If the cruise control operates correctly, troubleshooting is complete.

[b] If the cruise control does not operate correctly, all system diagnostics are complete. Review this section from the start to find the error. Refer to section 10.7.1.

10.8 FAN OPERATIONAL CONCERN (ON/OFF TYPE)

This section covers only the DDEC controlled fan operation, (fan type single, dual or two-speed). If the function is assigned, see description of DDEC fan control logic, listed in Table 10-6.

Cavity	Wire#	Function	Output/Input
X#	#	Fan Control 1	Output - Required
X#	#	Aux. Fan Control	Input - Optional
X#	#	Fan Override	Input - Optional

Table 10-6 DDEC Fan Control Logic Description

10.8.1 Digital Fan Operation

Items used in digital fan operation include:

1. The ECM provides ground (output Fan Control 1) and should be wired such that when this cavity grounds, the fan should turn off. When the circuit goes open, the fan should turn on.
2. When Aux. Fan Control is configured (input), this wire must be connected to battery ground, or the fan will always be on. Typically, this is used with an air conditioning pressure switch. High pressure opens this circuit, and turns the fan on for a minimum time that can be set with the programming station on later ECM software versions.
3. Fan Override - Grounding this wire will turn the fan on. This would normally be an OEM supplied switch on the dash.

Other than these items, the ECMs fan control output opens, turning the fan on due to engine temperatures that are above the programmed limits. Once a fan output turns the fan on for whatever reason, all fan off temperatures must be met before the fan will turn off.

Temperatures for most highway applications are listed in Table 10-7.

Fan Control	Actual Fan Status	Coolant Temp	Oil Temp	Air Temp
Fan Control - 1	Fan ON	96 ° C / 204 ° F	110 ° C / 230 ° F	66 ° C / 150 ° F
Fan Control - 2	Fan ON	98 ° C / 208 ° F	113 ° C / 235 ° F	N/A
Fan Control -	Fan OFF	92 ° C / 197 ° F	104 ° C / 219 ° F	49 ° C / 120 ° F

Table 10-7 Highway Application Temperatures

These temperature limits are only changeable in the base calibration.

10.8.2 Check Output Status

Perform the following steps to troubleshoot a fan operation problem:

1. Start engine.

2. Ensure the air conditioning of the vehicle is OFF.
3. Run engine for at least three minutes.
4. Plug in DDR.
5. Select switch / light status.
6. Check the status of the Fan Control #1 while noting the actual fan status as listed in Table 10-8.

	Status	Status	Status	Status
Fan Control #1	ON	OFF	ON	OFF
Actual Fan State	OFF	ON	ON	OFF
	Refer to section 10.8.3.	Refer to section 10.8.4.	Refer to section 10.8.6	Refer to section 10.8.7

Table 10-8 Troubleshooting Fan

10.8.3 Fan Information

The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM. The fan operation is normal if the steps that you checked led you to this section.

The fan status is correct according to what the ECM is requesting.

If you believe the fan state should be different, review the DDEC application and installation manual for information on fan control configuration.

10.8.4 Check Input Status

Read the status of the inputs used for fan operation listed in Table 10-9. (Note both together.)

	Status	Status	Status
Aux. Fan Control	OFF	ON	ON
Fan Override	OFF	ON	OFF
	Refer to section 10.8.5	Refer to section 10.8.8	Refer to section 10.8.3

Table 10-9 Input Status

10.8.5 Check for Input Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Disconnect vehicle 30-pin connector at the ECM.
3. Turn ignition ON.

4. Measure resistance between auxiliary fan control wire and a good ground.
   [a] If the measured resistance is greater than 1,000 Ω, an open exists in the auxiliary fan control wire, or auxiliary fan control is configured and not wired, or the switch is bad. Repair open or replace the switch if an auxiliary fan control is used. If this feature is not to be used, disable the auxiliary fan control with the programming station. Refer to section 10.8.10.
   [b] If the measured resistance is less than or equal to 1,000 Ω, refer to section 10.8.9.

Perform the following steps to troubleshoot fan always on. The steps that led to this procedure do not indicate a problem with the fan control logic in the ECM. The fan operation is normal if the steps that you checked led you to this section.

10.8.6 Check for Output Open

Perform the following steps to check for an output open:

1. With ignition off, locate OEM supplied wire used for Fan Control #1.
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Turn ignition ON.
5. Measure resistance between the fan control #1 wire and a good ground, battery (-).
   [a] If the measured resistance is greater than 48,000 Ω or open, an open exists in the FC#1 wire. Repair the open. Refer to section 10.8.10.
   [b] If the measured resistance is less than or equal to 48,000 Ω, refer to section 10.8.9.

10.8.7 Check for Output Short

Perform the following steps to check for an output short:

1. With ignition off, locate OEM supplied wire used for Fan Control #1.
2. Determine where the wire terminates. (e.g. fan solenoid, relay, data module, etc.)
3. Disconnect the Fan Control #1 wire at the solenoid/relay.
4. Measure resistance between the fan control #1 wire and a good ground, battery (-).
   [a] If the measured resistance is greater than 1,000 Ω or open, refer to section 10.8.9.
   [b] If the measured resistance is less than or equal to 1,000 Ω, the output wire is shorted to ground, keeping the fan off. Repair the short or replace the wire. Refer to section 10.8.10.

10.8.8 Check Override Request

Perform the following steps to check the fan override switch:

1. Is the fan override switch on?

[a] If the fan override is on, and the fan override is requesting fan on, this is normal.

[b] If the fan override is not on, the fan override wire is shorted to ground, repair the short or re-configure the input if this is an error in programming. Refer to section 10.8.10.

10.8.9 Check Connectors

Perform the following steps to check the connectors:

1. Check connectors for damaged, bent, or corroded terminals.

   [a] If the pins and terminals are not damaged, the problem may be due to the solenoid, ECM, or OEM device that operates the fan. Contact the OEM for further information or instructions. The ECM and wiring between the ECM and device appear to be operating correctly and in good repair. The ECM is requesting the fan operation correctly and the checks indicate the ECM and wire between the ECM and OEM device is okay.

   [b] If the pins or terminals are damaged, repair or replace them. Refer to section 10.8.10.

10.8.10 Verify Repairs

Perform the following steps to verify repairs:

1. Connect any removed connectors.
2. Start engine.
3. Operate engine under conditions that brought you to this section.
4. Check fan operation.

   [a] If the fan operates correctly, troubleshooting is complete.

   [b] If the fan does not operate correctly, review this section from the first step to find the error.

10.9 FAN OPERATIONAL CONCERN (VARIABLE SPEED TYPE)

The DDEC system via a PWM (Pulsewidth Modulation) signal will go to a high voltage (7-8 volts on a 12-volt system) on a cold engine for a low speed, and to a low voltage (0.8 - 1.0 volts on a 12-volt system) for a high speed.

Fan speed is ramped up as temperatures increase, as listed in Table 10-10. Calibrations can vary. The table is provided only as a guide.

Coolant Temperature	Speed
up to 197°F	Low speed
about 203°F	Medium speed
208°F and above	High speed

Table 10-10 Fan Speed vs Temperature

10.9.1 Verify Correct DDEC Configuration

Perform the following steps to verify the configuration:

1. Turn ignition ON.
2. Plug in DDR.
3. Select "View Calibration" (ECM Ins/Outs).
4. Review PWM functions to determine correct pin assignment for PWM fan.
   [a] If the cavity is assigned to PWM Fan, refer to section 10.9.2.
   [b] If the cavity is not programmed, reprogram the ECM and refer to section 10.9.7.

10.9.2 Check for Signal

Perform the following steps to check for signal:

1. Start and run the engine at idle.
2. Plug in DDR.
3. Review engine data list and watch the pulsewidth modulation number x wire = # of fan assignment (normally PWM#4).
4. Verify coolant, oil and air temperatures are cooler, less than 150 ° F. Verify the air conditioning input is grounded (On).
   [a] If the PWM value is 80 to 90% and the fan is at Low Speed, refer to section 10.9.3.
   [b] If the PWM value is 80 to 90% and the fan is at High Speed, refer to section 10.9.4.

10.9.3 Check Signal Engine Hot

Perform the following steps to check the signal status:

1. Start engine and warm up. Road test (until coolant temp is about 200 ° F).
2. View DDR data list display, Coolant Temp/PWM # (normally #4).
   [a] If PWM % decreases as the temperature increases, all checks appear normal. If this is an intermittent high speed operation, check A/C Freon pressure switch or wiring for an intermittent open. Refer to section 10.9.7.
   [b] If PWM % decreases as the temperature increases, but the fan speed stays low, refer to section 10.9.5.

10.9.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug PWM wire at the fan control valve.
3. Install a jumper between the PWM wire and the battery (-).
4. Unplug the engine harness connector.
5. Measure resistance between the PWM cavity and the battery (-).
   [a] If the measured resistance is greater than 1,000 Ω, the wire is open. Repair the open and refer to section 10.9.7.
   [b] If the measured resistance is less than 1,000 Ω, the valve or wiring (voltage supply) to the valve is defective. Replace.

10.9.5 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Unplug the engine harness connector.
3. Measure resistance between the PWM cavity and several ground sources (battery, chassis, etc.).
   [a] If the measured resistance is greater than 1,000 Ω, refer to section 10.9.6.
   [b] If the measured resistance is less than 1,000 Ω at any time, the wiring is shorting. Replace the wire and refer to section 10.9.7.

10.9.6 Check Connectors

Perform the following steps to check the connectors:

1. Check for damaged, bent or corroded connectors, pins, and terminals.

[a] If the connectors, pins, and terminals are not damaged, contact the OEM or fan valve supplier for instructions on further troubleshooting. If the ECM and wiring to the component appear to be okay, the problems could be with the control valve or battery and wiring.

[b] If the connectors, pins or terminals are damaged, repair or replace them and refer to section 10.9.7.

10.9.7 Verify Repairs

Perform the following steps to verify repairs:

1. Connect all removed connectors, etc.
2. Start and run the engine from cold to hot, while watching the fan speed operation.

   [a] If the operation is normal, troubleshooting is complete.

   [b] If the operation is not normal, all system diagnostics are complete. Review this section to find the error. Refer to section 10.9.1.

10.10 ENGINE BRAKE INOPERATIVE

The following procedure will troubleshoot DDEC controlled Engine Brake Inoperative.

10.10.1 Engine Brake Inoperative

Perform the following steps to troubleshoot the inoperative engine brake:

1. Turn ignition ON.
2. Plug in DDR.
3. View Diagnostic Data List to see if the correct application is programmed into the ECM.
4. Next to Engine Brake, the display should read ON or OFF. If it reads N/A, the DDC mainframe must be changed and the ECM must be reprogrammed after the change is made.
5. If the ECM is correctly configured, go to the view calibration area with the DDR and check to ensure that the two required inputs (Engine Brake Low and Engine Brake Medium) are configured.
6. If the inputs are not configured, or incorrectly configured, this must be corrected using the DDEC reprogramming station.
7. If the inputs are configured correctly, print or write down the inputs and outputs for future reference. Refer to section 10.10.2. Refer to the appropriate Application and Installation manual for engine brake operation.

10.10.2 Check Switches

Perform the following steps to troubleshoot the switches:

1. Turn ignition ON.
2. Plug in DDR.
3. Select Switch Light status - Inputs.
4. View DDR display of Eng Brk Low and Eng Brk Med.

NOTE:
Set brake dash switch position on low.

   [a] If Eng Brake Low is ON and Eng Brake Med is OFF, refer to section 10.10.3.

   [b] If Eng Brake Low is ON and Eng Brake Med is ON, medium and low inputs are shorted to each other. Repair. Refer to section 10.10.9.

   [c] If Eng Brake Low is OFF and Eng Brake Med is ON, input wires are reversed. Correct and refer to section 10.10.9.

   [d] If Eng Brake Low is OFF and Eng Brake Med is OFF, refer to section 10.10.4.

5. Turn brake enable dash switch on.

10.10.3 View Diagnostic Data Reader Display

Perform the following steps to troubleshoot the inoperative engine brake:

1. View DDR display.

NOTE:
Set brake dash switch position on medium.

- [a] If Eng Brake Low is OFF and Eng Brake Med is ON, refer to section 10.9.5.
- [b] If Eng Brake Low is ON and Eng Brake Med is ON, medium and low inputs are shorted to each other. Repair. Refer to section 10.10.9.
- [c] If Eng Brake Low is ON and Eng Brake Med is OFF, input wires are reversed. Correct and refer to section 10.10.9.
- [d] If Eng Brake Low is OFF and Eng Brake Med is OFF, refer to section 10.10.4.

10.10.4 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Turn engine brake switch to low.
3. Measure resistance between the engine brake low switch and a good ground (ECM side).
4. Set switch to Med. Measure resistance between medium input and a good ground.
   - [a] If the measured resistance is less than 10,000 Ω, either the switch is bad or the wire from the switch to the battery ground is bad. Replace the switch or repair the open.
   - [b] If the measured resistance is greater than 10,000 Ω, or open, an open exists in the input wire. Repair the open. Refer to section 10.10.9.

10.10.5 View Calibration - Engine Configuration

Perform the following steps to view calibration - engine configuration:

1. Go to View Cal-Eng Configuration. Check status of Eng Brk Serv Brk and Eng Brk mph. If Eng Brk Serv Brk indicates YES, or Eng Brk Min mph has number other than "0", check with the operator to ensure he or she understands how these functions operate.
   - [a] If the Eng Brk Serv Brk indicates YES, the application of service brake is required for engine brake operation.
   - [b] If the Eng Brk Min mph has a number other than "0", the brakes will not operate below this mph.

NOTE:
These two functions may work separately or together.

[c] If the Eng Brk Svc Brk indicate No, and Eng Brk Min mph indicate 0, refer to section 10.10.6.

10.10.6 Check Engine Brake Operation

Perform the following steps listed in Table 10-11 to check out the brake and clutch switch, and the wiring.

NOTE:
If table below leads to section 10.11, troubleshoot clutch and brake inputs. Then check operation of engine brake. If engine brake is still inoperative, refer to section 10.10.7.

1. Turn ignition ON. Engine must not be running.
2. Plug in DDR. Select switch/light status.

Step	Brake Pedal	Clutch Pedal	DDR Readout Looked At	DDR Display	Status OK	
1.	Released	Released	Service Brake (Release)	On Off	Yes No	refer to Step 2 refer to section 10.11
2.	Depressed	Released	Service Brake Release	On Off	No Yes	refer to section 10.11 refer to Step 3
3.	Released	Released	Clutch Release	On Off	Yes No	refer to Step 4 refer to section 10.11
4.	Released	Depressed	Clutch Release	On Off	No Yes	refer to section 10.11refer to section 10.10.7

Table 10-11 Engine Brake Operation

10.10.7 Check Brake Solenoids

Perform the following steps to troubleshoot the brake solenoids:

1. Check engine brake solenoids. Refer to OEM guidelines.
   [a] If solenoids are okay, refer to section 10.10.8.
   [b] If solenoids are bad, repair or replace the solenoids. Refer to section 10.10.9.

10.10.8 Verify Conditions

Perform the following steps to verify conditions:

1. Verify proper conditions are being met to enable engine brake:
   - [a] TPS % = 0 %
   - [b] Pulse width = 0 (or less)
   - [c] Engine speed >850 r/min
   - [d] Clutch release (input) = ON (if configured)
   - [e] Engine brake disable (input) = OFF (Auto Trans)
2. Are the conditions listed in 1a through 1e met?
   - [a] If conditions are not met, correct the problem (i.e. TPS). Refer to section 10.10.9.
   - [b] If the conditions are met, reprogram the ECM. Contact the OEM for possible TPS repair. Then, refer to section 10.10.9.

10.10.9 Verify Repairs

Perform the following steps to verify repairs:

1. Reinstall all connectors.
2. Test drive vehicle to see if the problem is corrected.
   - [a] If engine brakes operate correctly, troubleshooting is complete.
   - [b] If engine brakes do not operate, all system diagnostic checks are complete. Review this section to find the error. Refer to section 10.10.1, or contact Detroit Diesel Technical Service for possible ECM replacement.

10.11 MISCELLANEOUS DIGITAL INPUT FAULT

The following procedure will cover miscellaneous input switch faults. All faults function in the same manner, allowing the same troubleshooting process to be used regardless of the function.

There are 12 digital input cavities, listed in Table 10-12, available on a DDEC ECM. Any available function can be assigned (programmed with the Programming Station) to any of the available cavities.

When a digital input wire is switched to battery ground (usually #953), it is a request to the ECM to activate the function assigned to that wire. Additional conditions may need to be met for the feature to activate. Refer to the appropriate Application and Installation Manual for these conditions.

Input Cavities	Input Cavities
E1 #451	G2 #543
F1 #542	H2 #524
G1 #528	J2 #531
H1 #523	K2 #583
J1 #541	G3 #545
F2 #544	K3 #979

Table 10-12 Input Cavities

Available functions are listed in Table 10-13.

Functions	Functions	Functions
None	Limiting Torque Curve	Trans Retarder Status
Engine Brake Low	Diagnostic Request	Dual Throttle (LSG)
Engine Brake Med	Alt Min VSG/Fast Idle	A/C Fan Status
Aux Shutdown #1	Service Brake Release	Aux CLS
Aux Shutdown #2	Clutch Released	Fan Control Override
Park Brake / ISD	Set Coast OFF DDEC II	VSG Station Change
Idle Validation	Set / Coast ON	VSG Station Complement
Pressure / RPM Mode	Resume/Accel OFF DDEC II	Air Load Switch
Throttle Inhibit	Resume / Accel ON	In Neutral Switch
RPM Sync (Marine)	Cruise Enable	In Gear Switch
RPM Freeze (Marine)	PGS System Enable	KD Brake
Rating Switch #1	SEO / DIAG Request	Gas Valve Diagnostic
Rating Switch #2	Engine Brake Disable	-

Table 10-13 Available Input Functions

The following procedure will troubleshoot an input fault.

10.11.1 Verify Switch Status

Follow these steps to verify the switch status.

1. Turn ignition ON.
2. Plug in DDR.
3. Select switch light status.
4. Operate the engine or vehicle that would allow the feature to activate (e.g. activate switch, set brake, etc.).
5. Observe the status when the feature is active (or supposed to be active). See Figure 10-9.
   [a] The feature always reads OFF. Refer to section 10.11.2.
   [b] The feature switches from OFF to ON. Refer to section 10.11.3.
   [c] The feature always reads ON. This indicates the input wire is shorted to ground or the switch is faulty. Repair wire or replace switch. Refer to section 10.11.4.

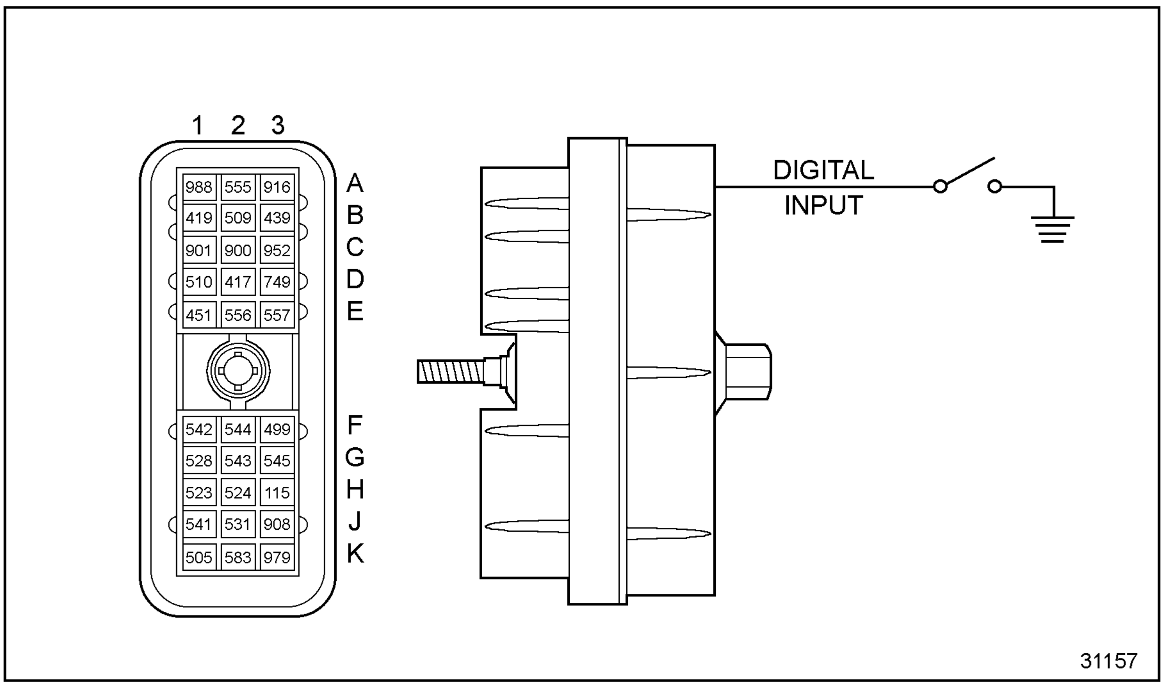


Figure 10-9 ECM Vehicle Harness Connector

10.11.2 Check for Open

Perform the following steps to check for an open:

1. Turn ignition OFF.
2. Unplug the vehicle interface harness connector at the ECM.

3. Operate switch. Enable the feature.
4. Measure the resistance between the input cavity affected and the battery ground.
   [a] If the measured resistance is greater than 10,000 Ω, the input wire or ground wire is open, or the switch is bad. Repair the open or replace the switch. Refer to section 10.11.4.
   [b] If the measured resistance is less than 10,000 Ω, refer to section 10.11.3.

10.11.3 Review the Operation of the Feature

Perform the following steps to check the operation of the feature:

1. The step that led you here indicates the input, wire, and switch, are operating correctly. Review the intended operation of the feature to determine if any other conditions need to be met for the feature to operate. (e.g. appropriate Application and Installation manual for the engine). Refer to section 2.4, for a list of related troubleshooting publications.
2. To verify the repairs to the feature, refer to section 10.11.4.

10.11.4 Verify Repairs

Perform the following steps to verify repairs.

1. Hook up all connectors that were previously removed.
2. Operate the engine or vehicle.
3. Activate the feature.
   [a] If the input feature operates correctly, troubleshooting is complete.
   [b] If the input feature is not operating, contact Detroit Diesel Technical Service.

10.12 MISCELLANEOUS DIGITAL OUTPUT FAULT

This section is designed to diagnose an output fault (feature not functioning). Since all outputs operate in the same manner, this troubleshooting section can be used regardless of the function assigned.

10.12.1 DDEC ECM

The DDEC ECM has six available digital output cavities. Three are located at the engine harness connector and three at the vehicle harness connector. Output functions (features) are assigned (programmed with the programming station) to any available cavity. The ECM switches the cavity to battery (-) to allow the function to activate. Some output activation is dependent on other parameters being met. (e.g. minimum, r/min, etc.) Perform the following steps to check the DDR for codes. Available output cavities are listed in Table 10-14.

Additional outputs could be added at a later date. Available functions are listed in Table 10-15.

Output Cavities	Output Cavities
VIH	ESH
A1 #988	W3 #563
A2 #555	X3 #564
F3 #499	Y3 #565

Table 10-14 Output Cavities

Functions	Functions	Functions
No Function	Fan Control #2	Turbo Recirc Valve
Low DDEC Volt	Deceleration Light	Optimized Idle Active
RPM Sync Active	Engine Brake Active	Low Range Solenoid (ESS)
PGS Active Light	VSG Active Indication	High Range Solenoid (ESS)
Vehicle Power Down	Oil Pressure Low Light	Shift Solenoid (Top2)
Starter Lockout	Oil Temp High Light	Shift Lockout (Top2)
Ext Brake Enable	Coolant Temp High Light	Gas Throttle Actuator
Trans Retarder Enable	Air Comp Solenoid	Fuel Supply Solenoid
Coolant Level Low Light	Crankcase Pressure High	KD Brake Solenoid
Cruise Active Light	Coolant Pressure Low	-
Fan Control #1	Ether Start	-

Table 10-15 Available Output Functions

10.12.2 Activate Output

Perform the following steps to attempt activation to troubleshoot an output fault.

1. Turn ignition ON.
2. Plug in DDR. Select ACTIVATE OUTPUTS.
3. Activate output associated with the fault.

NOTE:
Service any other codes first.

- [a] If the feature operates (e.g. light illuminates or solenoid activates, etc.) review the Application and Installation manual for the operation of the designated feature. Operation is dependent on other parameters. Refer to section 10.12.6.
- [b] If the feature does not operate or cannot be activated, refer to section 10.12.3.

10.12.3 Check for Open

Perform the following steps to check for open:

1. Turn ignition OFF.
2. Locate device end of output wire (e.g. light) and disconnect wire.
3. Turn ignition ON.
4. Measure resistance between the disconnected wire and battery (-).
   - [a] If the measured resistance is less than 46,000-48,000 Ω, refer to section 10.12.4.
   - [b] If the measured resistance is greater than 48,000 Ω, the wire is open. Refer to section 10.12.6.

10.12.4 Check for Voltage

Perform the following steps to check the voltage:

1. Measure voltage between the disconnected wire and a good ground.
   - [a] If voltage measurement is less than 2 volts, refer to section 10.12.5.
   - [b] If voltage measurement is greater than 2 volts, the output is shorted to a voltage source. Replace the wire and refer to section 10.12.6.

10.12.5 Check for Resistance

Perform the following steps to check for resistance at the ECM:

1. Turn ignition OFF.
2. Disconnect 30-pin connector that houses the wire/function you are checking (e.g. X3-engine harness connector, A1-VIH).
3. Measure resistance between the pin on the ECM and the ECM case.

[a] If the measured resistance is 46,000 to 48,000 Ω, contact the OEM or the hardware of the supplier of the features. For further troubleshooting, all output wiring and ECM operation appear to be operating correctly.

[b] If greater than 48,000 Ω, try a test ECM. Refer to section 10.12.6.

10.12.6 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Test the vehicle and attempt to operate the feature.
   [a] If the feature works correctly, troubleshooting is complete.
   [b] If the feature still does not work correctly, review this section to find the error. Refer to section 10.12.2.

10.13 FIRE TRUCK PRESSURE GOVERNOR FAULT

The following procedure will troubleshoot fire truck pressure governor fault.

10.13.1 Pressure Governor Operation

The Pressure Sensor Governor (PSG) System is a DDEC feature, programmed to allow the engine speed to change in order to maintain a steady water pump pressure (pressure mode) or hold a steady engine speed (RPM Mode).

10.13.2 Verify Correct Pressure Sensor Governor Configuration

Perform the following steps to verify the PSG configuration. Refer to the Application and Installation manual for the appropriate engine model to ensure correct inputs and outputs are configured. Required In / Outs are listed in Table 10-16.

1. Turn ignition ON.
2. Plug in DDR.
3. View H_2 O governor enabled (engine configuration).
4. View In / Outs. Verify correct configuration.
   [a] If the system is enabled and the in/outs are correctly configured, refer to section 10.13.3.
   [b] If the problem was found, correct the settings and retest. Refer to the *DDEC III Application And Installation* manual, 7SA800 and refer to section 10.13.10.3.

Inputs	Outputs
PGS Mode, (Press / RPM)	PGS Active
PGS Enable	Cruise Active
Res / Accel	-
Set / Coast	-

Table 10-16 Required In / Outs

10.13.3 Identify Problem

Use the following procedure to identify the problem with the PSG:

☐ Does not operate; refer to section 10.13.4.
☐ No pressure mode, refer to section 10.13.6.
☐ No increase function refer to section 10.13.7.
☐ No decrease function refer to section 10.13.8.
☐ EFC Fault Information refer to section 10.13.9.

10.13.4 Check System Ground

Perform the following steps to check the system ground:

1. Start engine.
2. Turn ON pump control switch.
3. Verify all interlocks are set (parking brake, transmission neutral, etc.).
4. Plug in DDR. Select Switch/Light status.
5. Observe the displays and PGS ENABLE.
   - [a] If PGS ENABLE reads OFF, the PGS ENABLE input (circuit #543) is not grounded. Check circuit #543 for an open between battery ground or a short to a voltage source. Repair fault and retest. Refer to section 10.13.5.
   - [b] If PGS ENABLE reads ON, refer to section 10.13.7.

10.13.5 Check Sensor Wiring

Perform the following steps to identify the problem:

1. Compare pressure sensor harness wiring to the diagram.
   - [a] If the wiring is correct, refer to section 10.13.9. If the EFC tests okay, refer to section 10.13.6.
   - [b] If the wiring is incorrect, correct the wiring and retest.

10.13.6 Verify Mode Selector Operation

Perform the following steps to identify the problem:

1. Start engine.
2. Turn ON pump control switch.
3. Verify all interlocks are set (parking brake, transmission neutral, etc.).
4. Plug in DDR. Select Switch/Light status.
5. Observe the displays and PGS MODE.
   - [a] If DDR displays ON when Pressure Mode is selected, the mode selector (circuit #523) is functioning properly. Check for possible intermittent open or short to voltage source. Check for faulty pressure transducer. Refer to section 10.13.5. See Figure 10-10.

[b] If the DDR displays OFF when Pressure Mode is selected, the mode selector wire (circuit #523) or switch is open or shorted to a voltage source. Repair the fault and retest. If the EFC tests okay, refer to section 10.13.9.

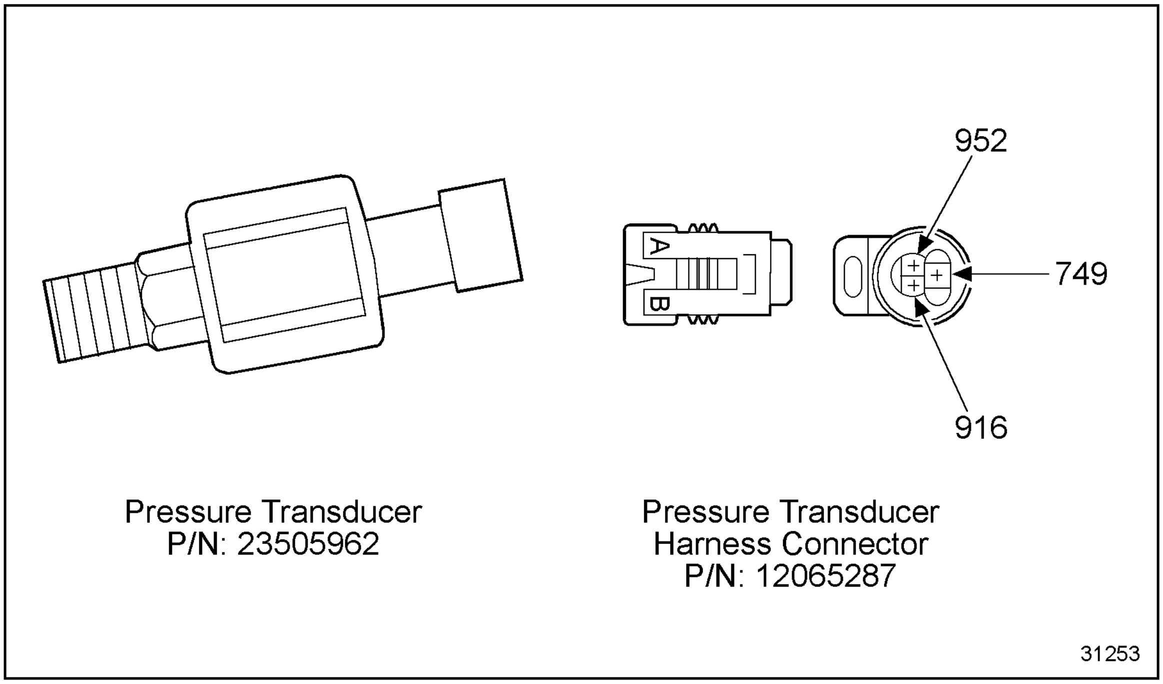


Figure 10-10 Pressure Transducer and Harness Connector

10.13.7 Check Resume / Accel Switch

Perform the following steps to identify the problem:

1. Start engine.
2. Turn ON pump control switch.
3. Verify all interlocks are set (parking brake, transmission neutral, etc.).
4. Plug in DDR. Select Switch/Light status.
5. Observe the displays and Res/Accel, while depressing the increase switch.
   [a] If DDR displays OFF to ON when increase is depressed, check the EFC. Refer to section 10.13.9.
   [b] If the DDR displays OFF when increase is depressed, circuit #541 is open or shorted to a voltage source. Repair the fault and retest.

10.13.8 Check Set / Coast Switch

Perform the following steps to identify the problem:

1. Start engine.

2. Turn ON pump control switch.
3. Verify all interlocks are set (parking brake, transmission neutral, etc.)
4. Plug in DDR. Select Switch/Light status.
5. Observe the displays and Set/Coast, while depressing the decrease switch.
   - [a] If DDR displays OFF to ON when Set/Coast decrease is depressed, check the EFC. Refer to section 10.13.9.
   - [b] If the DDR displays OFF when decrease is depressed, circuit #541 is open or shorted to a voltage source. Repair the fault and retest.

10.13.9 Electronic Fire Commander

The Detroit Diesel Electronic Fire Command ™ (EFC) is designed to support Detroit Diesel engines in the fire fighting market. It combines a Pressure Sensor Governor (PSG) controller, a system monitor, and a display for vital engine operating parameters into one compact, durable package. It also provides complete control and monitoring of the DDEC engine control system on a fire truck when pumping.

10.13.9.1 Pressure Sensor Governor Operating Modes

The EFC commands the Detroit Diesel PSG system to operate in one of two modes. The RPM Mode controls the engine speed to a constant number of revolutions per minute, and the Pressure Mode varies the engine speed to maintain a constant pump discharge pressure. The operating mode of the PSG can be changed from RPM Mode to Pressure Mode and back by pressing the MODE button. When the unit is first turned on, the RPM Mode is active. Pressing MODE switch engages the Pressure Mode and another press brings the system back to RPM Mode. The PSG system utilizes the engine speed or pump pressure that is current at the time the button is pressed.

In the Pressure Mode, the PSG system operates like cruise control for the water pump pressure, and maintains the pressure at a chosen setting. Engine speed is constantly adjusted to maintain the desired pump discharge pressure. A pressure sensor in the output side of the fire pump is used to measure and feed this pressure back to the DDEC Electronic Control Module (ECM).

The RPM Mode keeps the engine speed constant even when the load varies within the engine's operating capability. The pump output pressure may vary in this mode, but the engine speed does not. The driver/engineer uses the EFC to choose which of these two modes the PSG uses. The EFC also allows the driver/engineer to finely adjust the pressure setting or the engine speed setting to match prevailing conditions.

10.13.9.2 Setting the Revolutions Per Minute Mode

Perform the following steps to set the RPM Mode:

1. Start engine and ensure the EFC is ON.
2. Ensure the conditions are met for the Throttle Ready lamp to be ON. (These are usually interlocks necessary to allow increased throttle operation.)

3. The RPM Mode lamp should be lit, indicating the system is in RPM Mode.
4. Engine speed can be adjusted using the following buttons:
   - ☐ Press the PRESET button to command the engine to go to the preset speed.
   - ☐ Press the INC button to increase engine speed in 25 RPM increments each time the button is pressed.
   - ☐ Press and hold the INC button to increase the speed at a faster rate equivalent to 2 increments per second.
   - ☐ Press the DEC button to decrease engine speed in 25 RPM increments.
   - ☐ Press and hold the DEC button to decrease the speed at a faster rate equivalent to 2 increments per second.
   - ☐ Press the IDLE button to immediately return the engine to the normal idle speed.

10.13.9.3 Setting the Pressure Mode

Perform the following steps to set the Pressure Mode:

1. Start engine and adjust the system to run in the RPM Mode as described in the previous sections.
2. Ensure conditions are met for the PUMP ENGAGED and OKAY TO PUMP and THROTTLE READY lamps to be on. (This usually requires that required safety interlocks for engine speed increase and pump operation are met.)
3. Press the MODE button and the PRESSURE lamp will illuminate.
4. Pump discharge pressure can now be adjusted with the following buttons.
   - ☐ Press the PRESET button to command the engine to go to the preset pump pressure.
   - ☐ Press the INC button to increase discharge pressure in 4 PSI increments each time the button is pressed.
   - ☐ Press and hold the INC button to increase the pressure at a faster rate equivalent to 2 increments per second.
   - ☐ Press the DEC button to decrease discharge pressure in 4 PSI increments.
   - ☐ Press and hold the DEC button to decrease the pressure at a faster rate equivalent to 2 increments per second.
   - ☐ Press the IDLE button to return the engine immediately to the normal idle speed.

10.13.9.4 Cavitation

If the water pump discharge pressure falls below 30 psi and the engine r/min rises a minimum of 400 r/min above the current setpoint for more than five seconds, the system considers cavitation to have occurred. It takes the following actions:

- ☐ The engine will return to idle.
- ☐ The current engine speed and discharge pressure setpoints will be cleared.
- ☐ The check engine light will illuminate and a cavitation code will be logged.

10.13.9.5 Engine Parameter Display

Engine r/min, oil pressure, temperature, and system voltage are displayed continuously while the EFC is in operation. In addition, any diagnostic code accompanying a Check Engine or Stop Engine condition will be displayed on the Information Center message display. An audible alarm will also be activated with the code.

10.13.10 Programming the Electronic Fire Commander

Programming the EFC is simply a matter of selecting items from a menu:

- ☐ To enter the programming menu, press and hold the MODE and MENU buttons at the same time until "Press Idle to Exit" is displayed on the information center, then release both buttons.
- ☐ Moving through the menu is accomplished by pressing the MENU button.
- ☐ Changing a selection in the menu is performed by using the INC and DEC switches.
- ☐ Exiting the programming menu is accomplished in one of two ways.
  - ☐ Press IDLE to exit the menu and save changes.
  - ☐ Press MODE to exit the menu without saving changes.

10.13.10.1 Programming Menu Options

As you scroll through the menu by repeatedly pressing the MENU button, the following items, listed in Table 10-17, will appear sequentially in the Information Center display.

Item	Explanation
RPM Preset Point	preset engine speed
Pressure Set (PSI)	preset PSI
Engine Hour meter	information only
Pump Hour meter	information only
Engine degrees	oil or coolant
Pump Pressure (PSI)	pressure reading, if active
DDEC Software Version	ECM revision level
EFC Software Version	EFC revision level
Fire Commander I/O Test	test switches and outputs
Press Test Lights	tests display panel
Set Time Clock	set clock
Units of Measure	English/Metric
Welcome Message	enable/disable
Codes Currently Active	information
Connector Data	displays connection information
Save? [Idle Y]	exit and save options

Table 10-17 Information Center Menu

10.13.10.2 Additional Information

Engine r/mi

- ☐ The Information Center displays DDEC ECM diagnostic codes and limited engine information as well as PGS status.
- ☐ The Information Center display can be used as an aid to troubleshooting the Pressure Governor System and the Electronic Fire Commander.
- ☐ The Fire Commander I/O Test checks the outputs as well as the switches. It automatically runs through a test and displays the results for your information in troubleshooting.
- ☐ The connector data displays the cavities of inputs and outputs necessary for correct system operation.
- ☐ The interlock lamps show which interlock circuits have been closed and if that part of the system is ready for operation.

10.13.10.3 Troubleshooting the Electronic Fire Commander

This section lists some of the common troubles encountered during the installation and check out of the Electronic Fire Commander. These conditions are listed and the suggested actions follow each one. The Electronic Fire Commander wiring is listed in Table 10-18, listed in Table 10-19, listed in Table 10-20.

1. Condition: The EFC will not light up.
   - ☐ Check if the necessary switches are turned on.
   - ☐ Check if there is a 12 VDC between pins #1 and #2 at the EFC 4-pin connector.
2. Condition: The throttle will not increase in RPM Mode.
   - ☐ Check if the THROTTLE READY lamp is on. The EFC will not respond in RPM mode unless the OEM safety interlock requirements that enable the throttle are met.
   - ☐ Press the PRESET and then the INC switches. Does the EFC indicate it is increasing RPM on the data display?
   - ☐ Check the switch and outputs in the Menu I/O test.
   - ☐ Re-initialize the EFC. (Remove power to the EFC; wait ten seconds and then power the unit and try again.)

NOTE:
The EFC performs a "self-test" when it is powered up. This is indicated on the EFC by a momentary lighting of all the display segments.

3. Condition: The throttle will not increase in Pressure Mode.
   - ☐ Check that all three lamps: PUMP ENGAGED, OKAY TO PUMP, and THROTTLE READY are on.
   - ☐ Press the INC and then the PRESET buttons to increase pump pressure.
   - ☐ Check for a pump discharge pressure reading in the Menu.
   - ☐ Re-initialize the EFC.
4. Condition: The Engine Data Display is showing all zeroes.
   - ☐ Check that the connections at pins #3 and #4 of the EFC 4-pin connector are secure.
   - ☐ Check there is continuity on the 900 and 901 circuits from the ECM connector to the EFC connector.
5. Condition: The THROTTLE READY lamp will not turn on.
   - ☐ Check that the parking brake is on.
   - ☐ Check that the transmission is in neutral, or the hand throttle (PTO) is engaged.
   - ☐ Check for 12 VDC at pin #2 of the EFC 12-pin connector.
6. Condition: The PUMP ENGAGED and OKAY TO PUMP lamps do not turn on.
   - ☐ Check that all OEM safety requirements for pump operation are fulfilled.
   - ☐ Is the parking brake on?
   - ☐ Is the transmission in the proper range for pump operation?
   - ☐ Is the hand throttle (PTO) engaged?
   - ☐ Is there an OK to PUMP indication in the cab?
   - ☐ Check for 12 VDC at pin #10 of the EFC 12-pin connector.
7. Condition: The mode will not change from RPM to Pressure.

- ☐ Check: Are the PUMP ENGAGED and OKAY TO PUMP lamps on?
- ☐ Does the MODE switch pass in the menu I/O test?

8. Condition: The PRESET switch doesn't work.
   - ☐ Check that the proper lamps are on for the mode you want to operate.
   - ☐ Is there a valid preset programmed into the menu? If not, refer to section 10.13.10 and complete the steps given there.

☐ Does the PRESET switch pass the menu I/O test?

Connector 1:	Deutsch DT06-4S		
Cavity	**Circuit Description**	**DDC#**	**EFC Input/Output**
1	DDEC Accessory Power	439	(+) System Power
2	DDEC Accessory Ground	953	(-) System Ground
3	DDEC 1708 Data Link (+)	900	J1587 Serial Link
4	DDEC 1708 Data Link (-)	901	J1587 Serial Link

Table 10-18 Electronic Fire Commander Wiring

Connector 2:	DT06-12S		
Cavity	**Circuit Description**	**DDC#**	**EFC Input/Output**
1	DDEC PGS Mode Select	523	Output (ground) to DDEC
2	OEM Interlock from OEM	-	Input (+12 VDC)
3	Cavity plug	-	No connection
4	DDEC PGS Mode	499	Input (ground) from DDEC
5	DDEC PGS Enable	-	Output (ground) to DDEC
6	DDEC PGS Increase	-	Output (ground) to DDEC
7	DDEC PGS Decrease	-	Output (ground) to DDEC
8	DDEC PGS Active	-	Input (ground) from DDEC
9	Alarm	-	Output (ground) to DDEC
10	PTO Engaged	-	Input (+12 VDC) from OEM
11	Cavity Plug	-	No connection
12	Low fuel	-	Input (ground) from DDEC

Table 10-19 Electronic Fire Commander Wiring

	Pressure Sensor Connector:		
Circuit	**Cavity**	**Wire Color**	**Description**
916	B	Red/Black	Sensor Supply 5 VDC
749	C	Yellow	Fire Pump Pressure
952	A	Black	Sensor Return

Table 10-20 Electronic Fire Commander Wiring

10.14 OPTIMIZED IDLE FEATURE DOES NOT FUNCTION

The following procedure will troubleshoot Optimized Idle not functioning.

CAUTION:

To avoid personal injury from the engine starting accidently, do not replace the ECM with an ECM that is not programmed with Optimized Idle.

CAUTION:

To avoid personal injury from the engine starting while working in the engine compartment, remove the starter relay from the relay holder before performing any service or troubleshooting to the Optimized Idle system.

10.14.1 Check Diagnostic Data Reader for Codes

Perform the following steps to check the DDR for codes.

1. Plug DDR into connector.
2. Turn ignition ON.
3. Check the active and inactive codes for any Optimized Idle codes.
4. Turn ignition OFF.

NOTE:
Service any code first.

[a] If an Optimized Idle code 62, 63, or 74 is logged, go to the appropriate flash code section, based on Optimized Idle code logged.

[b] If an Optimized Idle code 62, 63 or 74 is not logged, refer to section 10.14.2.

10.14.2 Heater and Air Conditioning Fans Do Not Function

Perform the following steps to troubleshoot the heater and A/C fans.

1. Check the heater and A/C blower fuse.
2. Turn ignition ON.
3. Plug in DDR.

4. Check the vehicle power down relay switch. Select switch light status (VEH PWR DOWN).
   - [a] If the output status reads ON, check the relay and relay connections for proper operation. Refer to section 10.14.3.
   - [b] If the output status does not read ON, install a test ECM. Refer to section 10.14.11.

10.14.3 Check Optimized Idle Active Light

The Optimized Idle active light should flash when all of the following occur:

1. Engine idling.
2. The transmission is in NEUTRAL and high-range, if equipped.
3. The hood is closed and the park brake is set.
4. The cruise switch is turned ON.
   - [a] If the active light is not flashing, refer to section 10.14.4.
   - [b] If the light is flashing, after the engine shuts down, turn the thermostat on. When the light flashes, if the alarm turns ON and the engine starts, the system is OK.
   - [c] If the light is flashing, after the engine shuts down, turn the thermostat on. When the light flashes, if the alarm does not turn ON and the engine does not start, refer to section 10.14.10.

10.14.4 Check Idle Condition

Perform the following steps to troubleshoot Optimized Idle:

1. Check idle condition.
2. Verify the engine is at idle and not running on VSG. Optimized idle will not function if the engine is running on VSG, unless the idle timer is enabled on VSG.
   - [a] If the engine is not at idle, turn off the ISD on the VSG. Refer to section 10.14.11.
   - [b] If the engine is at idle, refer to section 10.14.5.

10.14.5 Check Idle Shutdown Enabled

Perform the following steps to troubleshoot Optimized Idle:

1. Check for idle shutdown enabled.
2. Using the DDR, view the calibration.
   - [a] If idle shutdown is not enabled, enable the idle shutdown and set a shutdown time. Refer to section 10.14.11.
   - [b] If the idle shutdown is enabled, refer to section 10.14.6.

10.14.6 Check Input Status

Perform the following steps to troubleshoot Optimized Idle:

1. Check for input status.
2. Using the DDR, check the park brake input status with the hood closed, the transmission in NEUTRAL (and high-range if equipped) and the park brake set.
   [a] If the park brake status is ON, refer to section 10.14.9.
   [b] If the park brake status is not ON, refer to section 10.14.7.

10.14.7 Check Hood Switch

Perform the following steps to troubleshoot the hood switch:

1. Check hood switch.
2. Measure the resistance across the hood switch contacts with the hood closed. See Figure 10-11.
   [a] If the resistance measures less than 100 Ω , refer to section 10.14.8.

[b] If the resistance measures greater than 100 Ω, replace or adjust the hood switch. Refer to section 10.14.11.

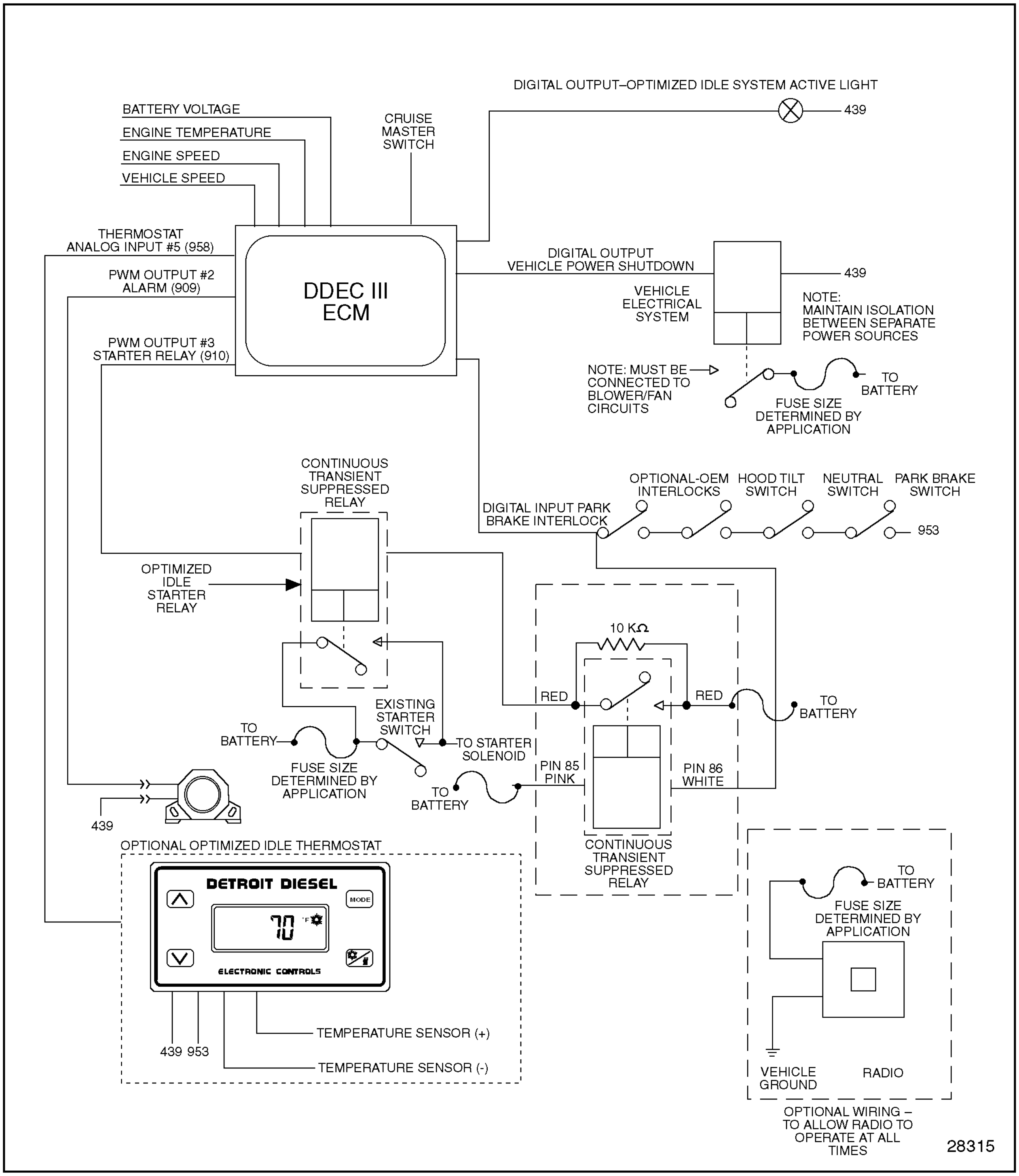


Figure 10-11 Optimized Idle Schematic

10.14.8 Check Park Brake Switch

Perform the following steps to troubleshoot the park brake switch and other OEM interlock devices.

1. Check the park brake switch and other OEM interlock devices (e.g. high-range switch).
2. Measure resistance across the park brake switch contacts with the park brake set.
   - [a] If the measured resistance is less than 100 Ω, the 953 ground wire is open somewhere between the ECM and the battery. Repair the open. Refer to section 10.14.11.
   - [b] If the measured resistance is more than 100 Ω, replace the park brake switch or other OEM interlock devices. Refer to section 10.14.11.

10.14.9 Check the Thermostat

Perform the following steps to check the thermostat operation:

1. Turn ignition ON.
2. Plug in the DDR.
3. Select switch light status OPIDL T-STAT.
   - [a] If the display reads ON with the thermostat enabled and the alarm is turned ON and the reader shows the switch status for the starter as ON after the alarm turns OFF, check the relay and starter solenoid connections. Refer to section 10.14.11.
   - [b] If the display reads ON with the thermostat enabled and the alarm is turned ON and the reader does not show the switch status for the starter as ON after the alarm turns OFF, refer to section 10.14.10.
   - [c] If the display reads ON with the thermostat enabled and the alarm OFF, replace the alarm. Refer to section 10.14.11.
   - [d] If the display does not read ON with the thermostat enabled, the thermostat input wire #958 is open between the thermostat and the ECM. Repair the open. Refer to section 10.14.11.

10.14.10 Oil Temperature Sensor Connection Check

Perform the following steps to troubleshoot the OTS connection:

1. Check the OTS connection.
   - [a] If the OTS connector is plugged into the oil temperature sensor, reprogram the ECM. Refer to section 10.14.11.
   - [b] If the OTS connector is not plugged into the OTS, plug in the OTS connector. Refer to section 10.14.11.

10.14.11 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Close the hood; set the park brake; put the transmission in NEUTRAL and the high-range, if equipped.
4. Start the engine.
5. Turn the cruise master switch to the ON position. If it was on before the vehicle started, turn the switch to OFF and then to ON.
6. Wait for the engine to shut down. After the idle timer expires, the engine will either shutdown or continue to run to charge the battery or keep the oil temperature between 60°F (16°C) and 104°F (40°C).
7. Turn the thermostat on, if installed. Change the set point and heating/cooling mode until the thermostat requires the engine to start. The icons will flash. If the thermostat is not installed, wait for the lube oil temperature to fall below 60°F (16°C).
8. The alarm will sound and the engine will start. Vehicle power (blower fans) will turn on approximately 30 seconds after the engine starts, due to the thermostat.
   - [a] If Optimized Idle operates properly, troubleshooting is complete.
   - [b] If Optimized Idle does not operate properly, troubleshooting is complete. Review this section from the first step to find the error. Refer to section 10.14.1.

10.15 TRANSMISSION INTERFACE FAULT

Numerous transmissions utilize the DDEC ECM to receive signals that are used to determine shift points, and/or other information.

10.15.1 Transmission Fault

Transmissions that currently utilize data links:

- ☐ J1587 - Allison World Transmissions
- ☐ J1939 Eaton, Allison
- ☐ J1922 Ceemat
- ☐ Advanced Interface
  - ☐ ESS ™, Rockwell - Refer to ESS Troubleshooting Manual
  - ☐ Top2, Eaton - Refer to MISC Output Troubleshooting
- ☐ PWM Signal Type - DDEC provides a PWM signal that is used by the transmission or its components

10.15.2 Verify Transmission Type

Perform the following steps to check the transmission type.

1. Turn ignition ON.
2. Plug in DDR.
3. Check transmission origination.
   [a] If a manual transmission, Allison hydraulic, Allison Electronic, Voith, ZF, refer to section 10.15.3.

   [b] If a J 1939/autoshift, Allison WT, Rockwell RXX-X, refer to the troubleshooting guide of the transmission manufacturer to troubleshoot the fault.

   [c] If the transmission type does not match the transmission correctly, reprogram and refer to section 10.15.4.

10.15.3 Review PWM #1 Signal

Perform the following steps to check the DDR for codes.

1. Perform road test with assistant.
2. Plug in DDR.
3. Watch PWM #1 signal.
   [a] If the PWM varies with the load changes, Alison Electric, Voith or ZF, the signal is normal. Review the wiring or transmission.

   [b] If the PWM signal is 0% or 100% when the signal is for Allison Hydraulic with load changes, the program is normal. Review the transmission, wiring or relay. Refer to section 10.15.4.

10.15.4 Verify Repairs

Perform the following steps to verify repairs. Start with the Menu Selection. An assistant is needed for the following procedure.

1. Perform road test.
   - [a] If the problem is resolved, troubleshooting is complete.
   - [b] If the problem still exists, contact the OEM or transmission supplier. The steps that led you here do not indicate a problem with the PWM #2 output or output wire. Verify the correct configuration. Refer to the *DDEC Application and Installation* manual, 7SA800, for the appropriate engine.

11 FLASH CODE 11 - VSG LOW

11.1 DESCRIPTION OF FLASH CODE 11

Flash Code 11 indicates that the Variable Speed Governor (VSG) input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage. This diagnostic condition is typically:

- ☐ Open sensor signal circuit (No VSG throttle control installed.)
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to the sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to sensor return circuit or to ground (This condition will result in numerous sensor codes.)

11.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 11

The SAE J 1587 equivalent code for Flash Code 11 is p 187 4, Variable Speed Governor (VSG) input low.

11.3 TROUBLESHOOTING FLASH CODE 11

The following procedure will troubleshoot Flash Code 11.

11.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in DDR.
3. Read active codes.
   - [a] If code 187/4 is logged and there are no VSG controls used, call DDC with the engine serial number to determine if re-calibration is necessary.
   - [b] If code 187/4 was logged and there are VSG controls used primarily, refer to section 11.3.2.
   - [c] If flash codes 100/4 and 91/4 were logged, refer to section 91.2.

11.3.2 Sensor Wiring Check

Perform the following steps to check the sensor and wiring:

1. Turn ignition OFF.
2. Disconnect VSG throttle sensor connector.
3. Install a jumper wire between sockets B (#510 signal) and C (5V-#916) of the VSG harness connector. See Figure 11-1.

NOTE:
Cavities of throttle controls may vary depending on the OEM.

4. Turn ignition ON.
5. Enable VSG throttle. Refer to OEM guidelines.
6. Read DDR for active codes.
   - [a] If active code 187/3 and any other codes are logged, refer to section 11.3.3.

[b] If active code 187/4 and any other codes are logged, refer to section 11.3.6.

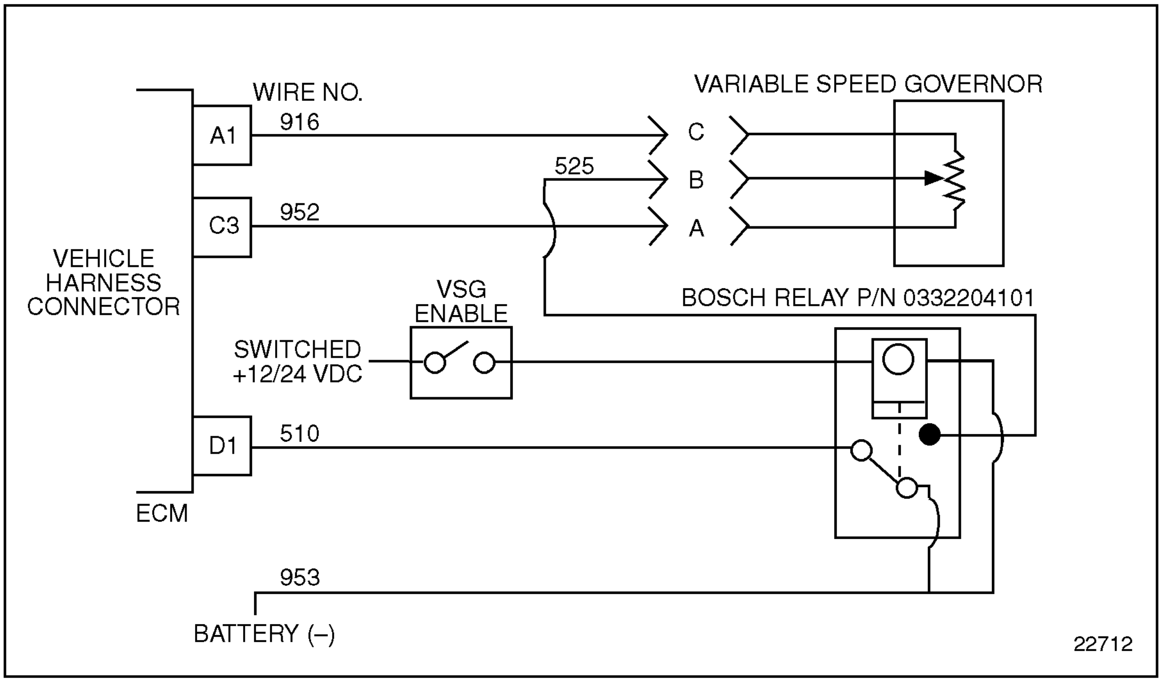


Figure 11-1 Variable Speed Governor Circuit

11.3.3 Check Hand Throttle Sensor Adjustment

Perform the following steps to check the hand throttle sensor:

1. Remove jumper and reconnect hand throttle sensor.
2. Turn ignition ON.
3. Plug in DDR.
4. Select VSG COUNTS on the DDR.
5. Enable VSG. Set to idle position.
6. Read counts.
   [a] If the count value set at idle (minimum throttle) is greater than 48 counts, refer to section 11.3.5.
   [b] If the count value set at idle (minimum throttle) is less than 48 counts, refer to section 11.3.4.

11.3.4 Adjust Hand Throttle Sensor

Perform the following steps to adjust the hand throttle sensor:

1. Turn ignition OFF.

2. If a variable hand throttle sensor is installed, adjust idle position (low-speed) stops on the hand throttle sensor.
3. If fixed resistors are installed, replace with new resistors. (Minimum counts MUST be greater than 48.)
4. Turn ignition ON.
5. Read VSG counts with throttle at low-speed position.
   - [a] If the idle count reading is greater than 48 counts, refer to section 11.3.12.
   - [b] If the idle count reading is less than 48 counts, refer to section 11.3.5.

11.3.5 Check Hand Throttle Sensor Connectors

Perform the following steps to check the hand throttle sensor connectors.

1. Turn ignition OFF.
2. Inspect the terminals at the hand throttle sensor connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets. See Figure 11-2.
   - [a] If the terminals and connectors are not damaged, replace hand throttle sensor. Refer to section 11.3.12.
   - [b] If the terminals and connectors are damaged, repair as necessary. Refer to section 11.3.12.

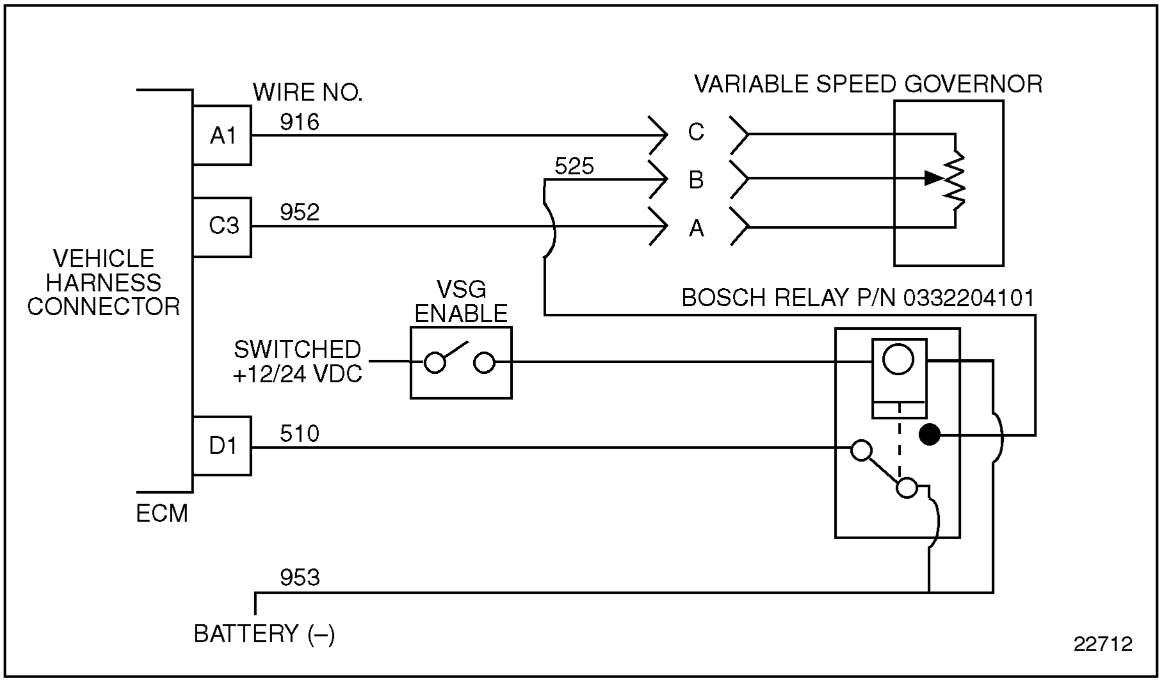


Figure 11-2 Variable Speed Governor Circuit

11.3.6 Check for +5 volts

Perform the following steps to check for +5 volts:

1. Turn ignition ON.
2. Enable VSG. Refer to OEM guidelines.
3. Measure voltage on the hand throttle sensor harness connector, socket C (5V #916, red lead) to socket A (return #952, black lead). See Figure 11-3.
   - [a] If the voltage reading is between 4 to 6 volts, refer to section 11.3.7.
   - [b] If the voltage reading is greater than 6 volts, refer to section 12.1.
   - [c] If the voltage reading is less than 4 volts, refer to section 11.3.10.

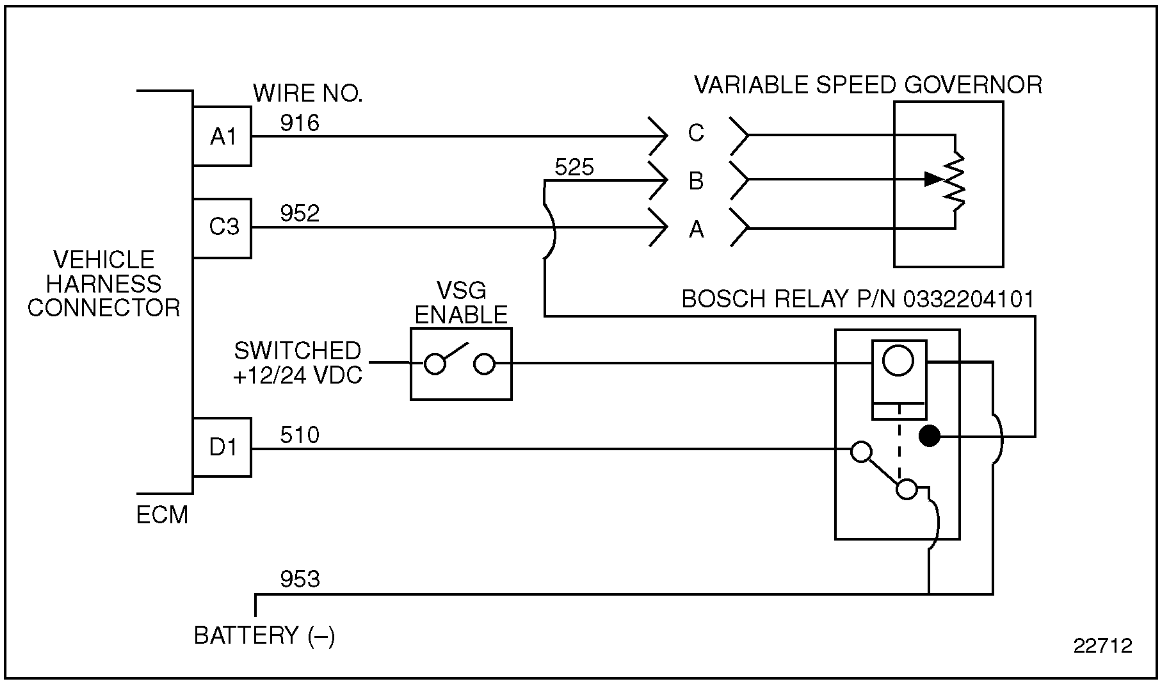


Figure 11-3 Variable Speed Governor Circuit

11.3.7 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Enable VSG. Refer to OEM guidelines.
4. Measure resistance between sockets A (return #952) and B (signal #525) on the hand throttle sensor harness connector. For VSG circuit, see Figure 11-4.
   - [a] If the resistance is greater than 1,000 Ω or open, refer to section 11.3.8.

[b] If the resistance is less than or equal to 1,000 Ω, the signal line #525 is shorted to the return line. Repair the short. Refer to section 11.3.12.

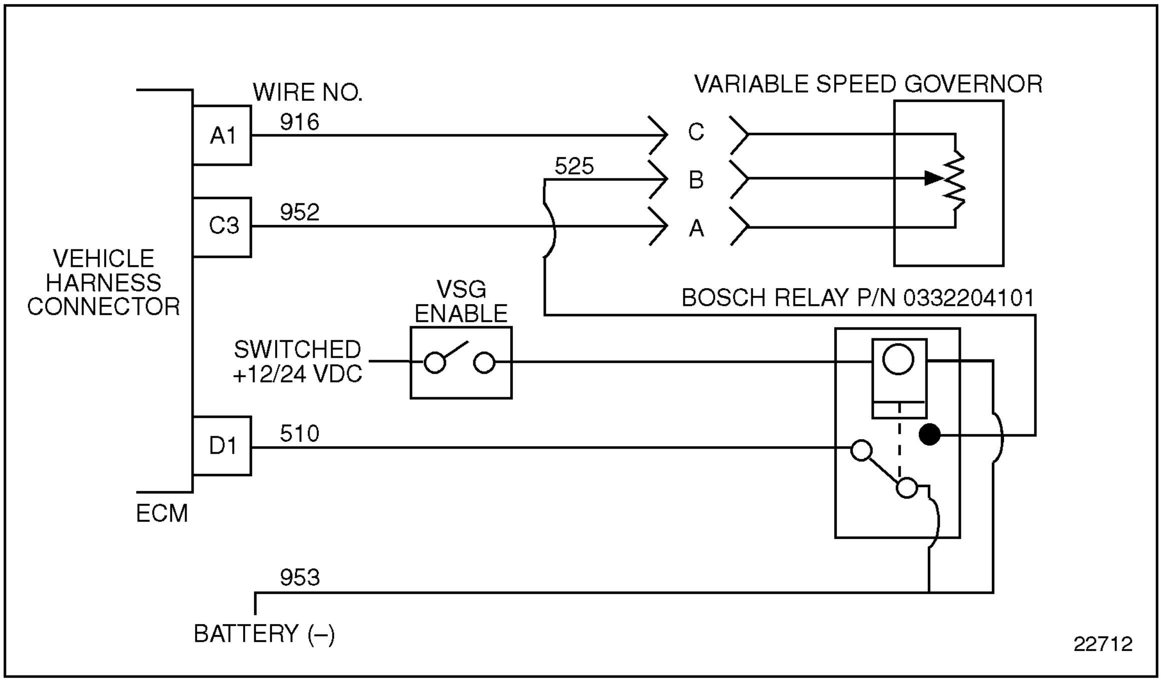


Figure 11-4 Variable Speed Governor Circuit

11.3.8 Check for Open Signal

Perform the following steps to check for open signal:

1. Install a jumper wire between sockets A and B of the hand throttle sensor harness connector. See Figure 11-4.
2. Enable VSG. Refer to OEM guidelines.
3. Measure resistance between sockets D1 (#510) and C3 (#952) on the vehicle harness connector.

   [a] If the resistance is less than or equal to 5 Ω, refer to section 11.3.9.

   [b] If the resistance is greater than 5 Ω or open and the signal line (#510) or return line (#952) is open, repair the open. Refer to section 11.3.12.

11.3.9 Check ECM Connectors

Perform the following steps to check for signal open:

1. Check terminals at the ECM vehicle harness connector (both the ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 11-5.

   [a] If the terminals and connectors are damaged, repair the terminals, connectors, or both. Refer to section 11.3.12.

[b] If the terminals and connectors are not damaged, contact DDC Technical Service. Refer to section 11.3.12.

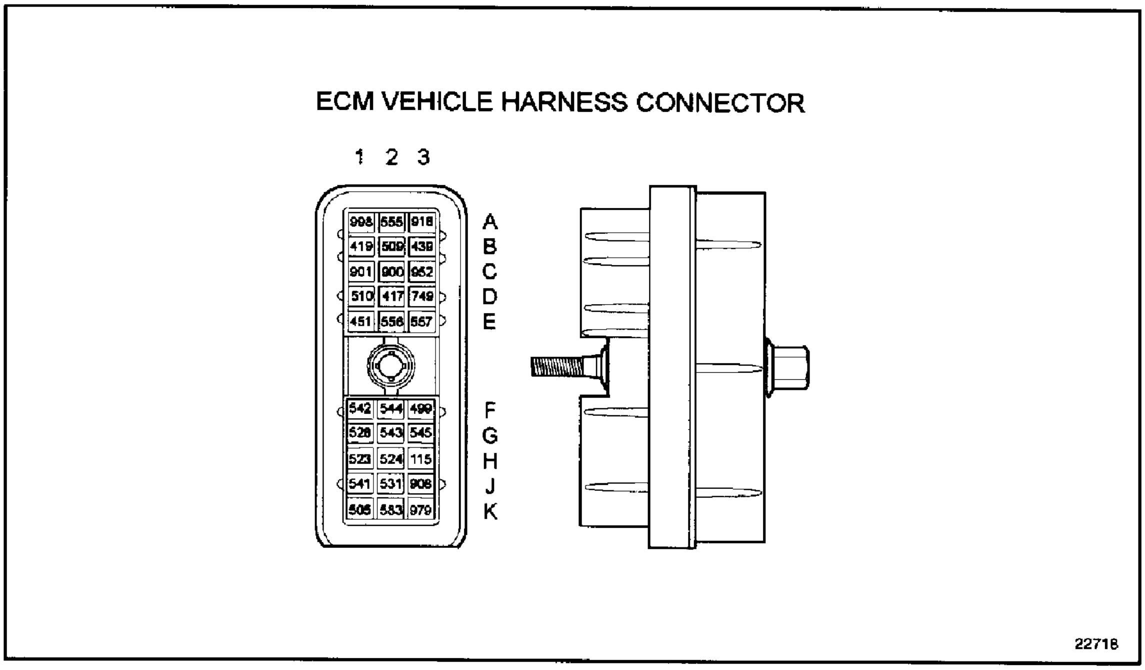


Figure 11-5 Electronic Control Module Vehicle Harness Connector

11.3.10 Check for Short to 5 Volt

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Disconnect the connector at the hand throttle sensor.
4. Measure resistance between sockets A and C on the hand throttle sensor harness connector. See Figure 11-6.

   [a] If the resistance measurement is greater than 1,000 Ω, refer to section 11.3.11.

[b] If the resistance measurement is less than or equal to 1,000 Ω, the vehicle +5 volt line (#916) is shorted to the return line (#952). Repair short. Refer to section 11.3.12.

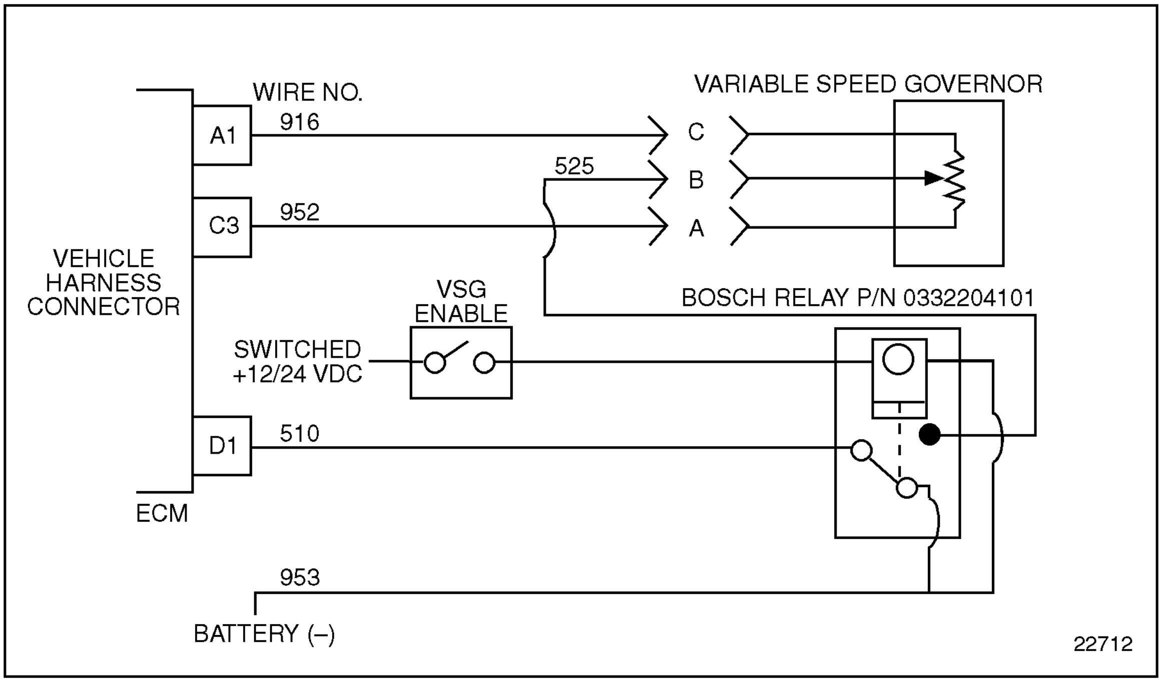


Figure 11-6 Variable Speed Governor Circuit

11.3.11 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line.

1. Install a jumper wire between sockets A and C of the hand throttle sensor harness connector. See Figure 11-6.
2. Measure resistance between sockets A3 (#916) and C3 (#952) on the vehicle connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 11.3.9.
   [b] If the resistance measurement is greater than 5 Ω, or open, the vehicle +5 volt line (#916) is open. Repair open. Refer to section 11.3.12.

11.3.12 Verify Repair

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.

6. Stop engine.
7. Check for logged codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 187/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 187/4 is logged, and other codes are logged, systems diagnostics are complete. Please review this section from the first step to find the error. Refer to section 11.3.1.

12 FLASH CODE 12 - VSG HIGH

12.1 DESCRIPTION OF FLASH CODE 12

Flash Code 12 indicates that the Variable Speed Governor (VSG) input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage. This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Throttle sensor not adjusted properly at full throttle

12.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 12

The SAE J1587 equivalent code for Flash Code 12 is p 187 3, Variable Speed Governor (VSG) input high.

12.3 TROUBLESHOOTING FLASH CODE 12

The following procedure will troubleshoot Flash Code 12.

12.3.1 Multiple Code Check

Perform the following steps to check for multiple codes:

1. Turn ignition ON. (For VSG circuit, see Figure 12-1.)
2. Plug in DDR.
   [a] If active code 187/3 and any other codes except 91/3 or 100/3 are logged, refer to section 12.3.2.
   [b] If active code 187/3 and codes 91/3 or 100/3 are logged, refer to section 91.2.

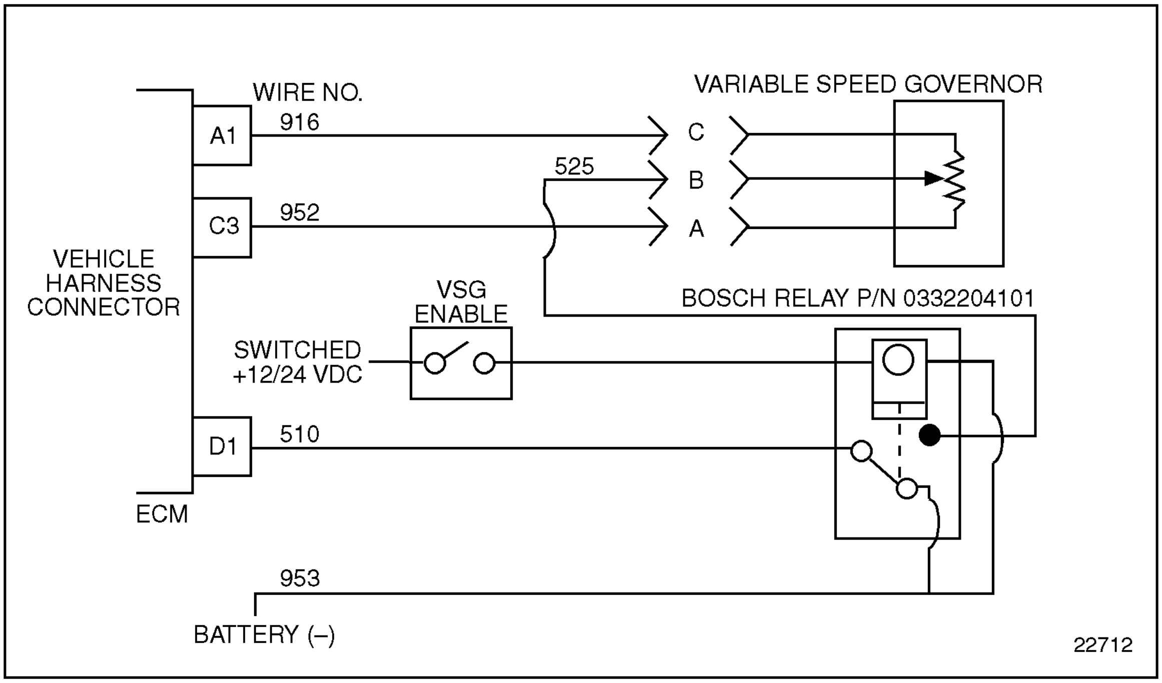


Figure 12-1 Variable Speed Governor Circuit

12.3.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Unplug the VSG throttle connector. (For VSG circuit, see Figure 12-1.)
3. Turn ignition ON.
4. Read active codes.

[a] If active code 187/4 is logged, and code 187/3 only occurs when the throttle is moved at or near full throttle (when connected), refer to section 12.3.3.

[b] If active code 187/3 is logged, and the code appears when the throttle is not at or near full throttle (when connected), refer to section 12.3.4.

12.3.3 Check Calibration

Perform these additional steps to check the calibration of the sensor:

1. Plug in the VSG throttle connector.
2. Turn ignition ON.
3. Plug in DDR.
4. Display VSG counts.
5. Dial throttle to Full Throttle.

   [a] If the VSG counts are greater than 968, adjust the maximum throttle travel. If not adjustable, replace the throttle control.

   [b] If the VSG counts are less than 968, refer to section 12.3.4.

12.3.4 Return Circuit Check

Perform these steps to check the return circuit:

1. Place the transmission in neutral.
2. Turn ignition OFF.
3. Install a jumper wire between pin A (return #952) and pin B (signal #510/525) of the VSG throttle harness connector.
4. Disconnect the vehicle harness connector at the ECM.
5. Enable VSG control. (This may require the ignition be turned on.)
6. Measure resistance between sockets C3 (#952) and D1 (#510) on the vehicle harness connector. See Figure 12-2.

   [a] If the resistance is less than or equal to 5 Ω, refer to section 12.3.5.

[b] If the resistance is greater than 5 Ω , the return line (#952) is open, repair the open. Refer to section 12.3.8.

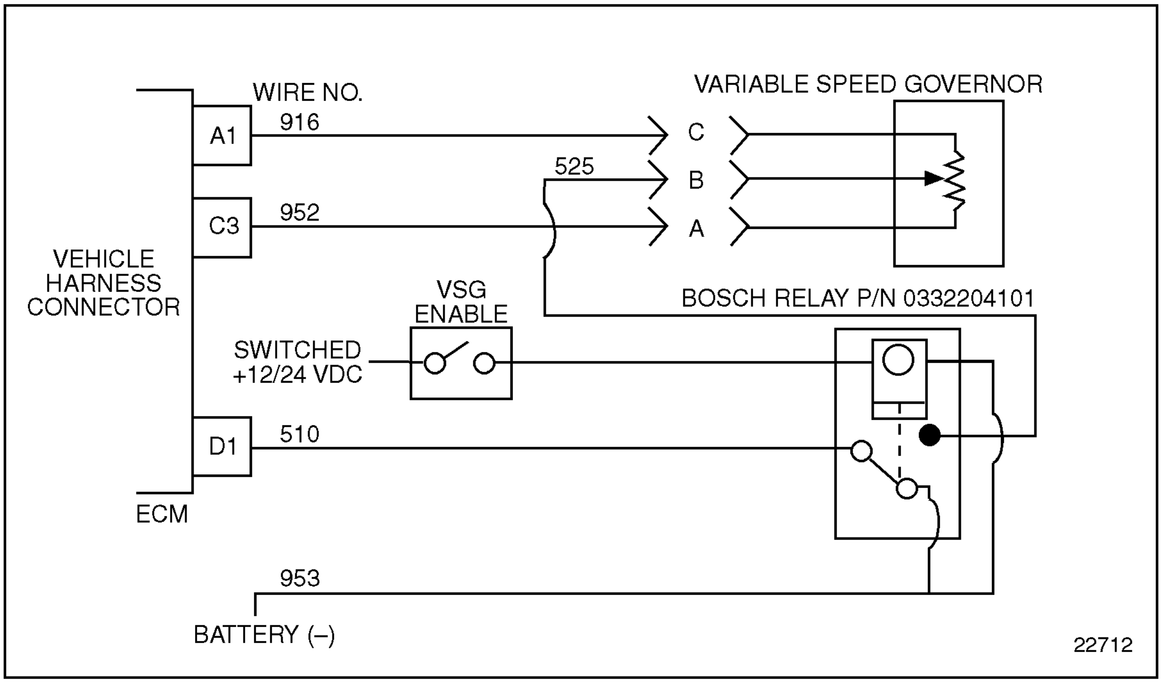


Figure 12-2 Typical Variable Speed Governor Circuit

12.3.5 Variable Speed Governor Throttle Connector Check

Perform these steps to check the VSG throttle connectors:

1. Inspect terminals at the VSG connectors (sensor side and harness side) for bent, corroded and unseated pins or sockets.

   [a] If the VSG connector terminals are damaged, repair terminals and/or connectors. Refer to section 12.3.8.

   [b] If the VSG connector terminals are in good condition with no signs of damage, refer to section 12.3.6.

12.3.6 Check for Short to Battery (+)

Perform these steps to check for short to battery (+).

1. Turn ignition OFF.
2. Unplug VSG connector.
3. Turn ignition ON.
4. Measure voltage between B (signal #525/#510) and battery ground. See Figure 12-3.

   [a] If measured voltage is less than or equal to 0.2 volts, refer to section 12.3.7.

[b] If measured voltage is greater than 0.2 volts, signal wire is shorted to 12/24 volt source. Repair or replace #510/#525 circuit. Refer to section 12.3.8.

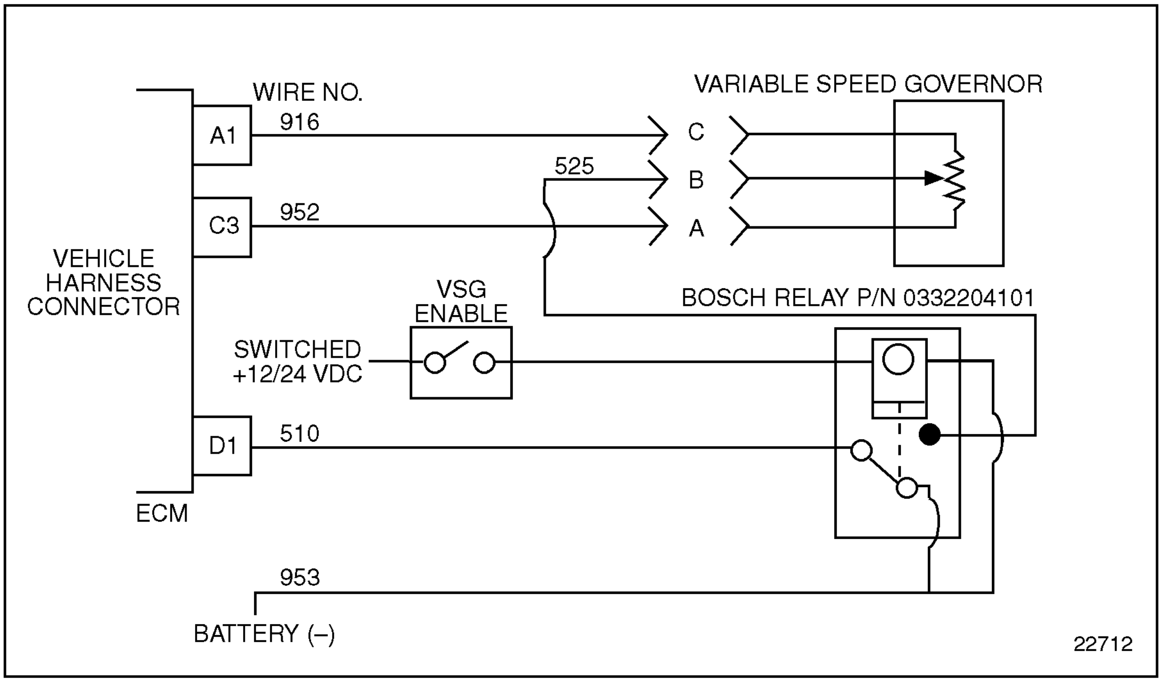


Figure 12-3 Variable Speed Governor Circuit

12.3.7 Check for Short

To check for short, perform the following:

1. Turn ignition OFF.
2. Unplug vehicle 30-pin connector and the VSG connector.
3. Turn ignition ON.
4. Enable VSG. Refer to OEM guidelines.
5. Measure resistance between A3 (#916) and D1 (#510). See Figure 12-4.

   [a] If resistance is greater than 5 Ω, check ECM connector. Refer to section 12.3.8.

[b] If resistance is less than 5 Ω, wire #916 (5-volt supply) is shorted to #510/#525 (signal). Repair short or replace wire. Refer to section 12.3.8 to verify repairs.

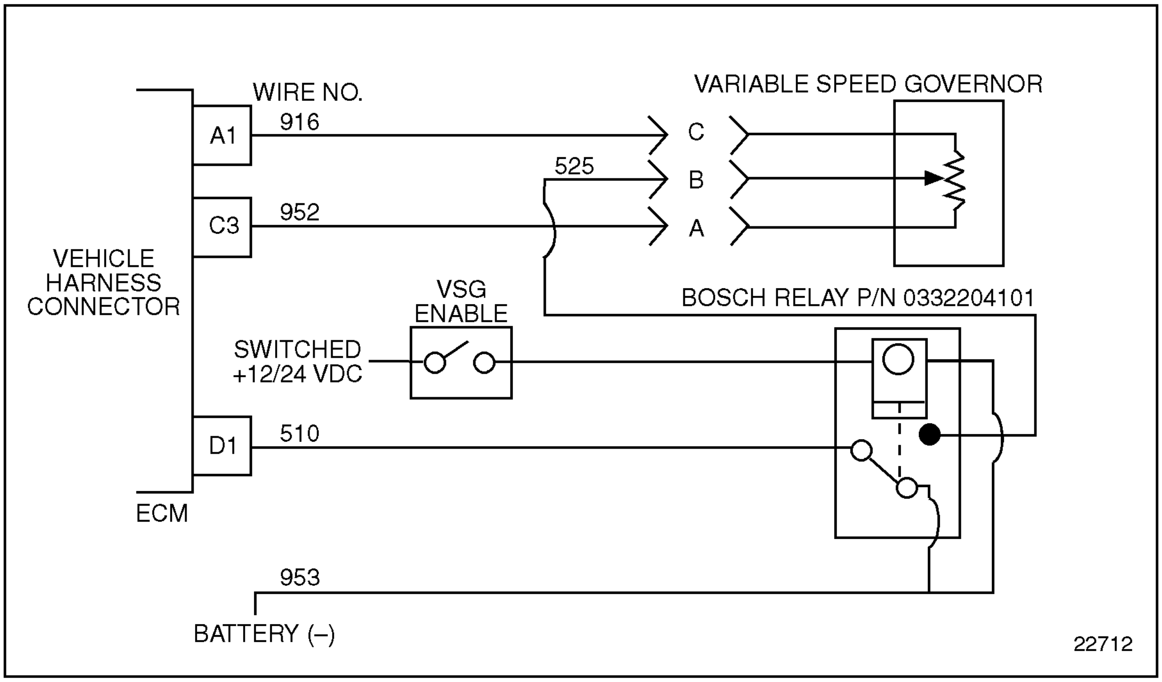


Figure 12-4 Variable Speed Governor Circuit

12.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Set parking brake, transmission in Neutral.
4. Turn ignition ON.
5. Clear codes.
6. Start and run the engine for one minute.
7. Stop engine.
8. Check DDR for codes.

   [a] If no codes are displayed, no further troubleshooting is required.

   [b] If code 187/3 is not logged, and other codes are logged, refer to section 9.1.

   [c] If code 187/3 is logged, and other codes are logged, refer to section 12.3.1.

13 (CHG) FLASH CODE 13 - CLS LOW

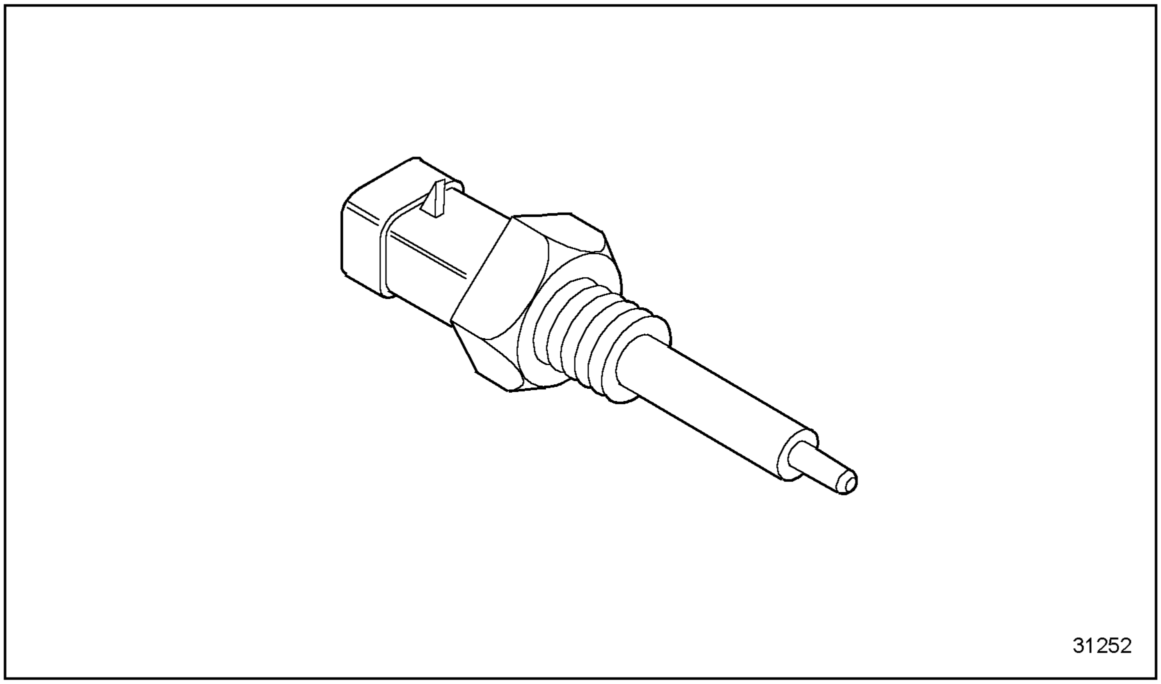


Figure 13-1 Coolant Level Sensor

13.1 DESCRIPTION OF FLASH CODE 13

Flash Code 13 indicates that the Coolant Level Sensor (CLS) input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage. See Figure 13-1. This diagnostic condition is typically:

- ☐ Sensor signal is shorted to the sensor return circuit or to ground
- ☐ Deteriorated coolant

13.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 13

The SAE J1587 equivalent code for Flash Code 13 is p 111 4, coolant level circuit low.

13.3 TROUBLESHOOTING FLASH CODE 13

The following procedure will troubleshoot Flash Code 13.

13.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect Coolant Level Sensor (CLS).
3. Turn ignition ON.
4. Start engine.
5. Read logged codes.
6. Stop engine.
   [a] If code P111/3 is logged, refer to section 13.3.2.
   [b] If code P111/4 is logged, refer to section 13.3.3.

13.3.2 Check Coolant Level Sensor Connector

Perform the following steps to check the CLS connector.

1. Inspect terminals at the CLS connector for bent, corroded and unseated pins or sockets. Ensure wires are not reversed at the CLS. See Figure 13-2.
   [a] If terminals and connectors are damaged, repair both. Refer to section 13.3.4.

[b] If terminals and connectors are not damaged, replace the CLS. Refer to section 13.3.4.

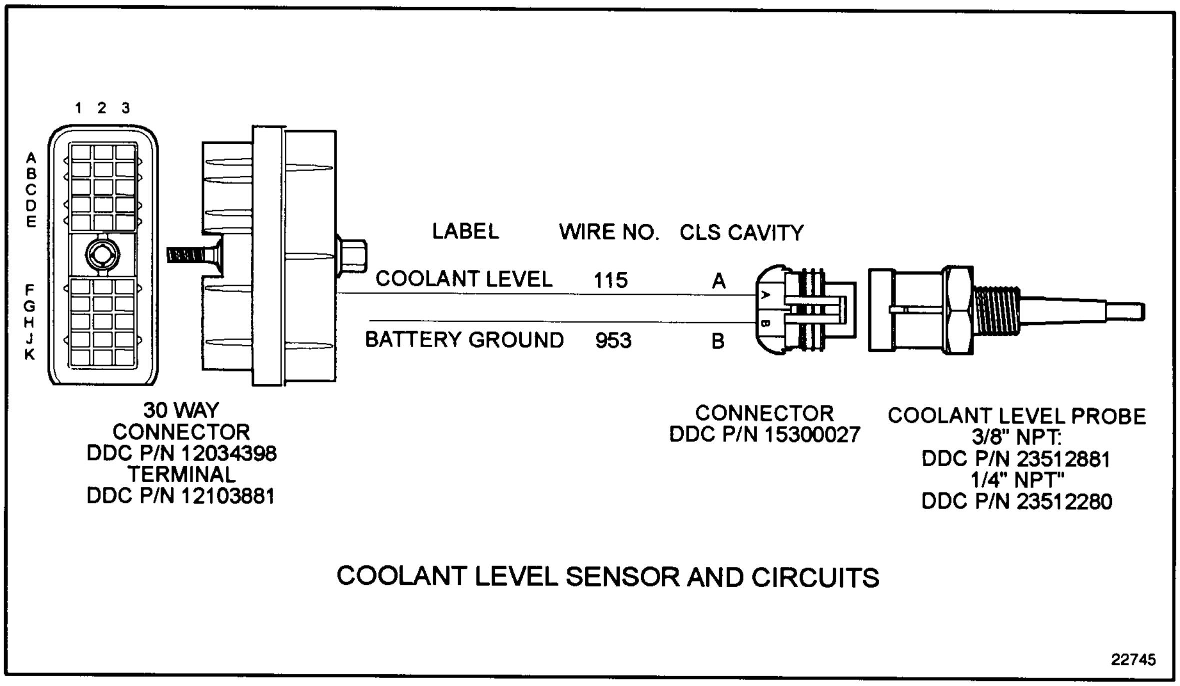


Figure 13-2 Coolant Level Sensor and Circuits

13.3.3 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A and B on the CLS harness connector. Also measure resistance between socket A and battery ground; and socket A and chassis ground. See Figure 13-2.
   [a] If the resistance is greater than 10,000 Ω or open, refer to section 13.3.2.
   [b] If the resistance is less than or equal to 10,000 Ω, the signal wire (#115) is shorted to the ground (#953), or to chassis ground. Repair short; refer to section 13.3.4.

13.3.4 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.

5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are displayed, troubleshooting is complete.
   [b] If code 111/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 111/4 is logged, refer to section 13.3.5.

13.3.5 Code 111/4 Logged

Perform the following steps to troubleshoot Code 111/4.

1. Remove CLS.
2. Plug opening.
3. Locate sensor probe in clean water.
4. Start and run the engine for one minute.
5. Check DDR for codes.
   [a] If code 111/4 is logged, all system diagnostics are complete. Review this section to find the error. Refer to section 13.3.1.
   [b] If code 111/4 is not logged, reprogram the ECM and replace the coolant with new. Repeat the test. Refer to section 13.3.4.

14 (CHG) FLASH CODE 14 - TEMP SENSOR HIGH

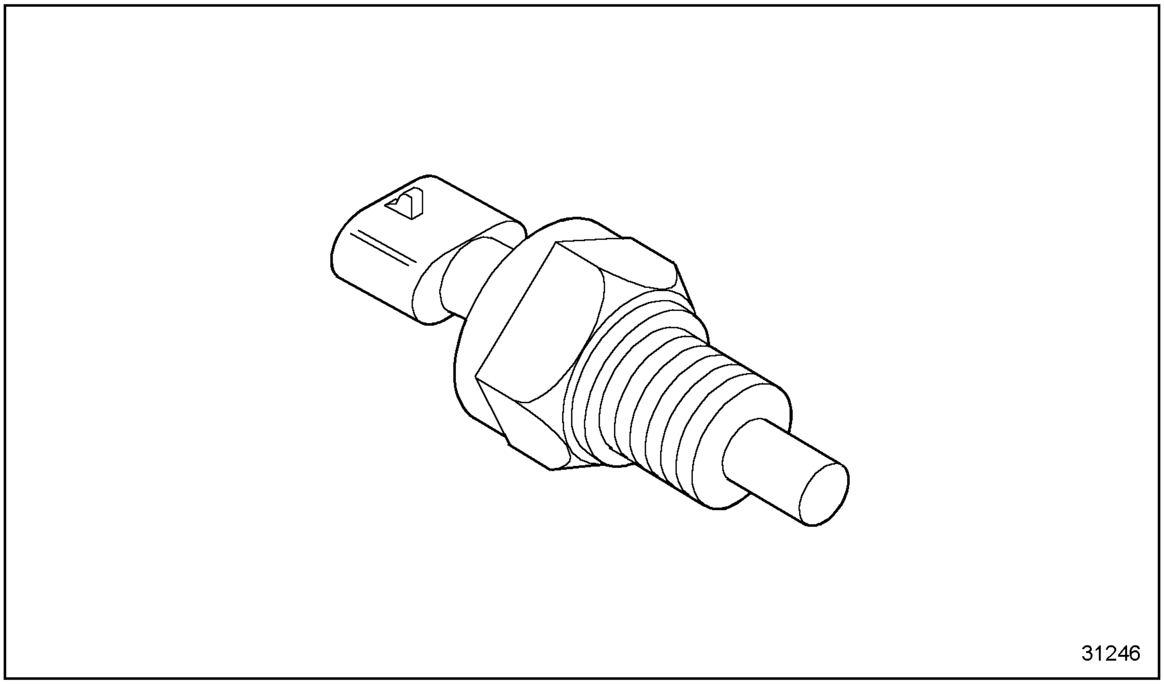


Figure 14-1 Coolant Temperature Sensor (Oil Temperature Sensor similar)

14.1 DESCRIPTION OF FLASH CODE 14

Flash Code 14 indicates that the engine Coolant Temperature Sensor (CTS) or Oil Temperature Sensor (OTS), See Figure 14-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor return circuit

14.2 SAE J1587 EQUIVALENT CODES FOR FLASH CODE 14

The SAE J1587 equivalent codes for Flash Code 14 are:

- ☐ p 110 3 - coolant temperature circuit high
- ☐ p 175 3 - oil temperature circuit high

14.3 TROUBLESHOOTING FLASH CODE 14

The following procedure will troubleshoot Flash Code 14.

14.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic data reader (DDR) and determine which code is logged.
   [a] If codes PID 110-FMI 3 is logged, refer to section 14.3.2.
   [b] If codes PID 175-FMI 3 is logged, refer to section 14.3.3.

14.3.2 Coolant Temperature Sensor Check

Perform the following steps to check the coolant temperature sensor (CTS).

1. Turn vehicle ignition OFF.
2. Disconnect CTS and install a jumper between the CTS connector sockets A and B. See Figure 14-2.
3. Turn vehicle ignition ON.
4. Read active codes.
   [a] If code 110/4 or any other codes except 110/3 are logged, refer to section 14.3.8.

[b] If code 110/3 is logged and any codes except code 110/4 are logged, refer to section 14.3.4.

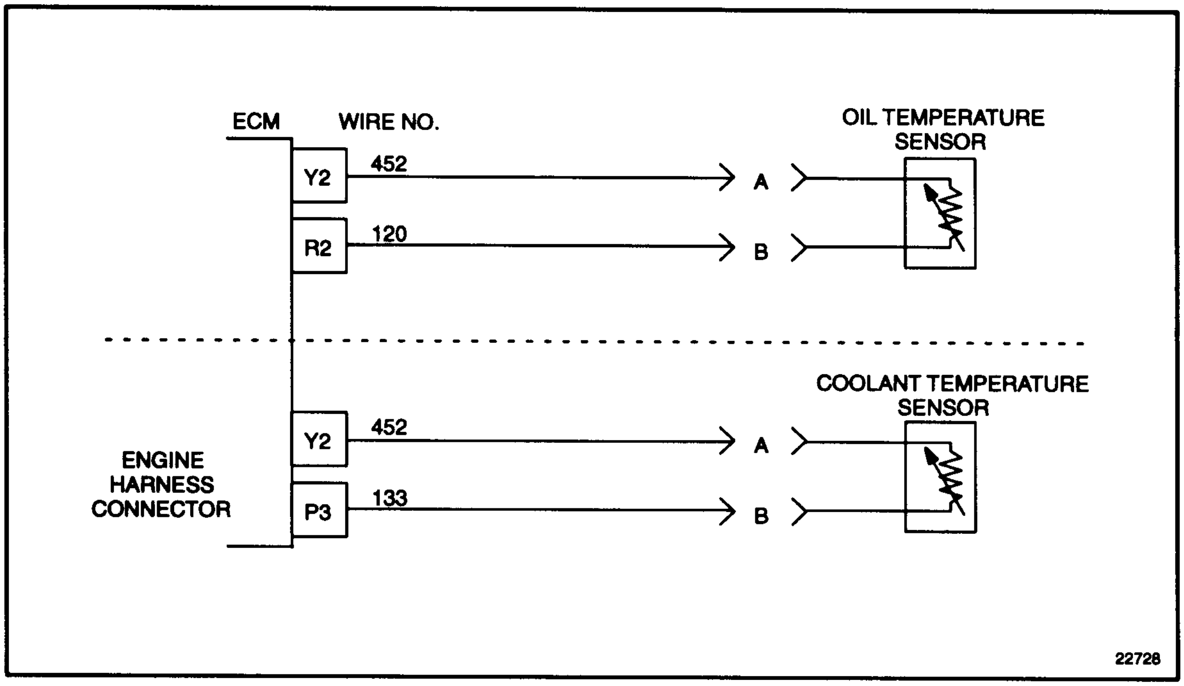


Figure 14-2 Temperature Sensor Circuits

14.3.3 Oil Temperature Sensor Check

Perform the following steps to check the oil temperature sensor (OTS).

1. Turn vehicle ignition OFF.
2. Disconnect OTS and install a jumper between OTS connector sockets A and B. See Figure 14-3.
3. Turn ignition ON.
4. Read active codes.

   [a] If code 175/4 is logged, refer to section 14.3.9.

[b] If code 175/3 is logged and any codes except code 175/4 are logged, refer to section 14.3.5.

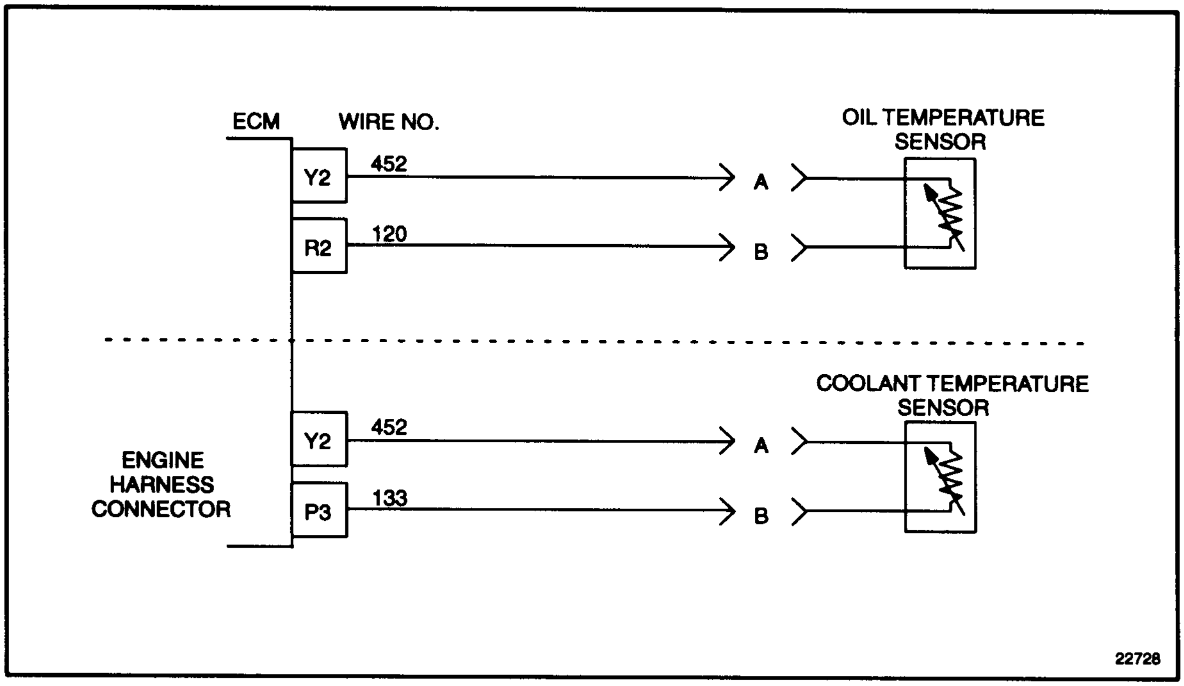


Figure 14-3 Temperature Sensor Circuits

14.3.4 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets P3 #133 and W1 #416 on the engine harness connector. See Figure 14-4.

   [a] If the resistance measurement is greater than 5 Ω or open, refer to section 14.3.6.

[b] If the resistance measurement is less than or equal to 5 Ω, the signal line (#133) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 14.3.11.

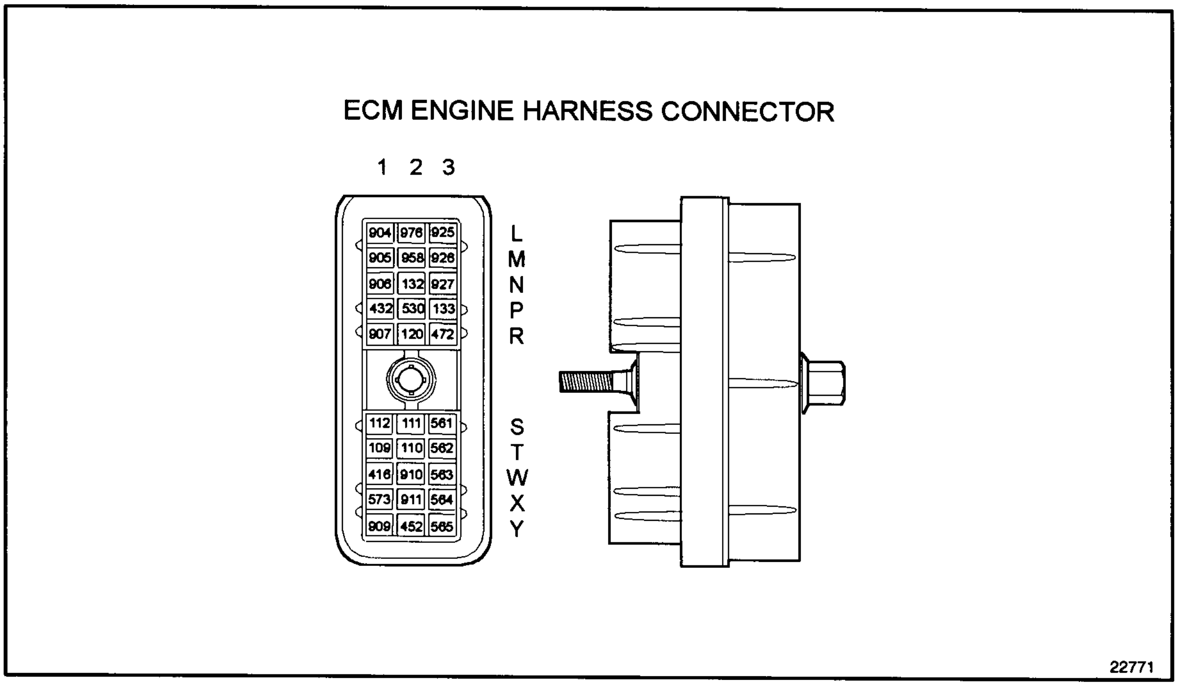


Figure 14-4 ECM Engine Harness Connector

14.3.5 Check for Signal Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets R2 #120 and W1 #416 on the engine harness connector. See Figure 14-4.

   [a] If the resistance measurement is greater than or equal to 5 Ω, refer to section 14.3.7.

   [b] If the resistance measurement is less than 5 Ω, the signal line (#120) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 14.3.11.

14.3.6 Check Coolant Temperature Sensor Connectors

Perform the following steps to check the CTS connectors.

1. Check terminals at the CTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 14-5.

[a] If terminals and connectors are in good condition, replace the CTS. Refer to section 14.3.11.

[b] If the terminals and connectors are damaged, repair them. Refer to section 14.3.11.

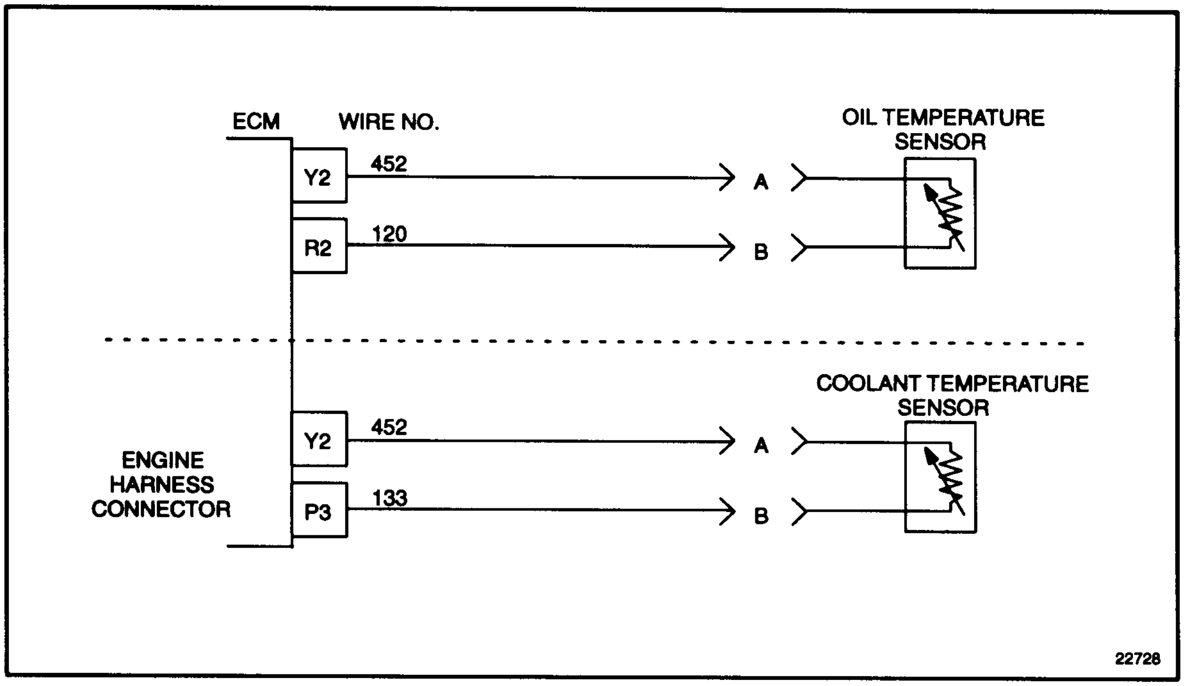


Figure 14-5 Temperature Sensor Circuits

14.3.7 Check Oil Temperature Sensor Connectors

Perform the following steps to check the OTS connectors.

1. Check terminals at the OTS connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 14-6.

   [a] If terminals or connectors are damaged, repair them. Refer to section 14.3.11.

[b] If terminals and connectors are not damaged, replace the OTS. Refer to section 14.3.11.

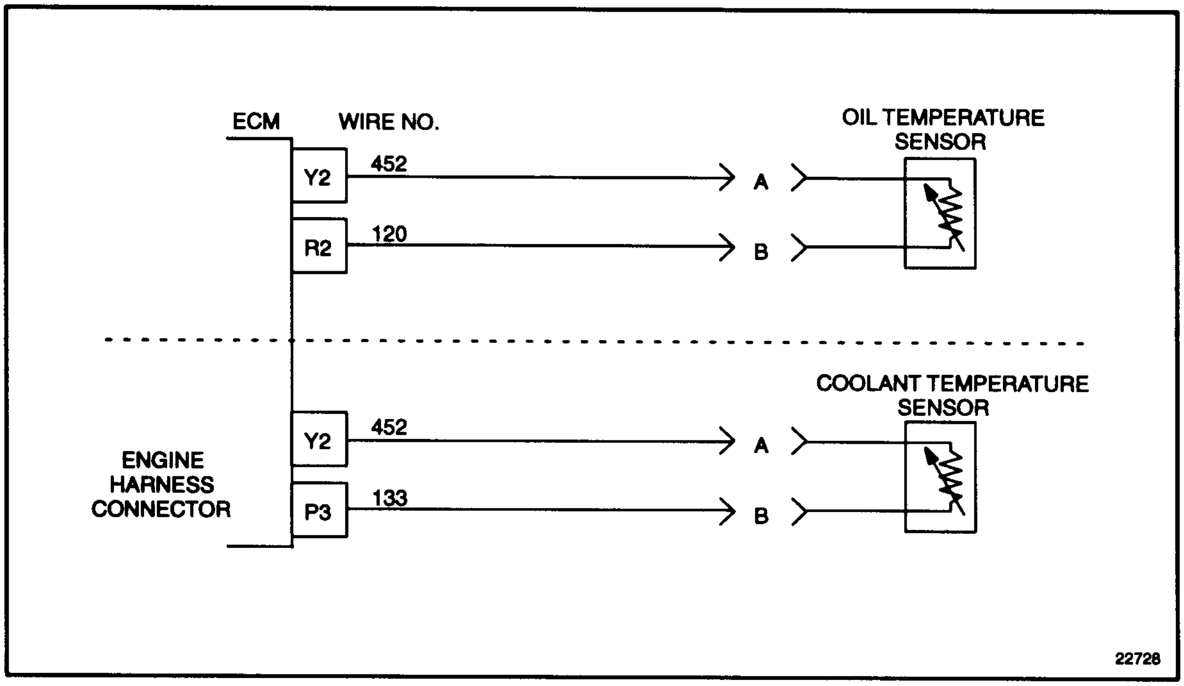


Figure 14-6 Temperature Sensor Circuits

14.3.8 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. Leave the jumper wire between A and B of the Temperature Sensor Connector.
3. Measure resistance between sockets P3 (#133) and Y2 (#452) on the engine harness connector. See Figure 14-7.

   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 14.3.10.

[b] If the resistance measurement is greater than 5 Ω or open, the signal line (#133) or return line (#452) is open. Repair the open. Refer to section 14.3.11.

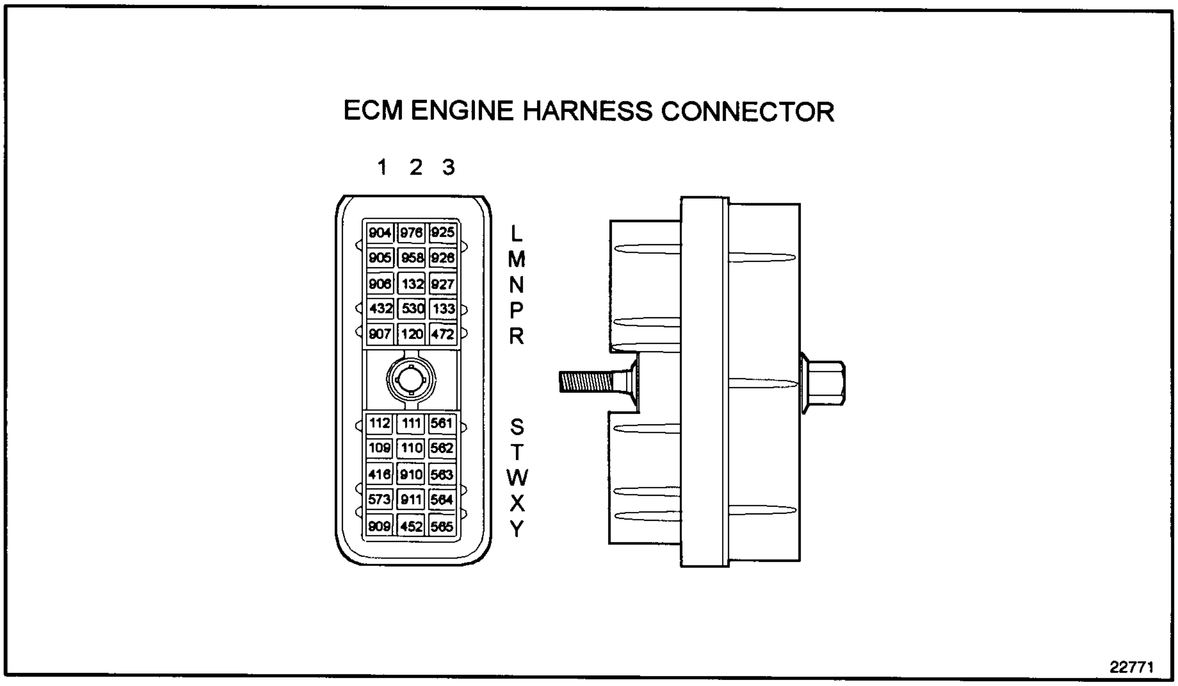


Figure 14-7 ECM Engine Harness Connector

14.3.9 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. Leave the jumper wire between A and B of the Temperature Sensor Connector.
3. Measure resistance between sockets R2 (#120) and Y2 (#452) on the engine harness connector. See Figure 14-7.

   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 14.3.10.

   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#120) or return line (#452) is open. Repair the open. Refer to section 14.3.11.

14.3.10 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 14-8.

   [a] If terminals or connectors are damaged, repair them. Refer to section 14.3.11.

[b] If terminals and connectors are not damaged, replace the CTS/OTS.

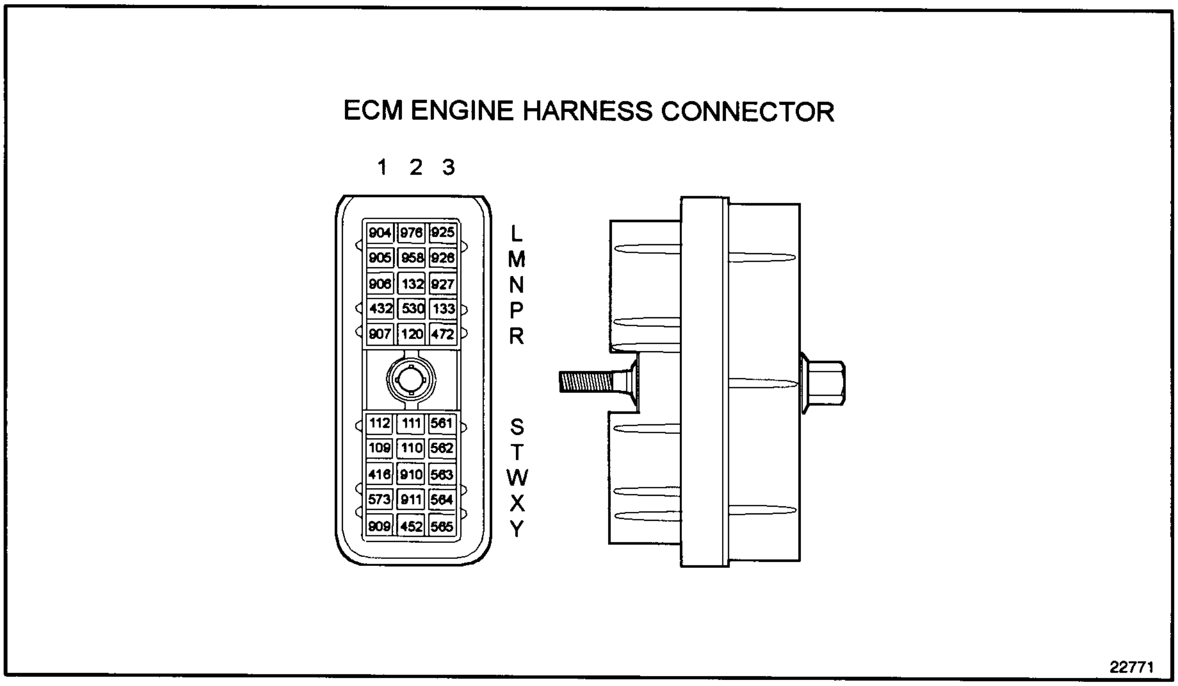


Figure 14-8 ECM Engine Harness Connector

14.3.11 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If code 110/3 or 175/3 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 14.3.1.
   - [c] If any codes except code 110/3 or 175/3 are logged, refer to section 9.1.

15 (CHG) FLASH CODE 15 - TEMP SENSOR LOW

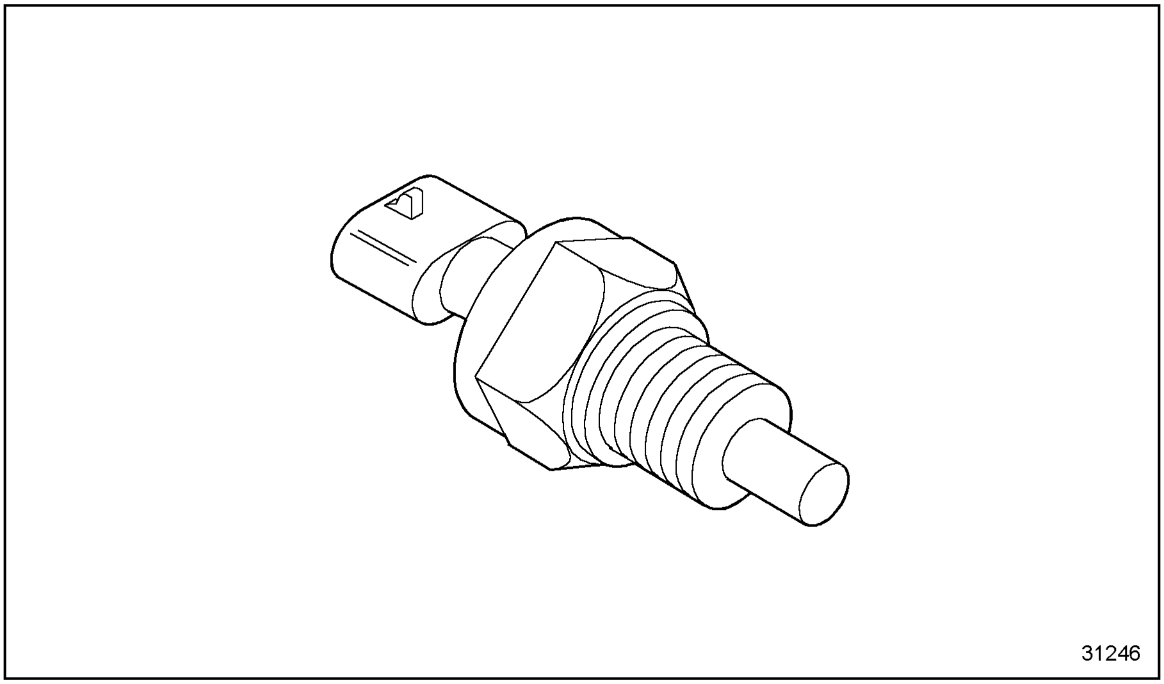


Figure 15-1 Coolant Temperature Sensor (Oil Temperature Sensor similar)

15.1 DESCRIPTION OF FLASH CODE 15

Flash Code 15 indicates that the Coolant Temperature Sensor (CTS), or Oil Temperature Sensor (OTS), see Figure 15-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Sensor signal is shorted to the sensor return circuit or to ground

15.2 SAE J1587 EQUIVALENT CODES FOR FLASH CODE 15

The SAE J1587 equivalent codes for Flash Code 15 are:

- ☐ p 110 4 - coolant temperature circuit low
- ☐ p 175 4 - oil temperature circuit low

15.3 TROUBLESHOOTING FLASH CODE 15

The following procedure will troubleshoot Flash Code 15.

15.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in diagnostic data reader (DDR) and determine which code is logged.
   [a] If codes PID 110-FMI 4 are logged, refer to section 15.3.2.
   [b] If codes PID 175-FMI 4 are logged, refer to section 15.3.3.

15.3.2 Coolant Temperature Sensor Check

Perform the following steps to check the coolant temperature sensor (CTS).

1. Turn vehicle ignition OFF.
2. Disconnect (unplug) CTS connector.
3. Start and run the engine for eight minutes.
4. Read active codes with engine still running.
   [a] If code 110/4 or any other codes are logged, refer to section 15.3.4.
   [b] If any codes except code 110/4 are logged, refer to section 15.3.6.

15.3.3 Oil Temperature Sensor Check

Perform the following steps to check the oil temperature sensor (OTS).

1. Turn vehicle ignition OFF.
2. Disconnect OTS connector. See Figure 15-2.
3. Start and run the engine for eight minutes.
4. Read active codes with engine running.
   [a] If code 175/4 is logged, refer to section 15.3.7.

[b] If any codes except code 175/4 are logged, refer to section 15.3.5.

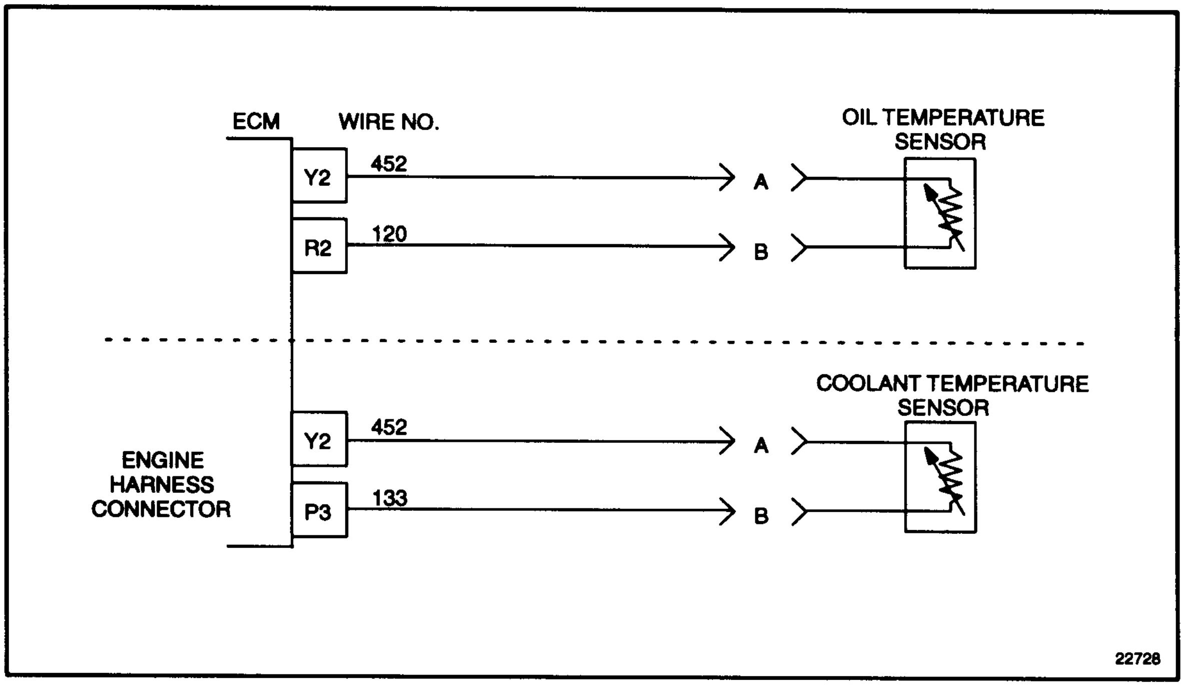


Figure 15-2 Temperature Sensor Circuits

15.3.4 Check Coolant Temperature Sensor Connectors

Perform the following steps to check the CTS connectors.

1. Check terminals at the CTS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 15-3.

   [a] If terminals and connectors are in good condition, replace the CTS. Refer to section 15.3.10.

[b] If the terminals and connectors are damaged, repair them. Refer to section 15.3.10.

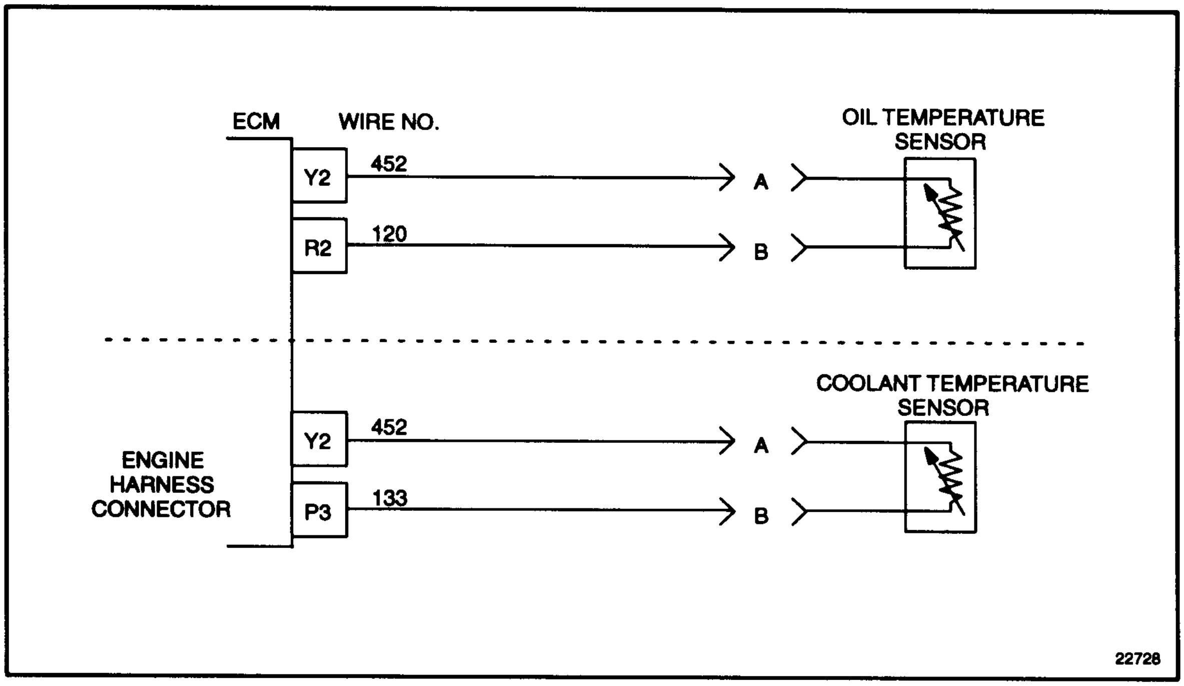


Figure 15-3 Temperature Sensor Circuits

15.3.5 Check Oil Temperature Sensor Connectors

Perform the following steps to check the OTS connectors.

1. Check terminals at the OTS connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 15-4.

    [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.

[b] If terminals and connectors are not damaged, replace the OTS. Refer to section 15.3.10.

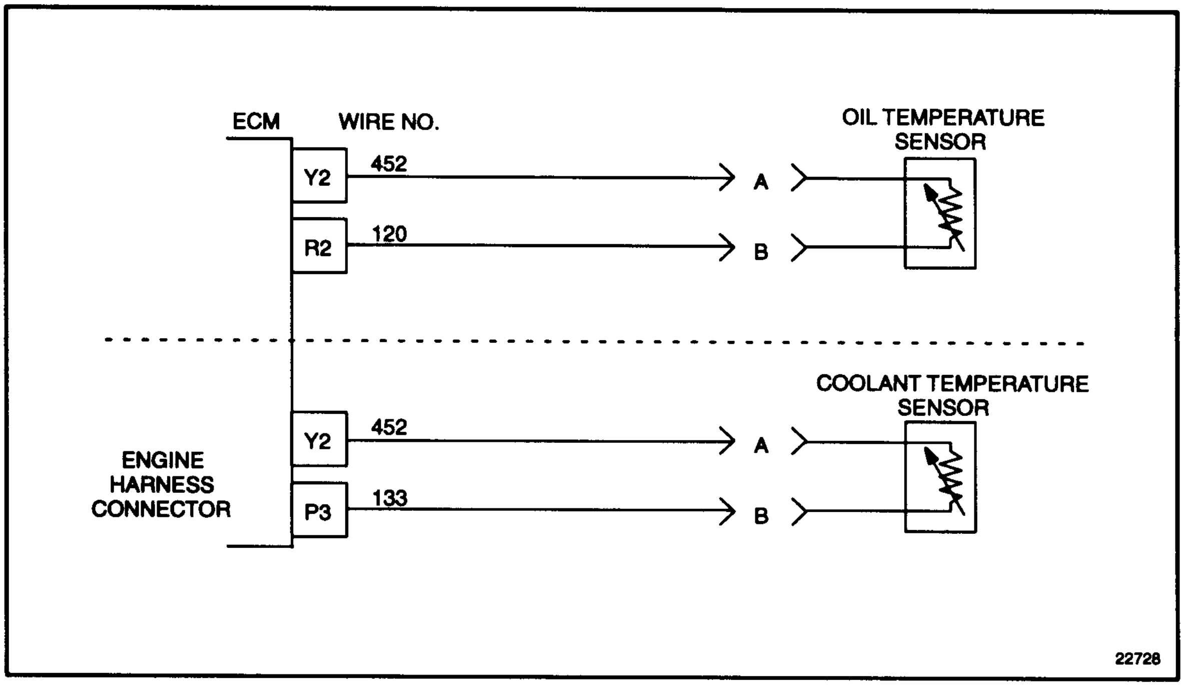


Figure 15-4 Temperature Sensor Circuits

15.3.6 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets P3 (#133) and Y2 (#452) on the engine harness connector. See Figure 15-5.
4. Measure resistance between socket P3 and a good ground.

   [a] If the resistance measurement between sockets P3 and Y2, or P3 and battery ground, is less than or equal to 5 Ω, the signal line (#133) is shorted to the return line (#452) or battery ground. Repair the short. Refer to section 15.3.10.

[b] If the resistance measurement between sockets P3 and Y2 is greater than 5 Ω or open, and the resistance measurement between sockets P3 and a good ground is greater than or equal to 5 Ω or open, refer to section 15.3.8.

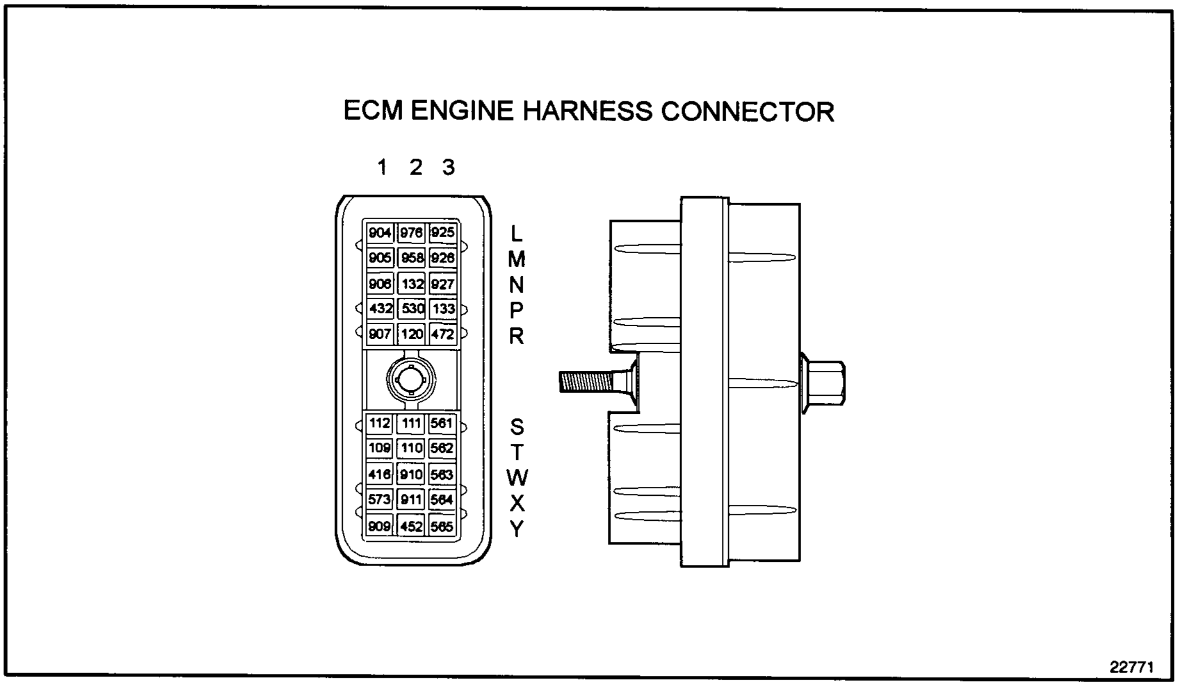


Figure 15-5 ECM Engine Harness Connector

15.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets R2, (#120) and Y2 (#452) on the engine harness connector. See Figure 15-6.
4. Measure resistance between socket R2 and a good ground.

[a] If the resistance measurement between sockets R2 and Y2, or R2 and battery (-) is less than or equal to 5 Ω, the signal line (#120) is shorted to the return line (#452) or battery ground. Repair the short. Refer to section 15.3.10.

[b] If the resistance measurement between socket R2 and Y2 is greater than 5 Ω or open, and the resistance measurement between socket R2 and a good ground is greater than or equal to 5 Ω or open, refer to section 15.3.9.

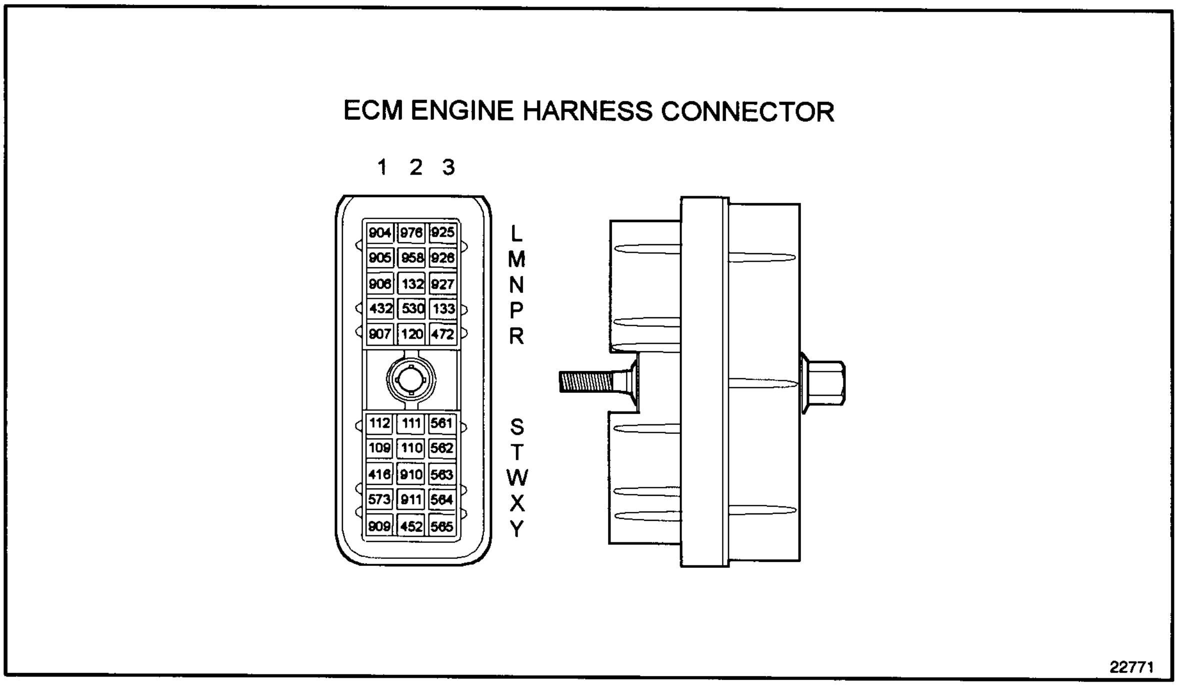


Figure 15-6 ECM Engine Harness Connector

15.3.8 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals P3 and Y2 of the ECM connector. See Figure 15-7.

   [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.

[b] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 15.3.10.

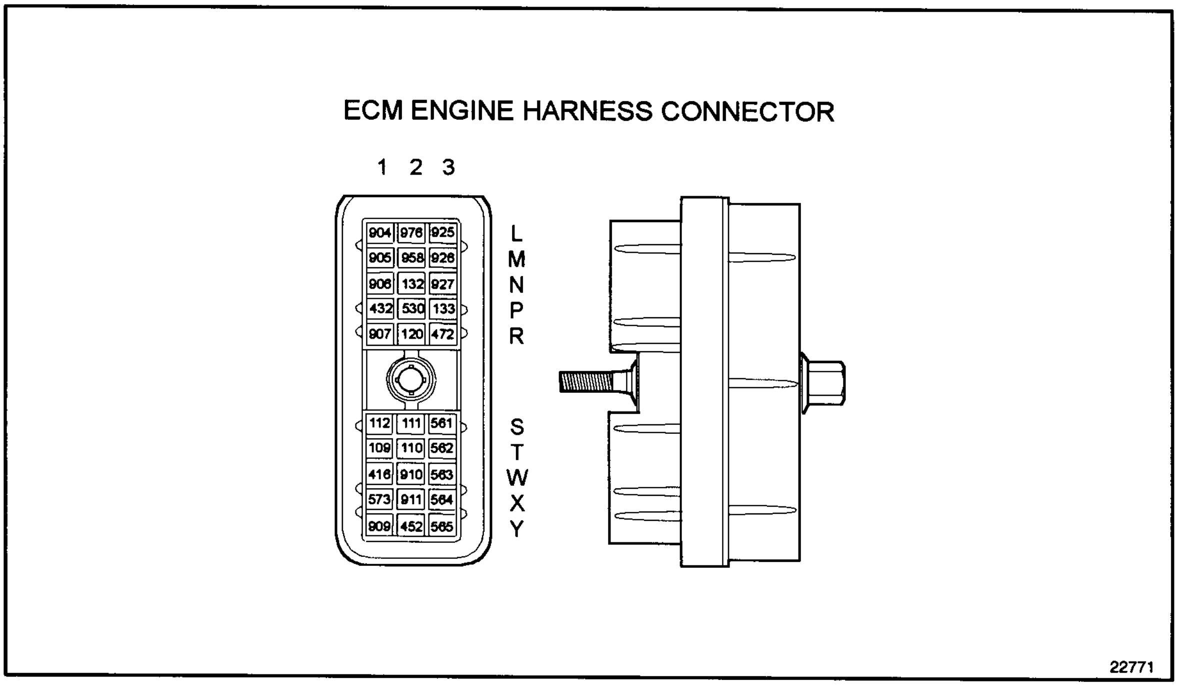


Figure 15-7 ECM Engine Harness Connector

15.3.9 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both sensor and harness side) for damage: bent, corroded and unseated pins or sockets. Check terminals R2 and Y2 of the ECM connector. See Figure 15-8.

   [a] If terminals or connectors are damaged, repair them. Refer to section 15.3.10.

[b] If terminals and connectors are not damaged, reprogram the ECM. Contact Detroit Diesel Technical Service Group. Refer to section 15.3.10.

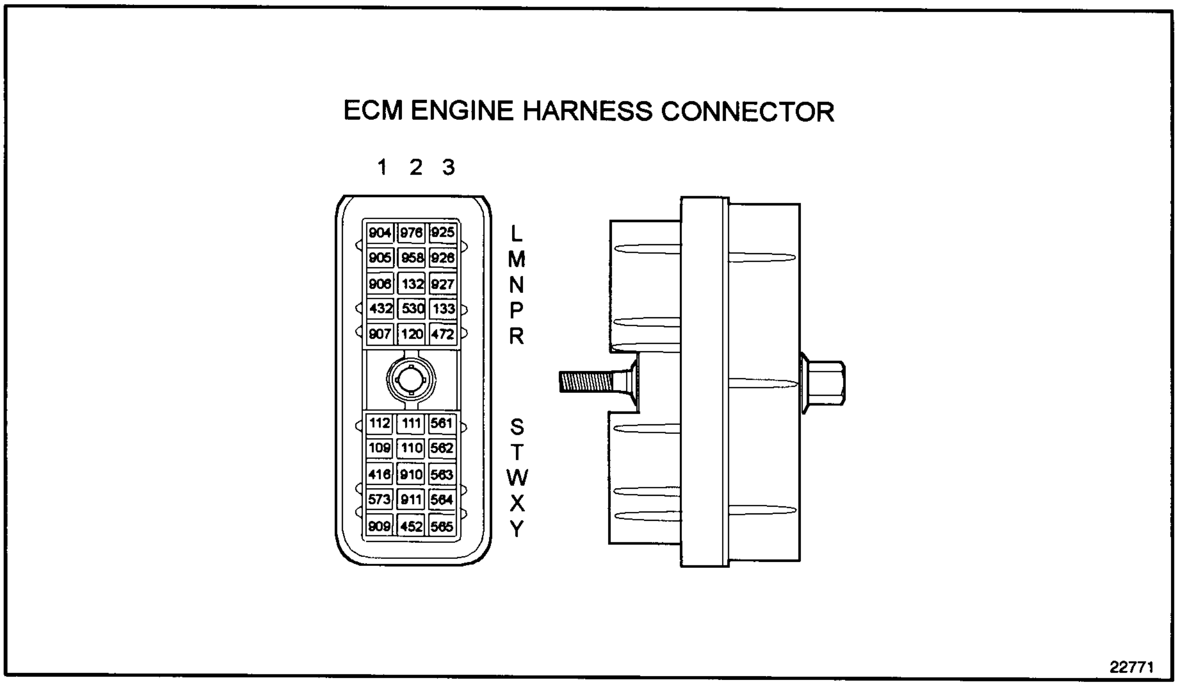


Figure 15-8 ECM Engine Harness Connector

15.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 110 or 175/4 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 15.3.1.
   [c] If any codes except code 110 or 175/4 are logged, refer to section 9.1.

16 (CHG) FLASH CODE 16 - CLS HIGH

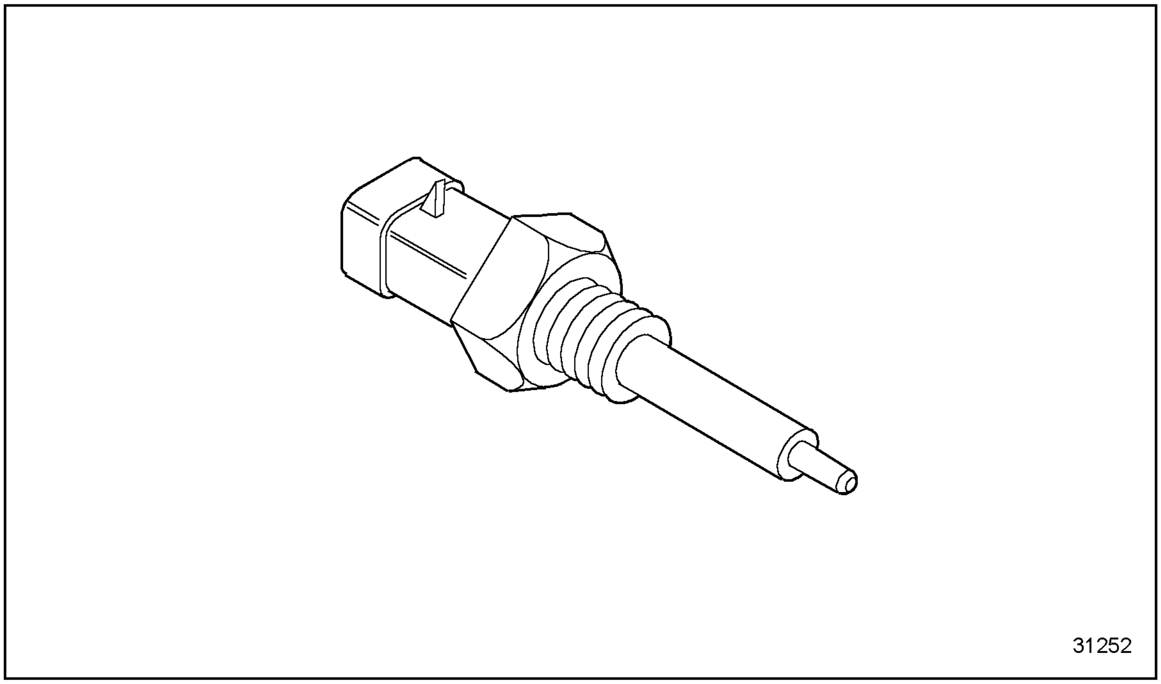


Figure 16-1 Coolant Level Sensor

16.1 DESCRIPTION OF FLASH CODE 16

Flash Code 16 indicates that the engine Coolant Level Sensor (CLS), see Figure 16-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor ground circuit

16.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 16

The SAE J1587 equivalent code for Flash Code 16 is p 111 3, coolant level circuit high.

16.3 TROUBLESHOOTING FLASH CODE 16

The following procedure will troubleshoot Flash Code 16.

16.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect Coolant Level Sensor (CLS) connector and install a jumper between sockets A and B of the CLS harness connector.
3. Attempt to start and run engine at idle.
4. Read DDR for active codes.
   [a] If active code 111/3 and any other codes except code 111/4 are logged, refer to section 16.3.2.
   [b] If active code 111/4 and any other codes are logged, refer to section 16.3.4.
5. Stop engine.

16.3.2 Signal Circuit Check

Perform the following steps to check the signal circuit.

1. Turn ignition OFF.
2. Disconnect the CLS.
3. Disconnect the vehicle harness connector.
4. Measure resistance between socket H3 (#115) on the vehicle harness connector and A (#115 signal) of the CLS connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 16.3.3.
   [b] If the resistance measurement is greater than 5 Ω, or the signal line #115 is open, repair the open. Refer to section 16.3.7.

16.3.3 Ground Circuit Check

Perform the following steps to check the ground circuit.

1. Measure resistance between cavity B (battery ground) of the CLS connector and battery ground.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 16.3.4.
   [b] If the resistance measurement is greater than 5 Ω, or open, the ground circuit is open. Repair and refer to section 16.3.7.

16.3.4 Signal Short to Ignition Check

Perform the following steps to check for a signal short to ignition.

1. Disconnect the vehicle harness connector at the ECM.
2. Remove the jumper wire at the CLS harness connector.
3. Turn ignition ON.
4. Measure voltage at cavity A (#115 signal) of the CLS connector and battery ground. See Figure 16-2.
   - [a] If the voltage measurement is less than or equal to 6 volts, refer to section 16.3.5.
   - [b] If the voltage measurement is greater than 6 volts, the CLS signal line (#115) is shorted to the 12/24 volt DC line. Repair the short or replace the #115 wire. Refer to section 16.3.7.

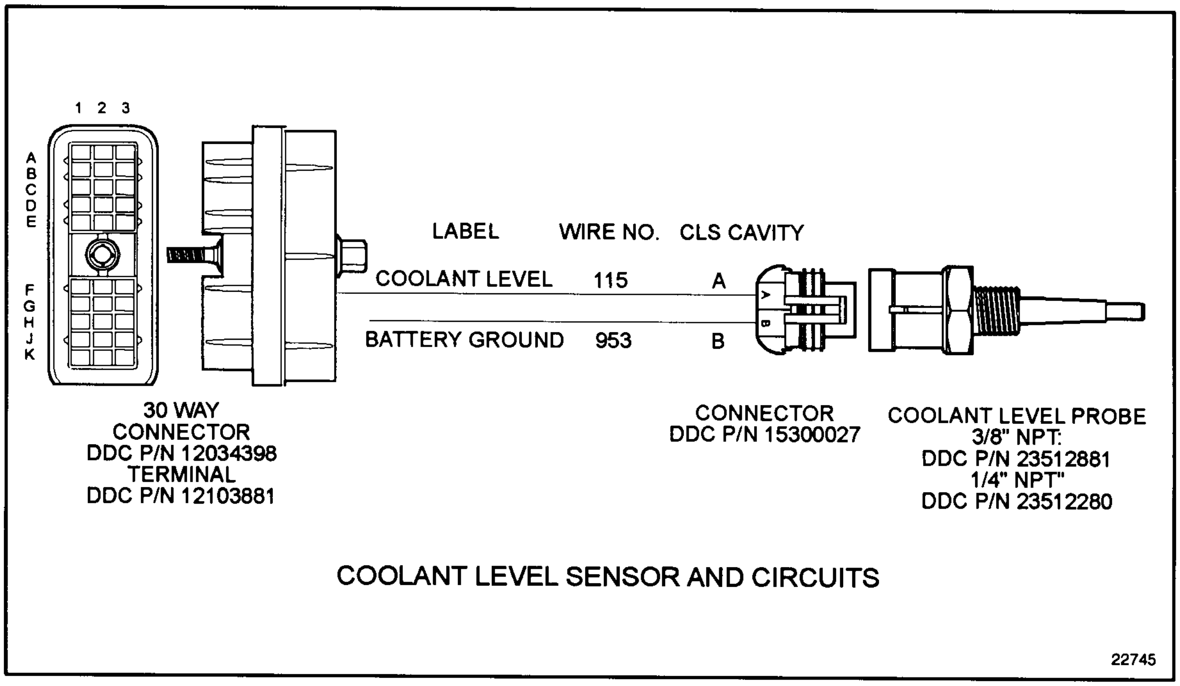


Figure 16-2 Coolant Level Sensor and Circuits

16.3.5 ECM Connectors Check

Perform the following steps to check the ECM connectors.

1. Inspect terminals at the vehicle harness connector (both the sensor and harness side) for bent, corroded and unseated pins or sockets. Check terminal and pin H3 at the ECM and all terminals and pins in the CLS connector. See Figure 16-3.
   - [a] If terminals and connectors are not damaged, replace the CLS. Refer to section 16.3.7. If this is a repeated failure of the CLS, refer to section 16.3.6.

[b] If terminals and connectors are damaged, repair both. Refer to section 16.3.7.

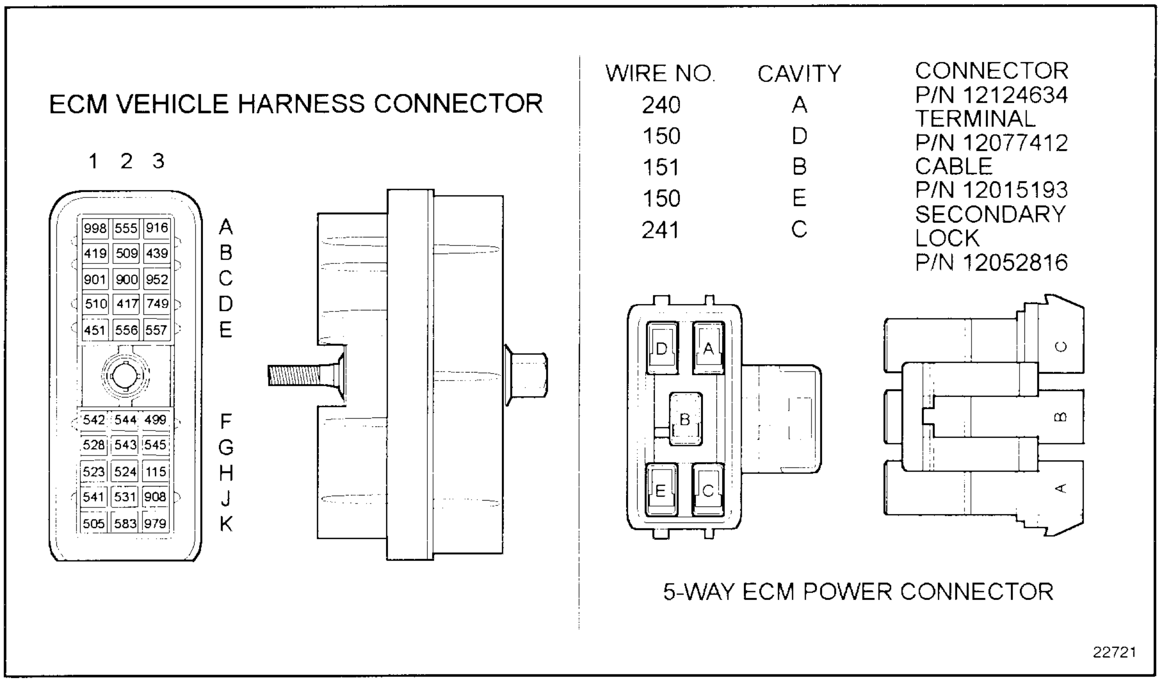


Figure 16-3 Vehicle Harness Connector

16.3.6 Alternator Ground Check

Perform the following steps to check the alternator ground.

1. Connect all connectors.
2. Remove alternator belt or disable alternator from charging.
3. Start and run the engine.
4. Read logged codes.
   [a] If no codes are logged, repair the alternator ground circuit. Refer to section 16.3.7.
   [b] If codes are logged, replace CLS. Refer to section 16.3.7.

16.3.7 Verify Repairs

Perform the following steps to verify the repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.
5. Start and run the engine for one minute.

6. Stop the engine.
7. Check DDR for codes.
   [a] If no codes are displayed, troubleshooting is complete.
   [b] If code 111/3 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 111/3 is logged, and other codes are logged, refer to section 16.3.1, and perform tasks.

17 (CHG) FLASH CODE 17 - THROTTLE VALVE HIGH

17.1 DESCRIPTION OF FLASH CODE 17

Flash Code 17 is currently used for gas fueled engines only. This code indicates that the Throttle Plate Input Voltage has exceeded 95% of the sensor supply voltage (normally >4.75 volts). Typically, the problem is an open sensor return, a short to the sensor supply or throttle body power is low.

17.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 17

The SAE J1587 equivalent code for Flash Code 17 is p 051/3, throttle plate input voltage high.

17.3 TROUBLESHOOTING FLASH CODE 17

The following procedure will troubleshoot Flash Code 17.

17.3.1 Check Actuator

Perform the following steps to check the actuator.

1. Unplug throttle actuator connector.
2. Turn ignition ON.
3. Plug in DDR.
   [a] If code p 051/3 is logged, refer to section 17.3.3.
   [b] If code p 051/4 is logged, refer to section 17.3.5.

17.3.2 Check Connectors

Perform the following steps to check the connectors.

1. Turn ignition OFF.
2. Check connectors, ECM side and throttle actuator side, for damaged, bent or broken pins.
   [a] If the connectors are not damaged, replace the actuator. Refer to section 17.3.6.
   [b] If the connectors are damaged, bent or have broken pins, repair or replace the connectors or pins; refer to section 17.3.6.

17.3.3 Check Sensor

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Unplug the engine sensor harness.
3. Measure resistance between W1 and R1. See Figure 17-1.
   [a] If the resistance measurement is less than or equal to 1,000 Ω, the wires are shorted to each other. Repair the short or replace the engine sensor harness. Refer to section 17.3.6.

[b] If the resistance measurement is greater than 1,000 Ω, refer to section 17.3.4.

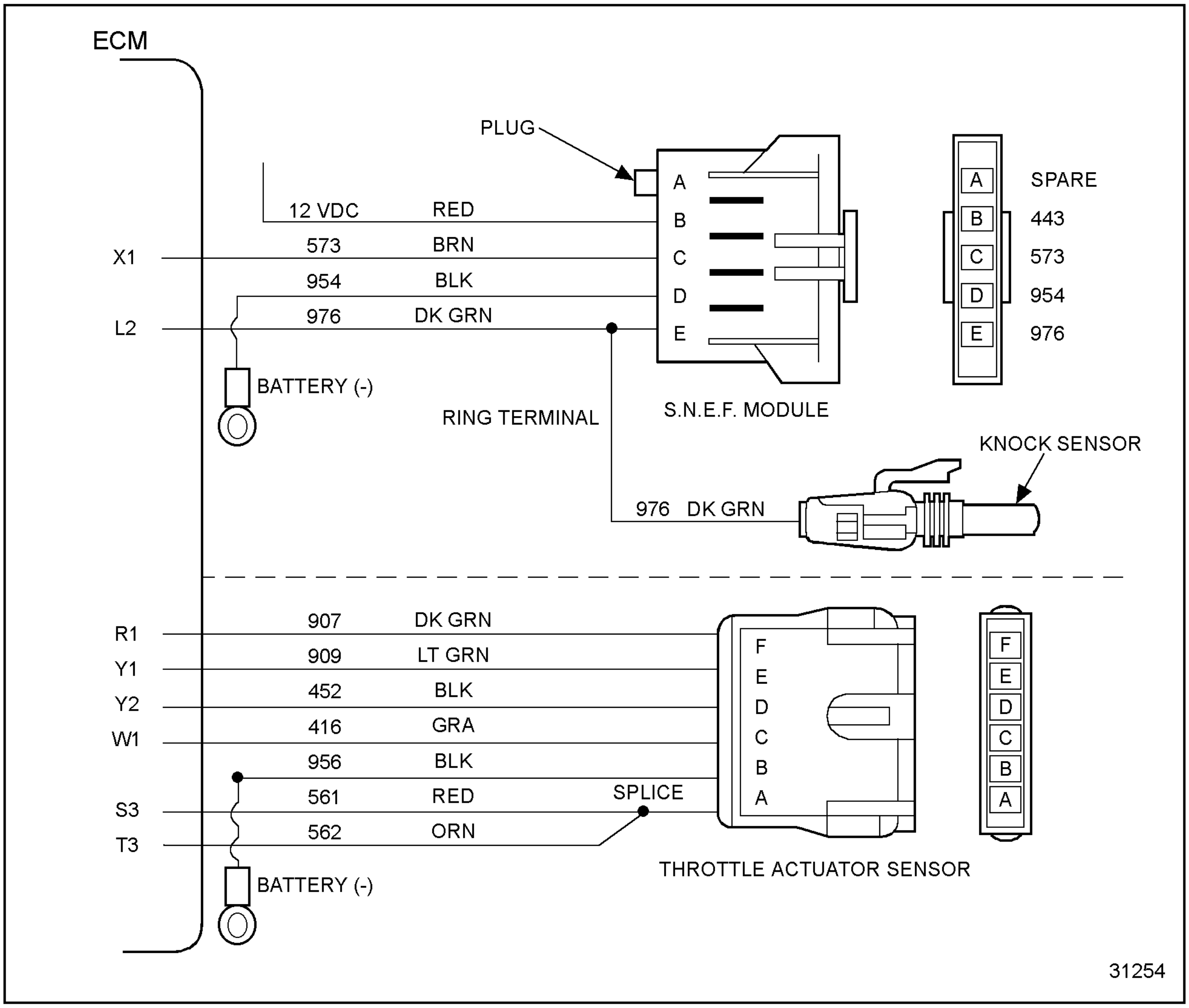


Figure 17-1 Gas Engine Sensor Harness

17.3.4 Check for Voltage

Perform the following steps to check for voltage.

1. Reconnect the engine sensor harness.
2. Measure voltage between cavity R1 and battery (-), ground.

[a] If the voltage measurement is greater than 4.5 volts, the wire is shorted to the voltage supply. Replace the #907 wire, or replace the harness. Refer to section 17.3.6.

[b] If the voltage is less than 4.5 volts, refer to section 17.3.5.

17.3.5 Check for Open

Perform the following steps to check for open.

1. Turn ignition OFF. Disconnect engine sensor harness.
2. Place a jumper wire between cavity F and D of the throttle actuator connector.
3. Measure resistance between R1 (#907) and Y2 (#452).
   - [a] If the measured resistance is greater than 1,000 Ω, the return line (#452) is open. Repair the open and refer to section 17.3.6.
   - [b] If the measured resistance is less than 1,000 Ω, refer to section 17.3.2.

17.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Plug in all connectors.
2. Clear the codes.
3. Start and run the engine.
4. Operate at idle and rated speed.
5. Turn ignition OFF.
6. Plug in DDR and read the codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If any codes are logged, review this section to find the error. Then, contact Detroit Diesel Technical Services.

18 (CHG) FLASH CODE 18 - THROTTLE VALVE LOW

18.1 DESCRIPTION OF FLASH CODE 18

Flash Code 17 is currently used for gas fueled engines only. This code indicates that the Throttle Valve Plate Input Voltage has dropped below the 5% sensor supply voltage (normally < 0.25 volts). Typically, the problem is an open signal or an open sensor supply.

18.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 18

The SAE J1587 equivalent code for Flash Code 18 is p 051/4, throttle plate input voltage low.

18.3 TROUBLESHOOTING FLASH CODE 18

The following procedure will troubleshoot Flash Code 18.

18.3.1 Check Actuator

Perform the following steps to check the actuator.

1. Unplug throttle actuator harness connector.
2. Install a jumper wire between cavity F and C.
3. Turn ignition ON.
4. Plug in DDR. Read the codes.
   - [a] If code p 051/3 and any other codes are logged, refer to section 18.3.2.
   - [b] If code p 051/4 is logged, refer to section 18.3.3.

18.3.2 Check Connectors

Perform the following steps to check the connectors.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Check connectors, both ECM and throttle actuator side, for bent, broken, or loose connections.
   - [a] If the connectors are not damaged, replace the actuator and refer to section 18.3.7.
   - [b] If the connectors are damaged, bent or have broken pins, repair or replace them. Refer to section 18.3.7.

18.3.3 Check for Open

Perform the following steps to check for open.

1. Turn ignition OFF.
2. Move jumper wire from cavity F and C to cavity F and D.
3. Remove engine harness connector.
4. Measure resistance between Y2 (#452) and R1 (#907). See Figure 18-1.
   - [a] If the measured resistance is greater than 1,000 Ω , wire #907 is open. Repair the open or replace the harness and refer to section 18.3.7.

[b] If the measured resistance is less than 1,000 Ω , refer to section 18.3.4.

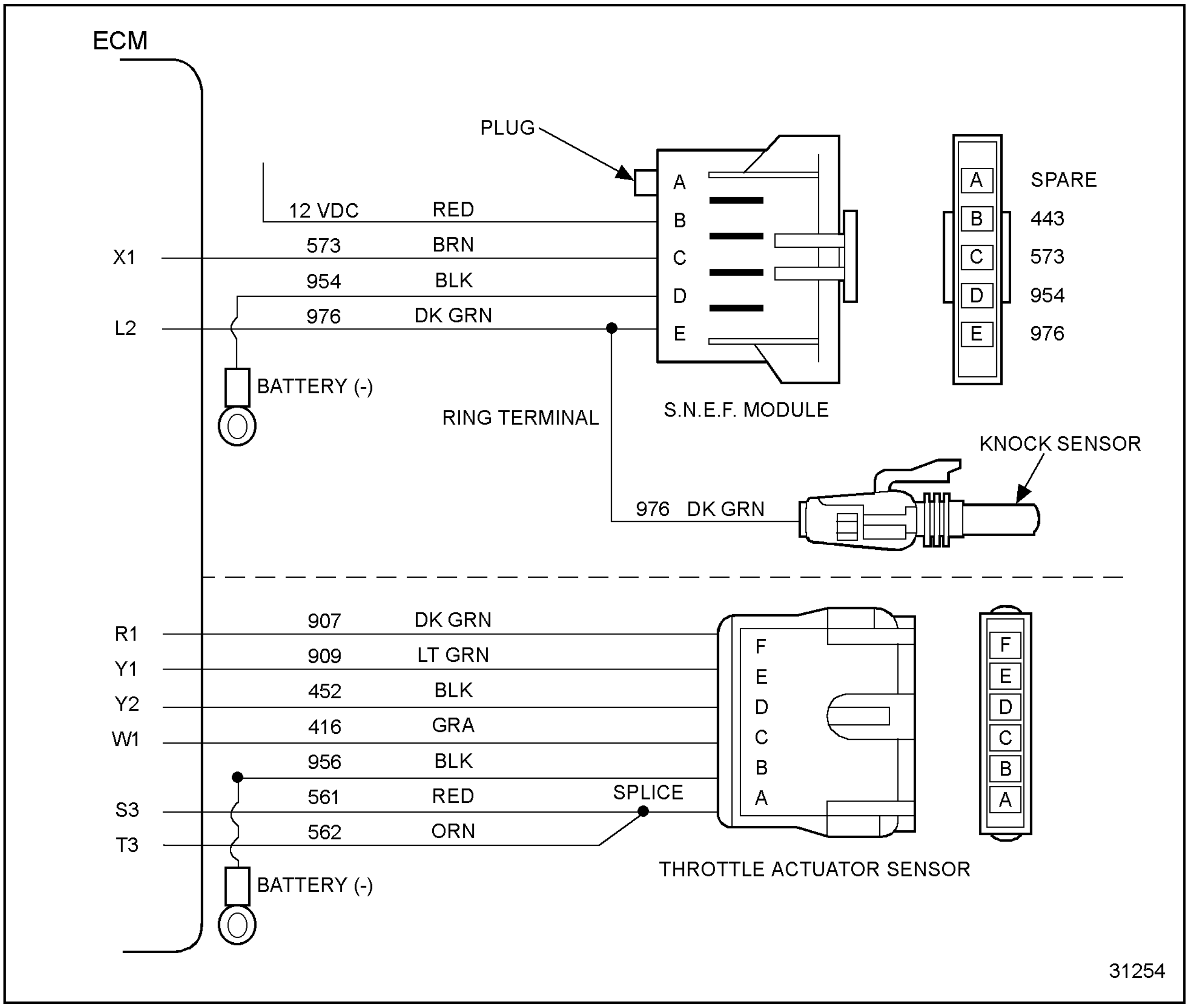


Figure 18-1 Gas Engine Sensor Harness

18.3.4 Check for Short to Return

Perform the following steps to check for a short to the return line.

1. Remove jumper.
2. Measure resistance between Y2 (#452) and R1 (#907), and Y2 (#452) and W1 (#416).

   [a] If either measured resistance is less than 1,000 Ω, those wires are shorted to each other. Replace the harness and refer to section 18.3.7.

   [b] If both measured resistance are greater than 1,000 Ω, refer to section 18.3.5.

18.3.5 Check for Short to Battery (-)

Perform the following steps to check for a short to the battery (-).

1. Measure resistance between R1 (#907) and battery ground, and W1 (#416) and battery ground.
   - [a] If either measured resistance is less than 1,000 Ω, then that wire is shorted to the battery (-). Replace the harness and refer to section 18.3.7.
   - [b] If the measured resistance is greater than 1,000 Ω, refer to section 18.3.6.

18.3.6 Check for 5 Volt Open

Perform the following steps to check for a 5 volt open.

1. Plug in the 30-pin connector for the engine sensor harness.
2. Turn ignition ON.
3. Measure voltage between cavity D (#452) and C (#416) of the actuator connector.
   - [a] If the measurement is less than 4.5 volts, wire #416 is open. Repair the open or replace the harness. Refer to section 18.3.7.
   - [b] If the measurement is between 4.5 and 5.5 volts, refer to section 18.3.2.

18.3.7 Verify Repairs

Perform the following steps to verify repairs.

1. Plug all connectors in.
2. Start and run the engine.
3. Plug in the DDR and read the codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If code p 051/4 is logged, please review this section from the first step to find the error. Refer to section 18.3.1. Then, contact Detroit Diesel Technical Services.

19 FLASH CODE 19

19.1 DESCRIPTION OF FLASH CODE 19

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

20 FLASH CODE 20

20.1 DESCRIPTION OF FLASH CODE 20

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

21 FLASH CODE 21 - TPS HIGH

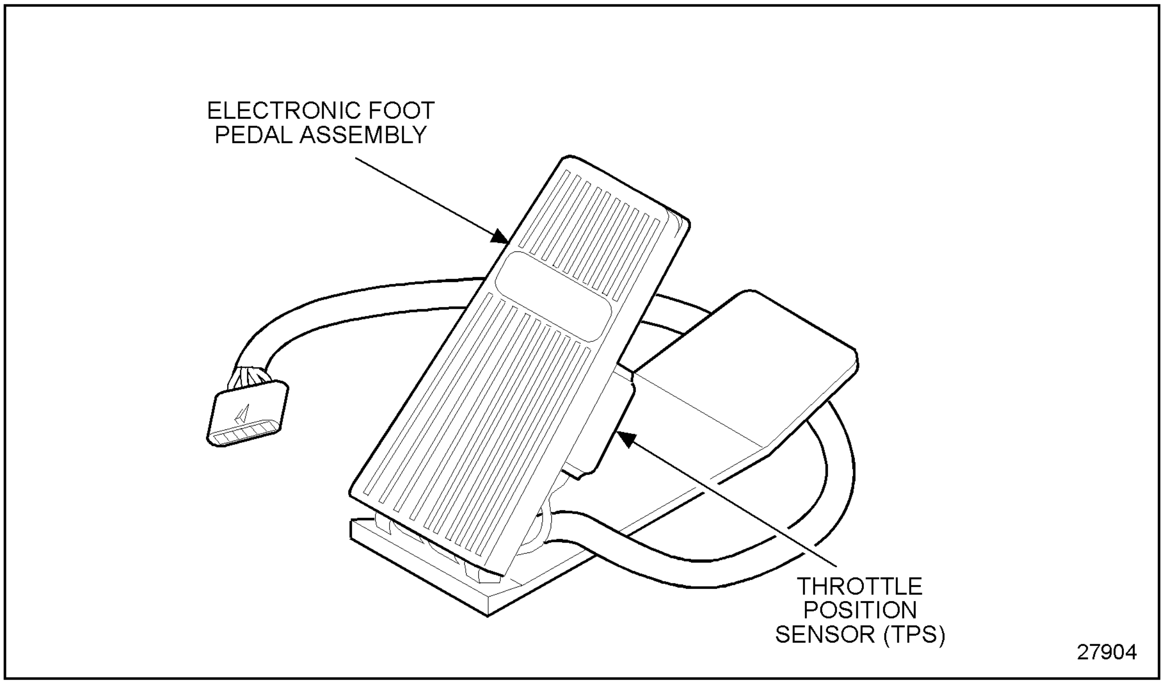


Figure 21-1 Throttle Position Sensor

21.1 DESCRIPTION OF FLASH CODE 21

Flash Code 21 indicates that the Throttle Position Sensor (TPS), see Figure 21-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

21.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 21

The SAE J1587 equivalent code for Flash Code 21 is p 091 3, TPS circuit high.

21.2.1 General Throttle Information (Limiting Speed Governor)

The correct TPS counts for DDEC III engines at idle should be 64 - 205 counts.

1. Typical DDEC III foot pedals today, at idle, provide 102 - 205 counts.
2. DDEC II foot pedals can be used on DDEC III engines. The counts from the DDEC II style pedal may go as low as 64 counts at idle, but this is still acceptable.
3. The DDEC system will log a TPS low volt code (PID 091, FMI 4, Flash Code 22) if the TPS counts go below 48.
4. The DDEC system will log a TPS high volt code (PID 091, FMI 3, Flash Code 21) if the TPS counts go above 968 counts.
5. In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
6. If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
7. If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

21.3 TROUBLESHOOTING FLASH CODE 21

The following procedure will troubleshoot Flash Code 21.

21.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 91/3 and no other active codes are logged, refer to section 21.3.2.
   [b] If any or all of the following codes are logged, 91/3, 91/4, 187/3, 100/3, refer to section 91.2.
   [c] If any codes except 91/3 are logged, refer to section 21.3.3.

21.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Unplug the TPS connector.
3. Turn ignition ON.
4. Read for active codes.
   [a] If active code 91/3 and any other codes are logged, refer to section 21.3.7.
   [b] If code 91/4 is logged, refer to section 21.3.3.

21.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition OFF.
2. Install a jumper wire between pin A (return #952) and pin B (signal #417) of the TPS harness connector.
3. Disconnect the vehicle harness connector at the ECM.
4. Measure resistance between sockets C3 and D2 on the vehicle harness connector. For Throttle Position Sensor schematic, See figure 21-2.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 21.3.4.

[b] If the resistance measurement is greater than 5 Ω, and the return line #952 is open, repair the open and refer to section 21.3.10.

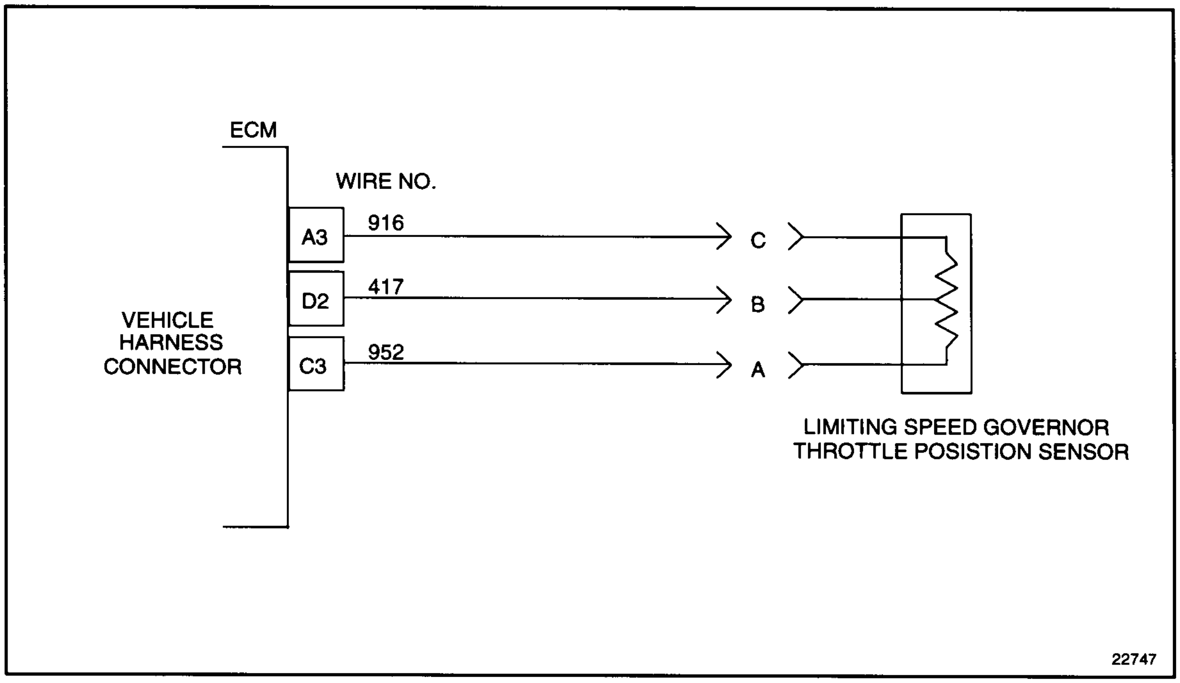


Figure 21-2 Throttle Position Sensor

21.3.4 Check Throttle Position Sensor Adjustment

Perform the following steps to check for TPS adjustment.

1. Reconnect vehicle harness connector and plug in the TPS.
2. Hook up DDR to the DDL connector and select Throttle Sensor Display.
3. Measure Throttle Counts at both no throttle and full throttle. Take several readings.
   [a] If TPS counts are ever greater than 968 counts, refer to section 21.3.5.
   [b] If TPS counts stay less than 968 counts, refer to section 21.3.6.

21.3.5 Throttle Position Sensor Adjustment

Perform the following steps to attempt TPS adjustment.

1. Check for pedal or linkage interferences.
2. Loosen the TPS screws and attempt to adjust for the correct throttle reading (64 - 205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
   [a] If the throttle counts are not correct, refer to section 21.3.6.
   [b] If the throttle counts are now correct, refer to section 21.3.10.

21.3.6 Check Throttle Position Sensor Connectors

Perform the following steps to check the TPS connectors.

1. Check terminals at the TPS connector (both sensor and harness side) for bent, corroded and unseated pins or sockets. See Figure 21-3.
   [a] If the terminals or connectors are damaged, repair both and refer to section 21.3.10.
   [b] If the terminals or connectors are not damaged, replace the TPS; refer to section 21.3.10.

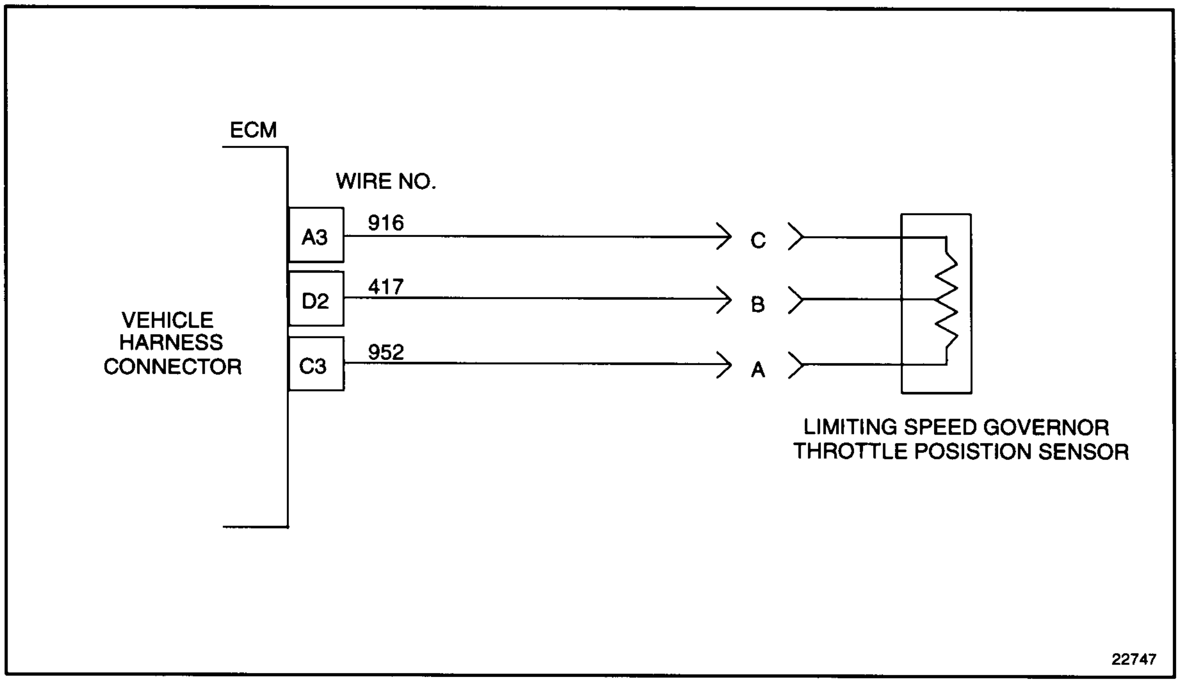


Figure 21-3 Throttle Position Sensor

21.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. Unplug the TPS connector.
3. Read resistance between sockets D2 and A3 on the vehicle harness connector. For ECM vehicle harness connector, see Figure 21-4.
   [a] If the resistance is greater than 100 Ω or open, refer to section 21.3.8.

[b] If the resistance is less than or equal to 100 Ω, the signal line (#417) is shorted to the vehicle +5 volt line (#916). Repair the short and refer to section 21.3.10.

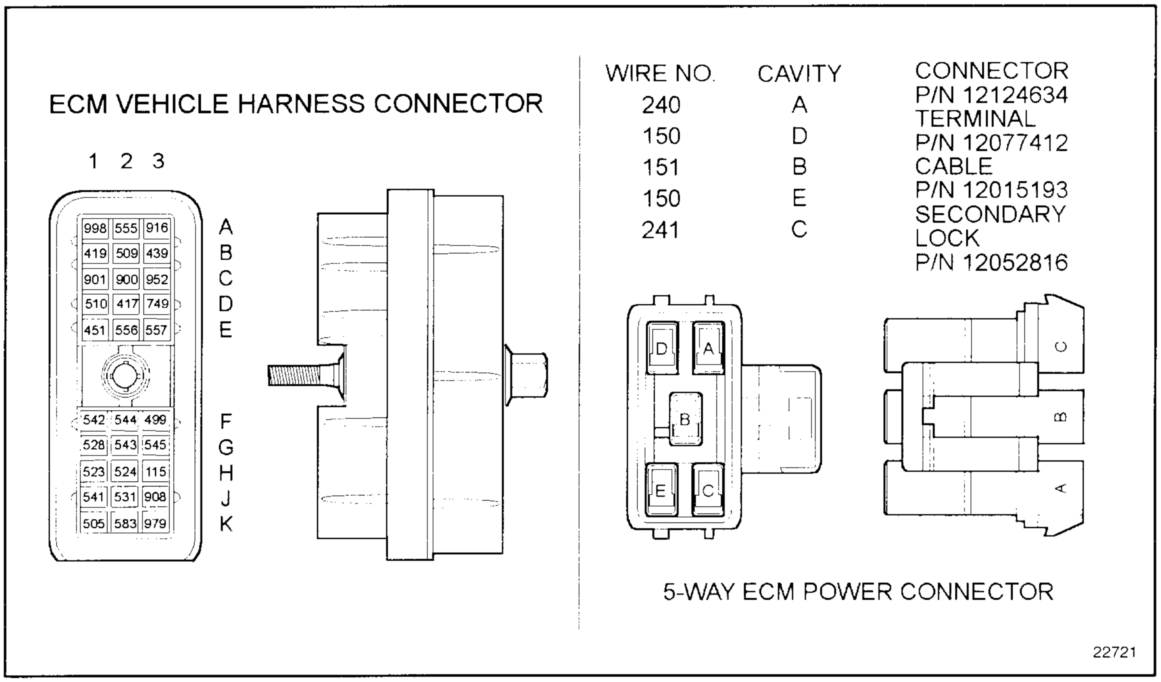


Figure 21-4 ECM Vehicle Harness Connector

21.3.8 Check for Short to Battery

Perform the following steps to check for a short to the battery.

1. Remove both fuses to the ECM.
2. Disconnect the 5-way power harness and vehicle harness connectors at the ECM.
3. Measure resistance between socket D2 on the vehicle harness connector and the 5-way power connector sockets A and C. See Figure 21-5.

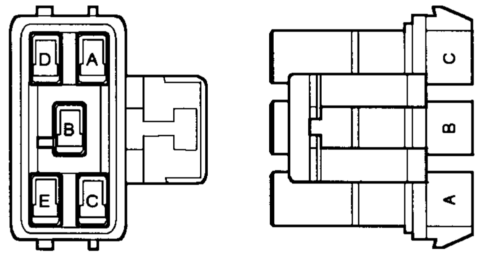
    [a] If the resistance is greater than 100 Ω, refer to section 21.3.9.

[b] If the resistance is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 21.3.10.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 21-5 5-Way ECM Power Connector

21.3.9 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded and unseated pins or sockets. See Figure 21-6.

   [a] If terminals and connectors are damaged, repair them. Refer to section 21.3.10.

[b] If terminals and connectors are not damaged, refer to section 21.3.1, to review this section. If review leads back here, install a test ECM or contact Detroit Diesel Technical Service.

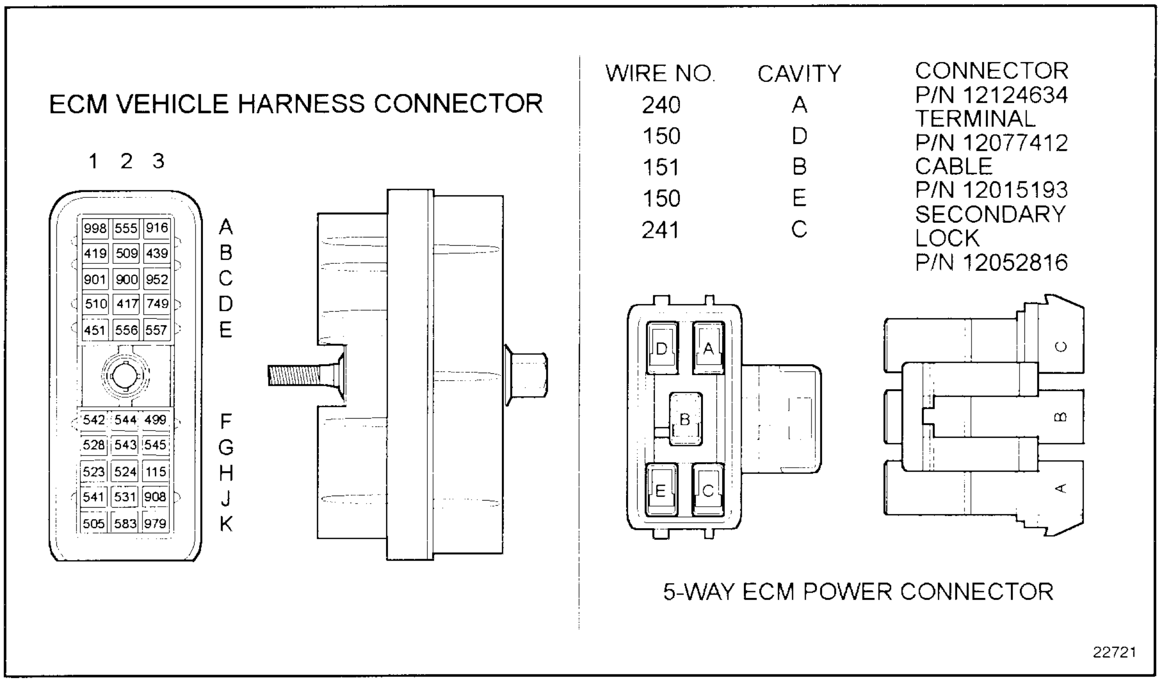


Figure 21-6 ECM Vehicle Harness Connector

21.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.
5. Start and run the engine for one minute. Check idle position and full throttle.
6. Stop engine.
7. Check DDR for codes.

[a] If no codes are displayed, troubleshooting is complete.

[b] If code 91/3 is not logged, and other codes are logged, refer to section 9.1.

[c] If code 91/3 is logged, and other codes are logged, all system diagnostics are complete. If a problem still exists, review this section from the first step to troubleshoot the error, refer to section 21.3.1.

22 FLASH CODE 22 - TPS LOW

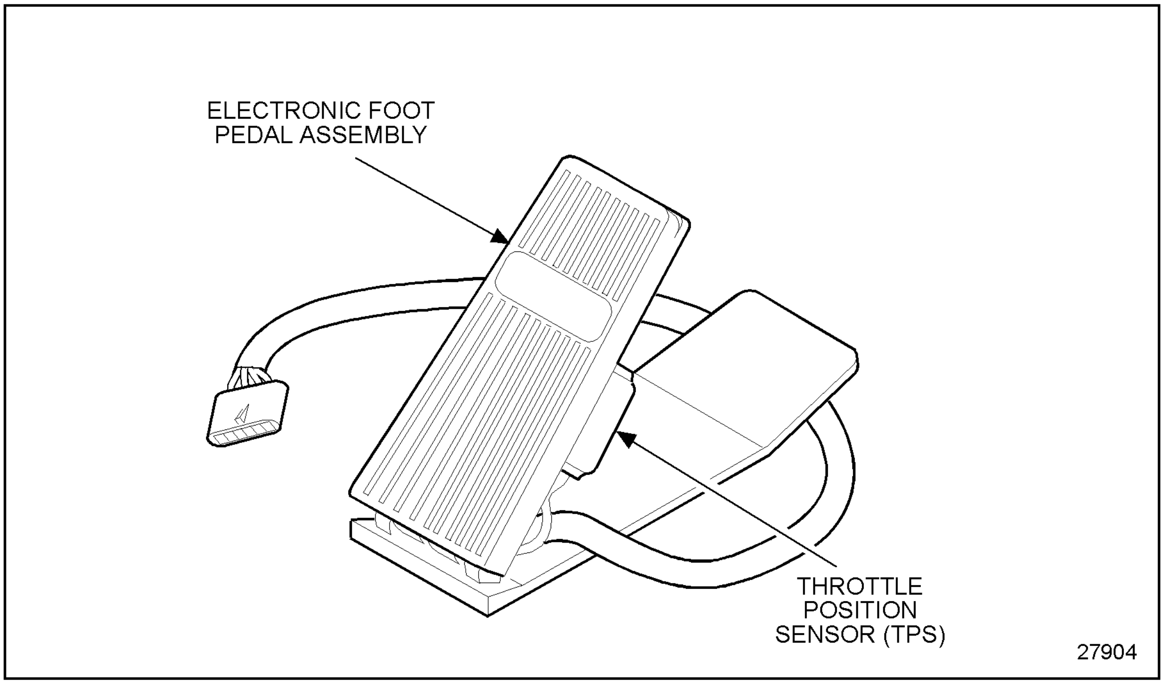


Figure 22-1 Throttle Position Sensor

22.1 DESCRIPTION OF FLASH CODE 22

Flash Code 22 indicates that the Throttle Position Sensor (TPS), see Figure 22-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground

22.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 22

The SAE J1587 equivalent code for Flash Code 22 is p 091 4, Throttle Position Sensor (TPS) circuit low.

22.2.1 General Throttle Information (Limiting Speed Governor)

The correct TPS counts for DDEC III engines at idle should be 64 - 205 counts.

1. Typical DDEC III foot pedals today, at idle, provide 102 - 205 counts.
2. DDEC II foot pedals can be used on DDEC III engines. The counts from the DDEC II style pedal may go as low as 64 counts at idle, but this is still acceptable.
3. The DDEC system will log a TPS low volt code (PID 091, FMI 4, Flash Code 22) if the TPS counts go below 48.
4. The DDEC system will log a TPS high volt code (PID 091, FMI 3, Flash Code 21) if the TPS counts go above 968 counts.
5. In order to go from 0% to 100% throttle, the counts have to increase 546 above the idle count, or 100 counts, whichever is greater.
6. If an idle validation switch (IVS) is configured, to go from 0% to 100% throttle, the counts have to increase 546 above the counts at which the IVS opens or 100 counts, whichever is greater.
7. If 0% throttle is attained with the foot off the pedal, and if 100% throttle is attained with the pedal to the floor, then the pedal should not be considered a factor for low power complaints.

22.3 TROUBLESHOOTING FLASH CODE 22

The following procedure will troubleshoot Flash Code 22.

22.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 91/4 and no other active codes are logged, refer to section 22.3.2.
   [b] If code 91/4 and any or all of the following codes are logged, 91/3, 187/4, or 100/4, refer to section 91.2.
   [c] If codes other than the above are logged, refer to section 9.1.

22.3.2 Check for Device

Perform the following steps to check for device.

1. If there is a throttle (LSG) wired to use the 417 (LSG) circuit, refer to section 22.3.3.
2. If there is no throttle (LSG) wired to use the 417 (LSG) circuit, contact Detroit Diesel Technical Service, for possible change to the calibration.
   [a] If required, reprogram the ECM after the mainframe is changed and refer to section 22.3.15.

22.3.3 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the TPS connector.
3. Install a jumper wire between sockets B (signal #417) and C (5V supply #916); see Figure 22-2.
4. Turn ignition ON.
5. Read active codes.
   [a] If code 91/4 and any other codes are logged, refer to section 22.3.7.

[b] If code 91/3 and any other codes are logged, refer to section 22.3.4.

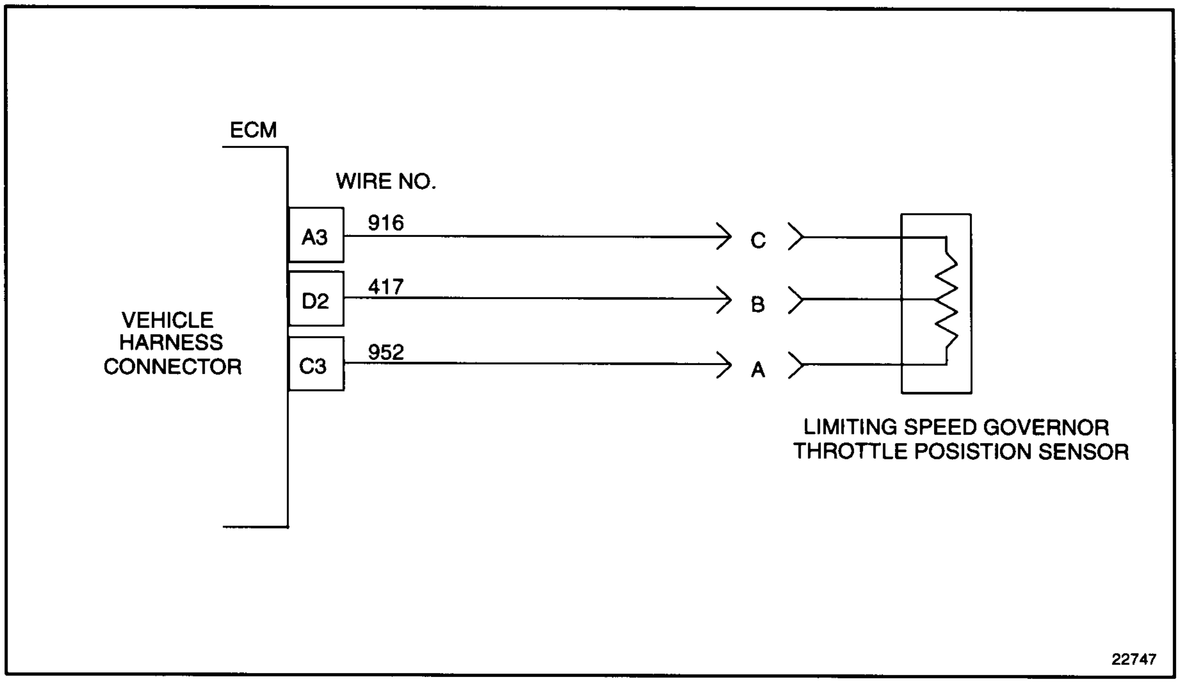


Figure 22-2 Throttle Position Sensor

22.3.4 Check Throttle Position Sensor Adjustment

Perform the following steps to check the TPS adjustment:

1. Remove jumper and reconnect TPS.
2. Hook DDR to the DDL connector and select TPS - Counts.
3. Read Throttle Counts at both no throttle and full throttle positions. Take several readings.
   [a] If at any time counts go lower than 49 counts, refer to section 22.3.5.
   [b] If counts never go lower than 49 counts, refer to section 22.3.6.

22.3.5 Attempt Throttle Position Sensor Adjustment

Perform the following steps to attempt a TPS adjustment:

1. Check for pedal or linkage interferences.
2. Loosen the TPS screws and attempt to adjust for the correct throttle reading (normal range - 64-205 counts). Do not attempt to adjust by bending the pedal mechanism.
3. Recheck counts at idle and at full throttle.
   [a] If the throttle count has been corrected, refer to section 22.3.15.
   [b] If the problem could not be corrected, refer to section 22.3.6.

22.3.6 Check Throttle Position Sensor Connectors

Perform the following steps to check the TPS connectors:

1. Check terminals at the TPS connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets.
   - [a] If the terminals or the connectors are damaged, repair them. Refer to section 22.3.15.
   - [b] If the terminals and connectors are not damaged, replace the TPS and refer to section 22.3.15.

22.3.7 Check for +5 Volts

Perform the following steps to check for +5 volts:

1. Remove jumper wire.
2. Turn ignition ON.
3. Measure voltage on TPS harness connector, socket C (5V supply #916) (red lead) to socket A (return #952) (black lead).
   - [a] If measured voltage is greater than 6 volts, refer to section 22.3.13.
   - [b] If measured voltage is less than 4 volts, refer to section 22.3.11.
   - [c] If measured voltage is between 4 and 6 volts, refer to section 22.3.8.

22.3.8 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A (return #952) and B (signal #417) at the TPS harness connector. See Figure 22-3.
4. Measure resistance between socket B (signal #417) and a good ground (battery ground and chassis ground).
   - [a] If resistance measurement is less than or equal to 100 Ω, the signal line #417 is shorted to the return line #952 or battery ground. Repair short. Refer to section 22.3.15.

[b] If resistance measurement on both readings is greater than 100 Ω or open, refer to section 22.3.9.

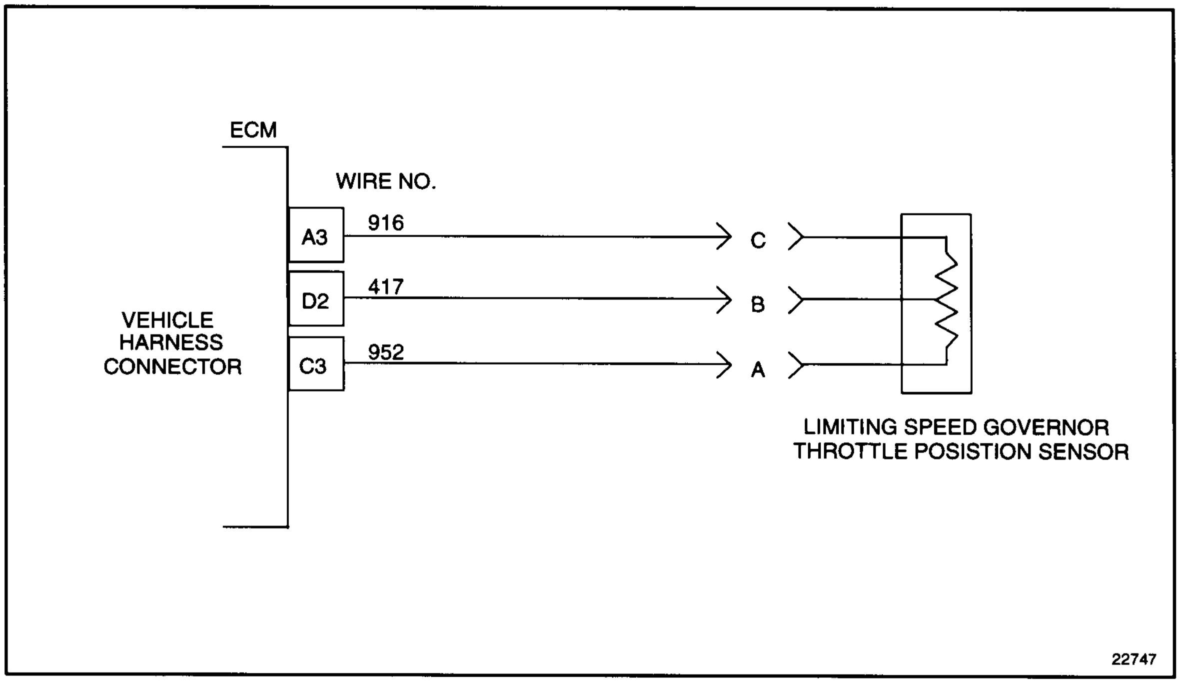


Figure 22-3 Throttle Position Sensor

22.3.9 Check for Signal Open

Perform the following steps to check for signal open:

1. Install a jumper wire between sockets A (return #952) and B (signal #417) of the TPS harness connector.
2. Measure resistance between sockets D2 and C3 on the vehicle connector.
   - [a] If the resistance is less than or equal to 5 Ω, refer to section 22.3.10.
   - [b] If the resistance is greater than 5 Ω or open, the signal line (#417) or return line (#952) are open, repair the open. Refer to section 22.3.15.

22.3.10 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 22-4.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 22.3.15.

[b] If terminals and connectors are not damaged, call Detroit Diesel Technical Service for assistance.

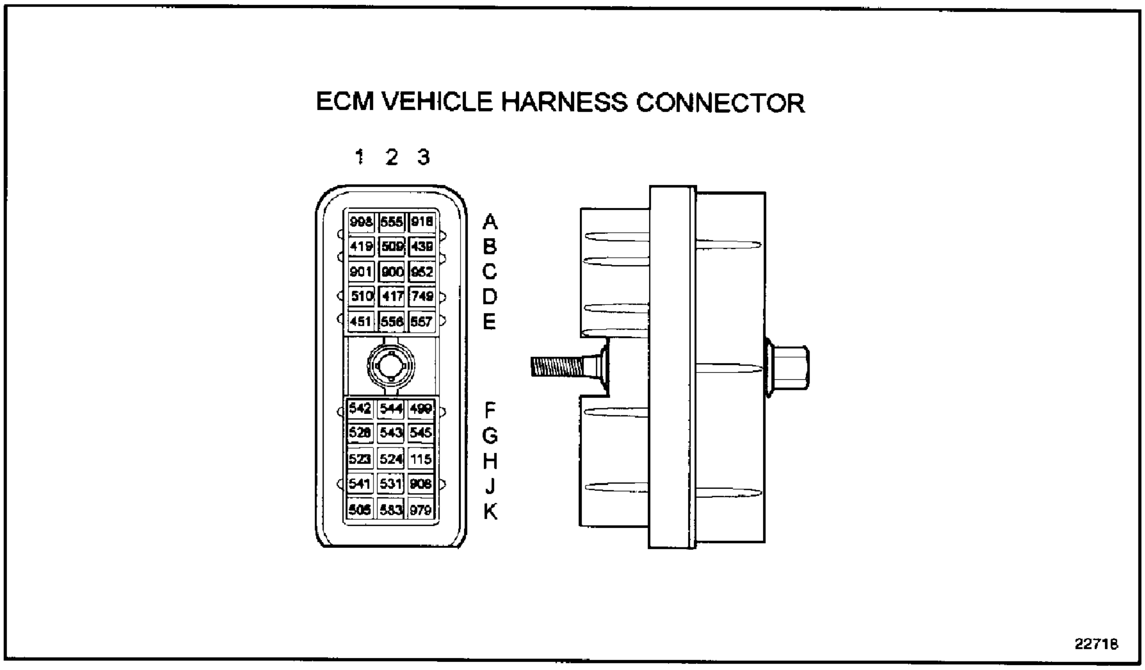


Figure 22-4 ECM Vehicle Harness Connector

22.3.11 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Measure resistance between sockets A (return #952) and C (5V #916) on the TPS harness connector. See Figure 22-5.

[a] If resistance between sockets A and C is greater than 1,000 Ω or open, refer to section 22.3.12.

[b] If resistance between sockets A and C is less than or equal to 1,000 Ω or open, the 5V wire (#916) is shorted to the return (#952). Repair the short and refer to section 22.3.15.

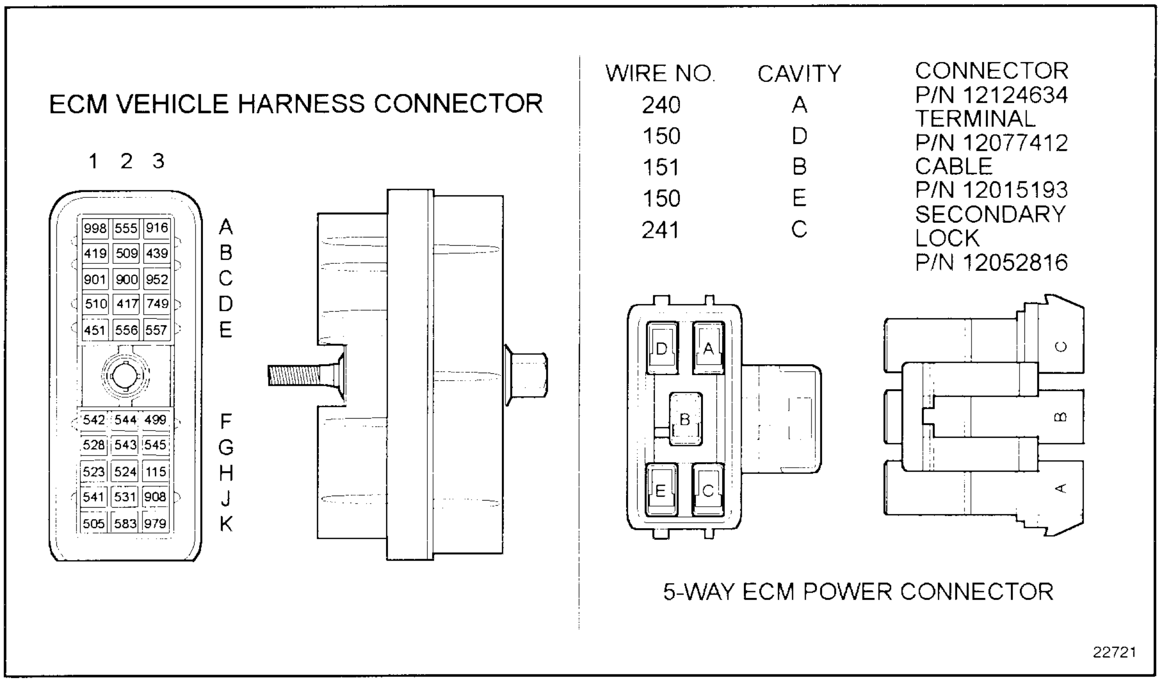


Figure 22-5 ECM Vehicle Harness Connector

22.3.12 Check for Open +5 Volt Line

Perform the following steps to check for an open +5 volt line:

1. Install a jumper wire between sockets A (return #952) and C (5V #916) on the TPS harness connector.
2. Measure resistance between sockets A3 and C3 on the vehicle harness connector. See Figure 22-6.

[a] If resistance between sockets A3 and C3 is less than or equal to 5 Ω or open, refer to section 22.3.10.

[b] If resistance between sockets A3 and C3 is greater than or equal to 5 Ω or open, the vehicle +5 volt line (#916) is open. Repair the open. Refer to section 22.3.15.

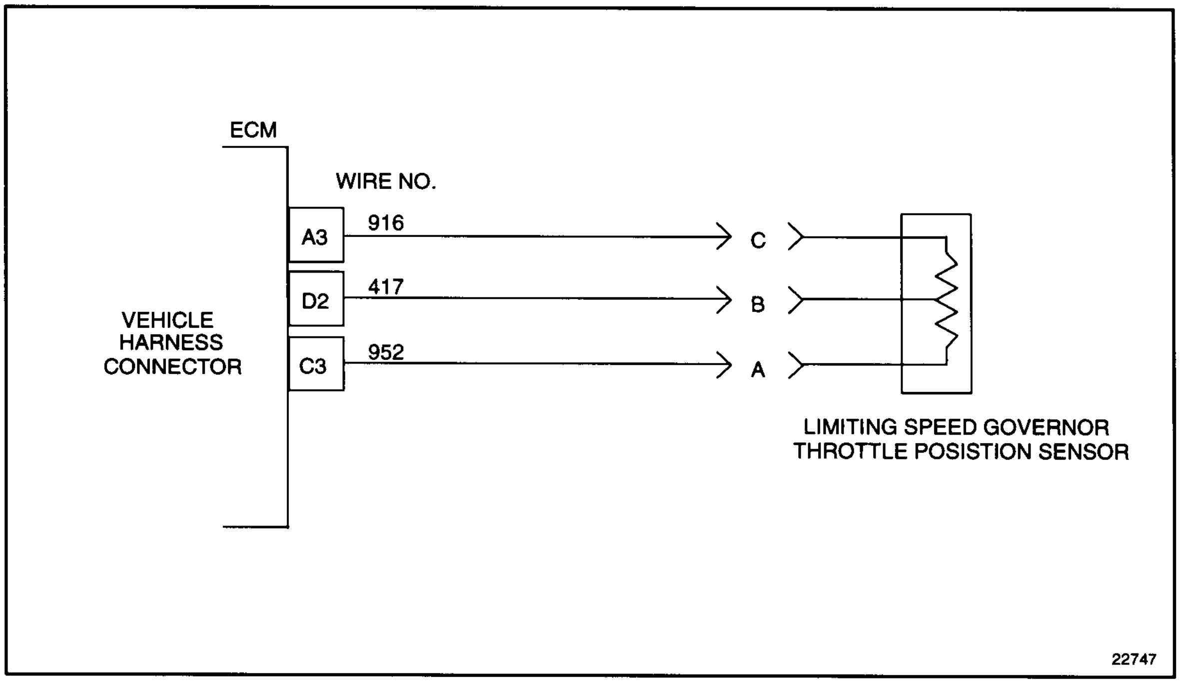


Figure 22-6 Throttle Position Sensor

22.3.13 Check for Short to Battery +

Perform the following steps to check for a short to the battery +:

1. Turn ignition OFF.
2. Remove both fuses to ECM.
3. Disconnect the 5-way power connector at the ECM.
4. Measure resistance between socket D2 on the vehicle harness connector and the 5-way power connector sockets A and C. See Figure 22-7.

   [a] If measured resistance is greater than 100 Ω or open, refer to section 22.3.14.

[b] If measured resistance is less than or equal to 100 Ω, a short exists between sockets where resistance was measured. Repair short and reinsert fuses; refer to section 22.3.15.

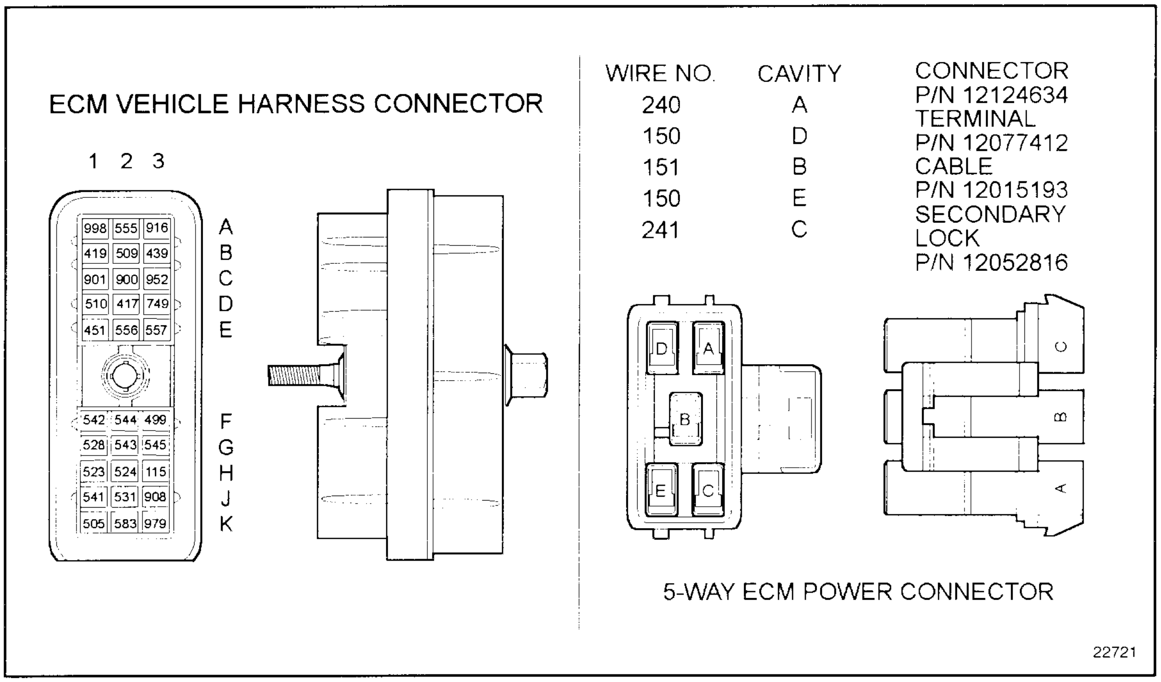


Figure 22-7 ECM Vehicle Harness Connector

22.3.14 Check for Outside DDEC Battery +

Perform the following steps to check for outside DDEC battery +:

1. Turn ignition OFF.
2. Remove ECM 5-pin power connector.
3. Remove ECM vehicle harness connector.
4. Turn ignition ON.
5. Measure voltage A3 (red lead) to battery ground.
6. Measure voltage C3 (red lead) to battery ground.

   [a] If measured voltage is less than 0.2 volts, refer to section 22.3.10.

   [b] If measured voltage is greater than 0.2 volts, outside power is spliced/shorted into either line #952 or line #916. Remove the splice/short. Refer to section 22.3.15.

22.3.15 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.

2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute at all throttle positions.
6. Stop engine.
7. Read active codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 91/4 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 22.3.1.
   [c] If code 91/4 is not logged, but other codes are logged, refer to section 9.1.

23 (CHG) FLASH CODE 23 - FUEL TEMP SENSOR HIGH

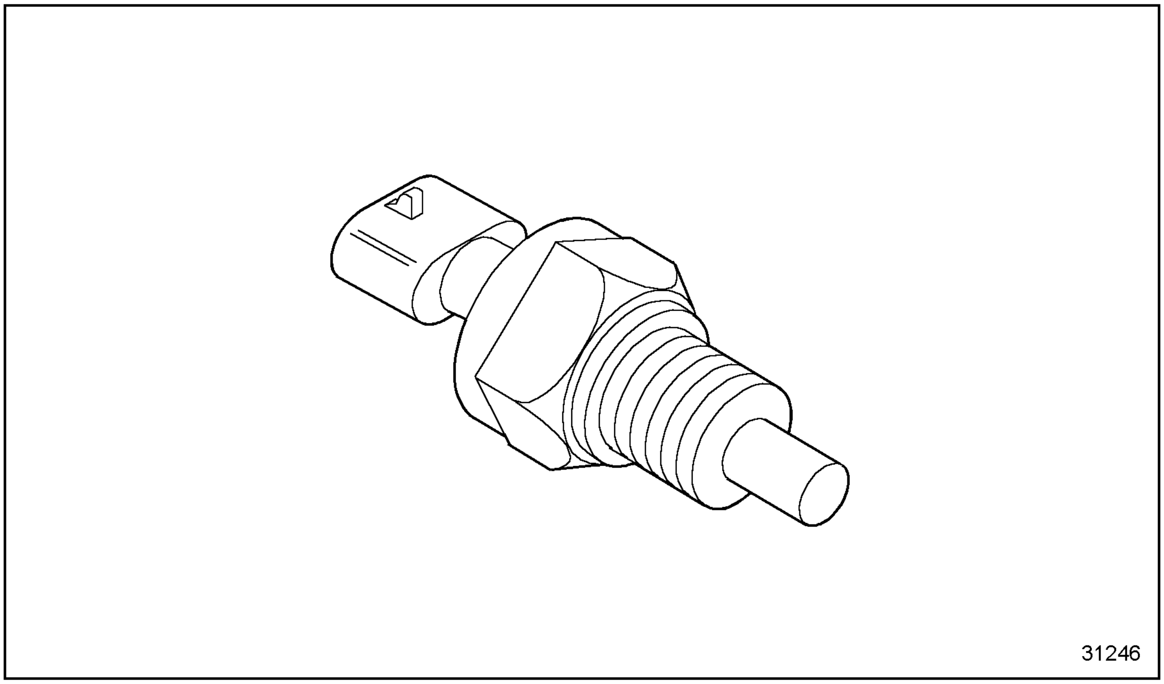


Figure 23-1 Fuel Temperature Sensor

23.1 DESCRIPTION OF FLASH CODE 23

Flash Code 23 indicates that the engine Fuel Temperature Sensor (FTS), see Figure 23-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor circuit return
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

23.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 23

The SAE J1587 equivalent code for Flash Code 23 is p 174 3, fuel temperature circuit high.

23.3 TROUBLESHOOTING FLASH CODE 23

The following procedure will troubleshoot Flash Code 23.

23.3.1 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the FTS connector.
3. Install a jumper wire between sockets A and B of the FTS harness connector. see Figure 23-2.
4. Turn ignition ON.
5. Read active codes.
   [a] If code 174/4 and any other codes except code 174/3 are logged, refer to section 23.3.2.
   [b] If any code except 174/4 is logged, refer to section 23.3.4.

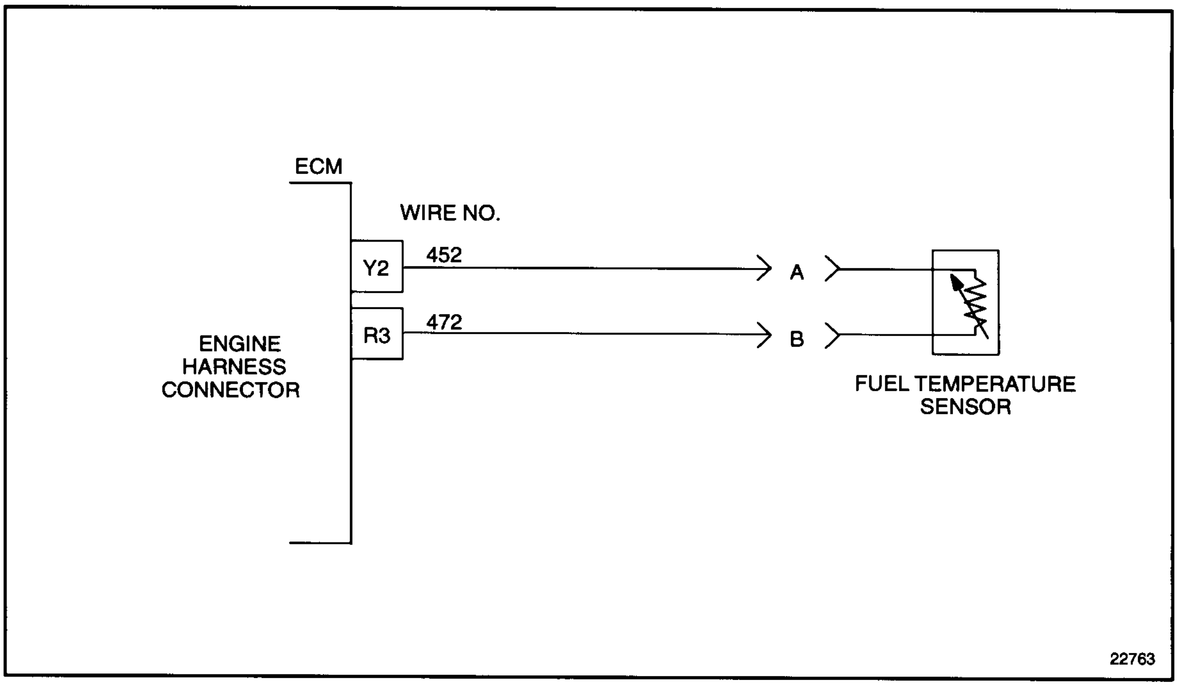


Figure 23-2 Fuel Temperature Sensor

23.3.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition OFF.
2. Remove jumper wire.

3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets R3 and W1 on the engine harness connector. See Figure 23-3.
   [a] If the measured resistance is greater than 100 Ω or open, refer to section 23.3.3.
   [b] If the measured resistance is less than or equal to 100 Ω, the signal line #472 is shorted to the engine +5 volt line #416. Repair the short; refer to section 23.3.6.

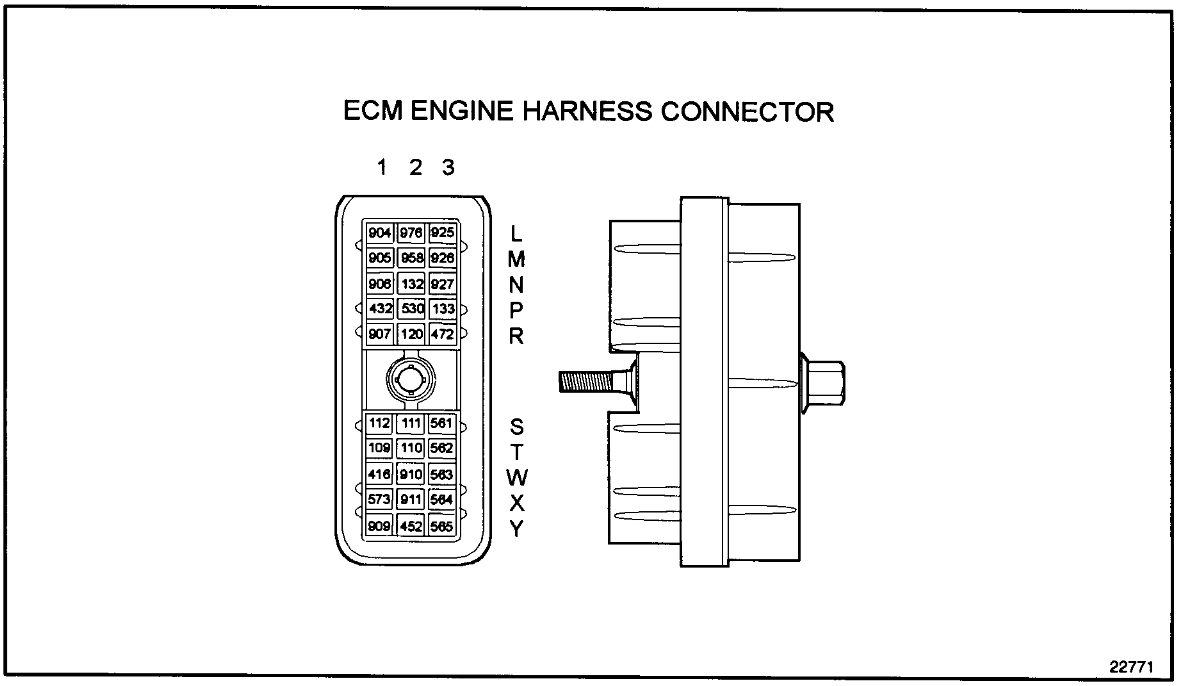


Figure 23-3 ECM Engine Harness Connector

23.3.3 Check Fuel Temperature Sensor Connectors

Perform the following steps to check the FTS connectors:

1. Check terminals at the FTS harness connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 23-4.
   [a] If terminals and connectors are damaged, repair them. Refer to section 23.3.6.

[b] If terminals and connectors are not damaged, replace the FTS. Refer to section 23.3.6.

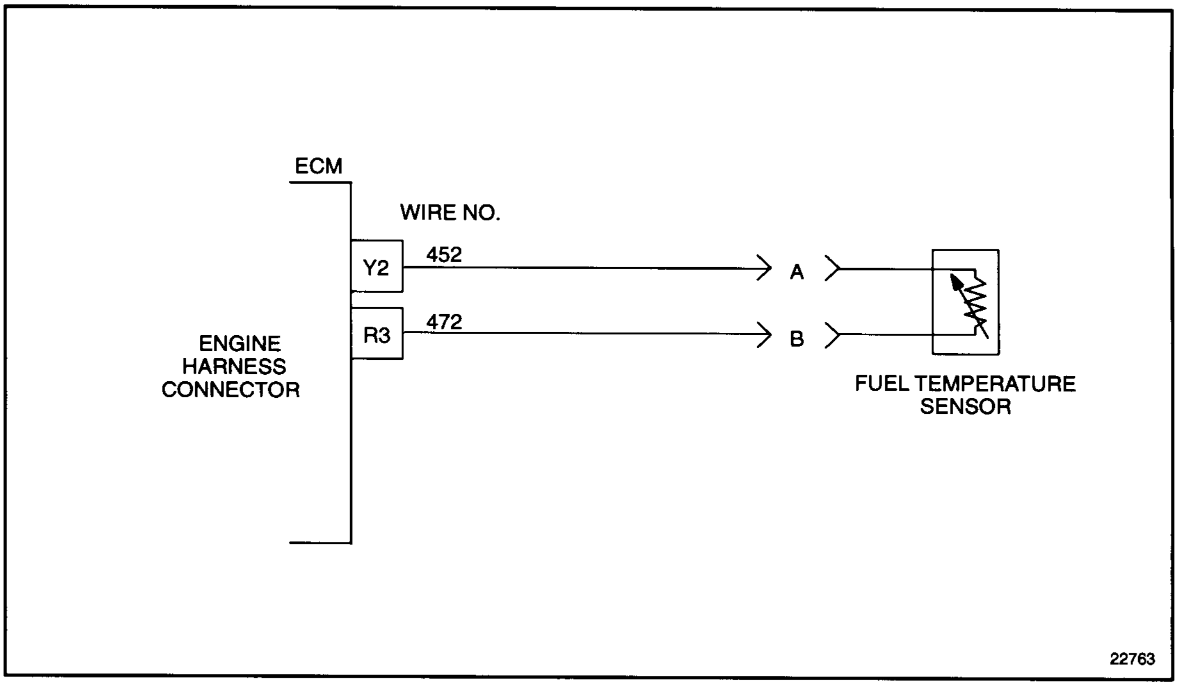


Figure 23-4 Fuel Temperature Sensor

23.3.4 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. The jumper wire is still in place at the FTS connector.
3. Measure resistance between sockets R3 and Y2 on the engine harness connector. See Figure 23-5.

   [a] If the measured resistance is greater than 5 Ω or open, the signal line #472 or return line #452 is open. Repair the open; refer to section 23.3.6.

[b] If the measured resistance is less than or equal to 5 Ω, refer to section 23.3.5.

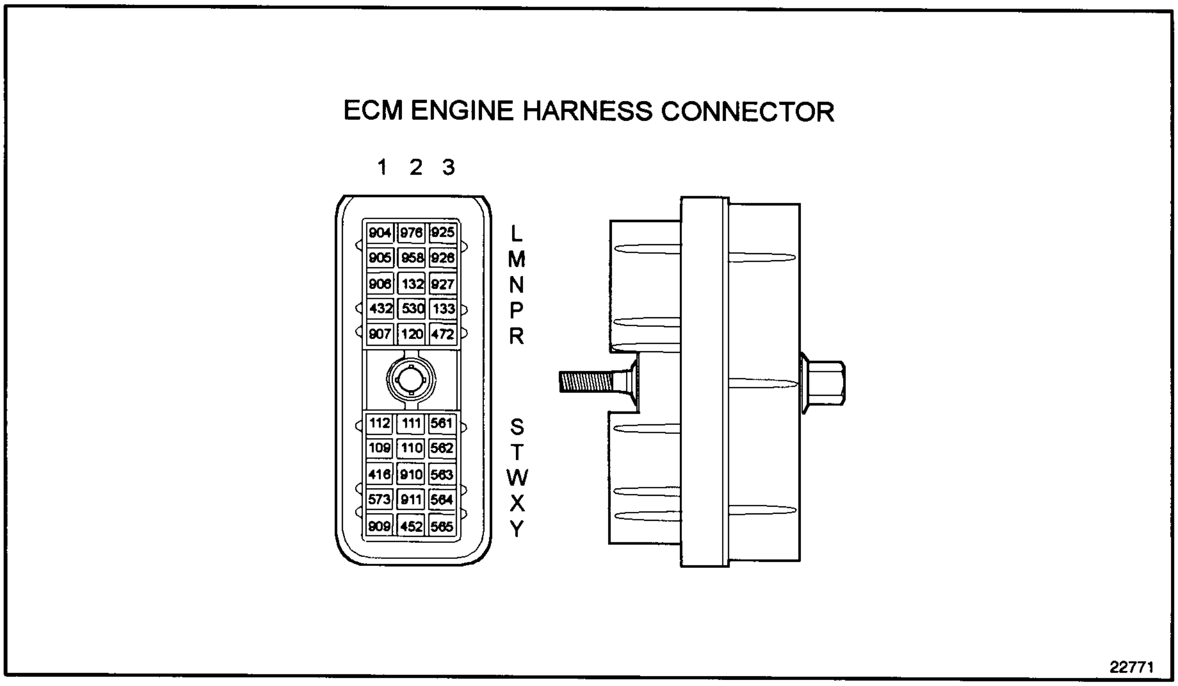


Figure 23-5 ECM Engine Harness Connector

23.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 23-6.

   [a] If terminals and connectors are damaged, repair them. Refer to section 23.3.6.

[b] If terminals and connectors are not damaged, install a test ECM. Refer to section 23.3.6.

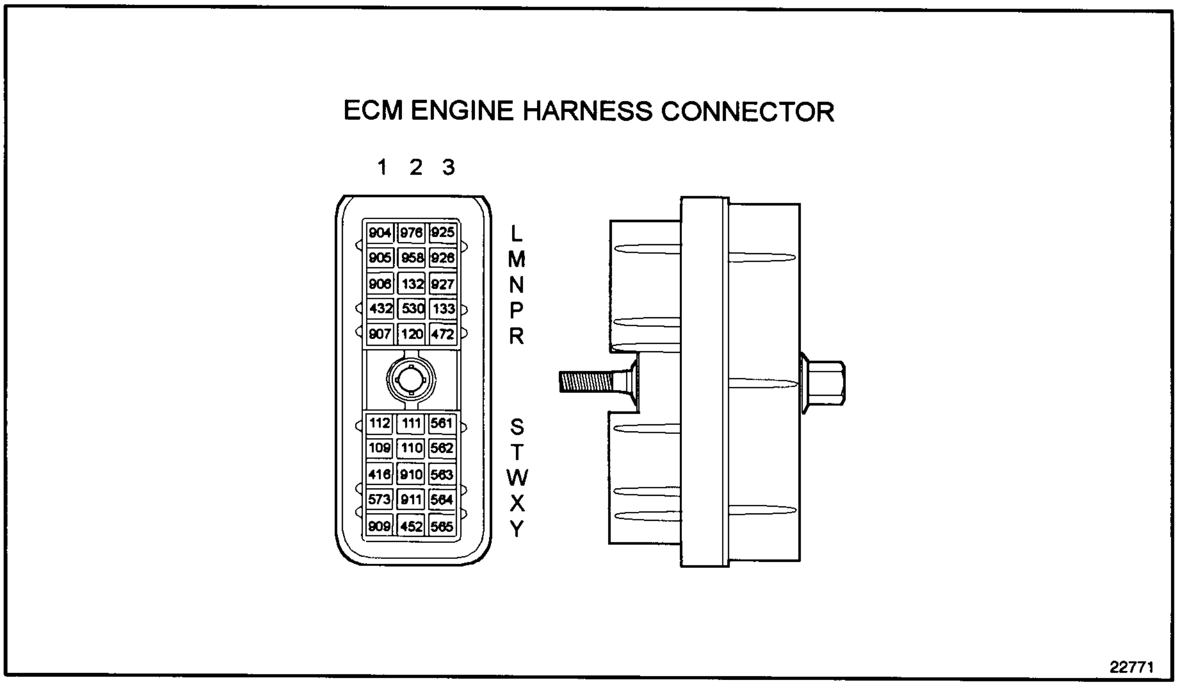


Figure 23-6 ECM Engine Harness Connector

23.3.6 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Read codes.

   [a] If no codes are logged, troubleshooting is complete.

   [b] If code 174/3 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 23.3.1.

   [c] If code 173/4 is not logged, but other codes are logged, refer to section 9.1.

24 (CHG) FLASH CODE 24 - FUEL TEMP SENSOR LOW

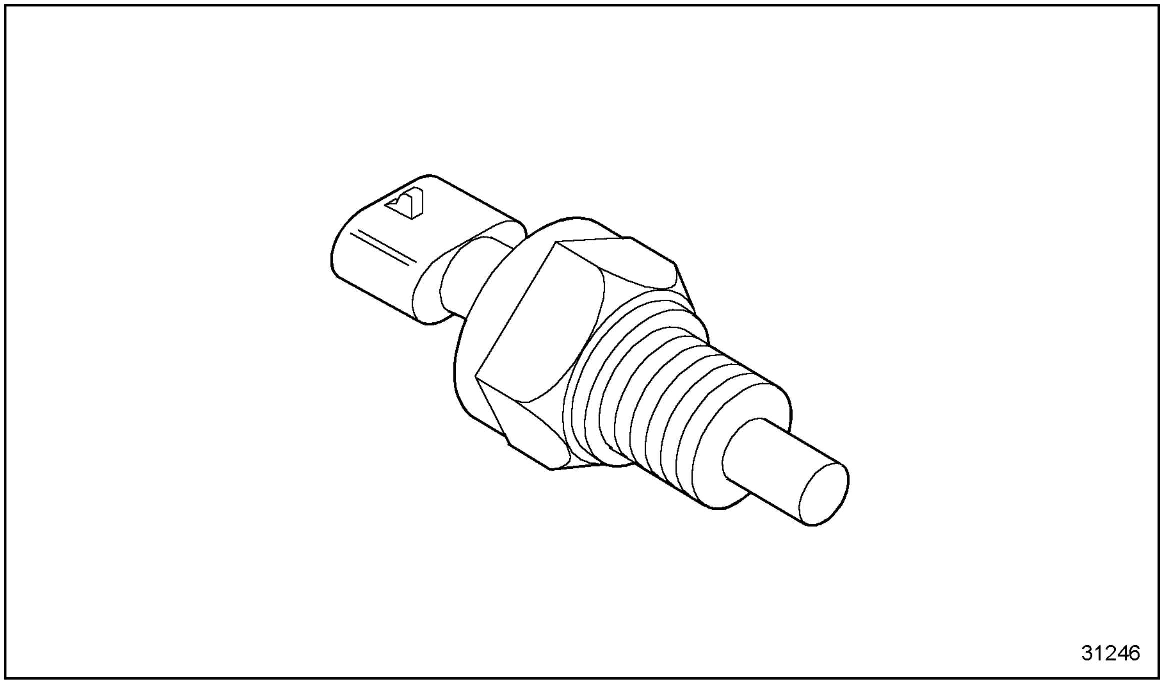


Figure 24-1 Fuel Temperature Sensor

24.1 DESCRIPTION OF FLASH CODE 24

Flash Code 24 indicates that the engine Fuel Temperature Sensor (FTS), see Figure 24-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Sensor signal circuit is shorted to sensor return circuit or to ground

24.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 24

The SAE J1587 equivalent code for Flash Code 24 is p 174 4, fuel temperature circuit low.

24.3 TROUBLESHOOTING FLASH CODE 24

The following procedure will troubleshoot Flash Code 24.

24.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   - [a] If active code 174/4 and no other active codes are logged, refer to section 24.3.2.
   - [b] If any or all of the following codes are logged, 110/3, 175/3, 174/3, or 102/3, refer to section 91.2.
   - [c] If codes other than the above are logged, refer to section 24.3.2.

24.3.2 Sensor Check

Perform the following steps to check the sensor:

1. Turn ignition OFF.
2. Disconnect the FTS connector.
3. Start and run engine for eight minutes.
4. Read active codes with engine still running.
   - [a] If code 174/4 and any other codes are logged, refer to section 24.3.4.
   - [b] If code 174/3 and any other codes except 174/4 are logged, refer to section 24.3.3.

24.3.3 Check Fuel Temperature Sensor Connectors

Perform the following steps to check the FTS connectors:

1. Check terminals at the FTS connector (both sensor and harness side) for bent, corroded, and unseated pins or sockets. See Figure 24-2.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 24.3.6.

[b] If terminals and connectors are not damaged, replace the FTS. Refer to section 24.3.6.

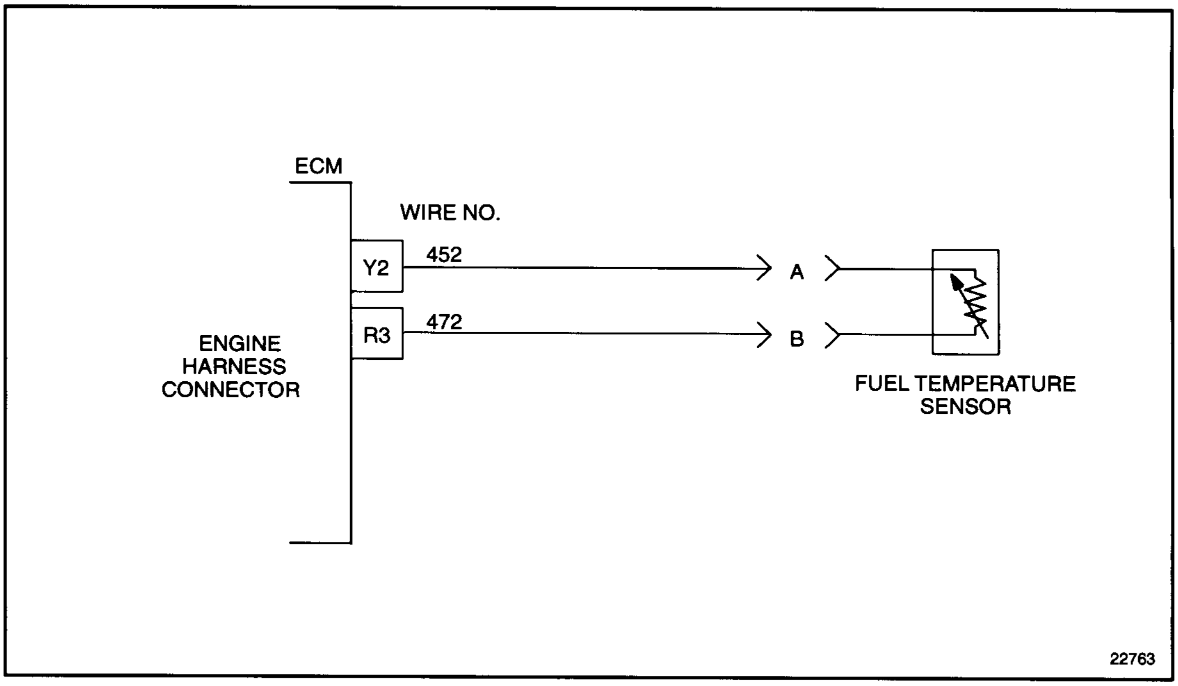


Figure 24-2 Fuel Temperature Sensor

24.3.4 Check for Short

Perform the following steps to check for a short:

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets R3 and Y2 on the engine harness connector. See Figure 24-3.
4. Measure resistance between socket R3 and a good ground (battery ground and chassis ground).

   [a] If resistance between sockets R3 and Y2, or R3 and battery ground, is less than or equal to 10,000 Ω, the signal line (#472) is shorted to the return line (#452) or battery ground. Repair short. Refer to section 24.3.6.

[b] If resistance between sockets R3 and Y2 is greater than 10,000 Ω or open, and resistance between socket B and a good ground is greater than 10,000 Ω or open, refer to section 24.3.5.

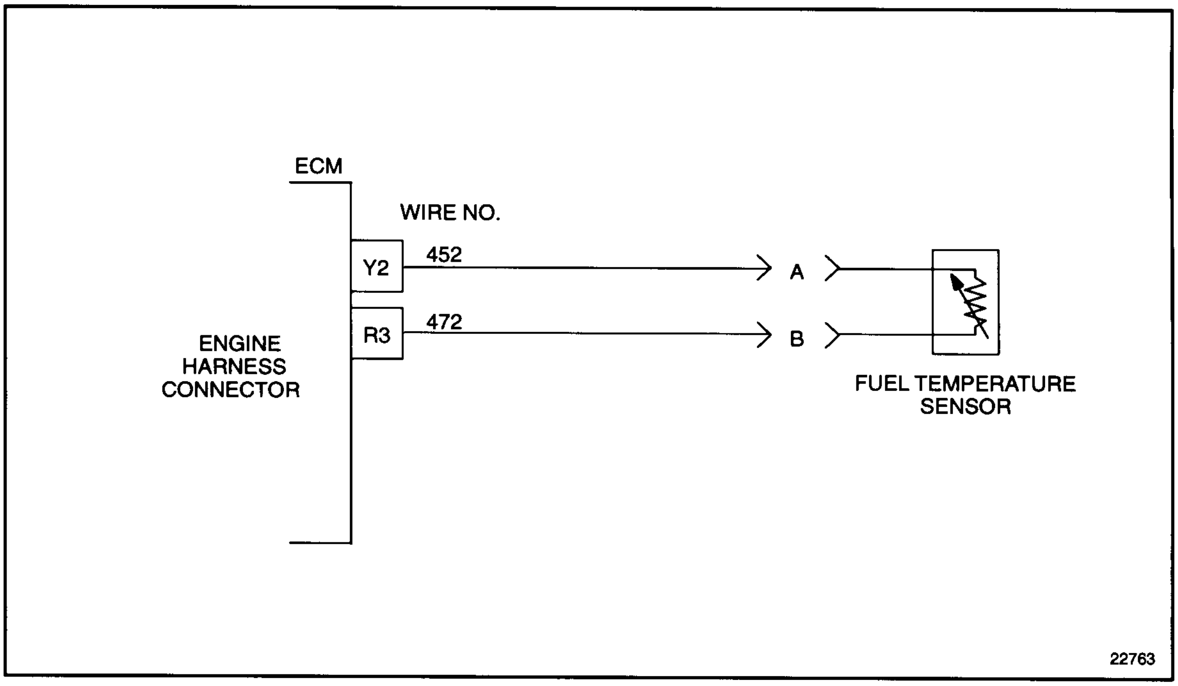


Figure 24-3 Engine Harness Connector

24.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors:

1. Check terminals at the ECM harness connector (both ECM and harness side) for bent, corroded, and unseated pins or sockets. See Figure 24-4.

   [a] If terminals and connectors are damaged, repair them. Refer to section 24.3.6.

[b] If terminals and connectors are not damaged, contact Detroit Diesel Technical Service. Refer to section 24.3.6.

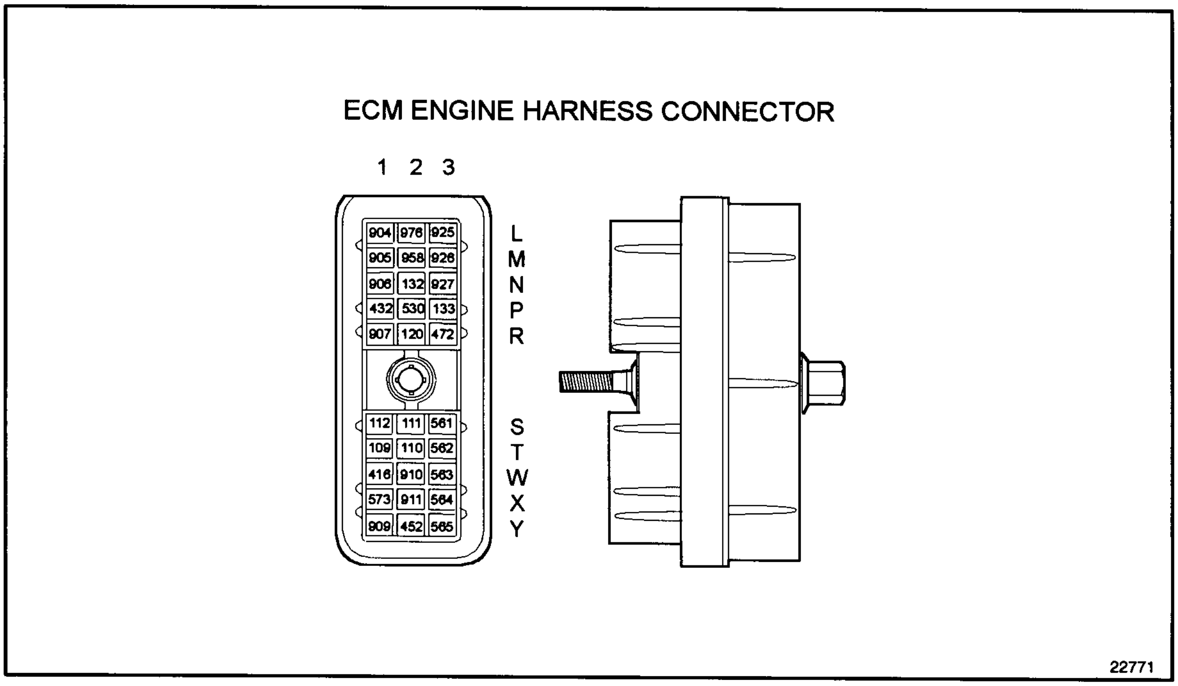


Figure 24-4 ECM Engine Harness Connector

24.3.6 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Read active codes.

    [a] If no codes are logged, troubleshooting is complete.

    [b] If code 174/4 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 24.3.1.

    [c] If code 174/4 is not logged, but other codes are logged, refer to section 9.1.

25 FLASH CODE 25

25.1 DESCRIPTION OF FLASH CODE 25

Code 25 will be flashed to indicate that the DDEC system has no active or inactive codes. No troubleshooting is required.

If using the DDR, the description will read:

No Active Codes or No Inactive Codes

26 FLASH CODE 26 - AUXILIARY INPUT ACTIVE

26.1 DESCRIPTION OF FLASH CODE 26

Flash Code 26 indicates that the Auxiliary Engine Shutdown #1 switch input to the ECM is active. The active switch input represents a low (grounded) external input circuit to the ECM.

Indicates that the Auxiliary Engine Shutdown #2 switch input to the ECM is active. The active switch input represents a low (grounded) external input circuit to the ECM.

26.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 26

The SAE J1587 equivalent codes for Flash Code 26 are:

- ☐ s 025 11 - auxiliary shutdown #1 active
- ☐ s 061 11 - auxiliary shutdown #2 active

26.3 TROUBLESHOOTING FLASH CODE 26

The following procedure will troubleshoot Flash Code 26.

26.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON. Start and run the engine.
2. Plug in DDR.
3. Read active codes.
   [a] If codes s 25-11 or s 61-11 are logged, refer to section 26.3.2.
   [b] If codes s 25-11 and s 61-11 are not logged, refer to section 9.1.

26.3.2 Check Calibration Configuration

Perform the following steps to check the calibration configuration:

1. Select ECM input/output configuration.
2. Determine cavity and wire number that is causing code to be logged.
3. Select switch/light status.
4. Determine status of that wire/cavity.
   [a] If the switch reads OFF, refer to section 26.3.3.
   [b] If the switch reads ON, the OEM supplied switch/relay is grounding the wire or a short to ground exists. Determine OEM supplied device or repair the short. Refer to section 26.3.4.
   [c] If no OEM device is used, remove the wire from the connector and plug, or use programming station to disable the function.

26.3.3 Confirm Switch Status

Perform the following steps to confirm switch status:

1. Start and run the engine for one minute.
2. Again, read switch status.
   [a] If the switch reads OFF, the condition no longer exists. Contact the OEM to learn which item is wired to this cavity. Refer to section 26.3.4.
   [b] If the switch reads ON, the OEM supplied device is grounding this wire. Contact the OEM for repair procedure. Refer to section 26.3.4.

26.3.4 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition ON.
2. Clear codes with DDR.
3. Note status of CEL/SEL.
4. If CEL/SEL not on, start and run the engine for one minute.
5. Read active and inactive codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If codes 25 or 61-11 and any other codes are logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 26.3.1.
   - [c] If codes 25 or 61-11 are not logged, but other codes are logged, refer to section 9.1.

27 (CHG) FLASH CODE 27 - AIR TEMP SENSOR HIGH

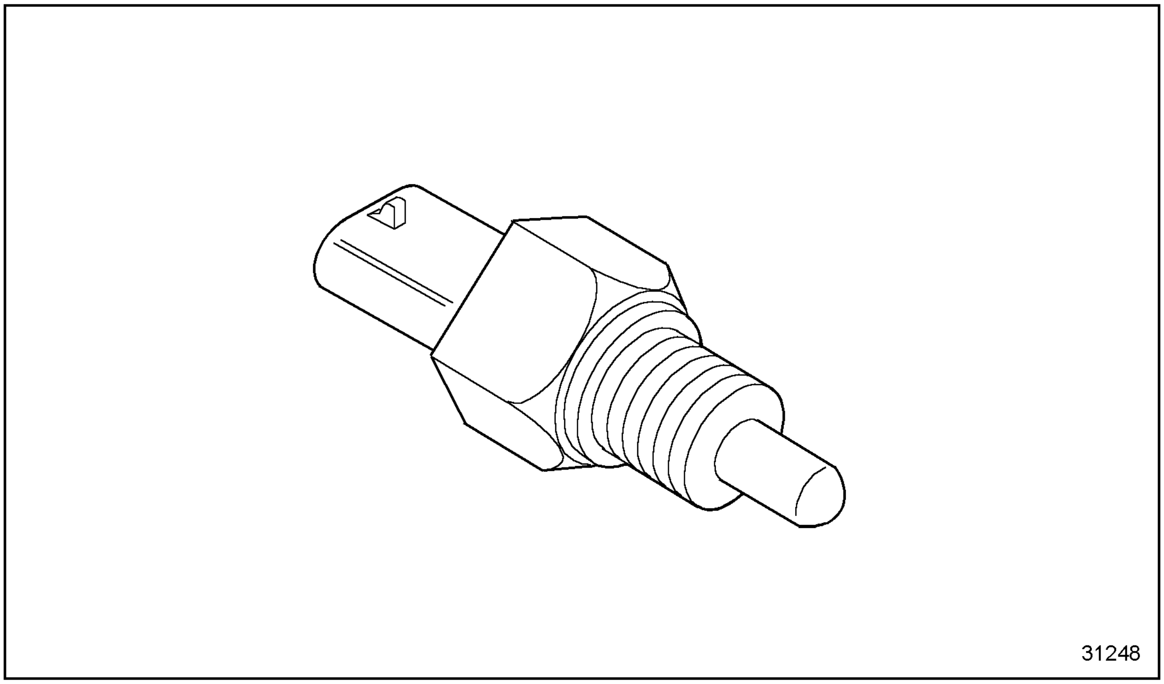


Figure 27-1 Air Temperature Sensor

27.1 DESCRIPTION OF FLASH CODE 27

Flash Code 27 indicates that the engine Air Temperature Sensor (ATS), see Figure 27-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

NOTE:
This code will only be logged during warm engine operation.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor return circuit

27.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 27

The SAE J1587 equivalent code for Flash Code 27 is p 172 3, air temperature circuit high.

27.3 TROUBLESHOOTING FLASH CODE 27

The following procedure will troubleshoot Flash Code 27.

27.3.1 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect ATS connector.
3. Install a jumper wire between sockets A and B of the ATS harness connector. See Figure 27-2.
4. Turn ignition ON.
5. Start and run engine for one minute (ensure oil temp is greater than 140 ° F).
6. Read active codes.
    [a] If code 172/4 or any other codes except 172/3 are logged, refer to section 27.3.2.
    [b] If any codes except code 172/4 are logged, refer to section 27.3.4.

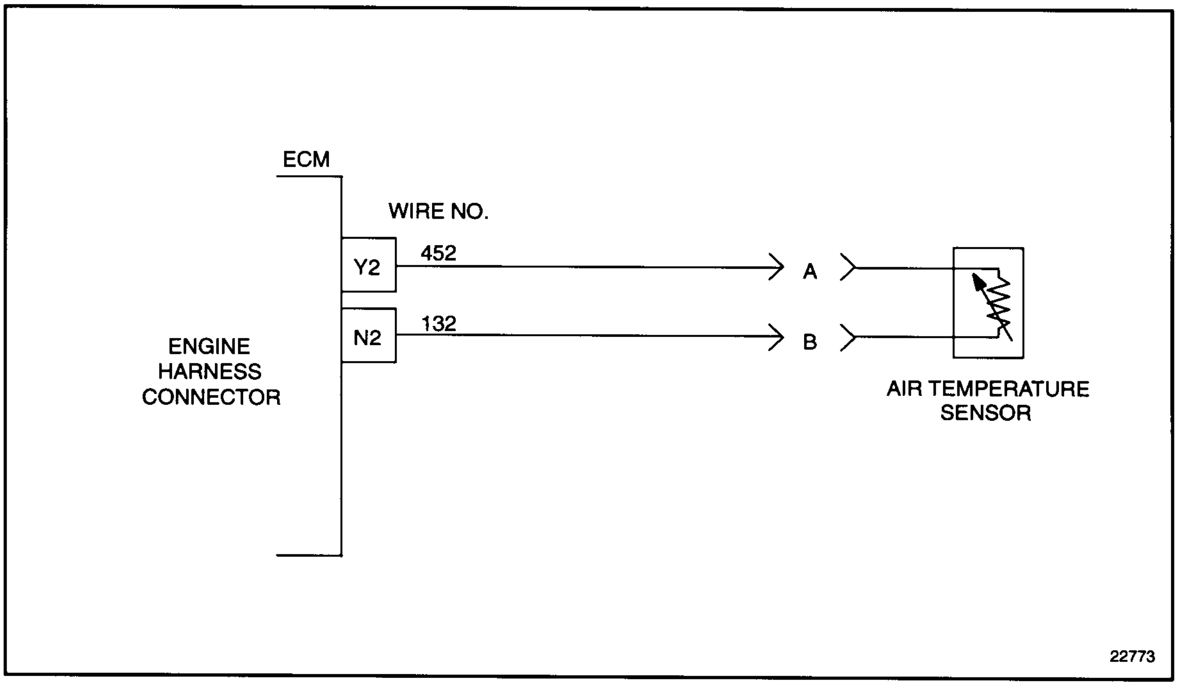


Figure 27-2 Air Temperature Sensor

27.3.2 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line.

1. Turn ignition/engine OFF.

2. Remove jumper wire.
3. Disconnect the engine harness connector at the ECM.
4. Measure resistance between sockets N2 and W1 on the engine harness connector. See Figure 27-3.
   [a] If the resistance measurement is less than or equal to 10 Ω, the signal line #132 is shorted to the engine +5 volt line (#416). Repair the short and refer to section 27.3.6.
   [b] If the resistance measurement between sockets N2 and W1 is greater than 10 Ω or open, refer to section 27.3.3.

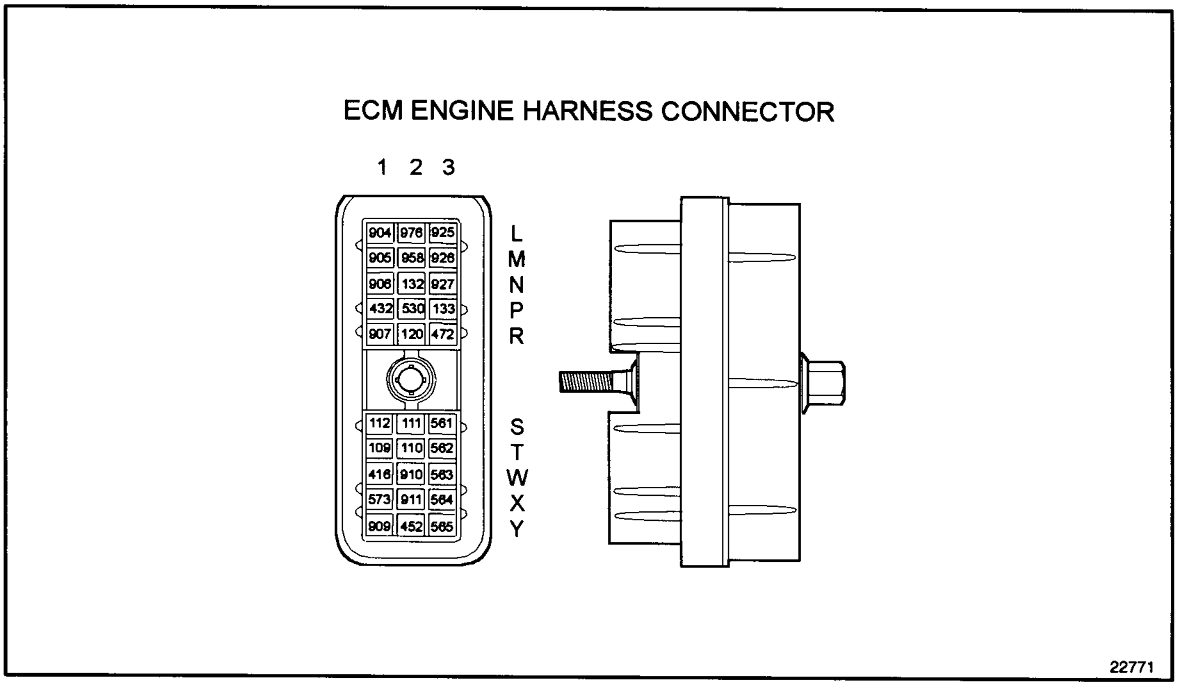


Figure 27-3 ECM Engine Harness Connector

27.3.3 Check Air Temperature Sensor Connectors

Perform the following steps to check the ATS connectors.

1. Check terminals at the ATS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets. See Figure 27-4.
   [a] If terminals or connectors are damaged, repair them. Refer to section 27.3.6.

[b] If terminals and connectors are not damaged, replace the ATS. Refer to section 27.3.6.

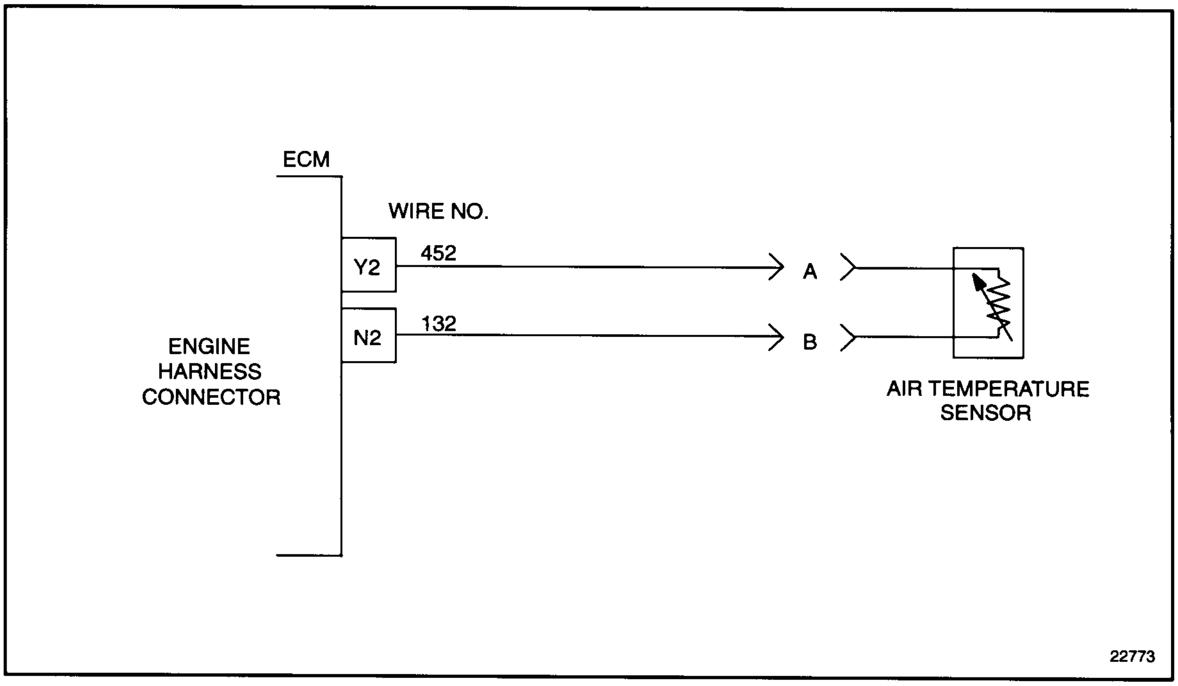


Figure 27-4 Air Temperature Sensor

27.3.4 Open Line Check

Perform the following steps to check for an open line.

1. Turn ignition OFF.
2. Disconnect the engine harness connector at the ECM. (Jumper still in place.)
3. Measure resistance between sockets N2 and Y2 on the engine harness connector. See Figure 27-5.

    [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 27.3.5.

[b] If the resistance measurement between sockets N2 and W1 is greater than 5 Ω or open, the signal line #132 or return line #452 is open. Repair the open. Refer to section 27.3.6.

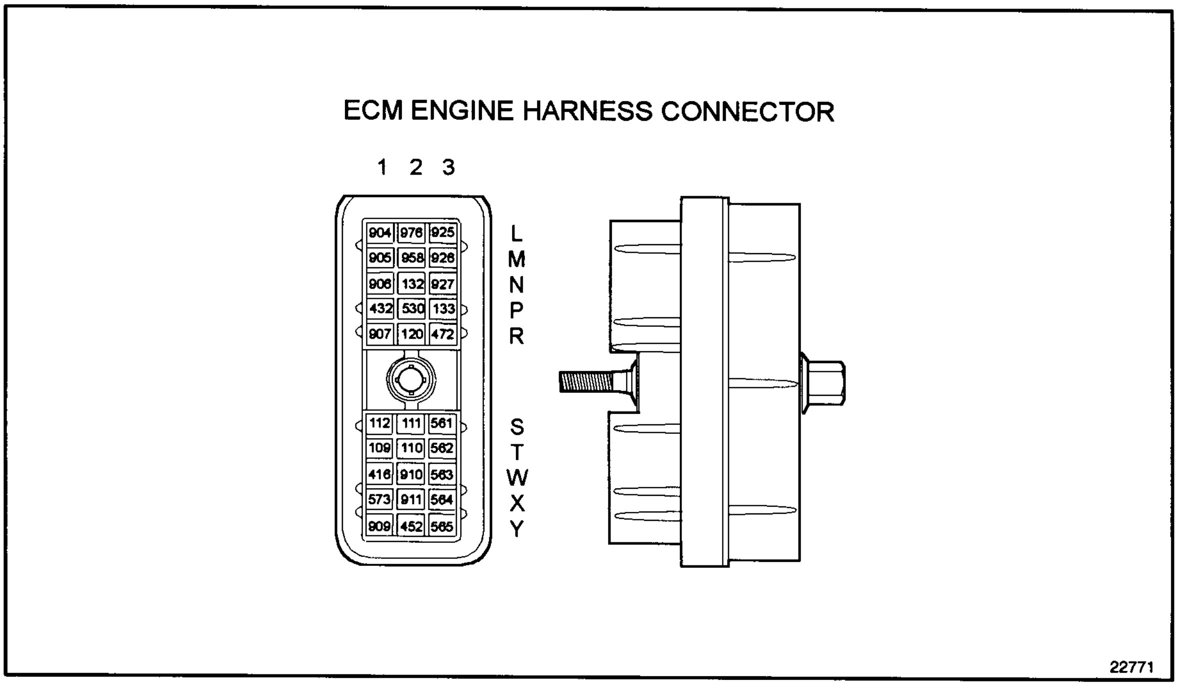


Figure 27-5 ECM Engine Harness Connector

27.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. See Figure 27-6.

   [a] If terminals or connectors are damaged, repair them. Refer to section 27.3.6.

[b] If terminals and connectors are not damaged, contact Detroit Diesel Technical Service. **Refer to section** 27.3.6.

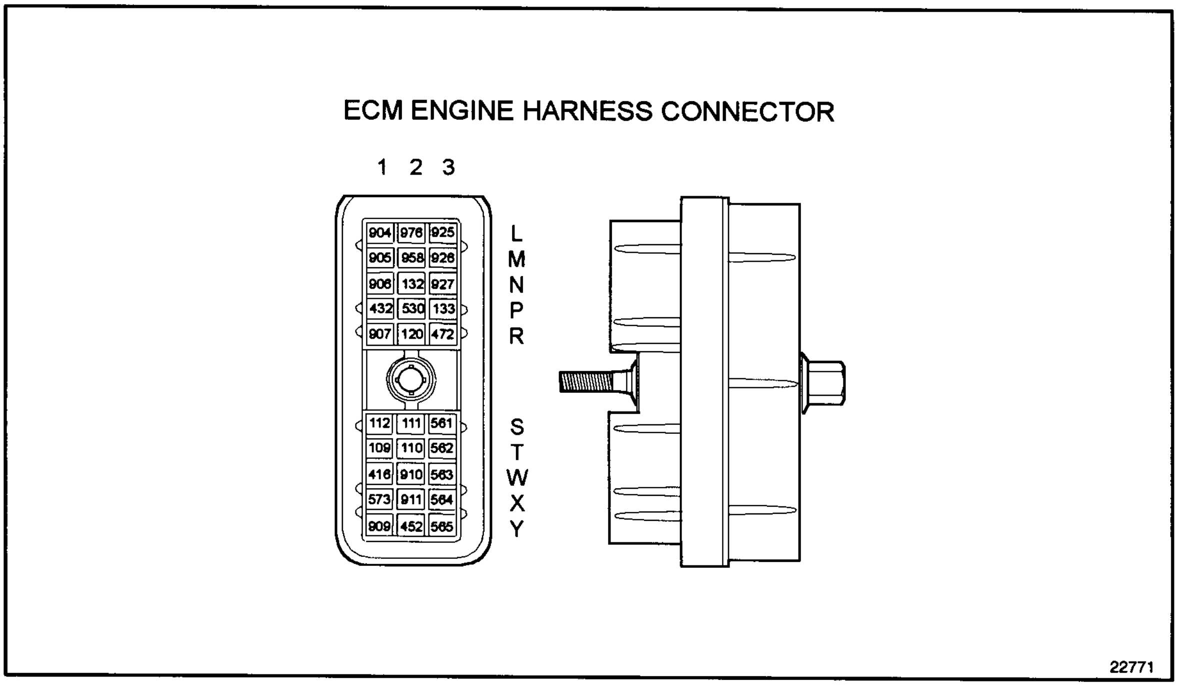


Figure 27-6 ECM Engine Harness Connector

27.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.
6. Stop engine.
7. Check DDR for codes.

   [a] If no codes are logged, troubleshooting is complete.

   [b] If code 172/3 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 27.3.1.

   [c] If any codes except code 172/3 are logged, refer to section 9.1.

28 (CHG) FLASH CODE 28 - AIR TEMP SENSOR LOW

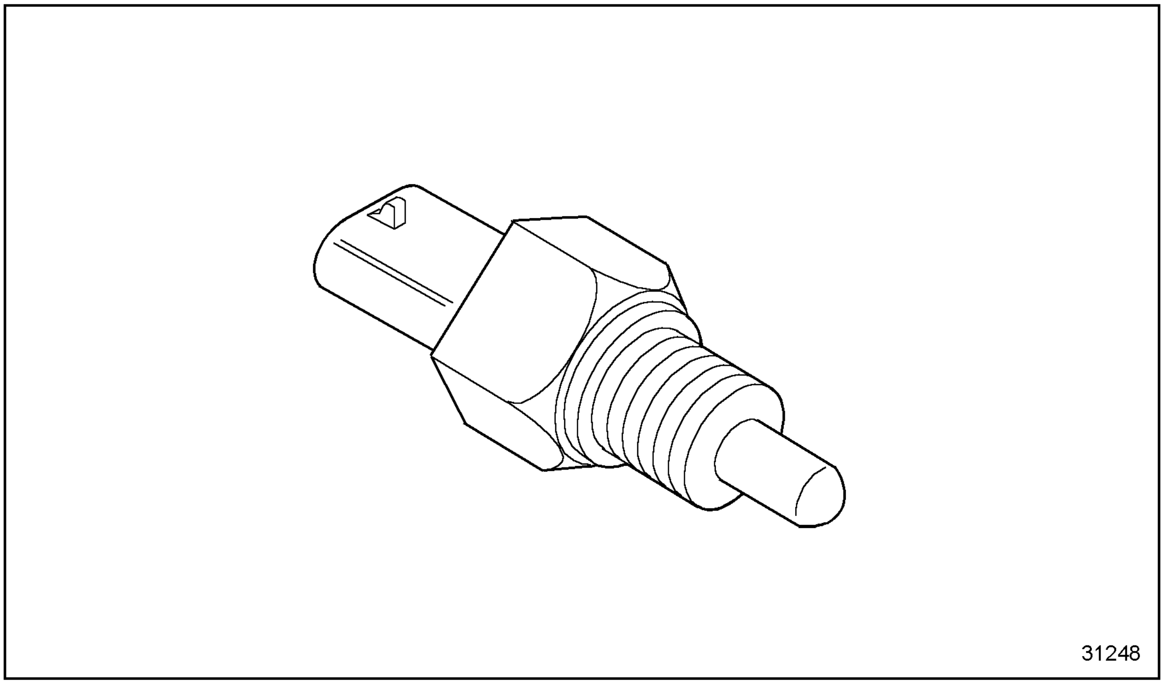


Figure 28-1 Air Temperature Sensor

28.1 DESCRIROMPTION OF FLASH CODE 28

Flash Code 28 indicates that the engine Air Temperature Sensor (ATS), see Figure 28-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Sensor signal circuit is shorted to sensor return
- ☐ Sensor signal circuit is shorted to ground

28.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 28

The SAE J1587 equivalent code for Flash Code 28 is p 172 4, air temperature circuit low.

28.3 TROUBLESHOOTING FLASH CODE 28

The following procedure will troubleshoot Flash Code 28.

28.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in DDR.
3. Read active codes.
   [a] If code 172/4 was logged and there are no other codes logged, refer to section 28.3.2.
   [b] If code 172/4 and any of the following codes 110/3, 175/3, 174/3, 72/3 or 102/3 were logged, refer to section 90.1.
   [c] If code 172/4 and any code except the following were logged 110/3, 175/3, 174/3, 72/3 or 102/3, refer to section 28.3.2.

28.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect the ATS connector. See Figure 28-2.

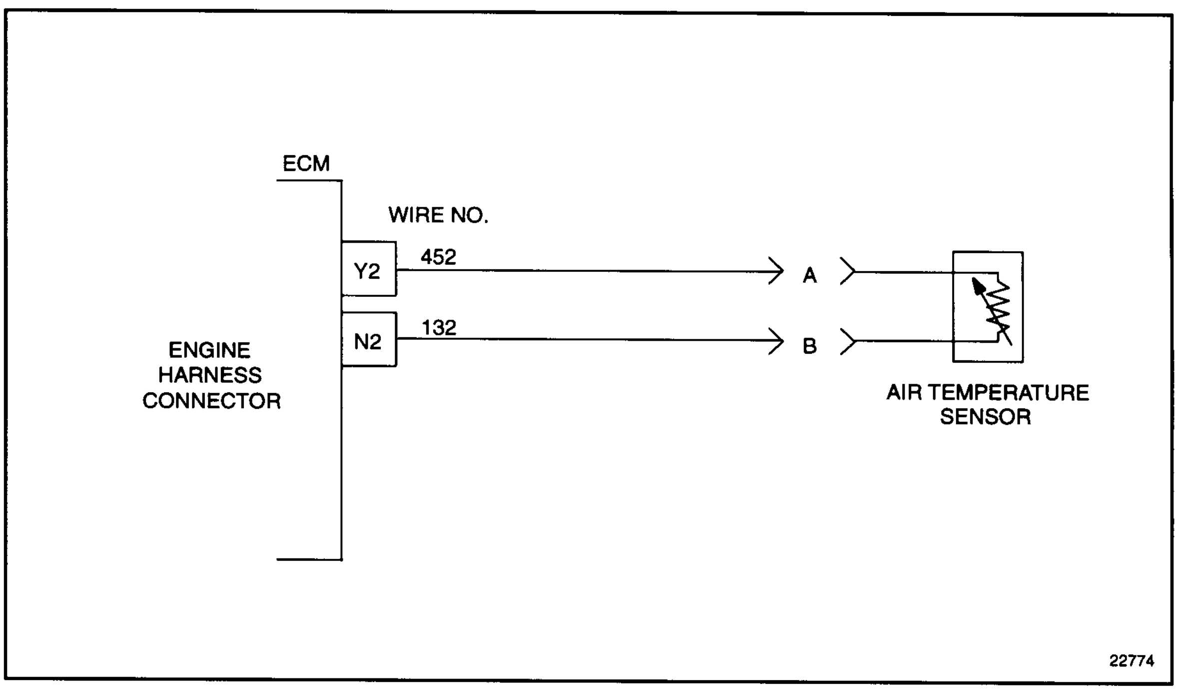


Figure 28-2 Engine Harness to Air Temperature Sensor Connector

3. Start engine and run until Check Engine light comes on, or for eight minutes.
4. With engine still running, read active codes.
   [a] If code 172/4 and any other codes were logged, refer to section 28.3.4.
   [b] If flash 172/3 and any other codes except 172/4 were logged, refer to section 28.3.3.

28.3.3 Check Air Temperature Sensor Connectors

Perform the following steps to check the ATS connector.

1. Check terminals at the ATS connector (both sensor and harness side) for damage; bent, corroded and unseated pins or sockets.
   [a] If terminals and connectors are not damaged, replace ATS. Refer to section 28.3.6.
   [b] If terminals and connectors are damaged, repair/replace wires and refer to section 28.3.6.

28.3.4 Check for Short

Perform the following steps to check for a short.

1. Turn the ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets N2 and Y2 on the engine harness connector. See Figure 28-3.
4. Measure resistance between socket N2 and a good ground.
   [a] If the resistance measurement between sockets N2 and Y2 and between socket N2 and a good ground is greater than 10 Ω or open, refer to section 28.3.5.

[b] If the resistance measurement between sockets N2 and Y2, or N2 and battery negative, is less than or equal to 10 Ω, the signal line #132 is shorted to the return line #452 or battery ground. Repair short. Refer to section 28.3.6.

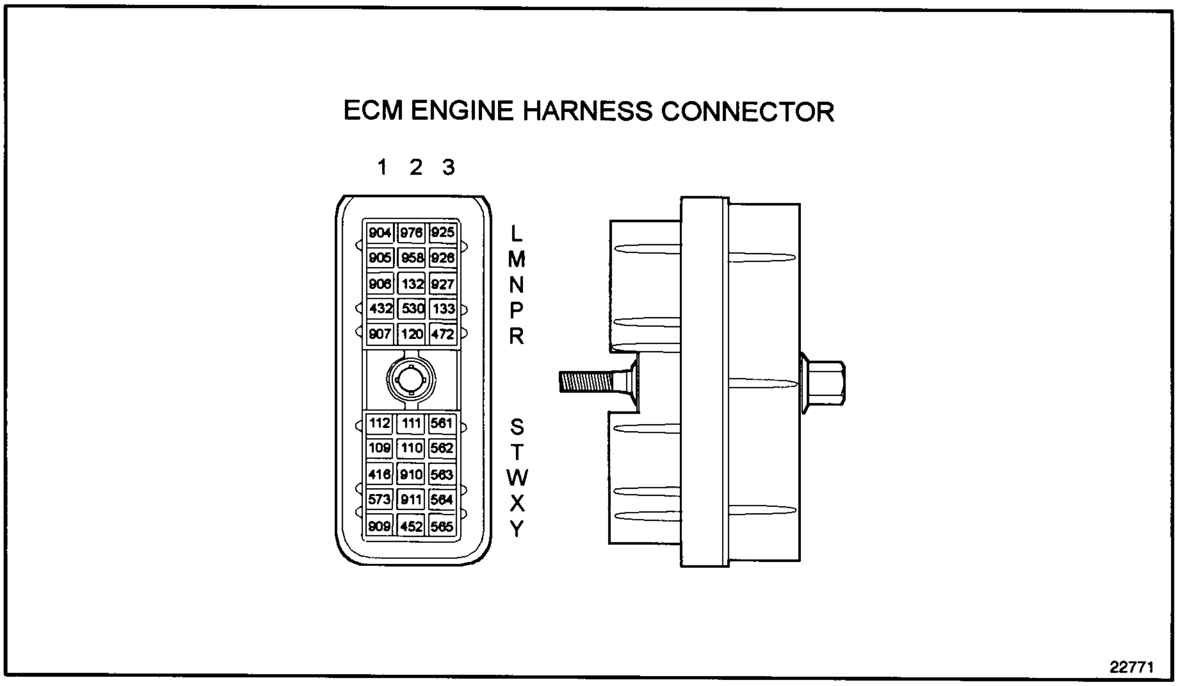


Figure 28-3 ECM Engine Harness Connector

28.3.5 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage; bent, corroded and unseated pins or sockets, especially N2 and Y2 of the ECM connector.

    [a] If terminals or connectors are not damaged, contact Detroit Diesel Technical Services and refer to section 28.3.6.

    [b] If terminals and connectors are damaged, repair them. Refer to section 28.3.6

28.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for eight minutes.

6. Stop engine.
7. Read inactive codes.
   [a] If no codes are displayed, troubleshooting is complete.
   [b] If code 172/4 is logged with any other codes, all system diagnostics are complete. Review this section from the first step to find the error.
   [c] If code 172/4 is not logged, but other codes are logged, refer to section 9.1.

29 FLASH CODE 29

29.1 DESCRIPTION OF FLASH CODE 29

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

30 FLASH CODE 30

30.1 DESCRIPTION OF FLASH CODE 30

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

31 (CHG) FLASH CODE 31 - ENGINE BRAKE FAULT CODE

31.1 DESCRIPTION OF FLASH CODE 31

Flash Code 31 indicates the engine brake low or medium circuit has an open or is shorted to battery ground.

This diagnostic condition is typically:

- ☐ Output circuit open
- ☐ Output wire is shorted to ground

31.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 31

The SAE J1587 equivalent code for Flash Code 31 is s 051 3/4 or s 052 3/4.

31.3 TROUBLESHOOTING FLASH CODE 31

The following procedure will troubleshoot Flash Code 31.

31.3.1 Check Configuration

Perform the following steps to check configuration.

1. If the unit has engine brakes, refer to section 31.3.2.
2. If the unit does not have engine brakes, the ECM is configured for engine brakes and shouldn't be. Contact DDC with the engine serial number to have the data changed. Reprogram the ECM after the change. Refer to section 31.3.10.

31.3.2 Determine Failure Mode

Perform the following steps to determine failure mode.

1. Turn vehicle ignition ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL) connector.
3. Read SAE code (051 or 052).
   - [a] If the reading is FMI=3, there is an open. Refer to section 31.3.3.
   - [b] If the reading is FMI=4, there is a short to ground. Refer to section 31.3.7.

31.3.3 Determine Engine Type

Perform the following steps to determine engine type.

1. Is this a Series 55 engine?
   - [a] If yes, reprogram the ECM. Then, refer to section 31.3.10.
   - [b] If no, refer to section 31.3.4.

31.3.4 Check for Open

Perform the following steps to check for open.

1. Turn vehicle ignition OFF.
2. Disconnect 2-pin connector pigtail from engine brake harness.
3. Disconnect 30-pin engine harness connector.
4. Install a jumper wire between pins #561 and #562, ECM side.
5. Measure resistance between S3 (#561) and T3 (#562) of the engine harness connector.
   - [a] If measured resistance is less than 50 Ω , refer to section 31.3.5.

[b] If measured resistance is greater than 50 Ω , one or both wires are open. Repair open. Refer to section 31.3.10.

31.3.5 Check for Open (Inside Valve Cover)

Perform the following steps to check for open in the inside valve cover.

1. Reconnect the engine harness connector. See Figure 31-1.
2. Relocate the jumper to pins A and B of the brake harness connector (brake side).
3. Remove rocker cover.
4. Disconnect the two #621 leads and the one #622 lead from the brake solenoids.
5. Measure resistance between both #621 wires and #622 wire.

   [a] If measured resistance is greater than 50 Ω or open, an open exists in one of the wires where the check was made. Repair open or replace the injector harness. Refer to section 31.3.10.

[b] If measured resistance is less than 50 Ω, refer to section 31.3.6.

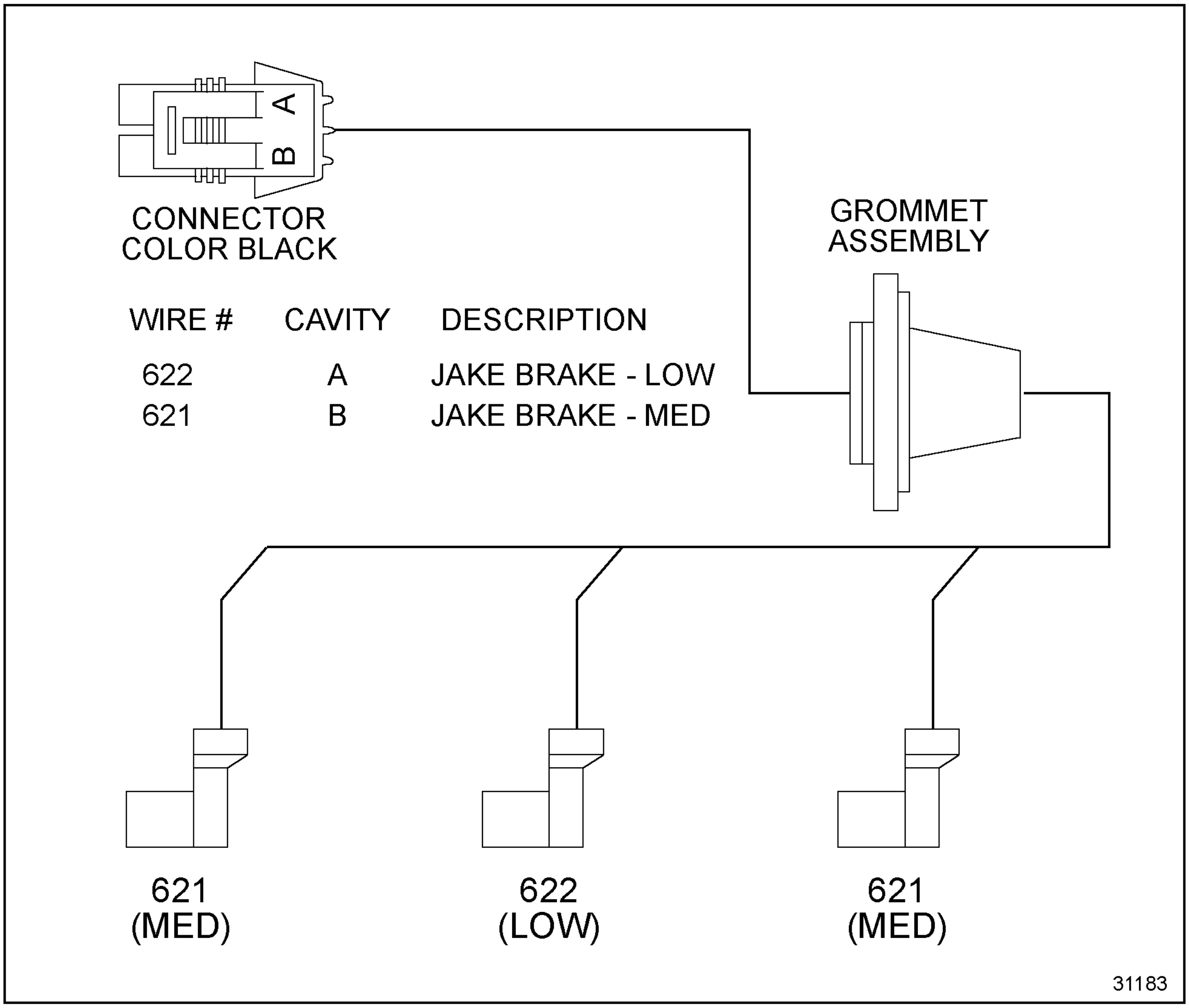


Figure 31-1 Engine Brake Harness Schematic

31.3.6 Check for Cylinder Block Ground

Perform the following steps to check for cylinder block ground.

1. If the cylinder block is connected to the battery ground, refer to section 31.3.9.
2. If the cylinder block is not connected to the battery ground, install a ground strap from the cylinder block to the battery negative (-). Refer to section 31.3.10.

31.3.7 Check for Short

Perform the following steps to check for a short.

1. Turn vehicle ignition OFF.

2. Unplug the engine harness connector.
3. Measure resistance between S3 (#561) and a battery ground, and S3 (#561) and the engine block. Repeat this check between T3 (#562) and battery ground, and T3 (#562) and the engine block.
   [a] If resistance for all measurements is greater than 5 Ω or open, refer to section 31.3.8.
   [b] If any measured resistance is less than 5 Ω, the wire where the measurement was read is shorted to ground or to the engine. Repair short or replace the wire. Refer to section 31.3.10.

31.3.8 Check for Short

Perform the following steps to check for a short between wires.

1. Measure resistance between S3 (#561) and T3 (#562).
   [a] If measured resistance is less than 10 Ω, the S3 and T3 wires are shorted to each other. Repair short. Refer to section 31.3.10.
   [b] If measured resistance is greater than 10 Ω, refer to section 31.3.9.

31.3.9 Check Brake Solenoids

Perform the following steps to check for brake solenoids.

1. Check brake solenoids. Refer to OEM guidelines.
   [a] If the solenoids are in good condition, contact Detroit Diesel Technical Service. Refer to section 31.3.10.
   [b] If the solenoids are damaged, repair or replace them. Refer to section 31.3.10.

31.3.10 Verify Repairs

Perform the following steps to verify repairs.

1. Connect any connectors removed for troubleshooting.
2. Start and run the engine. (Operate the engine brake.)
   [a] If no lights come on, and no codes are logged, the repairs are complete. No further troubleshooting is required.
   [b] If Check Engine Light displays with codes s 051 3/4 or 052 3/4, review this section to find the error. Refer to section 31.3.1.

32 FLASH CODE 32 - CEL / SEL FAULT

32.1 DESCRIPTION OF FLASH CODE 32

Flash Code 32 indicates that the wire for the SEL or CEL is open or shorted to Battery +.

This diagnostic condition is typically:

- ☐ Open/broken output wire
- ☐ Shorted output wire

32.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 32

The SAE J1587 equivalent code for Flash Code 32 is:

- ☐ s 238/3 SEL short to battery
- ☐ s 238/4 SEL open circuit
- ☐ s 239/3 CEL short to battery
- ☐ s 239/4 CEL open circuit

32.3 TROUBLESHOOTING FLASH CODE 32

The following procedure will troubleshoot Flash Code 32.

32.3.1 Determine Failure Mode Identifier (3 or 4)

Perform the following steps to determine FMI.

1. Turn ignition ON.
2. Plug in diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read codes.
   [a] If code 238/4 or 239/4 is logged, reprogram the ECM. Refer to section 32.3.3.
   [b] If code 238/3 or 239/3 is logged, refer to section 32.3.2.

32.3.2 Check for Short to Battery

Perform the following steps to determine failure.

1. Turn vehicle ignition OFF.
2. Disconnect vehicle harness connector.
3. Turn ignition ON.
4. Remove CEL bulb and SEL bulb.
5. Measure voltage between B2 (#509) and a good ground. See Figure 32-1.

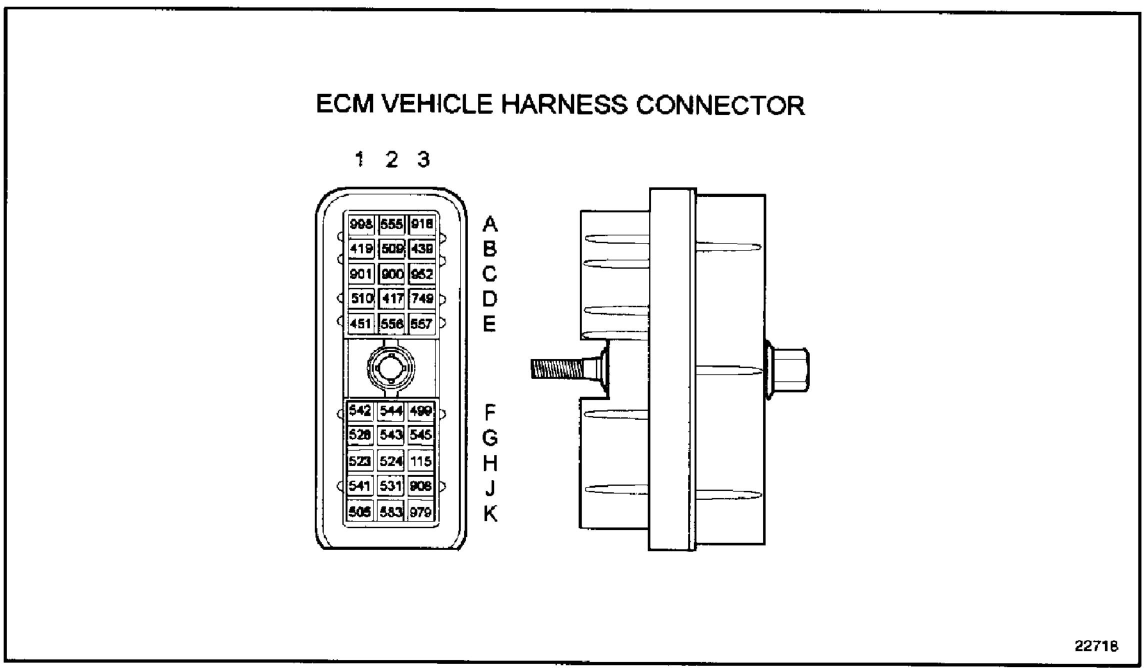


Figure 32-1 ECM Vehicle Harness Connector

6. Measure voltage between B1 and a good ground.
   [a] If either measurement was greater than 0.5 volts, the wire that had the reading is shorted to some voltage source. Replace the wire(s). Refer to section 32.3.3.
   [b] If no measurement was greater than 0.5 volts, contact Detroit Diesel Technical Service.

32.3.3 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. Start and run the engine.
3. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL). Read codes.
   [a] If active code 32 is logged, review this section to find the error. Refer to section 32.1.
   [b] If code 32 is not logged, troubleshooting is complete.

33 (CHG) FLASH CODE 33 - TBS HIGH

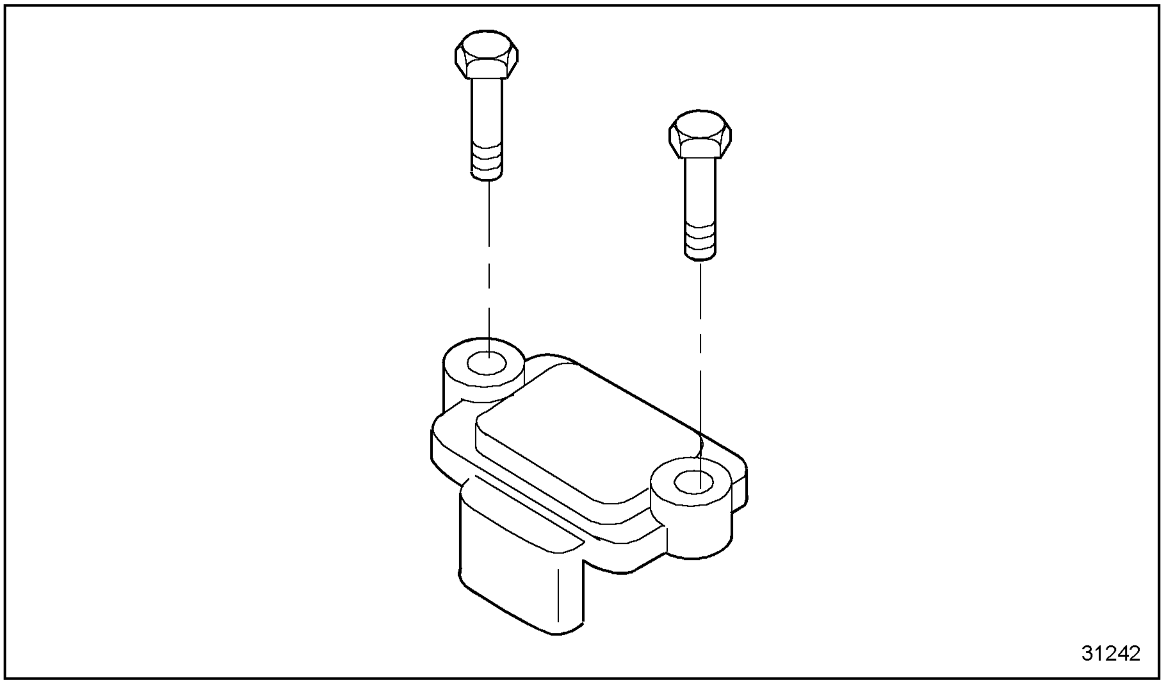


Figure 33-1 Turbo Boost Sensor

33.1 DESCRIPTION OF FLASH CODE 33

Flash Code 33 indicates that the engine Turbo Boost Sensor (TBS), see Figure 33-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

33.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 33

The SAE J1587 equivalent code for Flash Code 33 is p 102 3.

33.3 TROUBLESHOOTING FLASH CODE 33

The following procedure will troubleshoot Flash Code 33.

33.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
2. Turn vehicle ignition switch ON.
3. Read active codes.
   - [a] If code 102/3 and no other codes were logged, refer to section 33.3.2.
   - [b] If any of the following codes are also present: 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 90.1.

33.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect the TBS connector. See Figure 33-2.
3. Start and run the engine at idle.
4. Read active codes logged.
   - [a] If active code 102/3 and any other codes are logged, refer to section 33.3.5.

[b] If active code 102/4 and any other codes except 102/3 are logged, refer to section 33.3.3.

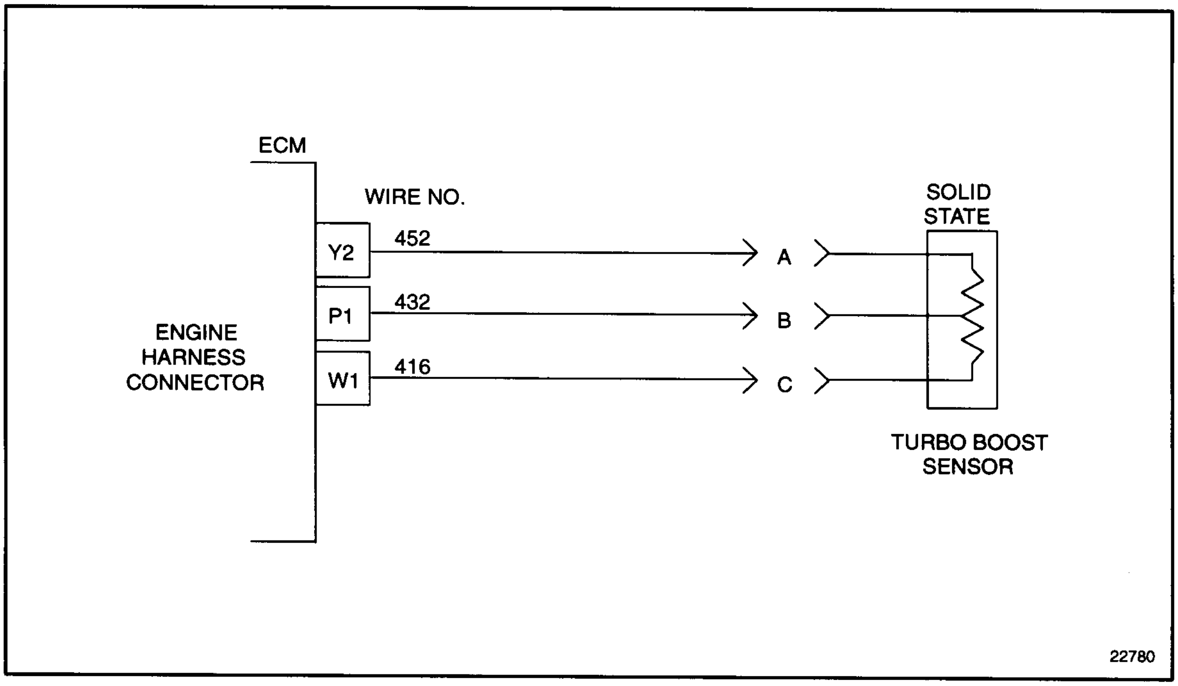


Figure 33-2 Turbo Boost Sensor

33.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn ignition switch OFF.
2. Install a jumper wire between pin A and pin B of the TBS harness connector. See Figure 33-3.
3. Disconnect the engine harness connector at the ECM. See Figure 33-4.
4. Measure resistance between sockets P1 and Y2 on the engine harness connector.

[a] If resistance measurement is less than or equal to 5 Ω, refer to section 33.3.4.

[b] If resistance measurement is greater than 5 Ω, the return line #452 is open. Repair the open. Refer to section 33.3.8.

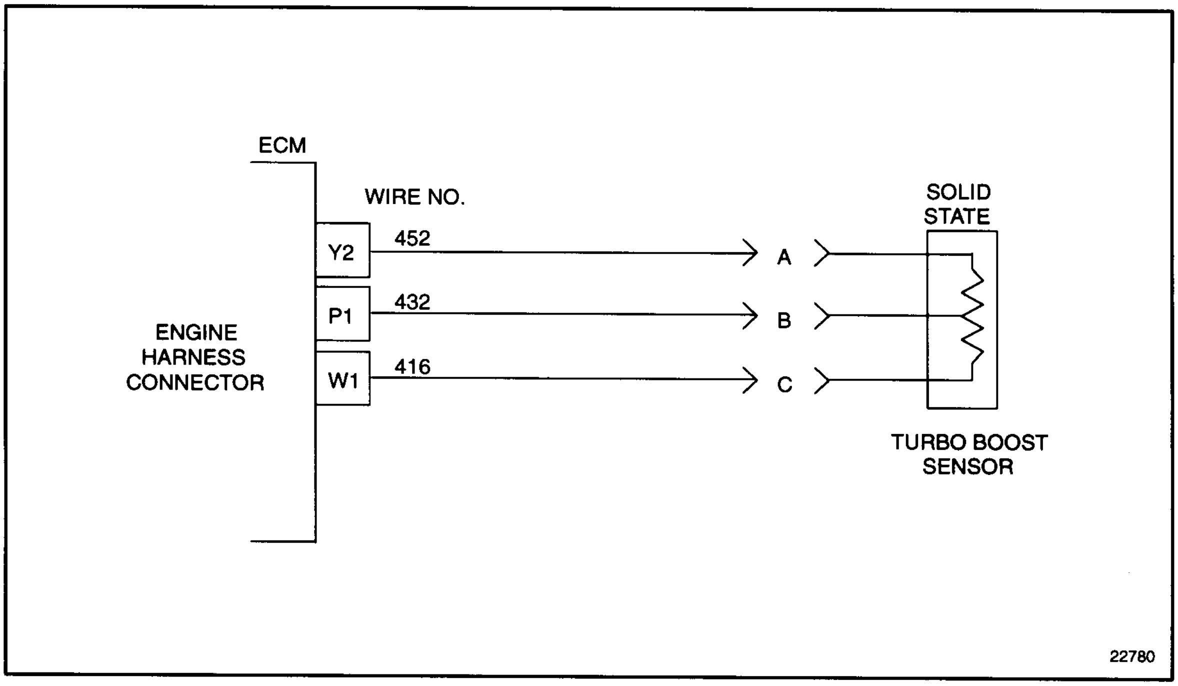


Figure 33-3 Turbo Boost Sensor

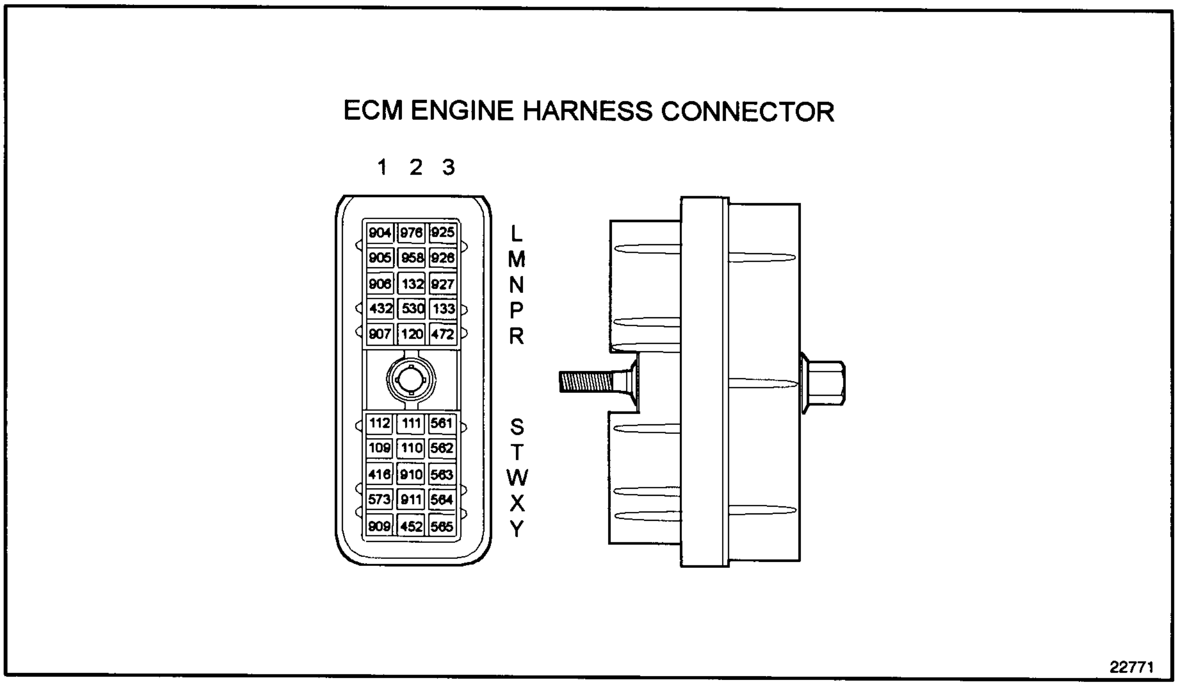


Figure 33-4 ECM Engine Harness Connector

33.3.4 Check Turbo Boost Sensor Connectors

Perform the following steps to check the TBS connectors.

1. Check terminals at the TBS connector (both sensor and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 33-5.
   [a] If the terminals and connectors are damaged, repair them. Refer to section 33.3.8.
   [b] If the terminals and connectors are not damaged, replace the TBS. Refer to section 33.3.8.

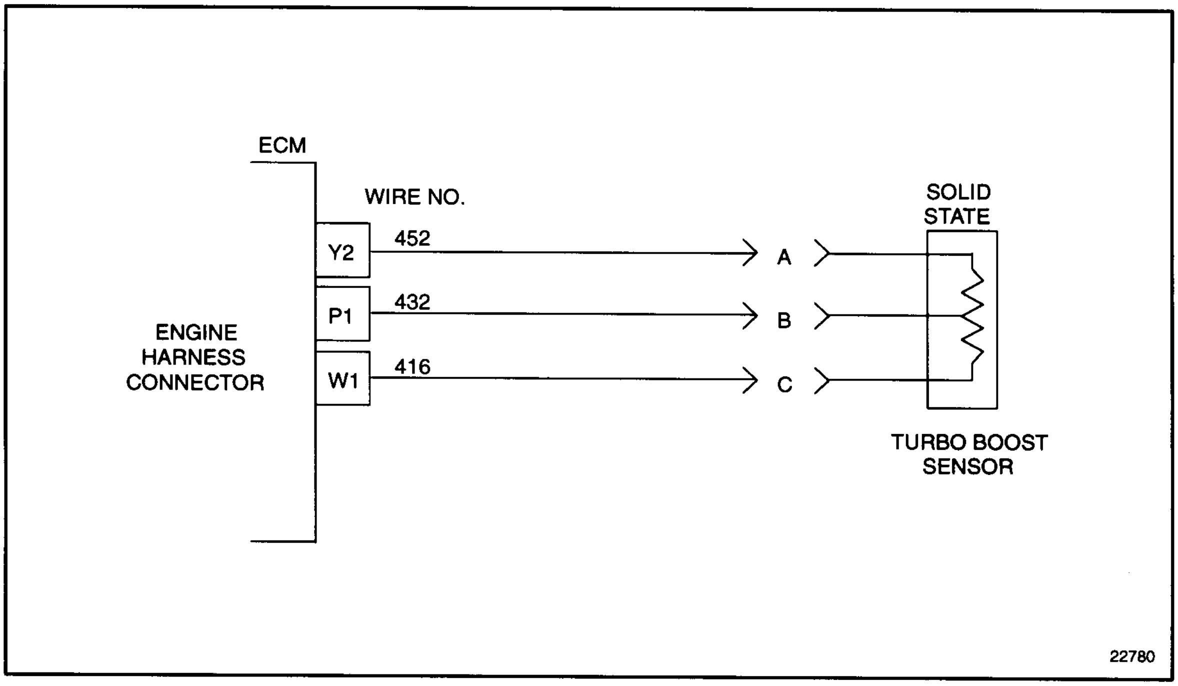


Figure 33-5 Turbo Boost Sensor

33.3.5 Check for Short to +5 Volt Line

Perform the following steps to check for a short to the +5 volt line:

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector from the ECM.
3. Measure resistance between sockets P1 and W1 on the engine harness connector. See Figure 33-6.
   [a] If measured resistance is less than or equal to 10,000 Ω, the signal line #432 is shorted to the engine +5 volt line #416. Repair short. Refer to section 33.3.8.

[b] If measured resistance is greater than 10,000 Ω, or open, refer to section 33.3.6.

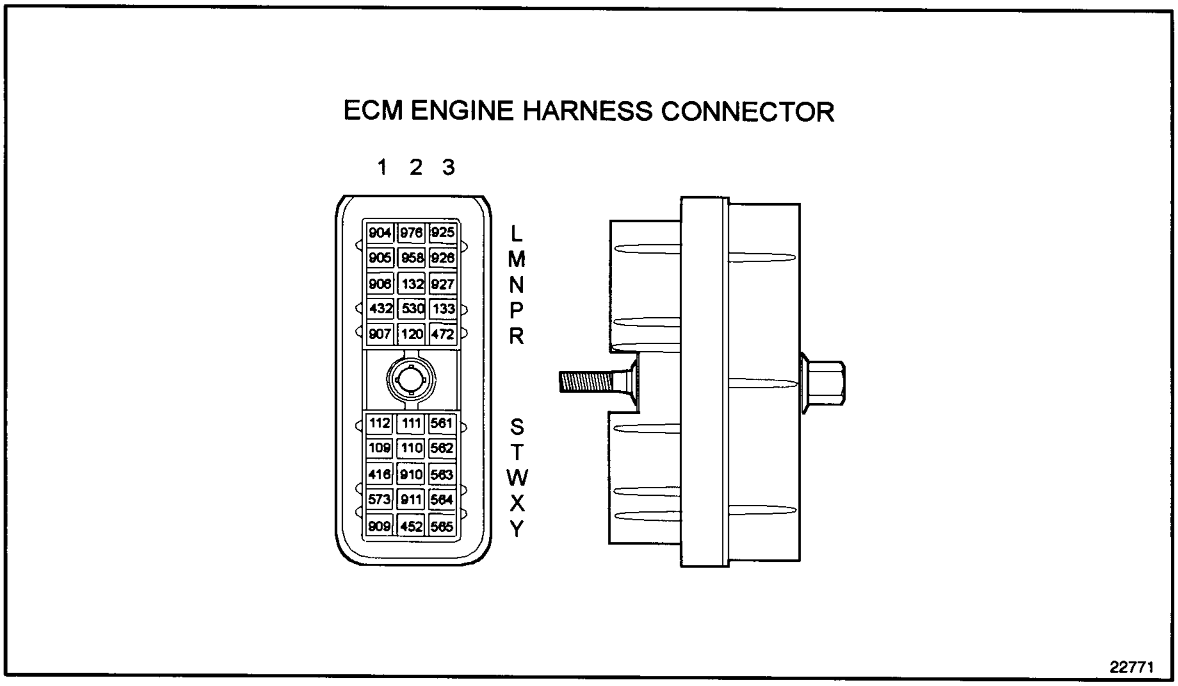


Figure 33-6 ECM Engine Harness Connector

33.3.6 Check for Short to Battery

Perform the following steps to check for a short to the battery (+):

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connector harness at the ECM. See Figure 33-7.
3. Measure resistance between sockets P1 of the engine harness connector and B3 on the vehicle harness connector.
4. Measure resistance between socket P1 on the engine harness connector and the 5-way power harness connector sockets A and C.

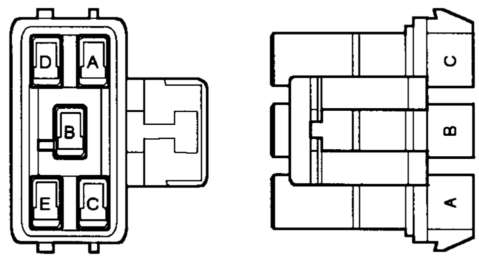
   [a] If the resistance measurement is less than or equal to 100 Ω, a short exists between sockets where the measurement was taken. Repair short and reinsert fuses, or reset breakers. Refer to section 33.3.8.

[b] If the resistance measurement is greater than 100 Ω, or open, refer to section 33.3.7.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 33-7 5-Way ECM Power Connector

33.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.

   [a] If terminals and connectors are damaged, repair both. Refer to section 33.3.8.

   [b] If terminals and connectors are not damaged, reprogram the ECM. Refer to section 33.3.8.

33.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.

[a] If no codes are logged, troubleshooting is complete.

[b] If code 102/3 is not logged, and other codes are logged, refer to section 9.1.

[c] If code 102/3 is logged, and other codes are logged, refer to section 33.3.1.

34 (CHG) FLASH CODE 34 - TBS LOW

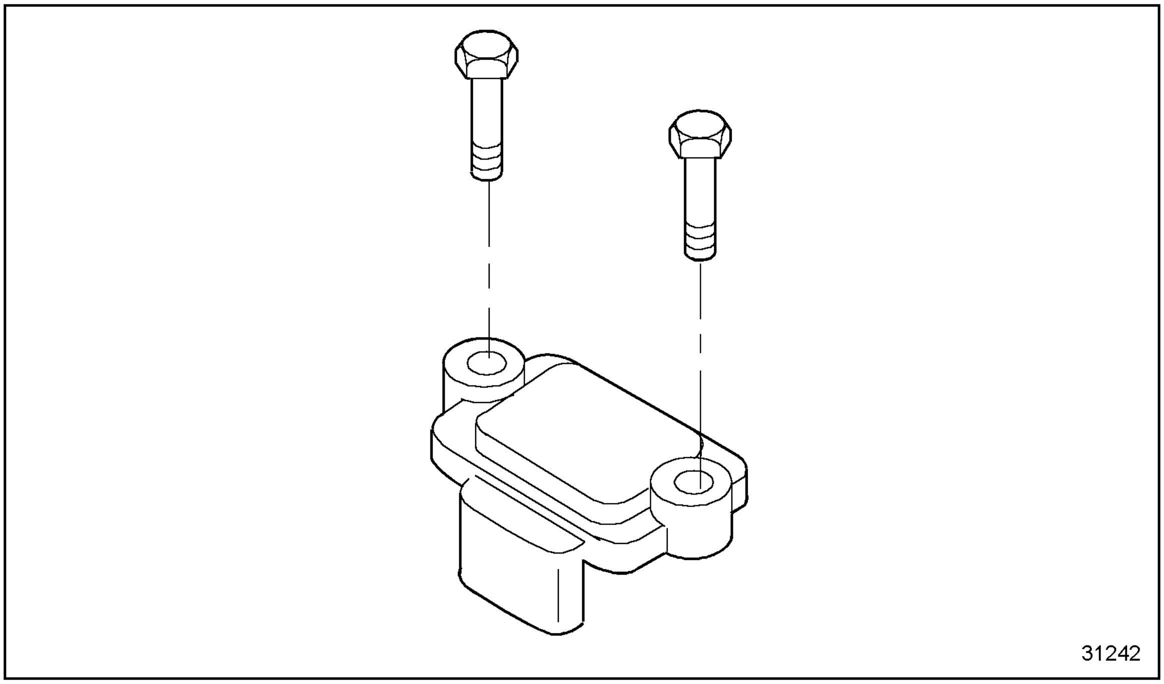


Figure 34-1 Turbo Boost Sensor

34.1 DESCRIPTION OF FLASH CODE 34

Flash Code 34 indicates that the engine Turbo Boost Sensor (TBS), see Figure 34-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit or ground

34.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 34

The SAE J1587 equivalent code for Flash Code 34 is p 102 4.

34.3 TROUBLESHOOTING FLASH CODE 34

The following procedure will troubleshoot Flash Code 34.

34.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL) connector.
2. Turn vehicle ignition switch ON.
3. Read active codes.
   - [a] If code 102/4 was logged and there are no other logged codes, refer to section 34.3.2.
   - [b] If code 102/4 and any of the following codes 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, were logged, refer to section 90.1.
   - [c] If code 102/4 was logged and none of the following codes 72/3 or 4, 73/3 or 4, 94/3 or 4, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, were logged, refer to section 34.3.2.

34.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn vehicle ignition OFF.
2. Disconnect TBS connector.
3. Install a jumper wire between sockets B and C of the TBS harness connector. See Figure 34-2.
4. Turn ignition ON.
5. Start engine and run until either the Check Engine Light is on, or until the engine has been running at least one minute at greater than 1000 r/min.
6. Read logged codes.
   - [a] If active code 102/4 and any other codes are logged, refer to section 34.3.4.

[b] If active code 102/3 and any other codes except 102/4 are logged, refer to section 34.3.3.

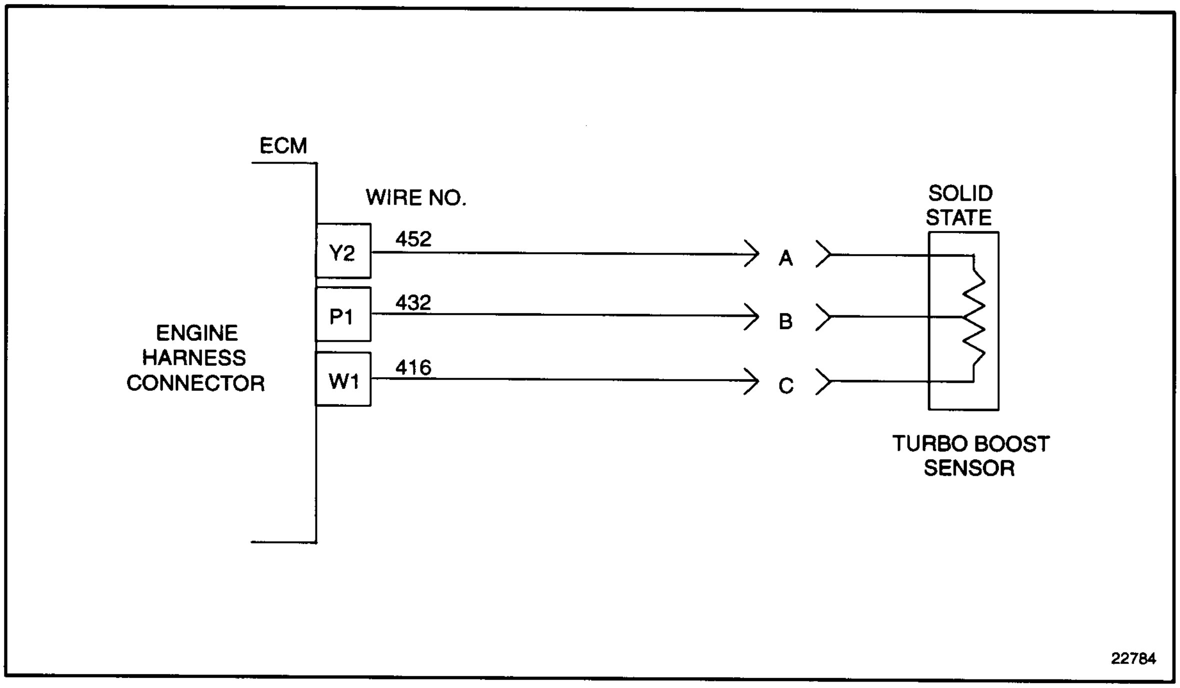


Figure 34-2 Turbo Boost Sensor Schematic

34.3.3 Check Turbo Boost Sensor Connectors

Perform the following steps to check the TBS connector.

1. Check terminals at the TBS connectors (both the TBS and harness side) for damage: bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them. Refer to section 34.3.11.
   [b] If the terminals and connectors are not damaged, replace the TBS. Refer to section 34.3.11.

34.3.4 Check for +5 Volt

Perform the following steps to check for +5 volt.

1. Remove jumper.
2. Turn ignition ON.
3. Measure voltage on TBS harness connector, pin C (red lead) to pin A (black lead).
   [a] If the voltage measurement is greater than 6 volts, refer to section 34.3.10.
   [b] If the voltage measurement is between 4 and 6 volts, refer to section 34.3.5.
   [c] If the voltage measurement is less than 4 volts, refer to section 34.3.8.

34.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the TBS harness connector. See Figure 34-3.
4. Measure resistance between sockets P1 and Y2 on the engine harness connector.
   - [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 34.3.6.
   - [b] If the resistance measurement is greater than 5 Ω, or open, and the signal line (#432) is open, repair the open. Refer to section 34.3.11.

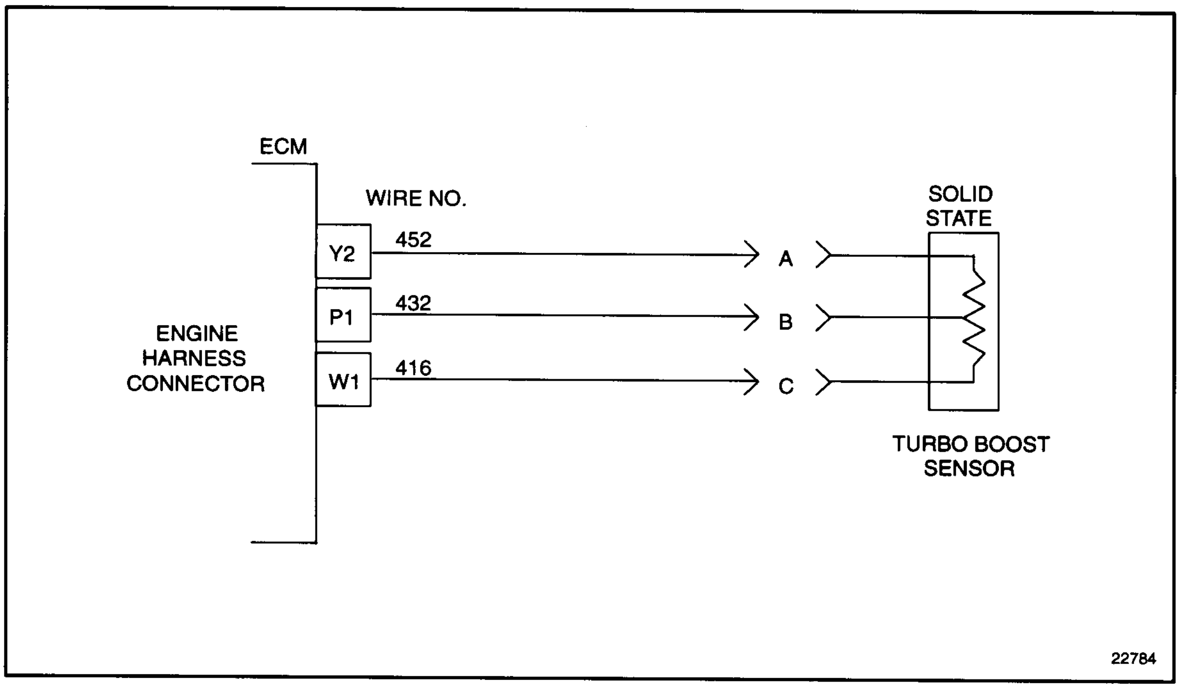


Figure 34-3 Turbo Boost Sensor Schematic

34.3.6 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins A and B on the TBS harness connector.
   - [a] If measured resistance between pins A and B is greater than 100 Ω, or open, go to step 3
   - [b] If measured resistance between pins A and B is less than 100 Ω, the signal line (#432) is shorted to the return line (#452). Repair the short. Refer to section 34.3.11.

3. Also measure resistance between socket B and a good ground.
   - [a] If measured resistance between socket B and a good ground is greater than 100 Ω, or open, refer to section 34.3.7.
   - [b] If measured resistance between socket B and a good ground is less than 100 Ω, the signal line (#432) is shorted to the battery ground. Repair the short and refer to section 34.3.11.

34.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 34-4.
   - [a] If terminals and connectors are damaged, repair them and refer to section 34.3.11.
   - [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 34.3.11.

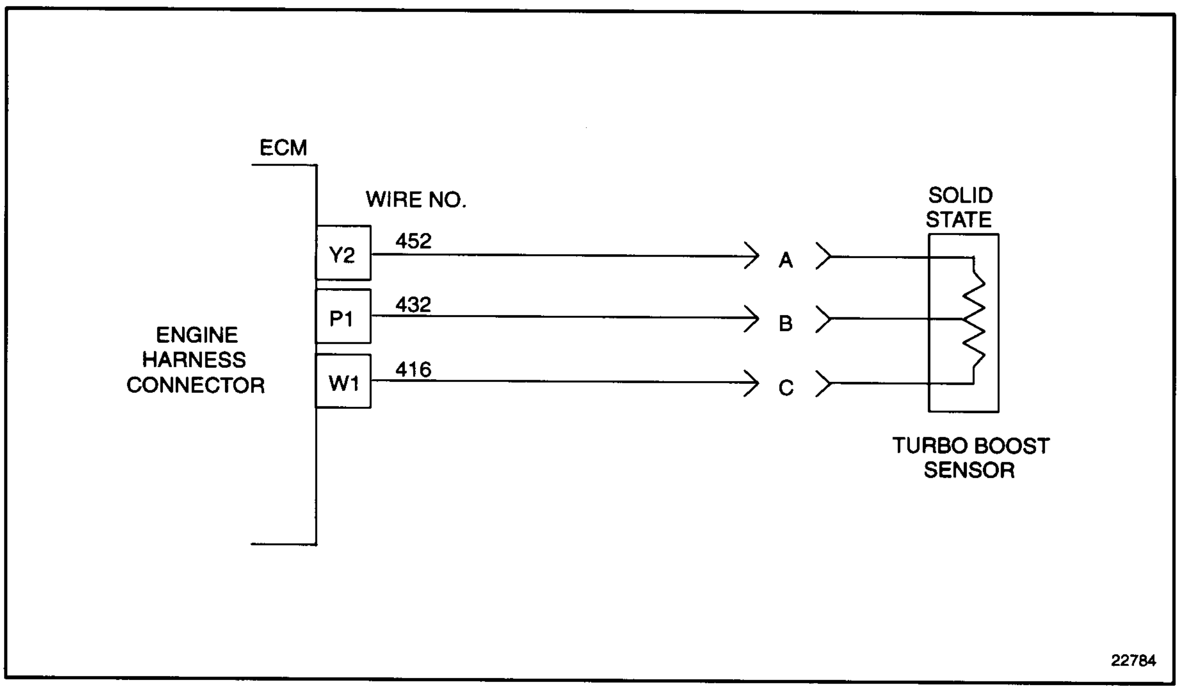


Figure 34-4 Engine Harness Connector to Turbo Boost Sensor

34.3.8 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between pins A and C of the TBS harness connector. See Figure 34-5.

4. Read resistance between sockets W1 and Y2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 34.3.9.
   [b] If the resistance measurement is greater than 5 Ω, or open, the vehicle +5 volt line (#416) is open. Repair open. Refer to section 34.3.11.

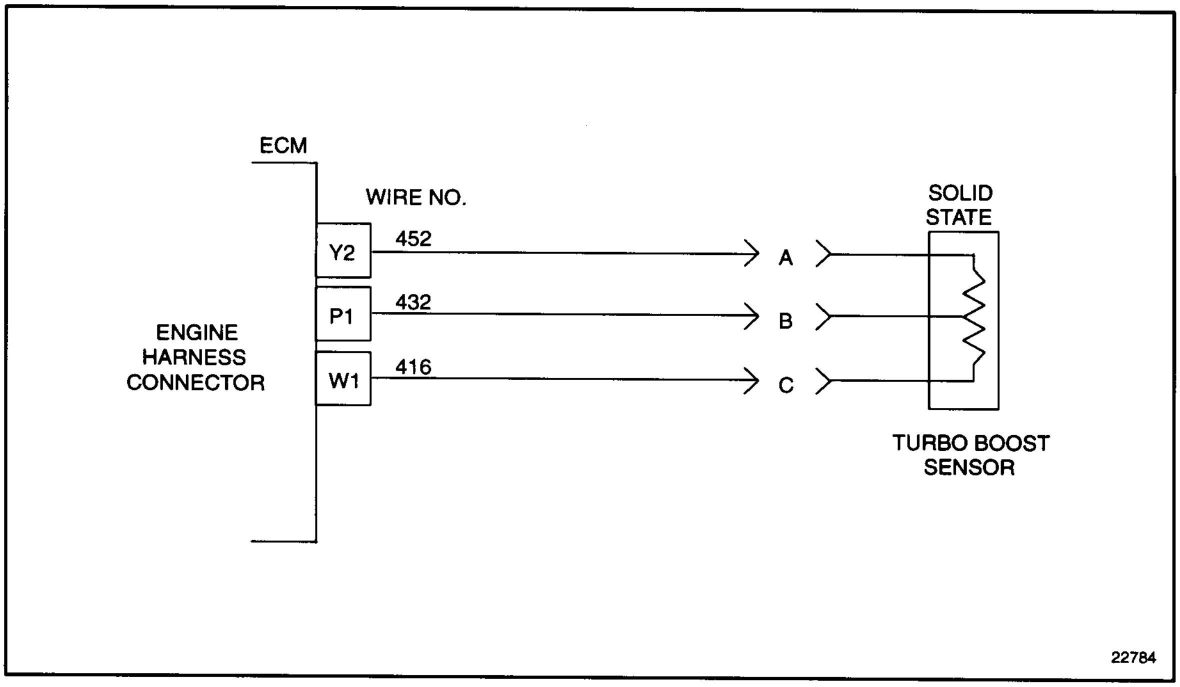


Figure 34-5 5-Way ECM Power Connector

34.3.9 Check for Short

Perform the following steps to check for short.

1. Remove jumper.
2. Measure resistance between pins A and C on the TBS harness connector. See Figure 34-6.
   [a] If measured resistance between pins A and C is greater than 100 Ω, or open, go to step 3
   [b] If measured resistance between pins A and C is less than 100 Ω, the 5 volt supply (#416) is shorted to the return line (#452). Repair the short. Refer to section 34.3.11.
3. Also measure resistance between socket C and a good ground.
   [a] If measured resistance between socket C and a good ground is greater than 100 Ω, or open, refer to section 34.3.7.

[b] If measured resistance between socket C and a good ground is less than 100 Ω, the 5 volt supply (#416) is shorted to the battery ground. Repair the short and refer to section 34.3.11.

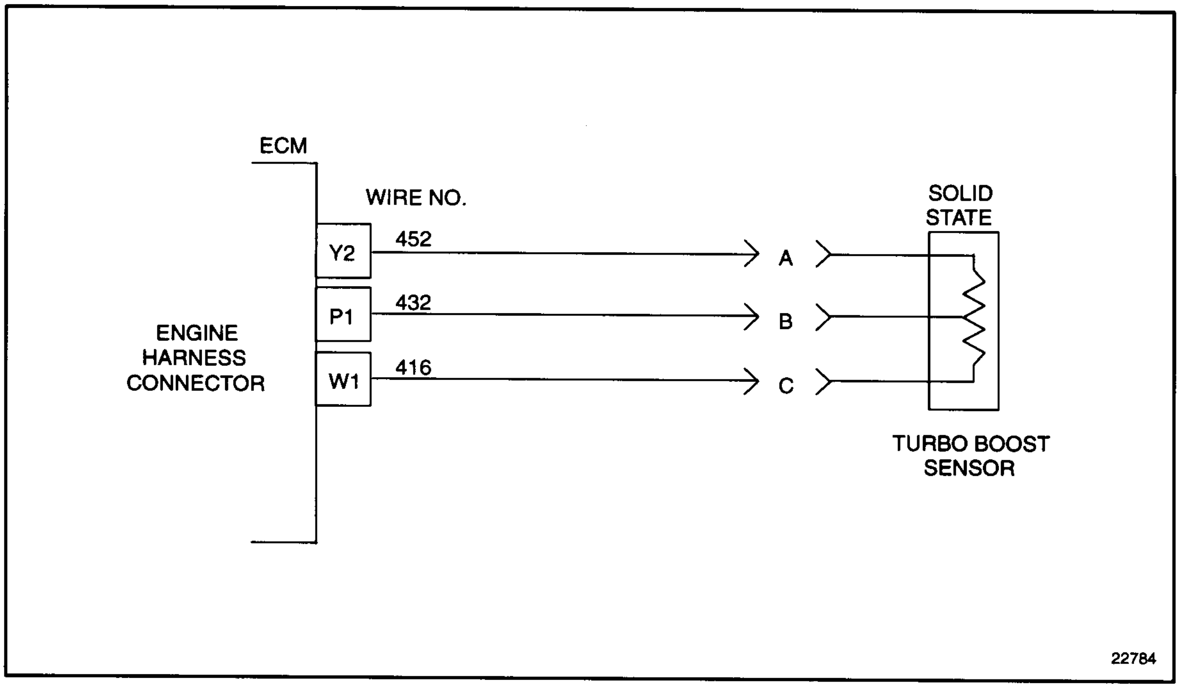


Figure 34-6 Turbo Boost Sensor Schematic

34.3.10 Check for Short to Battery +

Perform the following steps to check for short to battery +.

1. Turn vehicle ignition OFF.
2. Remove both fuses to the ECM.
3. Disconnect the engine harness, vehicle harness, and 5-way power connectors at the ECM.
4. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C. See Figure 34-7.

   [a] If measured resistance is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω was measured. Repair short and reinsert fuses. Refer to section 34.3.11.

[b] If the resistance measurement is greater than 100 Ω, or open, refer to section 34.3.7.

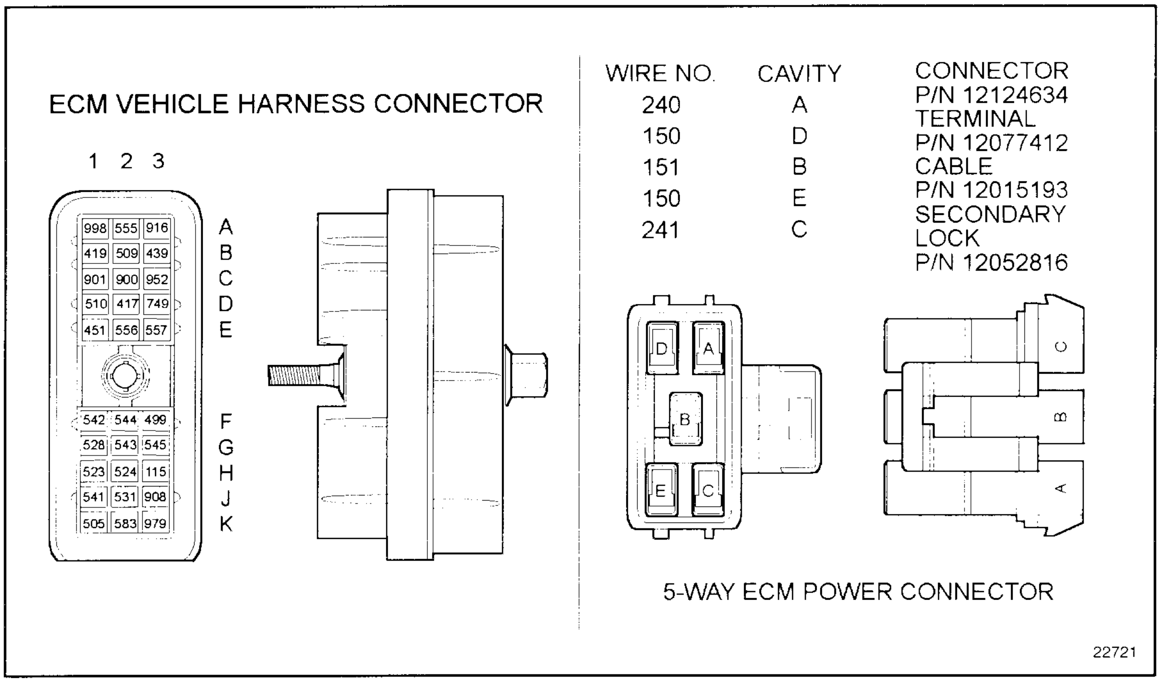


Figure 34-7 ECM Vehicle Harness Connector

34.3.11 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.

   [a] If no codes are logged, no further troubleshooting is required.

   [b] If code 102/4 and any other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 34.3.1.

   [c] If code 102/4 is not logged and any other codes are logged, refer to section 9.1.

35 FLASH CODE 35 - OPS HIGH

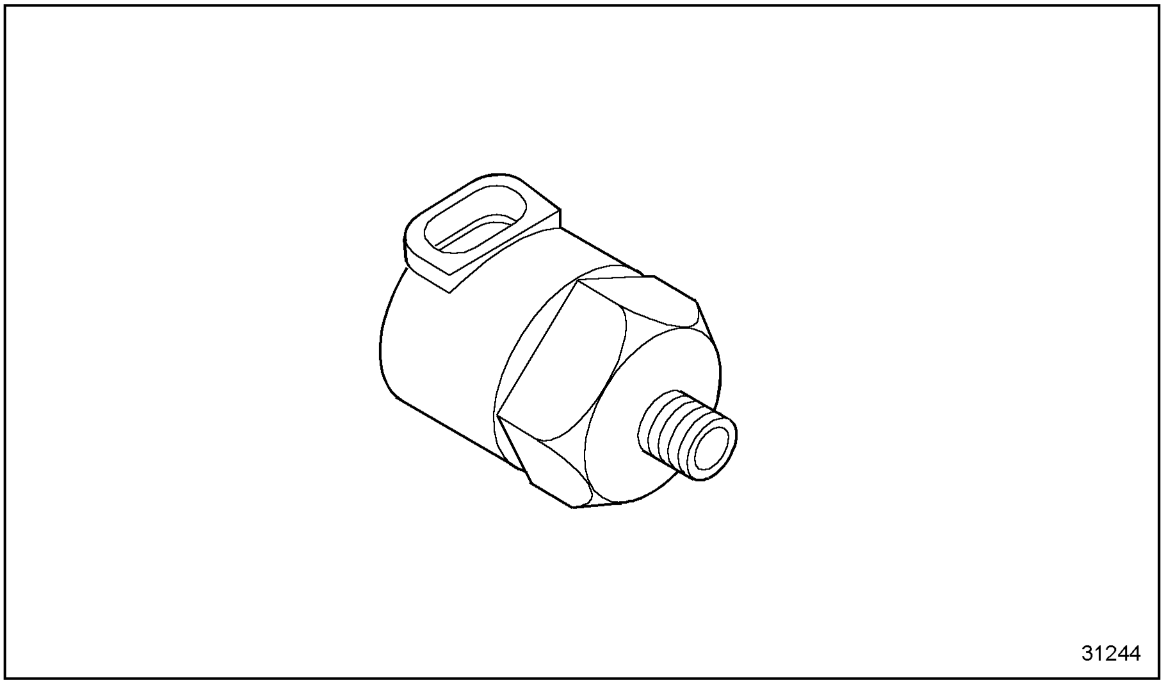


Figure 35-1 Oil Pressure Sensor

35.1 DESCRIPTION OF FLASH CODE 35

Flash Code 35 indicates that the engine Oil Pressure Sensor (OPS), see Figure 35-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply
- ☐ Failed/damaged sensor

35.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 35

The SAE J1587 equivalent code for Flash Code 35 is p 100 3, oil pressure circuit high.

NOTE:
Code 35 is logged if oil pressure is high, engine is warm, and engine is at idle.

35.3 TROUBLESHOOTING FLASH CODE 35

The following procedure will troubleshoot Flash Code 35.

35.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Turn vehicle ignition to OFF.
4. Read active codes.
   - [a] If code 100/3 and no other codes were logged, refer to section 35.3.2.
   - [b] If code 100/3 and any of the following codes were logged: 73/3 or 4, 94/3 or 4, 100/4, 101/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 90.1.

35.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS connector.
3. Turn ignition ON.
4. Start and run the engine.
5. Select engine temperature (COOLANT TEMP or OIL TEMP) on the DDR.
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. After warm-up, let engine run at idle.
8. Read active codes.
   - [a] If active code 100/3 and any other codes were logged, refer to section 35.3.5.
   - [b] If code 100/4 and any other codes except 100/3 were logged, refer to section 35.3.3.

35.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pin A and pin B of the OPS harness connector. See Figure 35-2.
4. Measure resistance between sockets P2 and Y2 on the engine harness connector.

[a] If resistance measurement is less than or equal to 5 Ω, refer to section 35.3.4.

[b] If resistance measurement is greater than 5 Ω, the return line (#452) is open. Repair the open and refer to section 35.3.8.

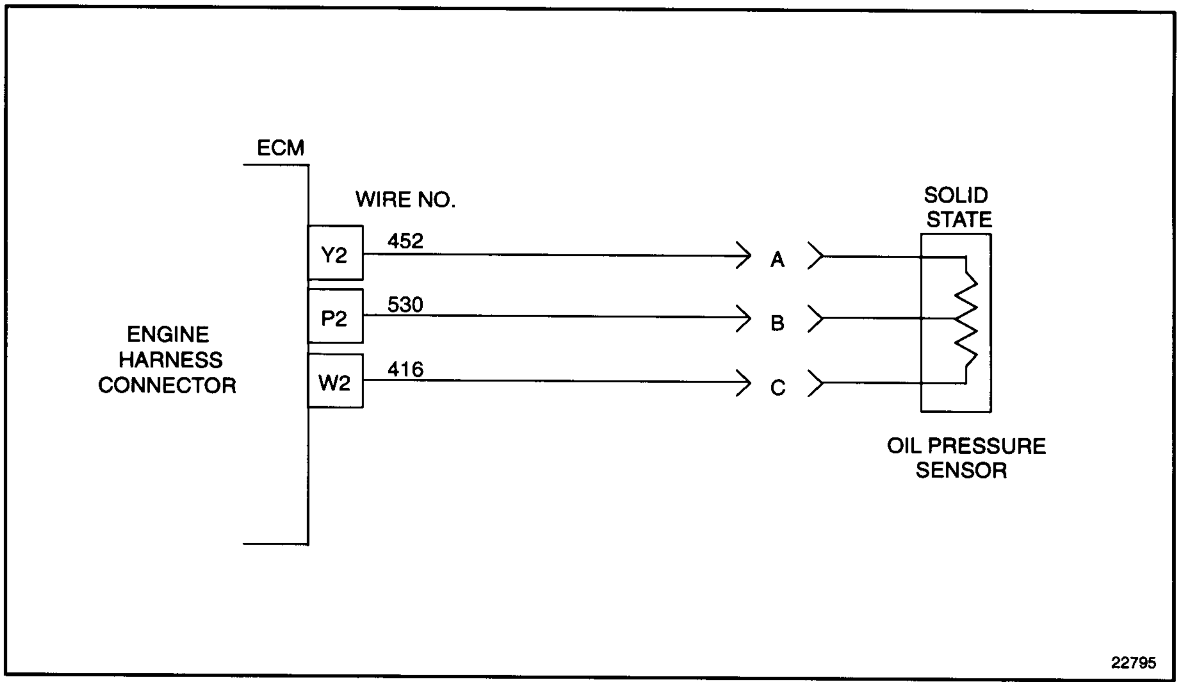


Figure 35-2 Engine Harness Connector to Oil Pressure Sensor

35.3.4 Check Oil Pressure Sensor Connectors

Perform the following steps to check the OPS connectors.

1. Check terminals at the OPS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.

   [a] If the terminals and connectors are damaged, repair them and refer to section 35.3.8.

   [b] If the terminals and connectors are not damaged, replace the OPS. Refer to section 35.3.8.

35.3.5 Check for Signal Short to 5 Volt

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Measure resistance between sockets P2 and W1 on the engine harness connector. See Figure 35-3.

[a] If the resistance measurement is less than or equal to 100 Ω, the signal line (#530) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 35.3.8.

[b] If the resistance measurement is greater than 100 Ω, or open, refer to section 35.3.6.

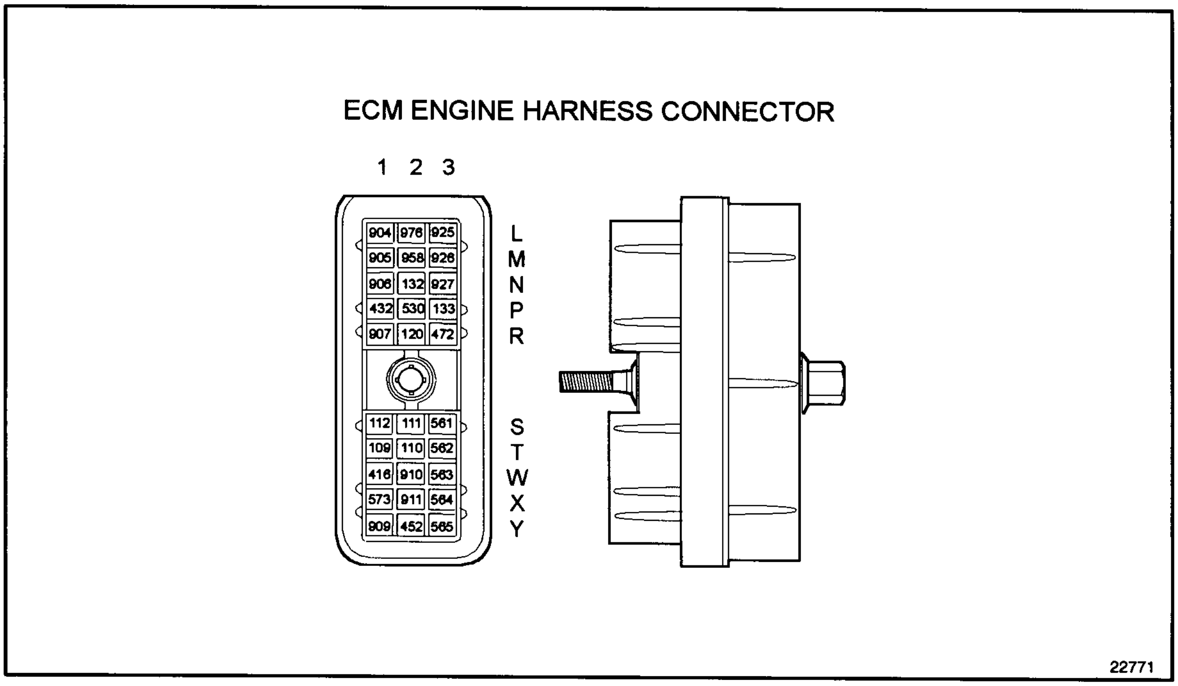


Figure 35-3 ECM Engine Harness Connector

35.3.6 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 35-4.
3. Measure resistance between socket P2 on the engine harness connector and socket B3 of the vehicle harness connector, and between P2 and the 5-way power harness sockets A and C.

   [a] If resistance measurement is greater than 100 Ω, or open, refer to section 35.3.7.

[b] If resistance measurement is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 35.3.8.

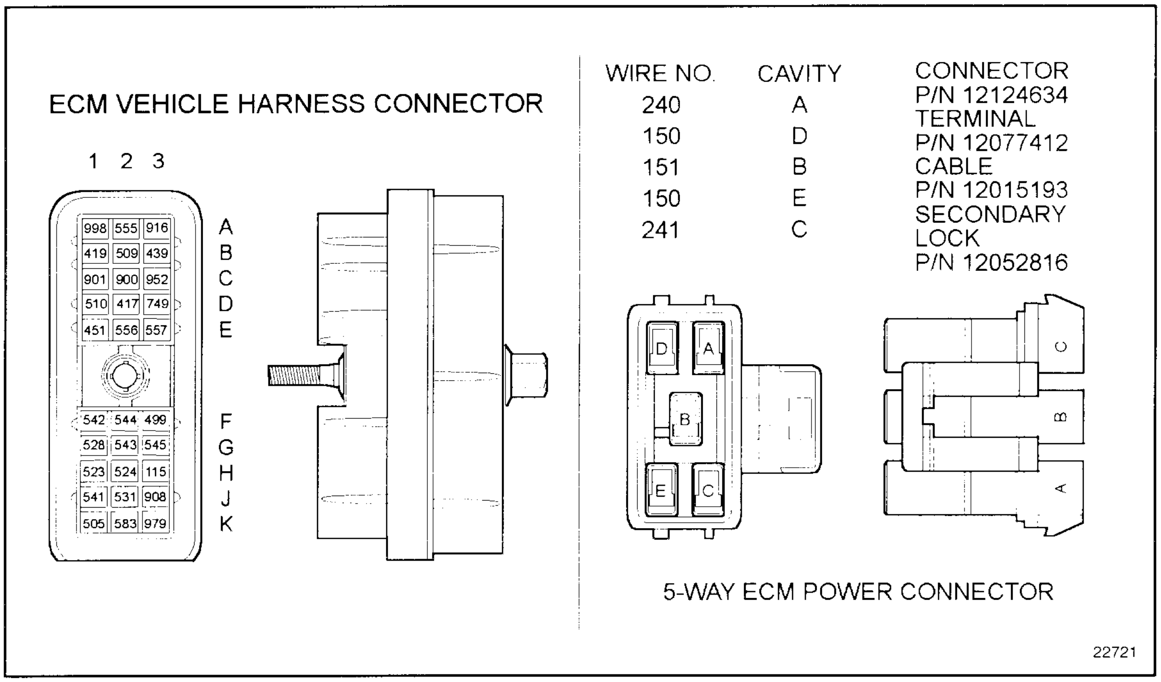


Figure 35-4 ECM Vehicle Harness Connector

35.3.7 Check ECM Connector

Perform the following steps to check the ECM connector:

1. Inspect the terminals at the ECM connector (ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.

   [a] If the terminals and connector are damaged, repair both and refer to section 35.3.8.

   [b] If the terminals and connector are not damaged, refer to section 35.3.4.

35.3.8 Verify Repairs

Perform the following steps to verify repairs:

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.

7. Check codes with DDR.

   [a] If no codes are logged, no further troubleshooting is required.

   [b] If code 100/3 is not logged, but other codes are logged, refer to section 9.1.

   [c] If code 100/3 is logged, all system diagnostics are complete. Contact Detroit Diesel Technical Service.

36 FLASH CODE 36 - OPS LOW

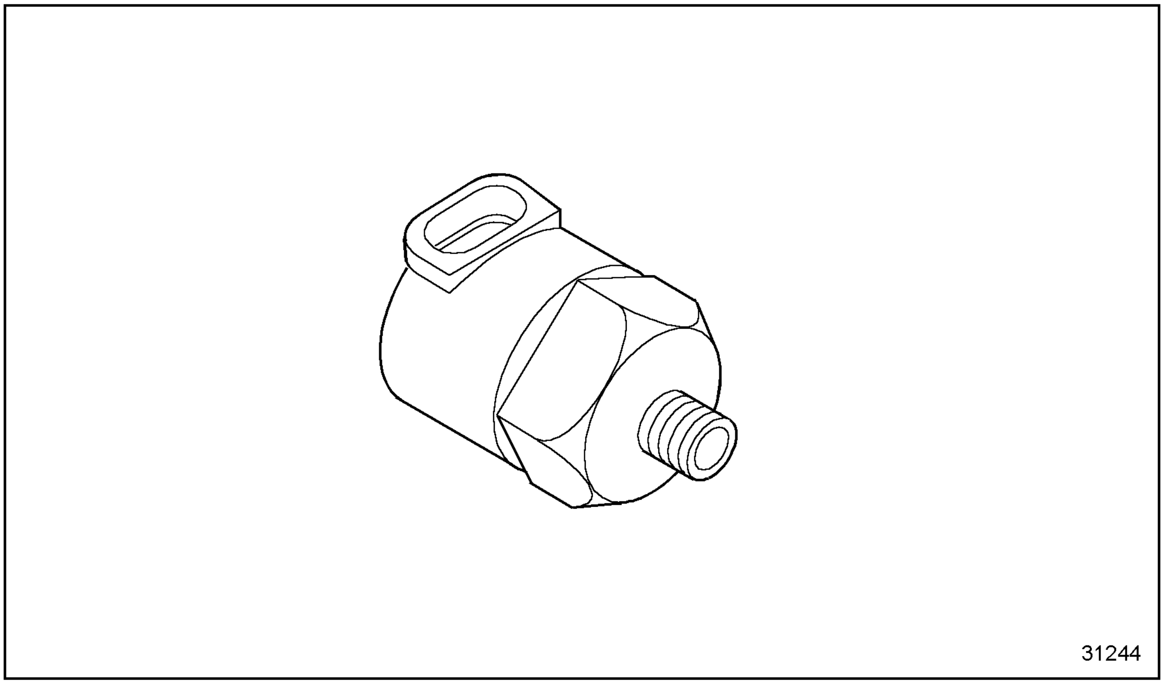


Figure 36-1 Oil Pressure Sensor

36.1 DESCRIPTION OF FLASH CODE 36

Flash Code 36 indicates that the engine Oil Pressure Sensor (OPS), see Figure 36-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

36.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 36

The SAE J1587 equivalent code for Flash Code 36 is p 100 4, oil pressure circuit low.

36.3 TROUBLESHOOTING FLASH CODE 36

The following procedure will troubleshoot Flash Code 36.

36.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
2. Turn vehicle ignition switch ON.
3. Turn vehicle ignition OFF.
4. Read active codes.
   - [a] If code 100/4 and no other codes were logged, refer to section 36.3.2.
   - [b] If code 100/4 was logged and none of the following codes were logged: 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 73/3 or 4, 94/3 or 4, 100/3, refer to section 36.3.2.
   - [c] If code 100/4 and any of the following codes were logged: 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 73/3 or 4, 94/3 or 4, 100/3, refer to section 90.1.

36.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect OPS connector and install a jumper wire between sockets B and C of the OPS harness connector. See Figure 36-2.
3. Turn ignition ON.
4. Read active codes.
5. If active codes 100/3 or 4 were logged, proceed with the following:
   - [a] If active code 100/4 and any other codes were logged, refer to section 36.3.4.
   - [b] If code 100/3 and any other codes except 100/4 were logged, refer to section 36.3.3.
6. If active codes 100/3 or 4 were not logged, warm up engine until either codes are logged or the engine temperature (COOLANT TEMP or OIL TEMP or DDR) has been greater than 60°C (140°F) for one minute.
   - [a] If active code 100/4 and any other codes were logged, refer to section 36.3.4.

[b] If code 100/3 and any other codes except 100/4 were logged, refer to section 36.3.3.

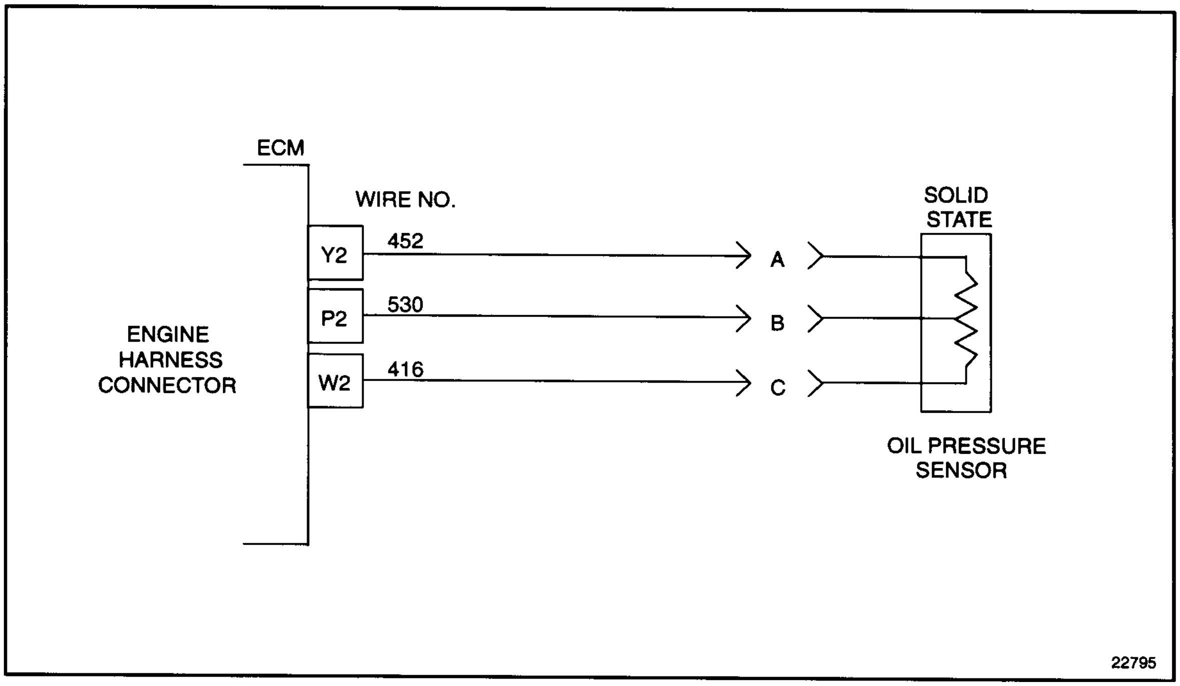


Figure 36-2 Engine Harness Connector to Oil Pressure Sensor

36.3.3 Check Oil Pressure Sensor Connectors

Perform the following steps to check the OPS connectors.

1. Turn ignition OFF.
2. Check terminals at the OPS connectors (both the sensor and harness side) for damage: bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them and refer to section 36.3.12.
   [b] If the terminals and connectors are not damaged, replace the OPS. Refer to section 36.3.12.

36.3.4 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Turn ignition ON.
4. Measure voltage on OPS harness connector, socket C (red lead) to socket A (black lead).
   [a] If the voltage measurement is less than 4 volts, refer to section 36.3.8.
   [b] If the voltage measurement is greater than 6 volts, refer to section 36.3.10.

[c] If the voltage measurement is between 4 and 6 volts, refer to section 36.3.5.

36.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn the ignition OFF.
2. Disconnect the engine harness connector at the ECM. See Figure 36-3.
3. Install a jumper wire between sockets A and B of the OPS harness connector.
4. Measure resistance between sockets P2 and Y2 on the engine harness connectors.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 36.3.11.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#530) is open. Repair the open and refer to section 36.3.12.

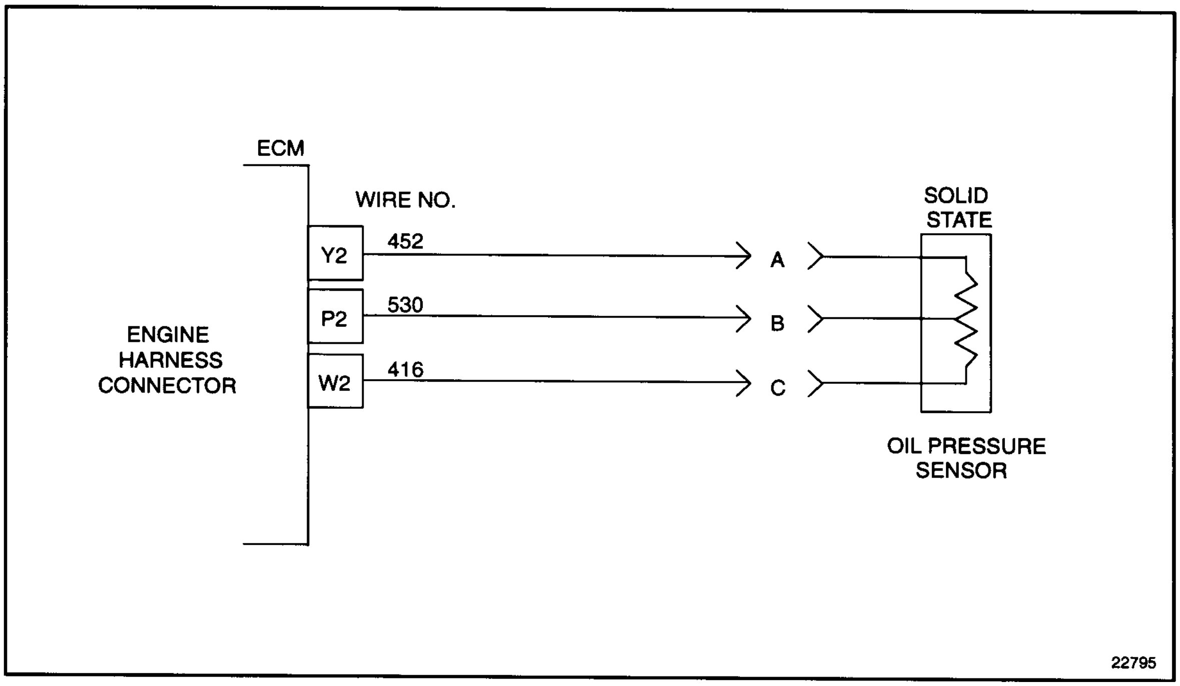


Figure 36-3 Engine Harness Connector to Oil Pressure Sensor

36.3.6 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between socket P2 and a good ground. Also measure resistance between P2 and Y2.
   [a] If both resistance measurements are greater than 100 Ω or open, replace OPS. Refer to section 36.3.12.

[b] If either resistance measurement is less than 100 Ω, the signal line (#530) is shorted to the return line (#452) or battery ground. Repair short and refer to section 36.3.12.

36.3.7 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded and unseated pins or sockets. Check W1, P2 and Y2 terminals and pins at ECM.
   [a] If the terminals and connectors are damaged, repair them and refer to section 36.3.12.
   [b] If the terminals and connectors are not damaged, reprogram the ECM. Refer to section 36.3.12.

36.3.8 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between pins A and C of the OPS connector.
4. Measure resistance between sockets W1 and Y2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 36.3.9.
   [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (#416) is open. Repair the open and refer to section 36.3.12.

36.3.9 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets A and C on the OPS harness connector. Also measure resistance between socket C and a good ground.
   [a] If either resistance measurement is less than or equal to 100 Ω, the engine +5 volt line (#416) is shorted to the return line (#452) or battery ground. Repair the short and refer to section 36.3.12.
   [b] If the resistance measurement is greater than 100 Ω or open, replace OPS and refer to section 36.3.12.

36.3.10 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.

2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 36-4.
3. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C.
   [a] If resistance measurement is greater than 100 Ω, or open, replace OPS. Refer to section 36.3.12.
   [b] If resistance measurement is less than or equal to 100 Ω, a short exists between sockets where less than 100 Ω resistance was read. Repair short and reinsert fuses. Refer to section 36.3.12.

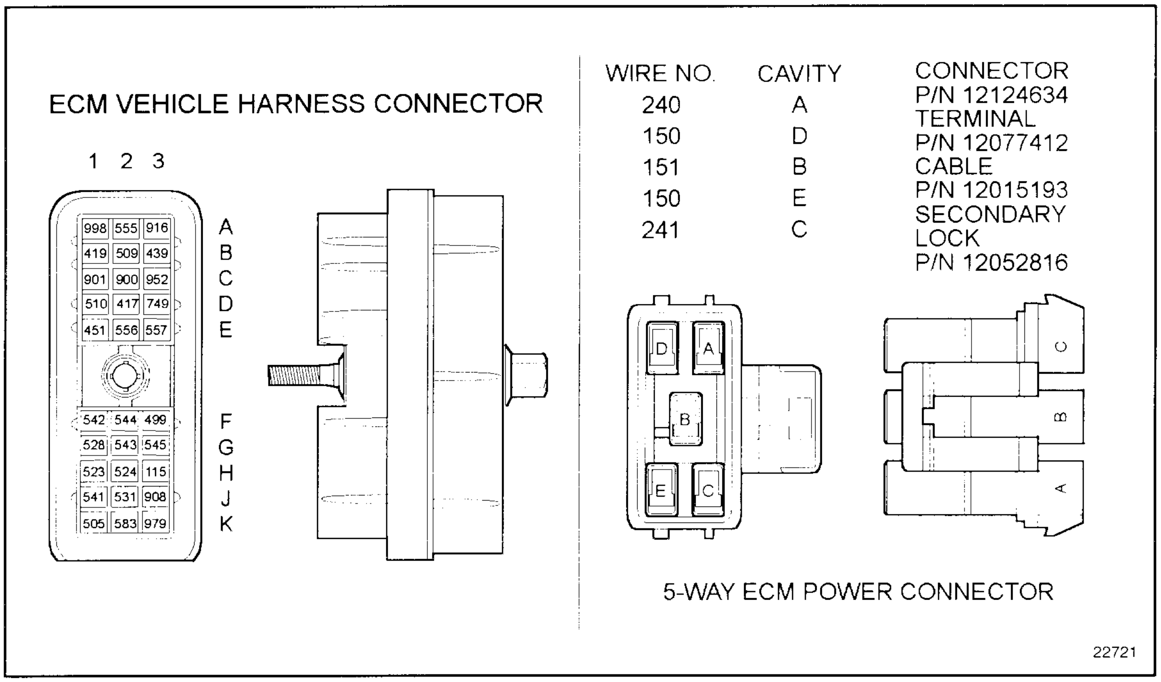


Figure 36-4 ECM Vehicle Harness Connector

36.3.11 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Measure resistance between sockets P2 and Y2 on the engine harness connector. See Figure 36-5.
   [a] If resistance measurement is greater than 100 Ω, or open, refer to section 36.3.6.

[b] If resistance measurement is less than or equal to 100 Ω, the signal line (#530) and return line (#452) are shorted together. Repair the short. Refer to section 36.3.12.

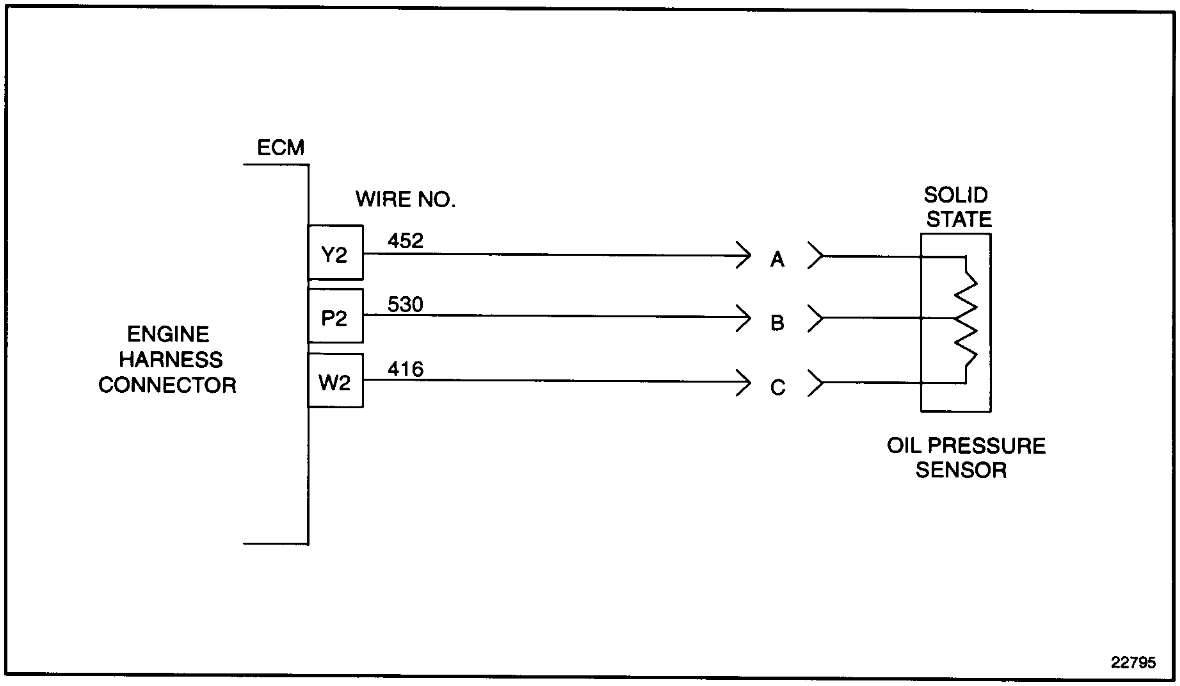


Figure 36-5 Engine Harness Connector to Oil Pressure Sensor

36.3.12 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 100/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 100/4 is logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 36.3.1.

37 FLASH CODE 37 - FPS HIGH

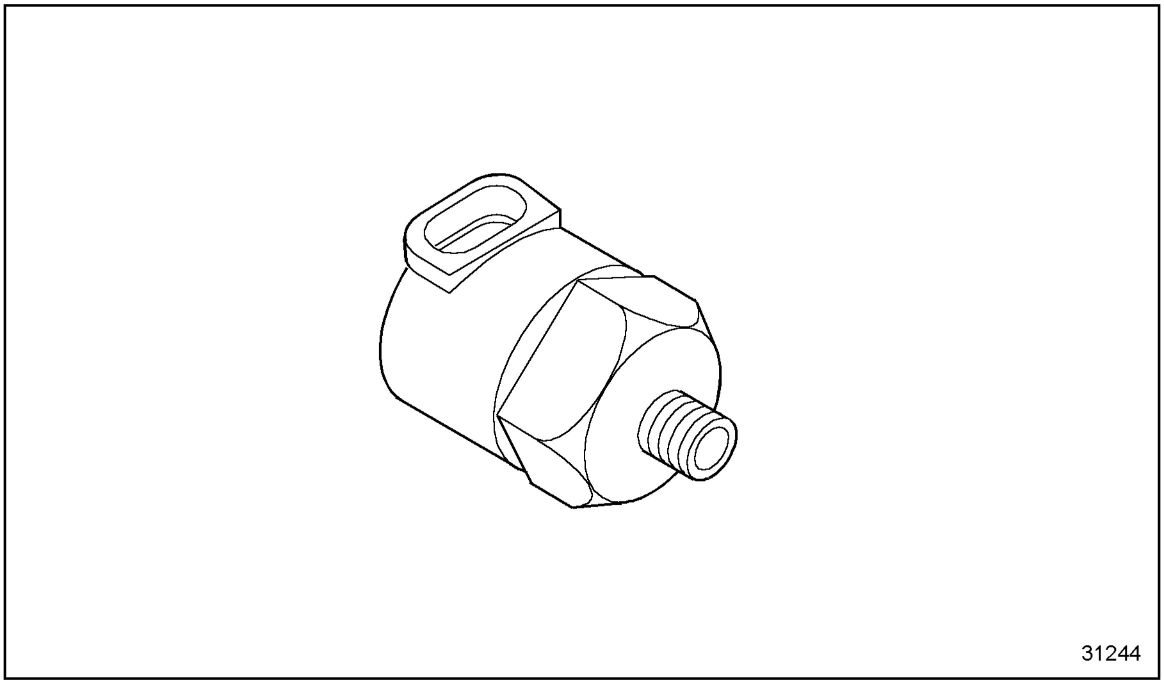


Figure 37-1 Fuel Pressure Sensor

37.1 DESCRIPTION OF FLASH CODE 37

Flash Code 37 indicates that the engine Fuel Pressure Sensor (FPS), see Figure 37-1, input to the ECM has exceeded 95% (normally >4.75 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor return circuit
- ☐ Sensor signal circuit is shorted to the sensor +5 volt supply

NOTE:
Require fuel pressure >60 psi.

37.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 37

The SAE J1587 equivalent code for Flash Code 37 is p 094 3.

37.3 TROUBLESHOOTING FLASH CODE 37

The following procedure will troubleshoot Flash Code 37.

37.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read active codes.
   [a] If active code 94/3 was logged, and no other codes were logged, refer to section 37.3.2.
   [b] If active code 94/3 and any or all of the following codes were logged, 110/3 or 4, 174/3 or 4, 175/3 or 4, 101/3 or 4, 102/3 or 4, 100/3 or 4, 94/4, 73/3 or 4, refer to section 90.1.

37.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FPS connector. See Figure 37-2.
3. Turn ignition ON.
4. Start and run engine.
5. Select Engine Temperature (COOLANT TEMP & OIL) on DDR.
6. Warm up engine until engine temperature reading is greater than 60°C (140°F).
7. Leave engine running at idle after warm-up. Run for five minutes.
8. Read active codes.
   [a] If active code 94/3 and any other codes were logged, refer to section 37.3.5.

[b] If active code 94/4 and any other codes except 94/3 were logged, refer to section 37.3.3.

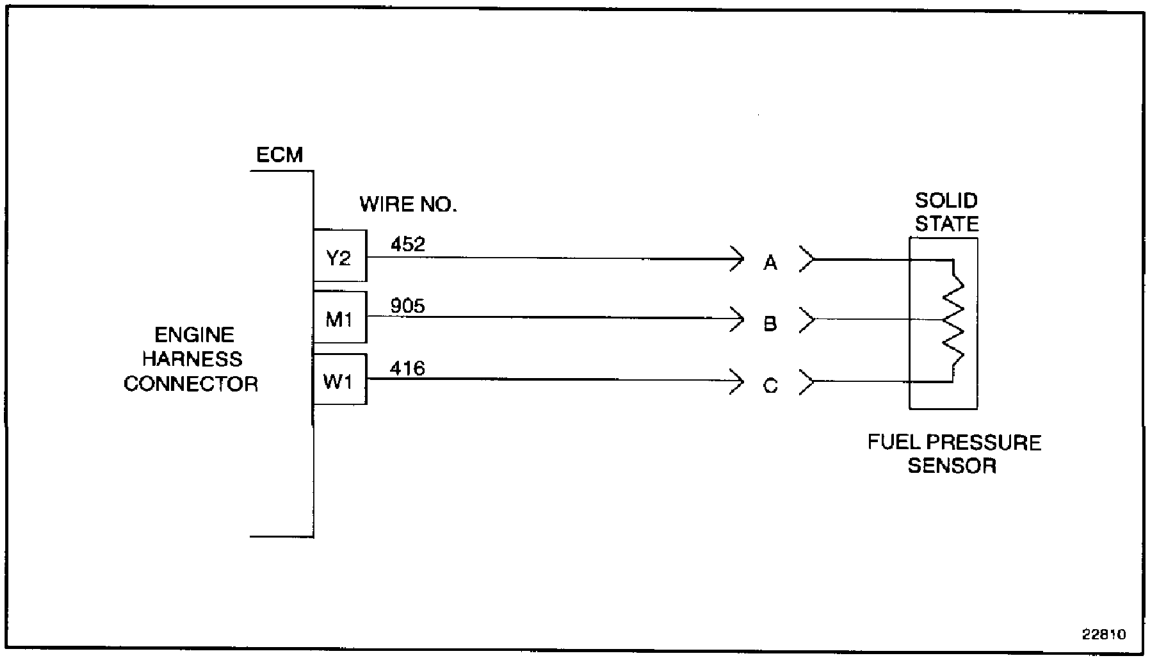


Figure 37-2 Engine Harness Connector to Fuel Pressure Sensor

37.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the FPS harness connector.
4. Measure resistance between sockets M1 and Y2 on the engine harness connectors.
   [a] If resistance measurement is less than or equal to 5 Ω, refer to section 37.3.4.
   [b] If resistance measurement is greater than 5 Ω, or open, the return line (#452) is open. Repair the open and refer to section 37.3.9.

37.3.4 Check Fuel Pressure Sensor Connectors

Perform the following steps to check the FPS connectors.

1. Inspect terminals at the FPS connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them and refer to section 37.3.9.

[b] If the terminals and connectors are not damaged, replace the FPS and refer to section 37.3.9.

37.3.5 Check for Short

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Measure resistance between sockets W1 and M1 on the engine harness connector.
   [a] If the resistance measurement is greater than 100 Ω or open, refer to section 37.3.6.
   [b] If the resistance measurement is less than or equal to 100 Ω, the signal line (#905) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 37.3.9.

37.3.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 37-3.
3. Measure resistance between socket M1 on the engine harness connector and socket B3 of the vehicle harness connector, and between M1 and the 5-way power harness sockets A and C.
   [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 37.3.8.

[b] If the resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 37.3.9.

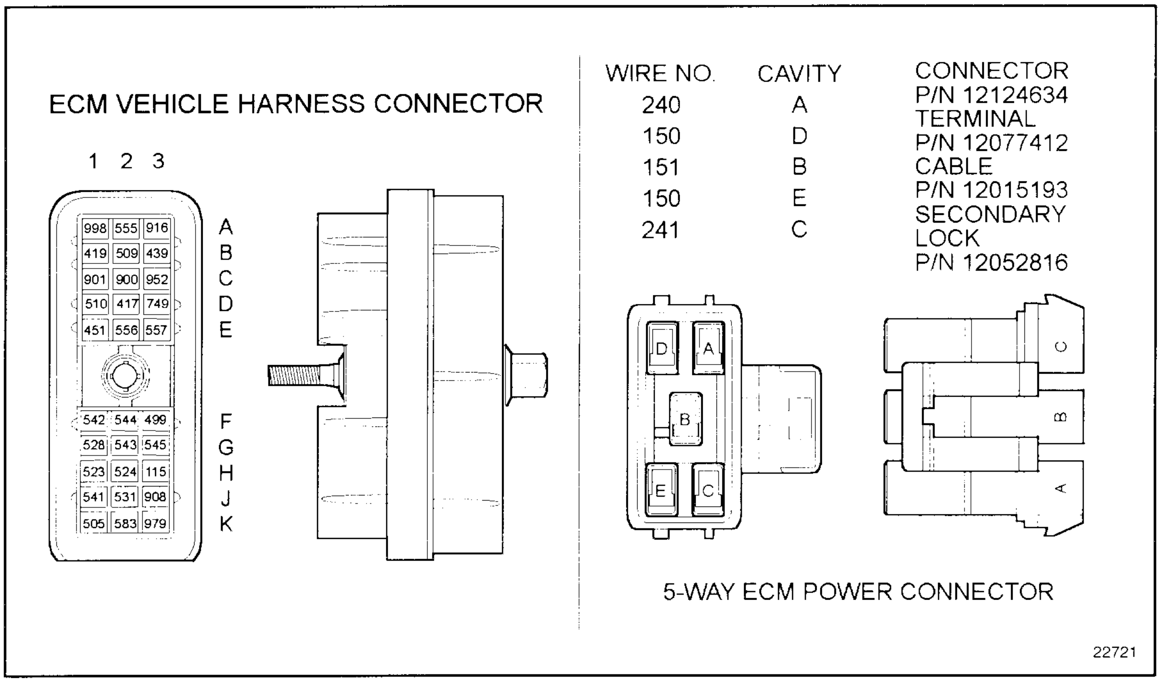


Figure 37-3 ECM Vehicle Harness Connector

37.3.7 Final Check

Perform the following steps to do a final check.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If active code 94/3 is logged, reprogram the ECM. Refer to section 37.3.9.
   [c] If any codes except code 94/3 are logged, refer to section 9.1.

37.3.8 Check ECM Connector

Perform the following steps to check the ECM connector.

1. Inspect terminals at the ECM connector (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 37.3.9.
   - [b] If terminals and connectors are not damaged, replace the FPS. Refer to section 37.3.7.

37.3.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are logged, no further troubleshooting is required.
   - [b] If code 94/3 is not logged, and other codes are logged, refer to section 9.1.
   - [c] If code 94/3 is logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 37.3.1.

38 FLASH CODE 38 - FPS LOW

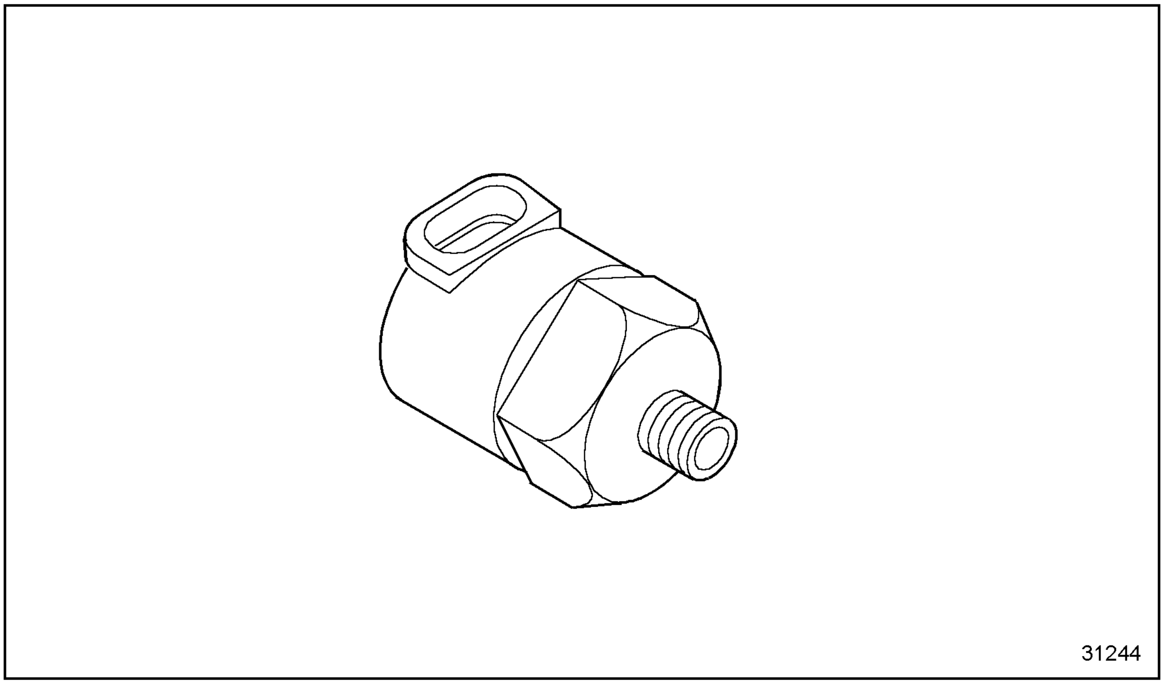


Figure 38-1 Fuel Pressure Sensor

38.1 DESCRIPTION OF FLASH CODE 38

Flash Code 38 indicates that the engine Fuel Pressure Sensor (FPS), see Figure 38-1, input to the ECM has dropped below 5% (normally < 0.25 volts) of the sensor supply voltage.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Open sensor +5 volt supply circuit
- ☐ Sensor signal is shorted to sensor return circuit or to ground
- ☐ Sensor +5 volt supply is shorted to the sensor return circuit

38.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 38

The SAE J1587 equivalent code for Flash Code 38 is p 094 4.

38.3 TROUBLESHOOTING FLASH CODE 38

The following procedure will troubleshoot Flash Code 38.

38.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug the diagnostic data reader (DDR) into the diagnostic data link (DDL).
3. Read active codes.
   [a] If active code 94/4 and no other codes were logged, refer to section 38.3.2.
   [b] If active code 94/4 and any or all of the following codes were logged, 94/3, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 90.1.
   [c] If active code 94/4 and codes other than the following codes were logged, 94/3, 100/3 or 4, 101/3 or 4, 110/3 or 4, 174/3 or 4, 175/3 or 4, refer to section 38.3.2.

38.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition switch OFF.
2. Disconnect FPS connector and install a jumper wire between sockets B and C of the FPS harness connector. See Figure 38-2.
3. Turn ignition ON.
4. Read logged codes.
5. If active codes 94/3 or 4 are not logged, start and run the engine until either these active codes display or engine temperature (COOLANT TEMP & OIL on DDR) has been greater than 60°C (140°F) for more than one minute.
   [a] If active code 94/4 and any other codes are logged, refer to section 38.3.4.

[b] If active code 94/3 and any other codes except code 94/4 are logged, check to ensure ECM and FPS connectors are wired properly. Refer to section 38.3.3.

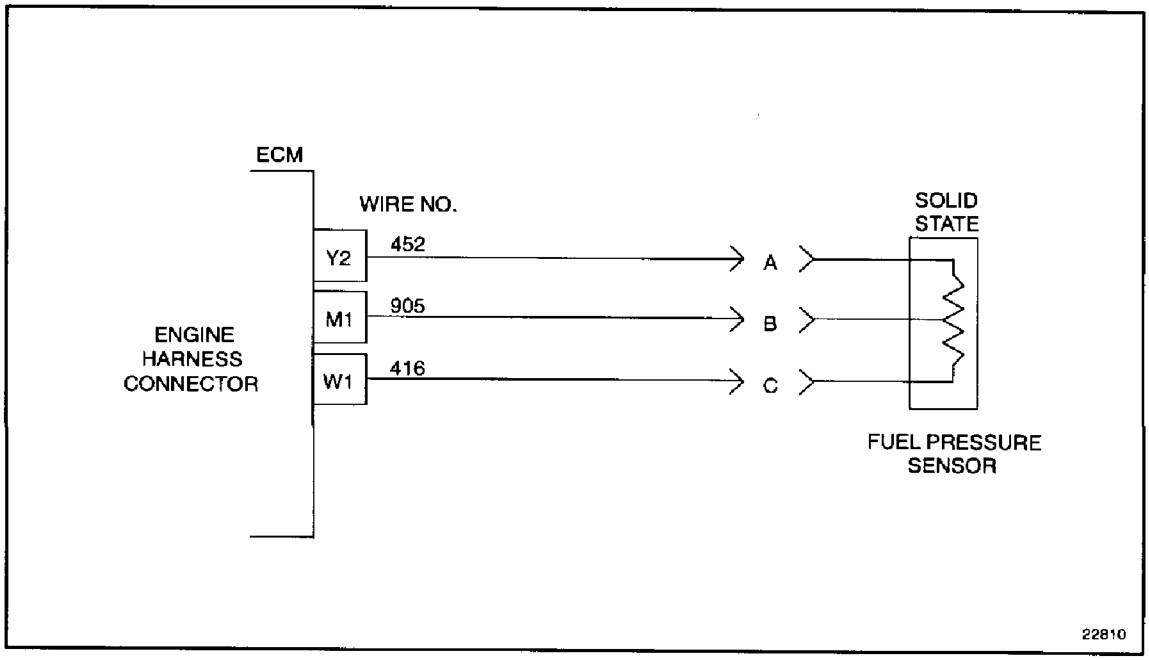


Figure 38-2 Engine Harness Connector to Fuel Pressure Sensor

38.3.3 Check Fuel Pressure Sensor Connectors

Perform the following steps to check the FPS connectors.

1. Inspect terminals at the FPS connectors (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If the terminals and connectors are damaged, repair them and refer to section 38.3.12.
   [b] If the terminals and connectors are not damaged, replace the FPS and refer to section 38.3.12.

38.3.4 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition OFF.
2. Remove jumper wire.
3. Turn ignition ON.
4. Measure voltage on FPS harness connector, socket C to socket A. See Figure 38-3.
   [a] If the voltage measurement is greater than 6 volts, refer to section 38.3.9.
   [b] If the voltage measurement is less than 4 volts, refer to section 38.3.7.

[c] If the voltage measurement is between 4 and 6 volts, refer to section 38.3.5.

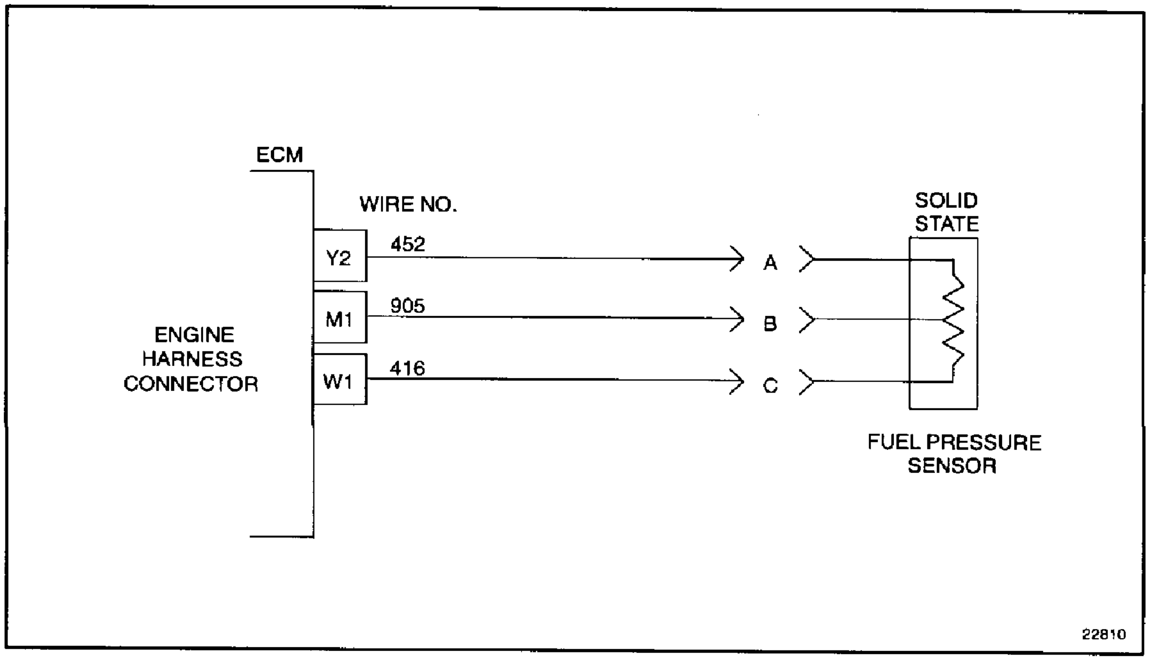


Figure 38-3 Engine Harness Connector to Fuel Pressure Sensor

38.3.5 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at the ECM.
3. Install a jumper wire between pins A and B of the FPS harness connector.
4. Measure resistance between sockets M1 and Y2 on the engine harness connector.
   [a] If resistance measurement is less than or equal to 5 Ω refer to section 38.3.10.
   [b] If the resistance measurement is greater than 5 Ω or open, the signal line (#905) or return line (#452) is open. Repair the open and refer to section 38.3.12.

38.3.6 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM harness connector (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. Check W1, M1 and Y2 terminals at ECM.
   [a] If terminals and connectors are damaged, repair them. Refer to section 38.3.12.
   [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 38.3.12.

38.3.7 Check for Open +5 Volt Line

Perform the following steps to check for open +5 volt line.

1. Turn vehicle ignition OFF.
2. Disconnect the engine harness connectors at the ECM.
3. Install a jumper wire between sockets A and C of the FPS harness connector. See Figure 38-4.
4. Measure resistance between sockets W1 and Y2 on the engine harness connector.
   - [a] If resistance measurement is less than or equal to 5 Ω refer to section 38.3.8.
   - [b] If the resistance measurement is greater than 5 Ω or open, the engine +5 volt line (#416) is open. Repair the open and refer to section 38.3.12.

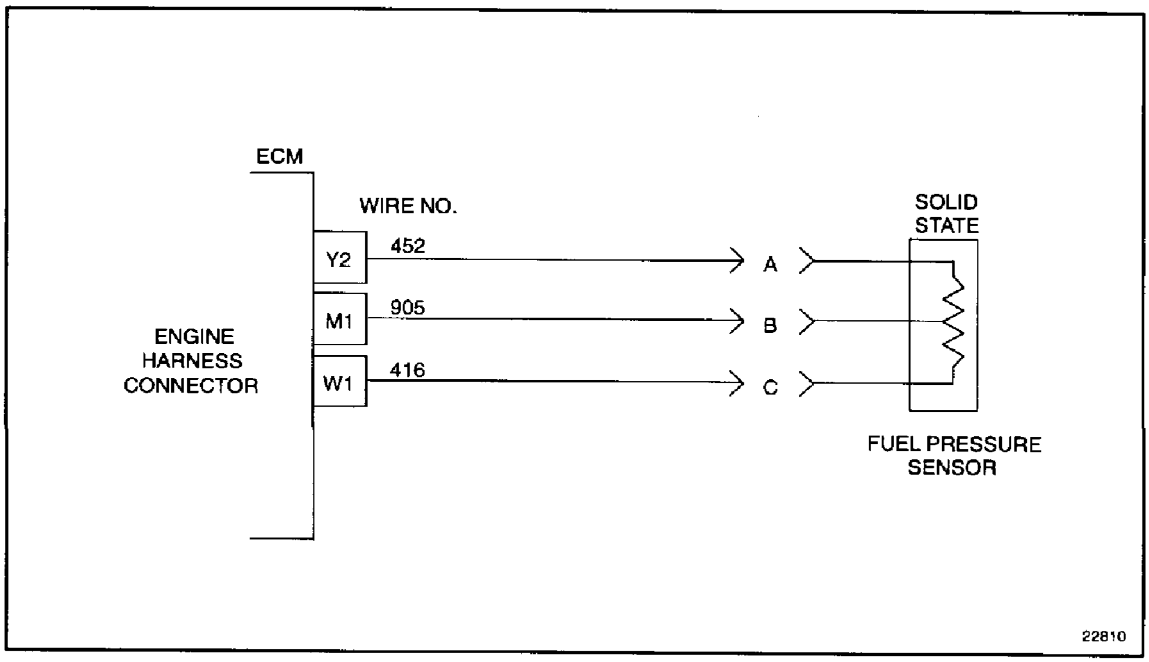


Figure 38-4 Engine Harness Connector to Fuel Pressure Sensor

38.3.8 Check for Short

Perform the following steps to check for a short.

1. Remove jumper wire.
2. Measure resistance between sockets A and C of the FPS harness connector.
   - [a] If the resistance measurement is greater than 100 Ω or open, refer to section 38.3.11.
   - [b] If the resistance measurement is less than or equal to 100 Ω, the return line (#452) is shorted to the engine +5 volt line (#416). Repair the short and refer to section 38.3.12.

38.3.9 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM. See Figure 38-5.
3. Measure resistance between socket W1 on the engine harness connector and socket B3 of the vehicle harness connector, and between W1 and the 5-way power harness sockets A and C.
   - [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 38.3.11.
   - [b] If the resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where less than 1,000 Ω was measured. Repair short and reinsert fuses. Refer to section 38.3.12.

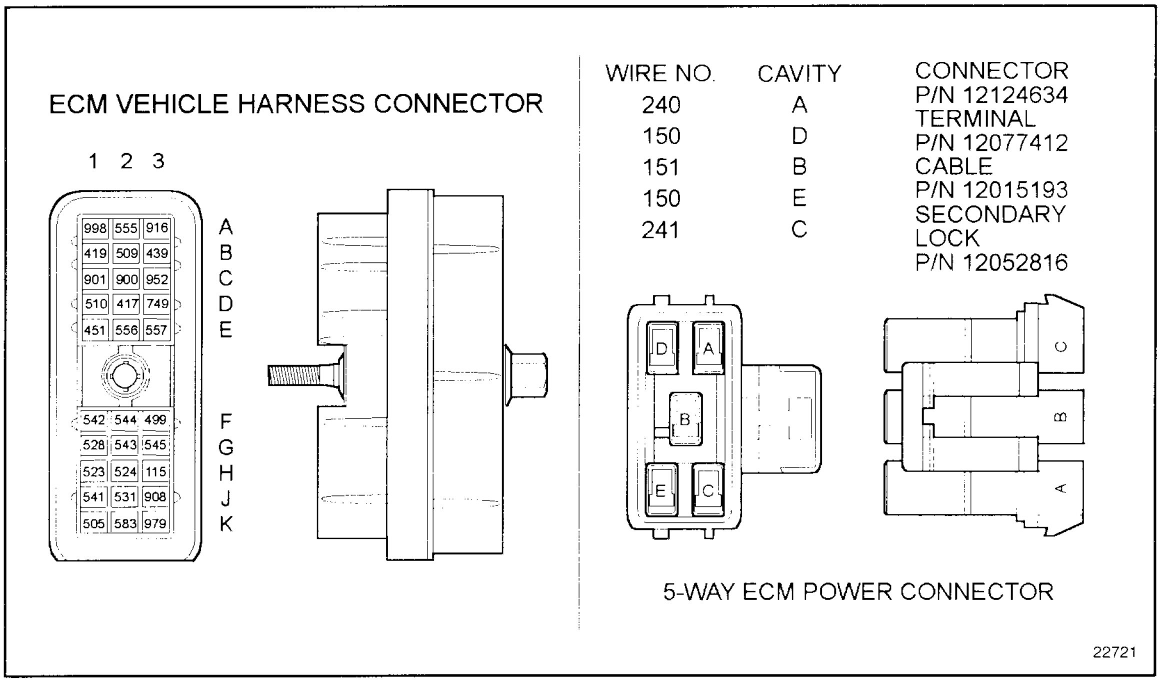


Figure 38-5 ECM Vehicle Harness Connector

38.3.10 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn ignition switch OFF.
2. Remove jumper wires.
3. Measure resistance between sockets M1 and Y2 on the engine harness connector. Also measure resistance between socket M1 and a good ground.

[a] If both resistance measurements are greater than 100 Ω or open, refer to section 38.3.11.

[b] If either resistance measurement is less than or equal to 100 Ω, the signal line (#905) and return line (#452) are shorted together, or the signal line (#905) is shorted to battery ground. Repair the short. Refer to section 38.3.12.

38.3.11 Replace Fuel Pressure Sensor

Perform the following steps to replace the FPS.

1. Turn ignition switch OFF.
2. Replace FPS.
3. Reconnect all connectors.
4. Turn ignition ON.
5. Clear codes.
6. Start and run the engine for one minute.
   [a] If check engine light comes on, refer to section 38.3.6.
   [b] If check engine light does not come on, refer to section 38.3.12.

38.3.12 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 94/4 is not logged, and other codes are logged, refer to section 9.1.
   [c] If code 94/4 is logged, and other codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 38.3.1.

39 FLASH CODE 39

39.1 DESCRIPTION OF FLASH CODE 39

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

40 FLASH CODE 40

40.1 DESCRIPTION OF FLASH CODE 40

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

41 (CHG) FLASH CODE 41 - TOO MANY SRS

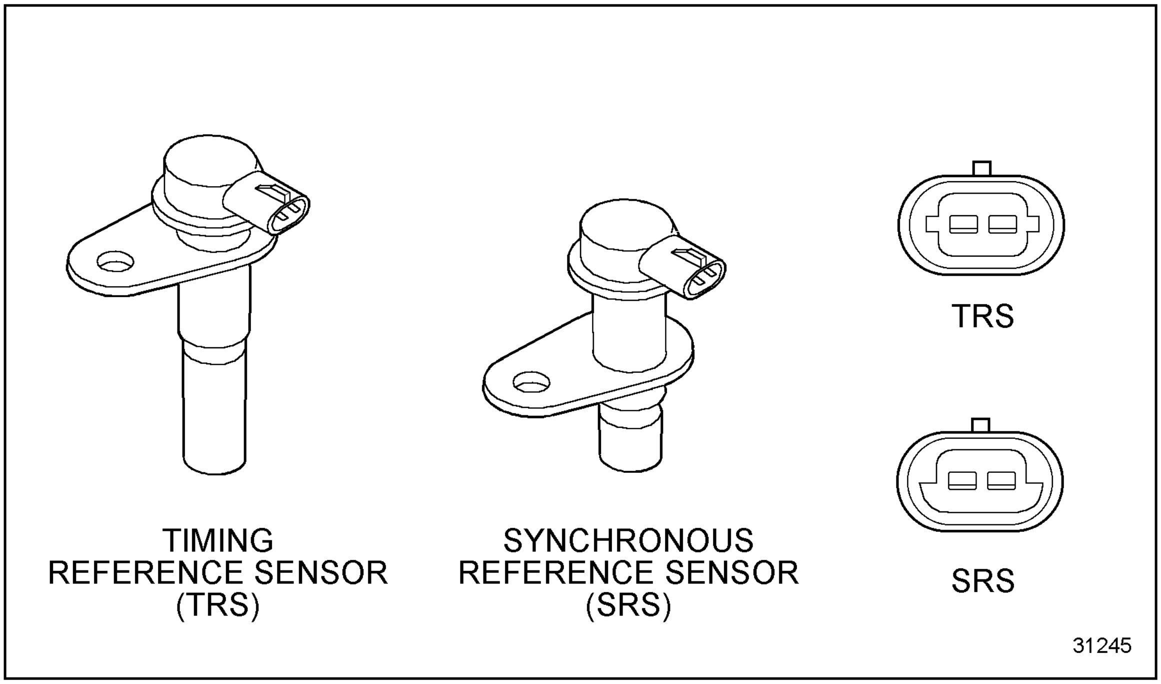


Figure 41-1 Synchronous Reference Sensor and Timing Reference Sensor

41.1 DESCRIPTION OF FLASH CODE 41

Flash Code 41 indicates that the ECM has detected extra Synchronous Reference Sensor pulses, or the ECM has detected missing Timing Reference Sensor pulses, see Figure 41-1.

41.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 41

The SAE J1587 equivalent code for Flash Code 41 is s 021 0.

41.3 TROUBLESHOOTING FLASH CODE 41

The following procedure will troubleshoot Flash Code 41.

41.3.1 Check for Signal Open

Perform the following steps to check for signal open.

1. Turn ignition OFF.
2. Disconnect engine harness connector at the ECM. See Figure 41-2.
3. Read resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance reading is less than or equal to 200 Ω, refer to section 41.3.2.
   [b] If the resistance reading is greater than 200 Ω or open, refer to section 41.3.3.

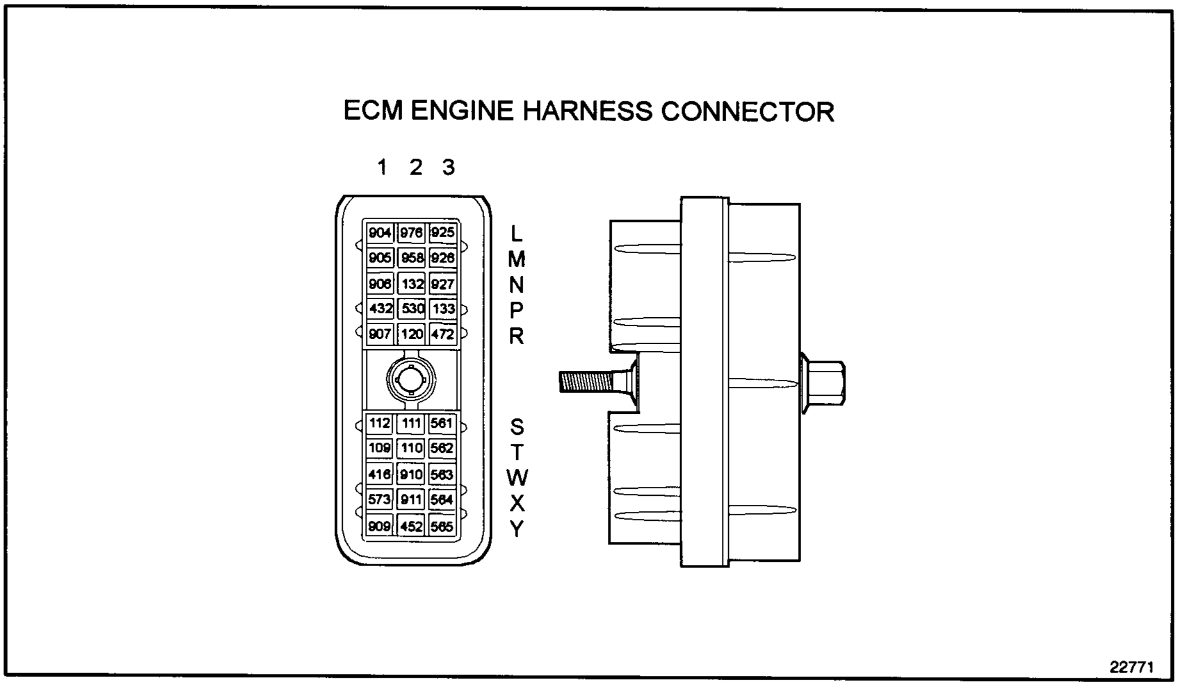


Figure 41-2 Engine Harness Connector

41.3.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector. See Figure 41-3.
3. Measure resistance between socket T1 and ground, and between socket T2 and ground.
   [a] If the resistance measurement is greater than 10,000 Ω or open, refer to section 41.3.4.

[b] If the resistance measurement is less than or equal to 10,000 Ω, a short exists between #110 and #109 or where less than 10,000 Ω resistance was read. Repair the short. Refer to section 41.3.15.

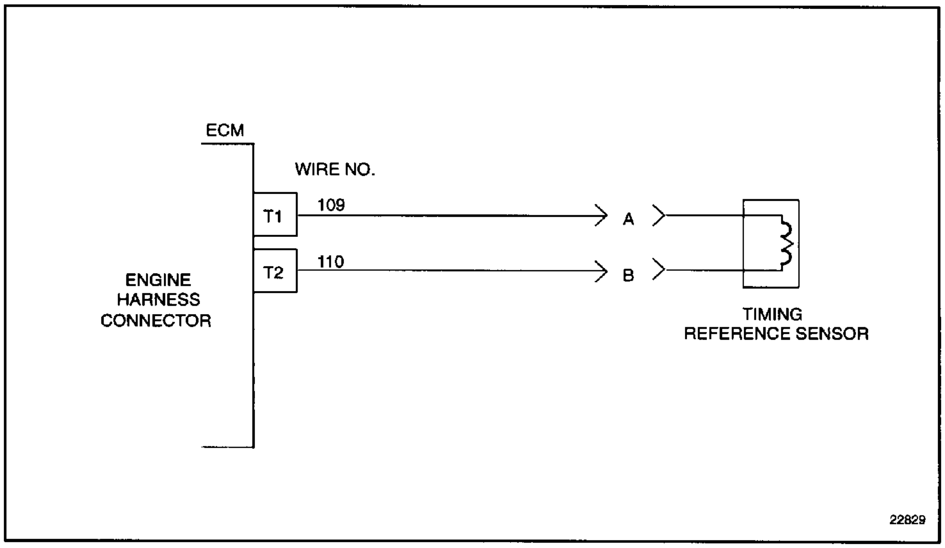


Figure 41-3 Engine Harness Connector to Timing Reference Sensor

41.3.3 Open Timing Reference Sensor Line Check

Perform the following steps to check the open TRS line.

1. Disconnect the TRS connector.
2. Install a jumper wire between sockets A and B of the TRS harness connector.
3. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 41.3.4.
   [b] If the resistance measurement is greater than 5 Ω, or open, the signal line #110 or return line #109 is open. Repair the open. Refer to section 41.3.15.

41.3.4 Check Timing Reference Sensor Resistance

Perform the following steps to check TRS resistance.

1. Measure resistance of TRS across sensor connector pins A and B. See Figure 41-4.
   [a] If the resistance measurement is greater than 200 Ω, refer to section 41.3.12.
   [b] If the resistance measurement is less than 100 Ω, refer to section 41.3.12.

[c] If the resistance measurement is between 100 and 200 Ω, refer to section 41.3.5.

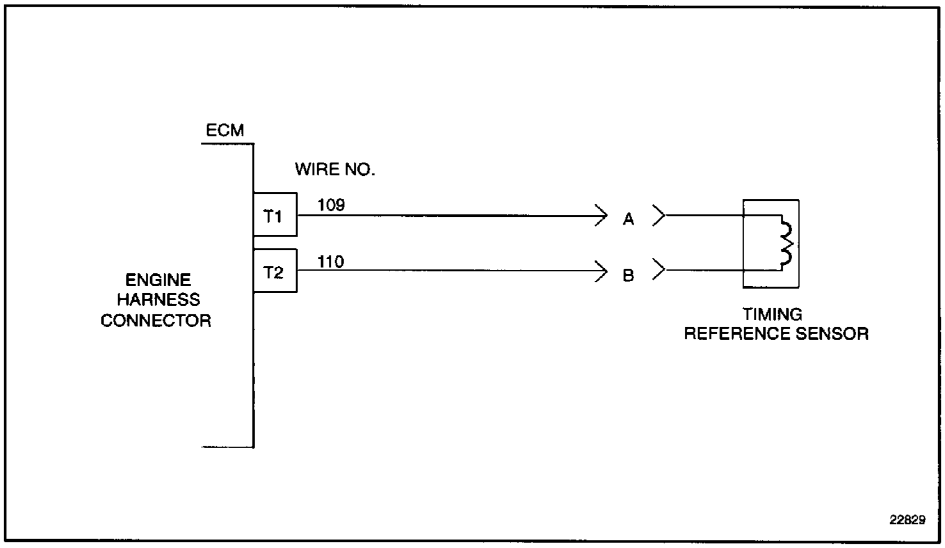


Figure 41-4 Engine Harness Connector to Timing Reference Sensor

41.3.5 Check Timing Reference Sensor / Synchronous Reference Sensor Gap

Perform the following steps to check the TRS/SRS gap.

1. Bar the engine until the TRS is over a TRS tooth of the pulse wheel.
2. Check the gap between TRS and the tooth of the pulse wheel (0.020 to 0.040 in.). A depth micrometer can be used.
   [a] If the gap setting is correct, refer to section 41.3.6.
   [b] If the gap setting is not correct, adjust the TRS/SRS until the gap setting is correct. If the problem returns, the pulse wheel may be loose or bad or damaged. Refer to section 41.3.15.

41.3.6 Synchronous Reference Sensor Code Check

Perform the following steps to check for SRS code.

1. Check for SRS code.
   [a] If code 21/1 is not logged, refer to section 41.3.7.
   [b] If code 21/1 is logged, refer to section 41.3.8.

41.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connectors (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.
   [b] If terminals and connectors are not damaged, install a test ECM.
   Refer to section 41.3.15.

41.3.8 Synchronous Reference Sensor Resistance Check

Perform the following steps to check SRS resistance.

1. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 41-5.
   [a] If measured resistance is greater than 200 Ω , or open, refer to section 41.3.10.
   [b] If measured resistance is less than 200 Ω , or open, refer to section 41.3.9.

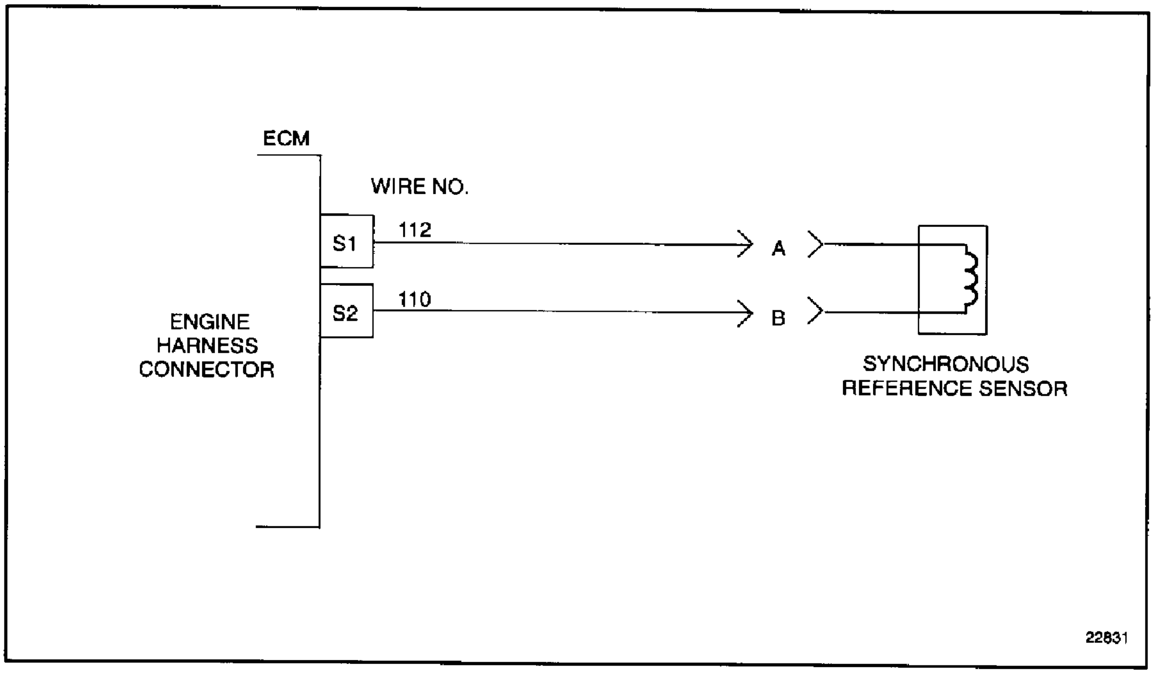


Figure 41-5 Engine Harness Connector to Synchronous Reference Sensor

41.3.9 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS connector.
2. Measure resistance between sockets S1 and S2 on the engine harness connector.
   [a] If measured resistance is greater than 10,000 Ω, or open, refer to section 41.3.11.

[b] If measured resistance is less than or equal to 10,000 Ω, the signal line #111 is shorted to the return line #112. Repair the short. Refer to section 41.3.15.

41.3.10 Open Synchronous Reference Sensor Line Check

Perform the following steps to check for an open SRS line.

1. Disconnect the SRS connector.
2. Install a jumper wire between sockets A and B of the SRS harness connectors.
3. Measure resistance between sockets S1 and S2 on the engine harness connector.

    [a] If measured resistance is less than or equal to 5 Ω, refer to section 41.3.11.

    [b] If measured resistance is greater than 5 Ω, or open, the signal line #111 or return line #112 is open. Repair the open and refer to section 41.3.15.

41.3.11 Synchronous Reference Sensor Test

Perform the following steps to test the SRS.

1. Measure resistance of SRS across the sensor connector pins A and B.

    [a] If measured resistance is less than or equal to 100 Ω, refer to section 41.3.13.

    [b] If measured resistance is greater than 200 Ω, refer to section 41.3.13.

    [c] If measured resistance is between 100 and 200 Ω, refer to section 41.3.7.

41.3.12 Check Timing Reference Sensor Connectors

Perform the following steps to check TRS connectors.

1. Check terminals at the TRS (both the TRS and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 41-6.

    [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.

[b] If terminals and connectors are not damaged, replace the TRS. Refer to section 41.3.14.

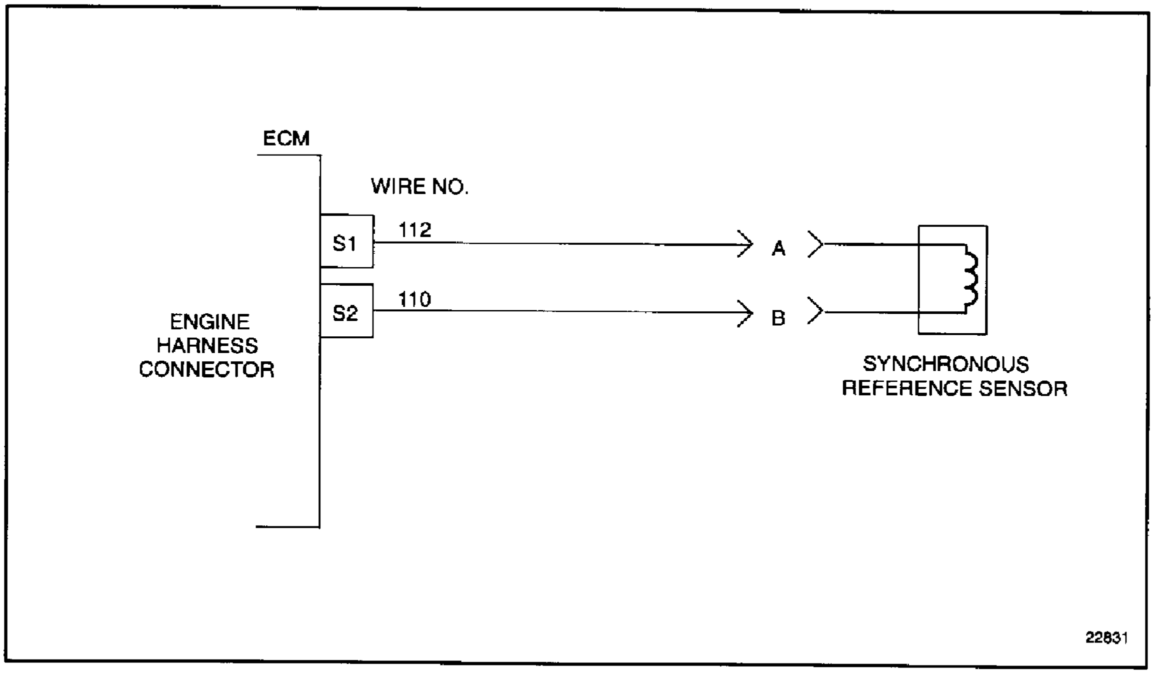


Figure 41-6 Engine Harness Connector to Synchronous Reference Sensor

41.3.13 Check Synchronous Reference Sensor Connectors

Perform the following steps to check the SRS connectors.

1. Check terminals at the SRS (both the SRS and harness side) for damage: bent, corroded, and unseated pins or sockets, or bad contacts.
   [a] If terminals and connectors are damaged, repair them. Refer to section 41.3.15.
   [b] If terminals and connectors are not damaged, replace the SRS. Refer to section 41.3.14.

41.3.14 Verify Synchronous Reference Sensor / Timing Reference Sensor

Perform the following steps to verify operation of the SRS/TRS.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.

[b] If code 21/0 and any other codes are logged, and the SRS was not replaced, refer to section 41.3.6.

[c] If any codes except code 21/0 are logged, refer to section 9.1.

41.3.15 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.

   [a] If no codes are logged, troubleshooting is complete.

   [b] If code 21/0 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 41.3.1 or contact Detroit Diesel Technical Service.

   [c] If any codes except code 21/0 are logged, refer to section 9.1.

42 (CHG) FLASH CODE 42 - TOO FEW SRS

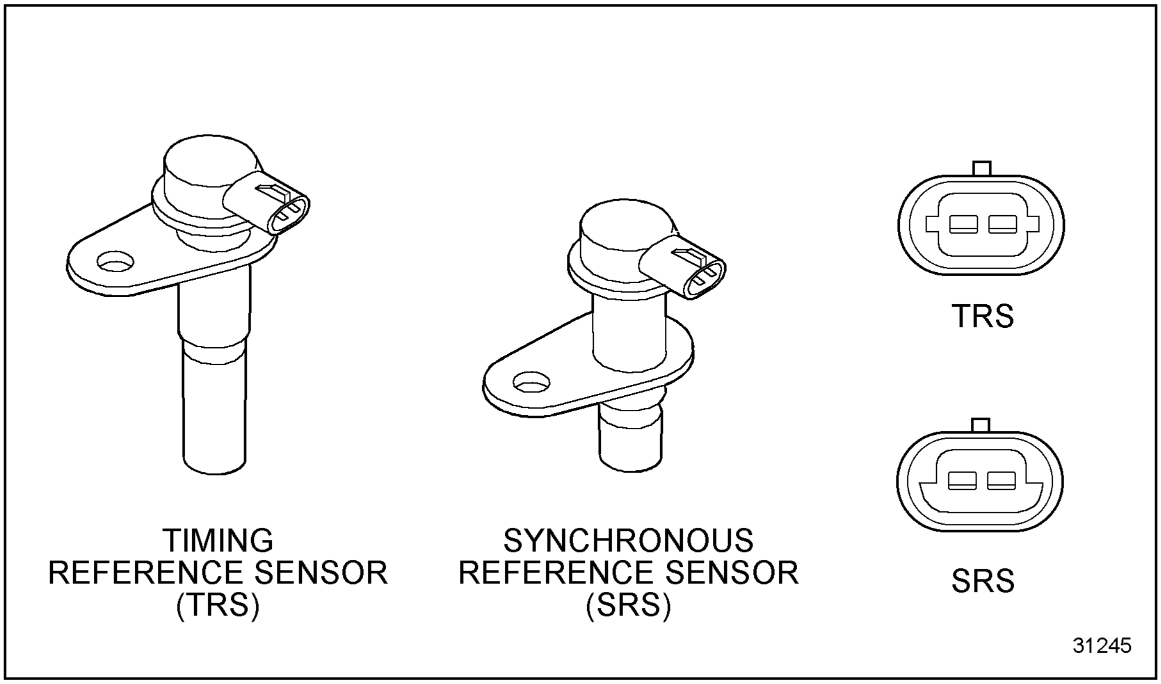


Figure 42-1 Synchronous Reference Sensor and Timing Reference Sensor

42.1 DESCRIPTION OF FLASH CODE 42

Flash Code 42 indicates that the ECM has detected missing Synchronous Reference Sensor (SRS) pulses, or the ECM has detected extra Timing Reference Sensor (TRS) pulses, see Figure 42-1.

42.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 42

The SAE J1587 equivalent code for Flash Code 42 is s 021 1.

42.3 TROUBLESHOOTING FLASH CODE 42

The following procedure will troubleshoot Flash Code 42.

42.3.1 Resistance Check

Perform the following steps to check resistance.

1. Turn vehicle ignition OFF.
2. Disconnect engine harness connector at ECM.
3. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 42-2.
   [a] If the resistance measurement is less than or equal to 200 Ω, refer to section 42.3.2.
   [b] If the resistance measurement is greater than 200 Ω or open, refer to section 42.3.3.

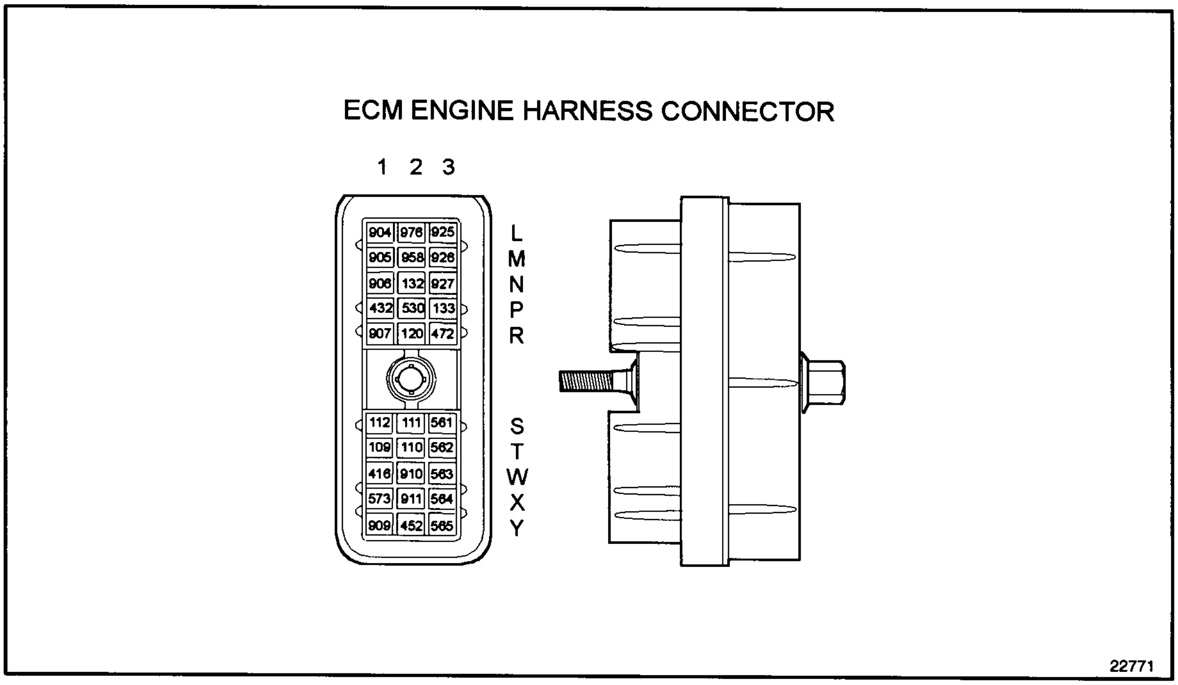


Figure 42-2 ECM Engine Harness Connector

42.3.2 Check for Short

Perform the following steps to check for a short.

1. Disconnect the SRS Connector.
2. Measure resistance between sockets S1 and S2 on the engine harness connector. See Figure 42-3.
3. Measure resistance between socket S1 and ground, and between socket S2 and ground.

[a] If the resistance measurement is less than or equal to 10,000 Ω, a short exists. Repair the short. Refer to section 42.3.16.

[b] If the resistance measurement is greater than 10,000 Ω, or open, refer to section 42.3.4.

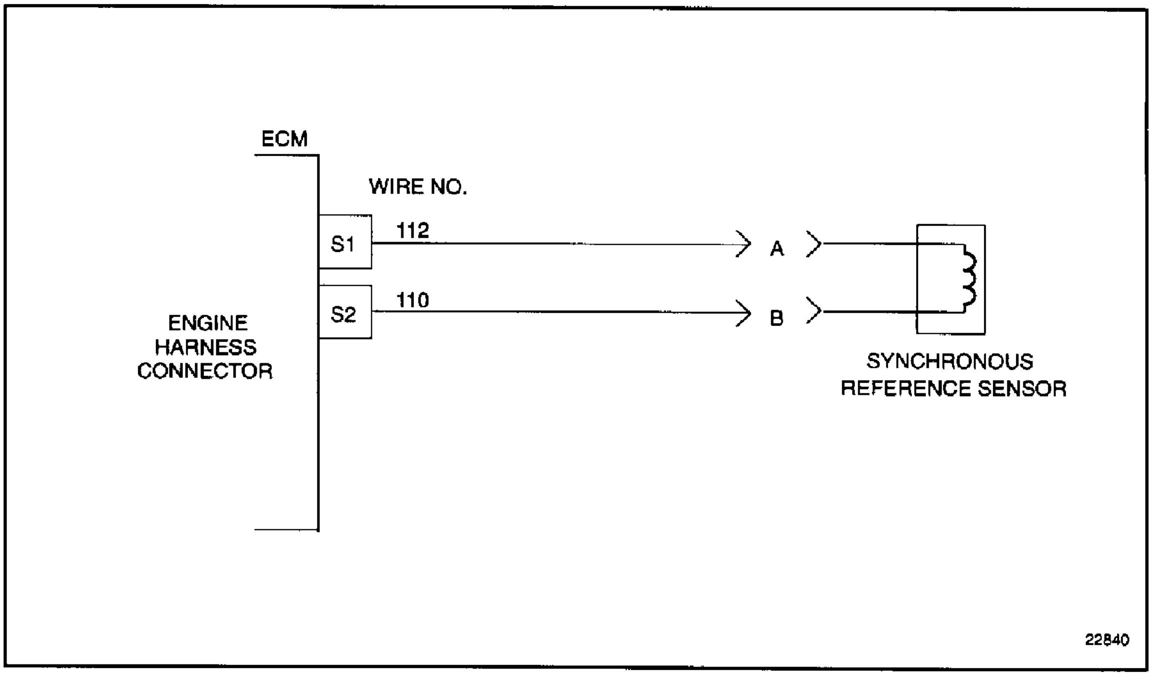


Figure 42-3 Engine Harness Connector to Synchronous Reference Sensor

42.3.3 Open Synchronous Reference Sensor Line Check

Perform the following steps to check for an open SRS line.

1. Disconnect the SRS connector.
2. Install a jumper wire between sockets A and B of the SRS harness connector. See Figure 42-4.
3. Measure resistance between sockets S1 and S2 on the engine harness connector.

    [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 42.3.4.

[b] If the resistance measurement is greater than 5 Ω or open, the signal line (#111) or return line (#112) is open. Repair the open. Refer to section 42.3.16.

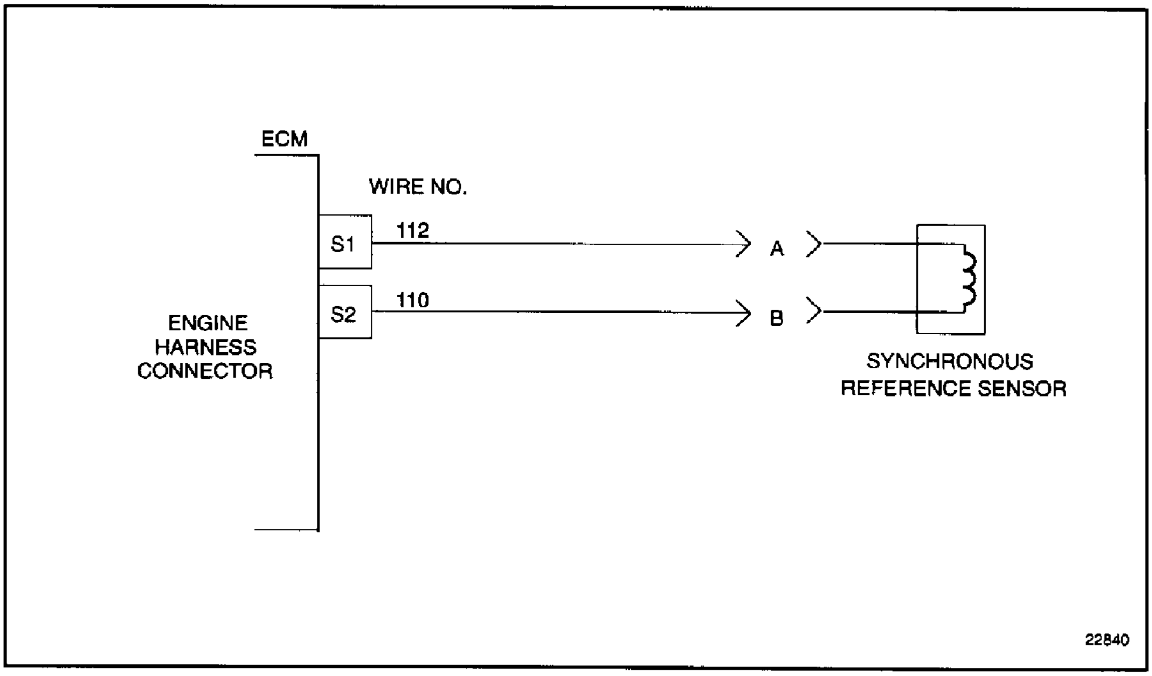


Figure 42-4 Engine Harness Connector to Synchronous Sensor

42.3.4 Synchronous Reference Sensor Test

Perform the following steps to test the SRS.

1. Measure resistance of SRS across the sensor connector pins A and B.

   [a] If the resistance measurement is less than or equal to 100 Ω, refer to section 42.3.12.

   [b] If the resistance measurement is greater than 200 Ω, refer to section 42.3.12.

   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 42.3.5.

42.3.5 Check Synchronous Reference Sensor Gap

Perform the following steps to check the SRS gap.

1. Bar engine until SRS is over the SRS pin.
2. Check the gap between SRS and the pin.

   [a] If the gap setting is correct (0.020 - 0.040 in.), refer to section 42.3.6. A depth micrometer can be used.

   [b] If the gap setting is not correct, adjust the SRS until the gap setting is correct. If the problem returns, the pulse wheel may be loose or bad. Refer to section 42.3.16.

42.3.6 Check for Timing Reference Sensor Code

Perform the following steps to check for TRS code.

1. Check for TRS code.
   [a] If code 21/0 is not logged, refer to section 42.3.7.
   [b] If code 21/0 is logged, refer to section 42.3.8.

42.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connectors (both the ECM and harness side) for damage: bent, corroded, and unseated pins or sockets. See Figure 42-5.
   [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.
   [b] If terminals and connectors are not damaged, refer to section 42.3.15.

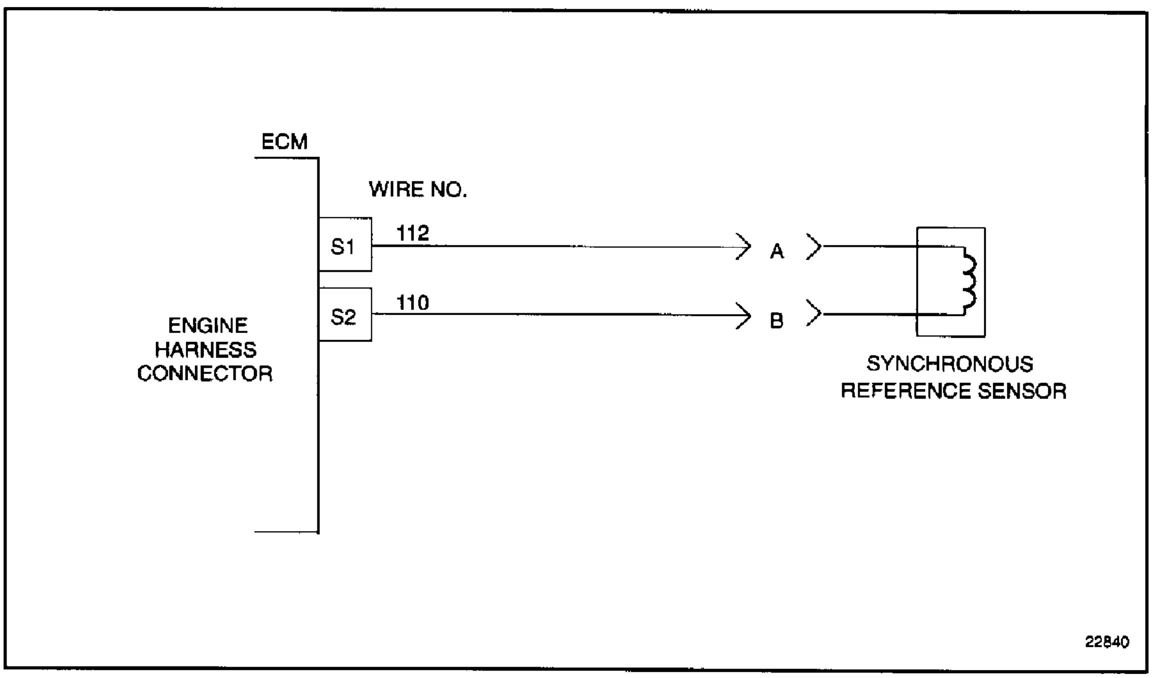


Figure 42-5 Engine Harness Connector to Synchronous Sensor

42.3.8 Timing Reference Sensor Resistance Check

Perform the following steps to check TRS resistance.

1. Remove the engine harness connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector. See Figure 42-6.

[a] If the resistance measurement is greater than 200 Ω, refer to section 42.3.10.

[b] If the resistance measurement is less than or equal to 200 Ω, refer to section 42.3.9.

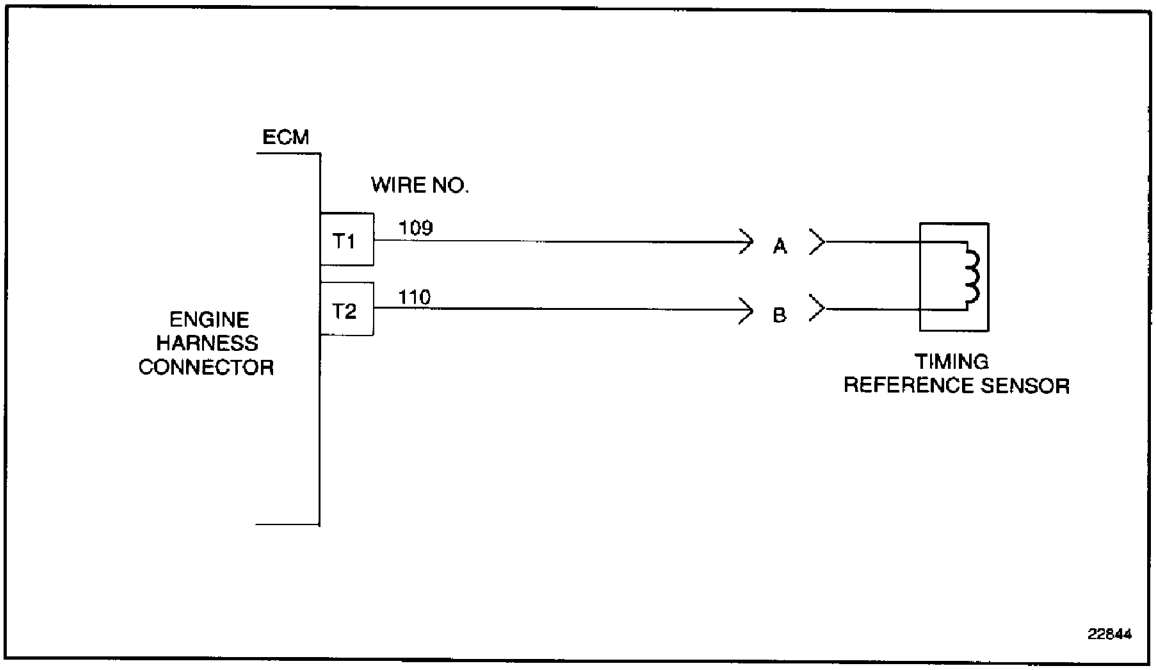


Figure 42-6 Engine Harness Connector to Timing Reference Sensor

42.3.9 Check for Short

Perform the following steps to check for a short.

1. Disconnect the TRS connector.
2. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If measured resistance is greater than 10,000 Ω, or open, refer to section 42.3.11.
   [b] If measured resistance is less than or equal to 10,000 Ω, the signal line (#110) is shorted to the return line (#109). Repair the short. Refer to section 42.3.16.

42.3.10 Open Timing Reference Sensor Line Check

Perform the following steps to check for an open TRS line.

1. Disconnect the TRS connector.
2. Install a jumper wire between sockets A and B of the TRS harness connector. See Figure 42-7.
3. Measure resistance between sockets T1 and T2 on the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 42.3.11.

[b] If the resistance measurement is greater than 5 Ω, or open, the signal line (#110) or return line (#109) is open. Repair the open. Refer to section 42.3.16.

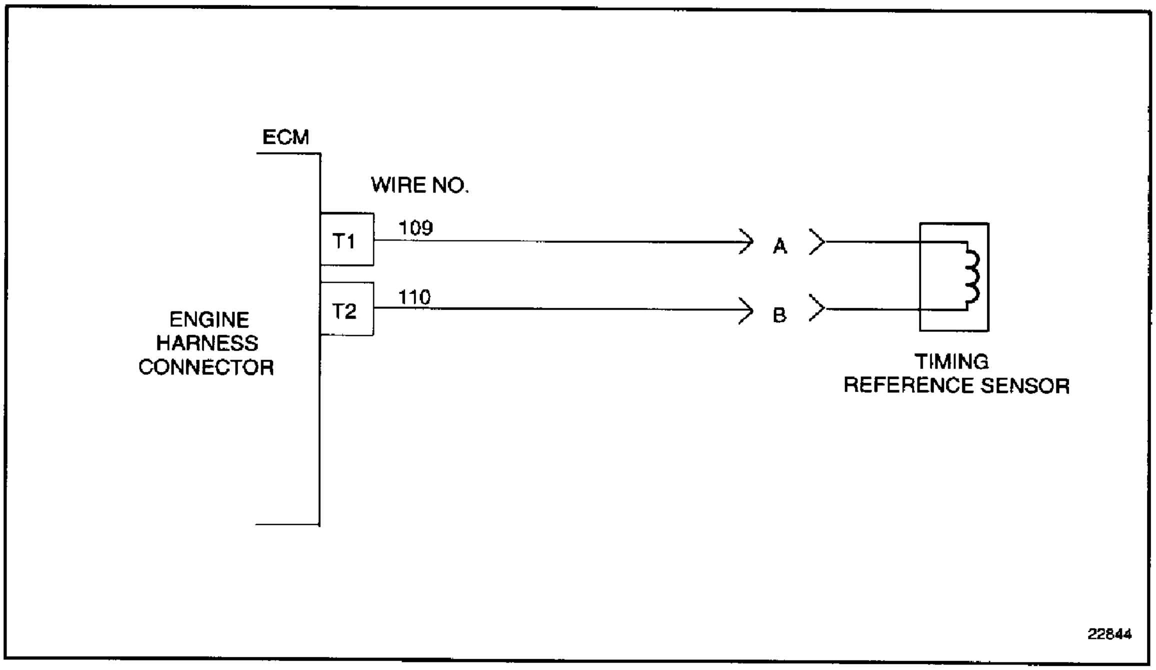


Figure 42-7 Engine Harness Connector to Timing Reference Sensor

42.3.11 Timing Reference Sensor Test

Perform the following steps to test the TRS.

1. Measure resistance of TRS across the sensor connector pins A and B.

   [a] If the resistance measurement is greater than 200 Ω, refer to section 42.3.13.

   [b] If the resistance measurement is less than 100 Ω, refer to section 42.3.13.

   [c] If the resistance measurement is between 100 and 200 Ω, refer to section 42.3.7.

42.3.12 Check Synchronous Reference Sensor Connectors

Perform the following steps to check the SRS connectors.

1. Check terminals at the SRS (both the SRS and harness side) for damage: bent, corroded, and unseated pins or sockets, or a bad contact. See Figure 42-8.

   [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.

[b] If terminals and connectors are not damaged, replace the SRS. Refer to section 42.3.14.

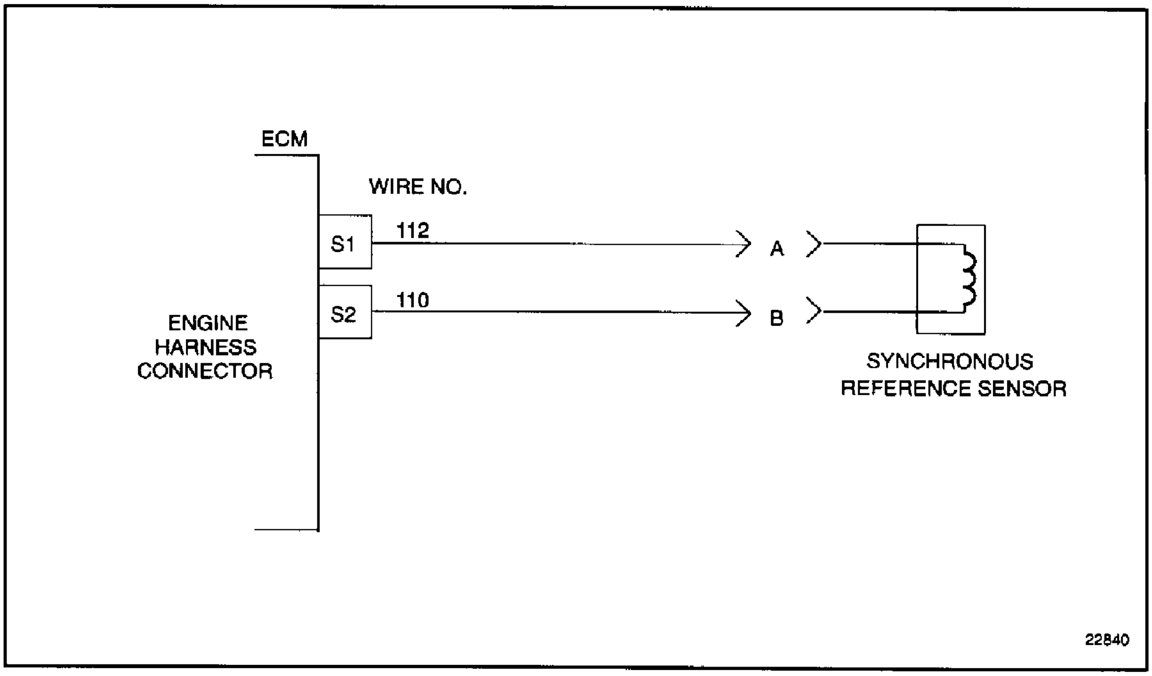


Figure 42-8 Engine Harness Connector to Synchronous Reference Sensor

42.3.13 Check Timing Reference Sensor Connectors

Perform the following steps to check the TRS connectors.

1. Check terminals at the TRS (both the TRS and harness end) for damage: bent, corroded, and unseated pins or sockets or bad contacts. See Figure 42-9.

   [a] If terminals and connectors are damaged, repair them. Refer to section 42.3.16.

[b] If terminals and connectors are not damaged, replace the TRS. Refer to section 42.3.14.

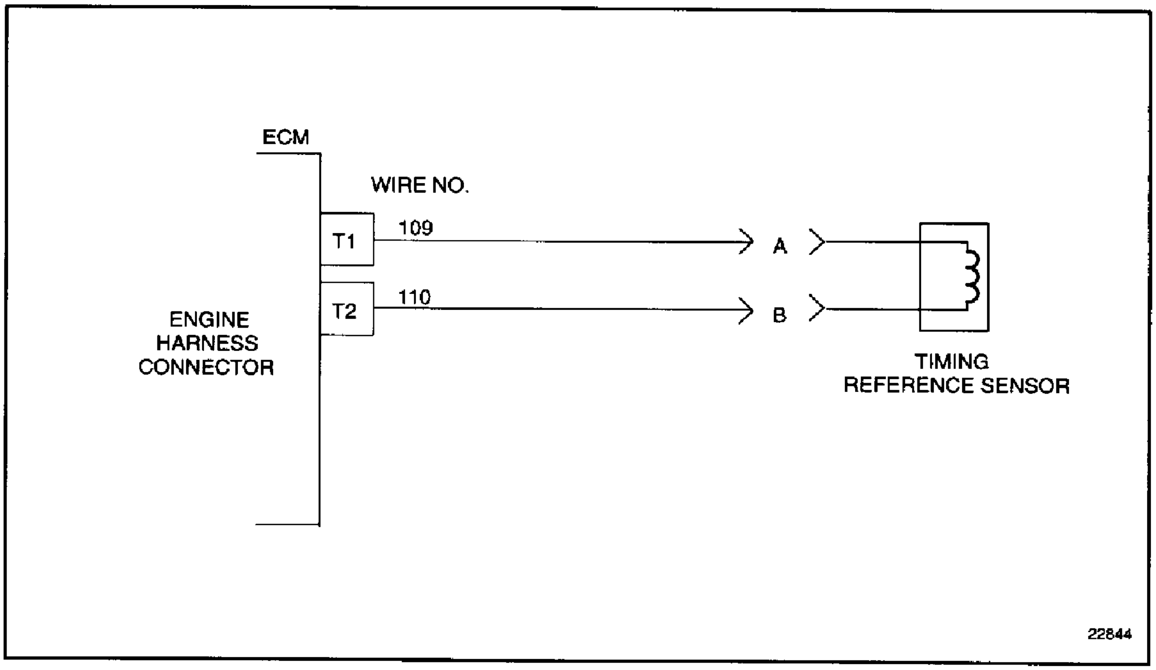


Figure 42-9 Engine Harness Connector to Timing Reference Sensor

42.3.14 Verify Synchronous Reference Sensor / Timing Reference Sensor

Perform the following steps to verify operation of the SRS/TRS.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If any codes except code 21/1 are logged, refer to section 9.1.
   [c] If code 21/1 and any other codes are logged, and the TRS was not replaced, refer to section 42.3.6.
   [d] If code 21/1 and any other codes are logged, and the TRS was replaced, refer to section 42.3.15.

42.3.15 Verify Cranking Voltage

Perform the following steps to verify cranking voltage.

1. Turn vehicle ignition OFF.
2. Connect all connectors.
3. Connect 12 volt from a fully charged battery to the 5-pin power connector. See Figure 42-10.
4. Connect to ECM.
5. Start engine.
   - [a] If engine starts, check the battery. If a voltage equalizer is installed, check the operation of the equalizer. If the equalizer is not working, refer to section 42.3.16.
   - [b] If the engine does not start, replace the ECM. Refer to section 42.3.16.

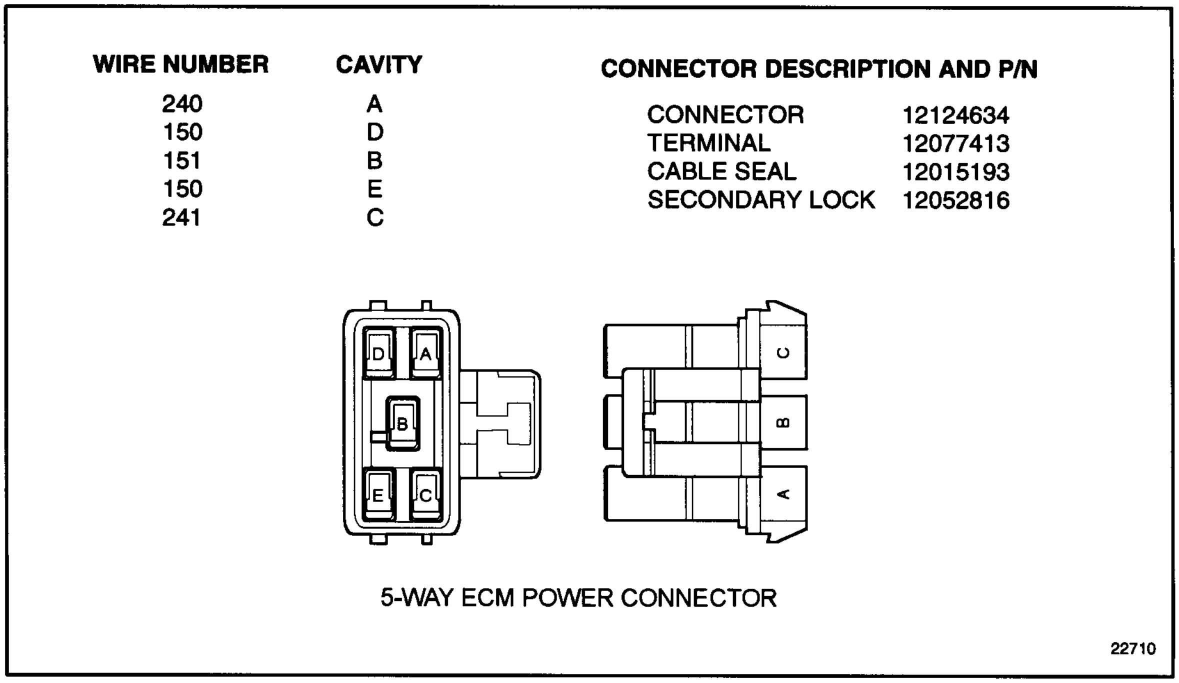


Figure 42-10 5-Way ECM Engine Power Connector

42.3.16 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn vehicle ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.

[a] If no codes are logged, troubleshooting is complete.

[b] If code 21/1 and any other codes are logged, all system diagnostics are complete. Review this section to find the error. Refer to section 42.3.1.

[c] If any codes except code 21/1 are logged, refer to section 9.1.

43 FLASH CODE 43 - COOLANT LEVEL LOW

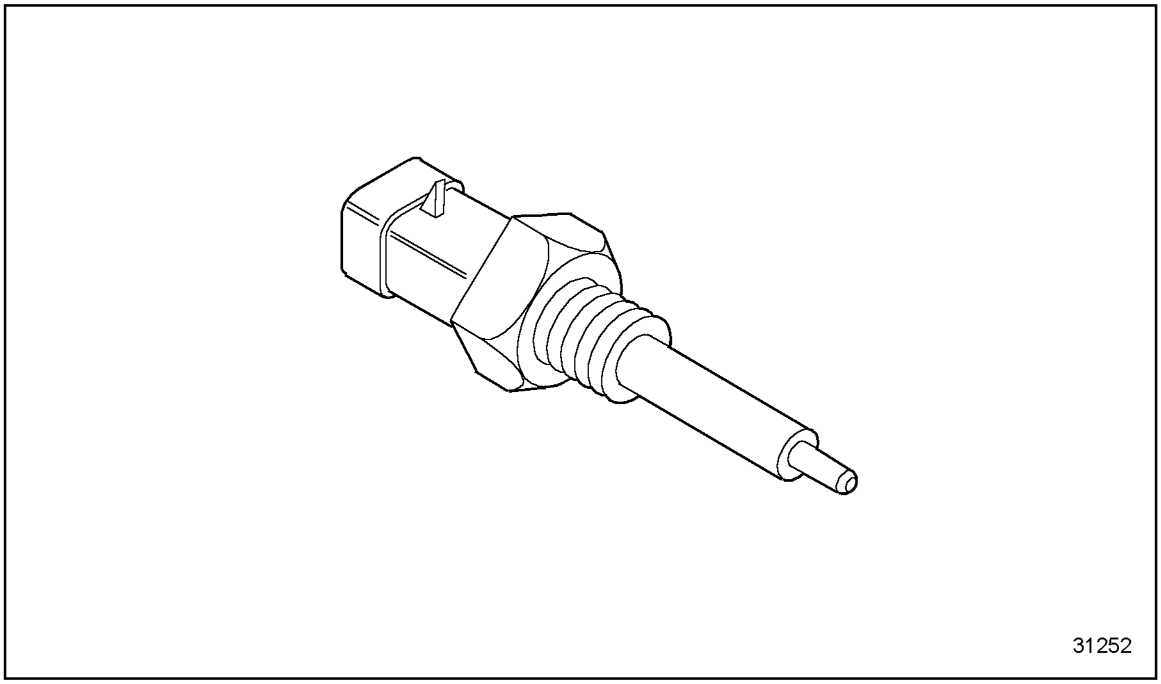


Figure 43-1 Coolant Level Sensor

43.1 DESCRIPTION OF FLASH CODE 43

Flash Code 43 indicates that the ECM has detected that the engine coolant level has dropped below the recommended safe operating range, see Figure 43-1.

There is a significant difference between the coolant level sensors used in Detroit Diesel Electronic Controls (DDEC) II and DDEC III applications.

- ☐ Externally, the sensors physically look the same.
- ☐ The sensor used for the DDEC II system has a black colored connector.
- ☐ The sensor used for the DDEC III system has an off-white colored connector.

A coolant level module must be used with all coolant level sensors for DDEC II applications. All DDEC III applications, except Volvo, do not require a coolant level module.

43.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 43

The SAE J1587 equivalent code for Flash Code 43 is p 111 1.

43.3 TROUBLESHOOTING FLASH CODE 43

The following procedure will troubleshoot Flash Code 43.

43.3.1 Coolant Level Low

Perform the following steps to diagnose the coolant level low.

1. Turn ignition ON; plug in DDR.
2. Read active codes.
   [a] If code 111-1 is logged, there is an indication of a low coolant level condition. Add coolant to ensure coolant level probe is immersed in coolant.
   [b] If code 111-1 remains active, refer to section 43.3.2.

43.3.2 Replace Coolant Level Sensor

Using the sensor tester may be of assistance. Use Tool J 37164.

NOTE:
When replacing the coolant level sensor, the CLS could be an OEM supplied part.

1. Turn ignition OFF; replace CLS.
2. Turn ignition ON.
3. Read active codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes are logged, refer to section 43.3.3.

43.3.3 Clean and Check Alternator Grounds

Perform the following steps to check the alternator ground.

1. If the grounds are clean and good, troubleshooting is complete.
2. If the grounds are damaged, repair the ground circuit and verify repairs.
   Refer to section 43.3.4.

43.3.4 Verify Repairs

Perform the following steps to verify repairs

1. Turn ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear DDR codes.

5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 111/1, and any other codes are logged, refer to section 43.3.1, and repeat the procedure, or contact Detroit Diesel Technical Service.
   [c] If any code other than 111/1 is logged, refer to section 9.1.

44 FLASH CODE 44 - TEMP HIGH

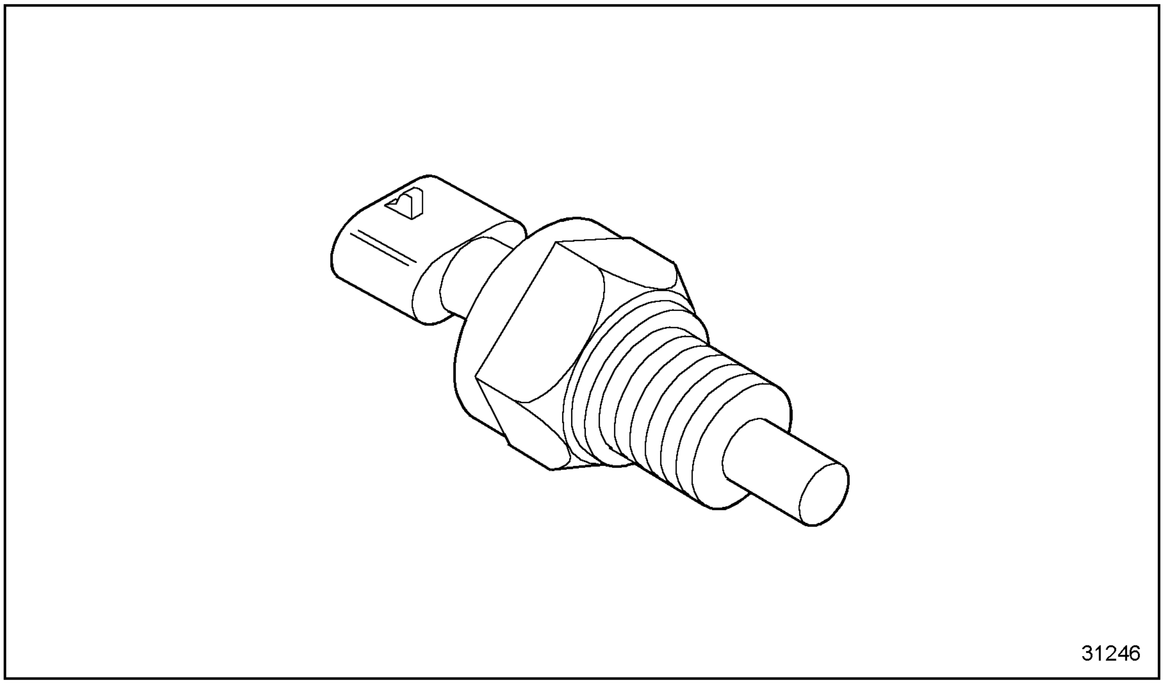


Figure 44-1 Coolant Temperature Sensor (Oil Temperature Sensor similar)

44.1 DESCRIPTION OF FLASH CODE 44

Flash Code 44 indicates that the ECM has detected that the engine coolant temperature has exceeded the recommended safe operating range. See Figure 44-1, for the sensor.

It also indicates that the ECM has detected that the engine oil temperature has exceeded the recommended safe operating range. This normally occurs due to a mechanical fault.

44.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 44

The SAE J1587 equivalent code for Flash Code 44 is p 110 0, coolant temperature high.

The SAE J1587 equivalent code for Flash Code 44 is p 175 0, oil temperature high.

44.3 TROUBLESHOOTING FLASH CODE 44

Perform the following steps to troubleshoot Flash Code 44.

44.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If active codes other than 110/0 or 175/0 are logged, service them first.
   [b] If active codes 110/0 or 175/0 are logged, and no other codes are logged, oil or coolant temperature was higher than it should have been. Inspect for damage. Plug in the reader and determine if code is coolant or oil temperature high.
   [c] If active code 110/0 is logged, and the duration of this code is less than 20 seconds, or if it has multiple occurrences which average less than 20 seconds each, contact Detroit Diesel Technical Service.

NOTE:
For information concerning high temperature levels, refer to section 4.1 in the service manual.

45 FLASH CODE 45 - OIL PRESSURE LOW

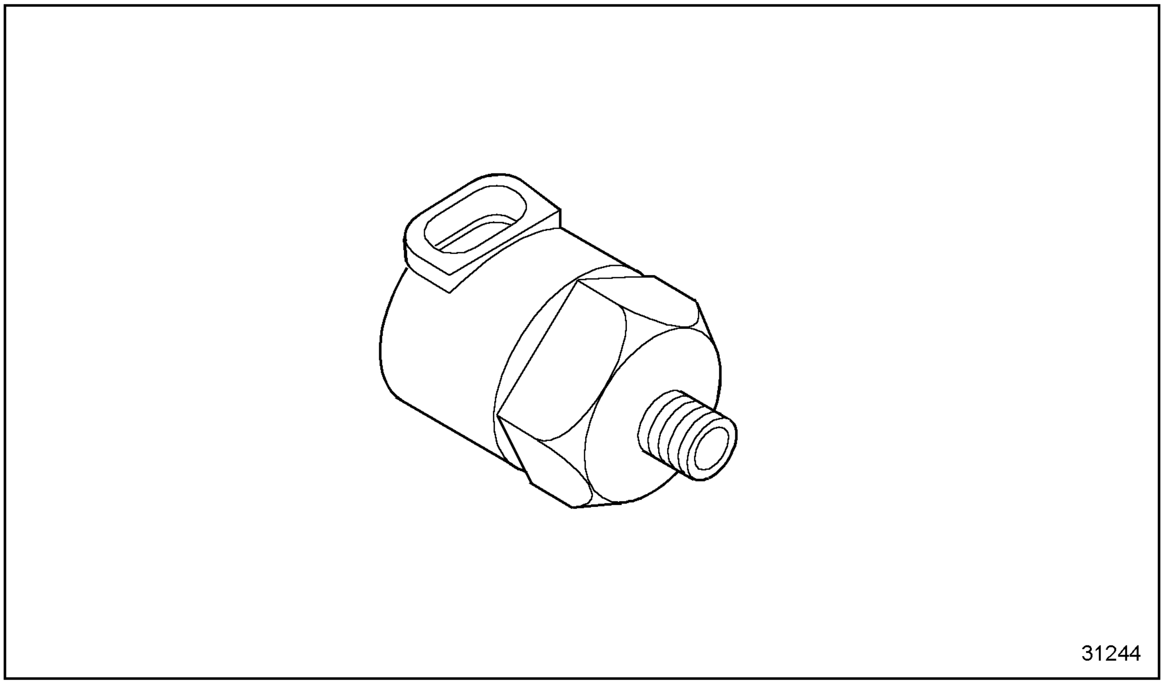


Figure 45-1 Oil Pressure Sensor

45.1 DESCRIPTION OF FLASH CODE 45

Flash Code 45 indicates that the ECM has detected that the engine oil pressure has dropped below the recommended safe operating range. See Figure 45-1 for the engine oil pressure sensor.

Conditions: ECM looks for a minimum pressure vs. speed. This can vary for each engine type.

45.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 45

The SAE J1587 equivalent code for Flash Code 45 is p 100 1, oil pressure low.

45.3 TROUBLESHOOTING FLASH CODE 45

Perform the following steps to troubleshoot Flash Code 45.

45.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR)
3. Read active codes.
   [a] If codes other than 110/1 are logged, service them first.
   [b] If code 110/1 is logged, and no other codes are logged, there was an engine running condition at which oil pressure was lower than it should have been.

NOTE:
For information concerning low oil pressure level, refer to section 3.1 in the engine service manual.

46 FLASH CODE 46 - BATTERY VOLTAGE LOW

46.1 DESCRIPTION OF FLASH CODE 46

Flash Code 46 indicates that the DDEC system has detected that the main battery supply voltage to the ECM has dropped below the recommended operating range.

The DDEC system will operate on 12 or 24 volts.

- ☐ Normal operating voltage of the DDEC system is 11 to 32 volts DC, measured at the ECM.
- ☐ Operating the ECM between 6 and 11 volts may result in degraded engine operation. (Transient operation in this range during engine starting is considered normal for 12-volt systems.)
- ☐ Operating the ECM over 32 volts will cause damage.
- ☐ Reversing polarity will cause damage to the ECM if the power harness is not properly fused.

46.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 46

The SAE J1587 equivalent code for Flash Code 46 is p 168 1.

The power harness supplies 12 or 24 volts to the ECM. The system must be sourced directly from the battery.

NOTE:
Connection to reverse polarity will damage the system if not properly fused.

46.3 TROUBLESHOOTING FLASH CODE 46

The following procedure will troubleshoot Flash Code 46.

46.3.1 Battery Check

Perform the following steps to check the battery.

1. Start and run the engine for one minute.
2. Measure voltage on battery + terminal (red lead) to battery - terminal (black lead). Recommended fuse applications are listed in Table 46-1. Power harness length criteria is listed in Table 46-2.
   [a] If the engine does not start, inspect the battery and charging/starting system, and proceed if okay. Refer to section 9.1.
   [b] If the engine does start and the voltage measurement is less than or equal to 10.0 volts, service the discharged battery and charging/starting system.

[c] If the engine does start and the voltage measurement is greater than 10.0 volts, refer to section 46.3.2.

Number of Cylinders	Dual Fuse or Circuit Breaker Size	Single Fuse or Circuit Breaker Size
6	2 @ 15 amp	1 @ 30 amp
8	2 @ 20 amp	1 @ 40 amp
12	4 @ 15 amp	2 @ 30 amp
16	4 @ 20 amp	2 @ 40 amp
20	4 @ 15 amp2 @ 20 amp	2 @ 30 amp1 @ 40 amp

Table 46-1 Fuse Size Recommendations

Length from ECM to Battery or Bus Bar (ft) *	Minimum Wire Size (Ga) *	Total Resistance of Maximum Length (m Ω) *	Length from ECM to Battery or Bus Bar (m) †	Minimum Wire Size (Ga) †	Total Resistance of Maximum Length (m Ω) †
0 to 28 ‡	12	24.8	0 to 6 ‡	2.5	22.8
28 to 44 ‡	10	24.57	6 to 10 ‡	4	23.55
44 to 70 ‡	8	24.58	10 to 14 ‡	6	21.98
70 to 110 ‡	6	24.7	14 to 26 ‡	10	23.66
110 to 178 ‡	4	25.0	26 to 40 ‡	16	23.2
0 to 14 §	12	24.8	0 to 3 §	2.5	22.8
14 to 22 §	10	24.57	3 to 5 §	4	23.55
22 to 35 §	8	24.58	5 to 7 §	6	21.98
35 to 55 §	6	24.7	7 to 13 §	10	23.66
55 to 89 §	4	25.0	13 to 20 §	16	23.2

* United States
†International
‡ Dual Fuse
§ Single Fuse

Table 46-2 Maximum Resistance vs Power Harness Length

46.3.2 Voltage Check at ECM

Perform the following steps to check voltage at the ECM.

1. Keep engine running.
2. Select ECM INPUT VOLT on DDR.
3. Observe ECM voltage reading on DDR.

[a] If the voltage measurement is less than or equal to 10.0 volts, refer to section 46.3.3.

[b] If the voltage measurement is greater than 10.0 volts, refer to section 46.3.5.

46.3.3 Voltage Check at ECM Via Volt-Ohm Meter

Perform the following steps to check voltage at the ECM.

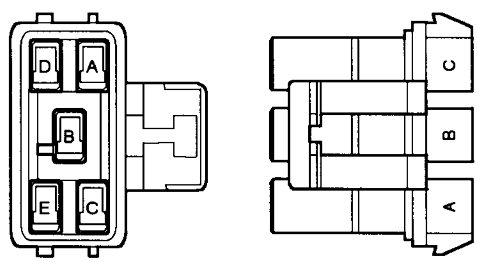
1. Turn the vehicle ignition OFF.
2. Disconnect 5-way power harness connector at the ECM.
3. Measure voltage from socket A and C (red lead) of 5-way power harness connector and a good battery ground (black lead). Don't use line (#151) as a ground reference. For 5-way ECM power harness connector, see Figure 46-1. For power harness schematic, see Figure 46-2.

   [a] If the voltage measurement is less than or equal to 11.5 volts, refer to section 46.3.4.

   [b] If the voltage measurement is greater than 11.5 volts, refer to section 46.3.5.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N	
CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 46-1 5-Way ECM Power Connector

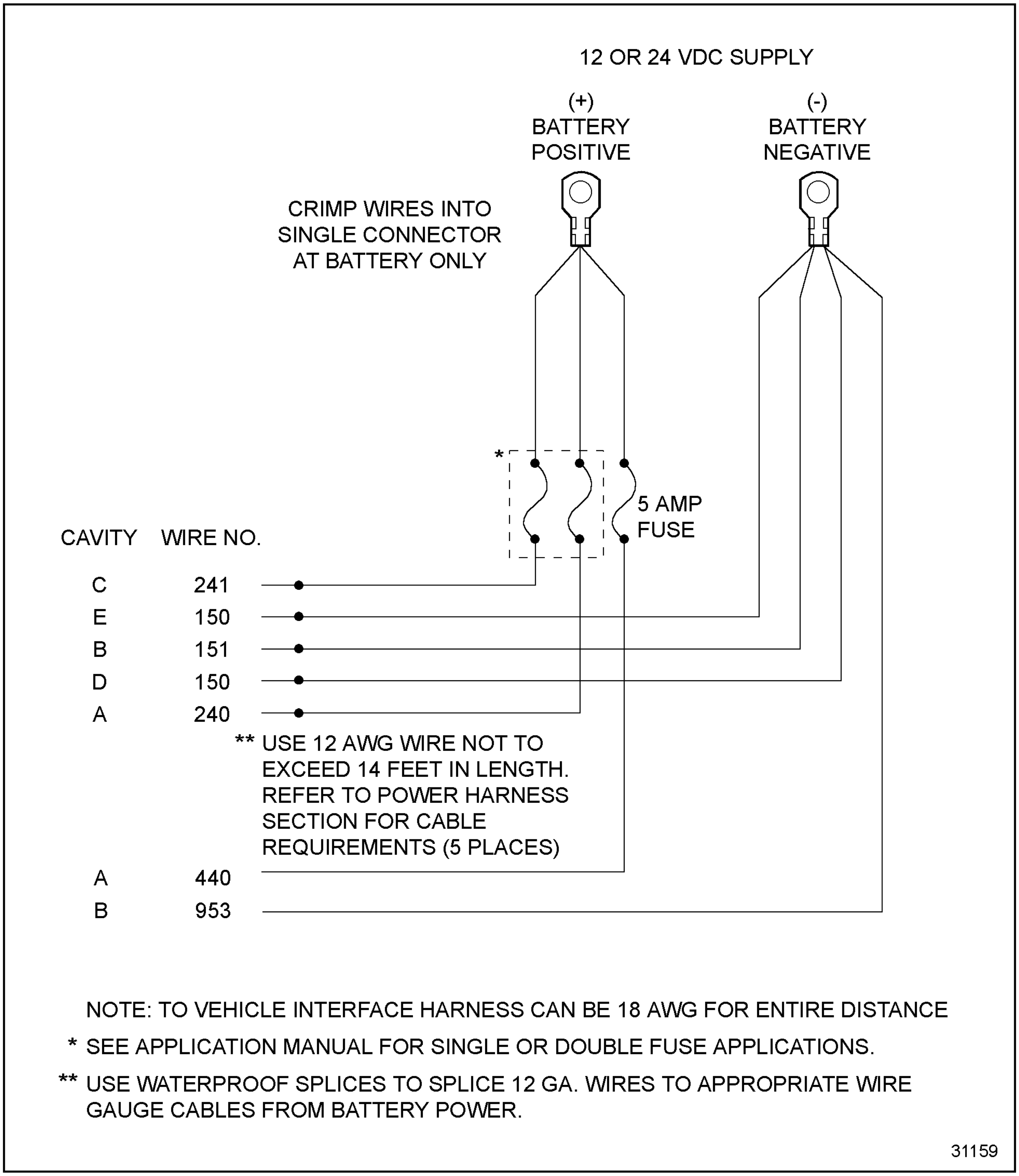


Figure 46-2 Power Harness

46.3.4 Check for Bad Battery + Line

Perform the following steps to check for a bad battery + line.

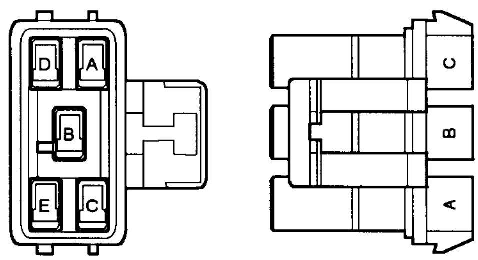
1. Remove fuse(s) to the ECM.

2. Measure voltage at socket A of one fuseholder (red lead) to a good ground (black lead). For 5-way ECM power harness, see Figure 46-3.
3. Repeat voltage measurement at other fuseholder.
   [a] If the voltage measurement is greater than 11.5 volts on both readings, the battery + line between the fuseholder and ECM has an open, or the ECM power connector has a corroded connection. Repair the problem. Refer to section 46.3.8.
   [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the battery + line near the battery is open, or a corroded connection exists at battery + terminal. Repair the problem. Refer to section 46.3.8.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 46-3 5-Way ECM Power Harness

46.3.5 Ground Check at ECM

Perform the following steps to check the ground at the ECM.

1. Disconnect the 5-way power harness connectors at the ECM. For 5-way ECM power harness, see Figure 46-3.
2. Measure voltage on socket A (red lead) to socket D (black lead) and socket C of 5-way power harness connector (red lead) to socket E, (black lead).
   [a] If voltage measurement is greater than 11.5 volts on either reading, refer to section 46.3.6.
   [b] If the voltage measurement is less than or equal to 11.5 volts on either reading, the ground wire (#150) is open or has a corroded connection. Repair ground wire, and refer to section 46.3.8.

46.3.6 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check terminals at the ECM 5-way power harness connector (both ECM and harness side) for damage; bent, corroded, and unseated pins or sockets.
   - [a] If terminals and connector are damaged, repair them. Refer to section 46.3.8.
   - [b] If terminals and connector are not damaged, verify the power and ground are wired directly to the battery. Refer to section 46.3.7.

46.3.7 Code Check

Perform the following steps to check for codes.

1. Install the vehicle interface module.
2. Turn ignition ON; plug in DDR.
3. Check for codes.
   - [a] If code reoccurs, install test ECM, then refer to section 46.3.8.
   - [b] If code does not reoccur, check power harness wires for breaks, abrasions, etc. Then refer to section 46.3.8.

46.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
   - [a] If no codes are displayed, troubleshooting is complete.
   - [b] If code 168/1 is not logged, and other codes are logged, refer to section 9.1.
   - [c] If code 168/1 is logged, and other codes are logged, all system diagnostics are complete. To troubleshoot the error, refer to section 46.3.1.

47 (CHG) FLASH CODE 47 - AIR / FUEL PRESSURE HIGH

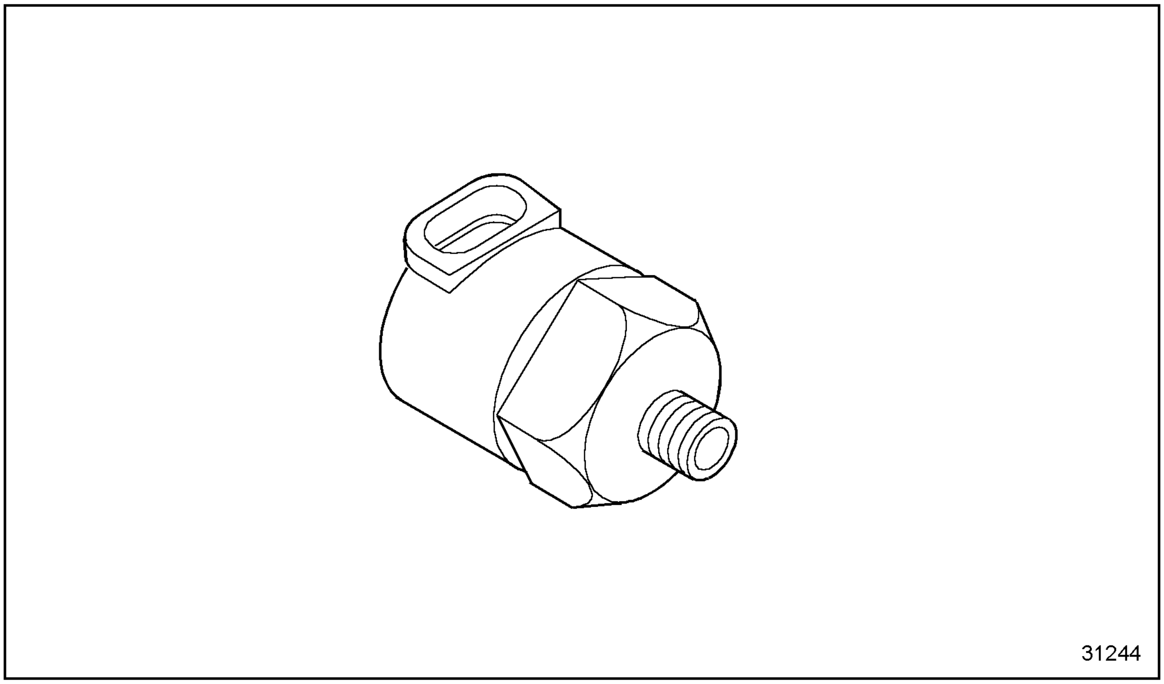


Figure 47-1 Fuel Pressure Sensor

47.1 DESCRIPTION OF FLASH CODE 47

Flash Code 47 indicates that the ECM has detected that the fuel pressure, air inlet pressure, or turbo boost pressure has exceeded a programmed operating range. This normally occurs due to a mechanical fault in the air system or fuel system of the engine. See Figure 47-1, for the fuel pressure sensor.

NOTE:
Not all engines use a fuel pressure sensor.

For gas engines, code 47 indicates that the air inlet pressure has exceeded a calibration limit programmed in the ECM.

For diesel engines, code 47 indicates that the turbo boost pressure has exceeded a calibration limit programmed in the ECM.

47.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 47

The SAE J1587 equivalent code for Flash Code 47 is p 094/0, fuel pressure high.

The SAE J1587 equivalent code for Flash Code 47 is p 106/0, air inlet pressure high (Gas-fueled engines).

The SAE J1587 equivalent code for Flash Code 47 is p 102/0, turbo boost pressure high (Diesel-fueled engines).

47.3 TROUBLESHOOTING FLASH CODE 47

This code is a mechanical fault. Check for reasons for high fuel pressure. Refer to appropriate service manual, section 5.

This (Gas-fueled engine) code is a mechanical fault. Check for reasons for high air inlet pressure. Refer to appropriate service manual, section 6.

This (Diesel-fueled engine) code is a mechanical fault. Check for reasons for high turbo boost pressure, e.g. wastegate bypassed. Refer to appropriate service manual, section 6.

48 (CHG) FLASH CODE 48 - AIR / FUEL PRESSURE LOW

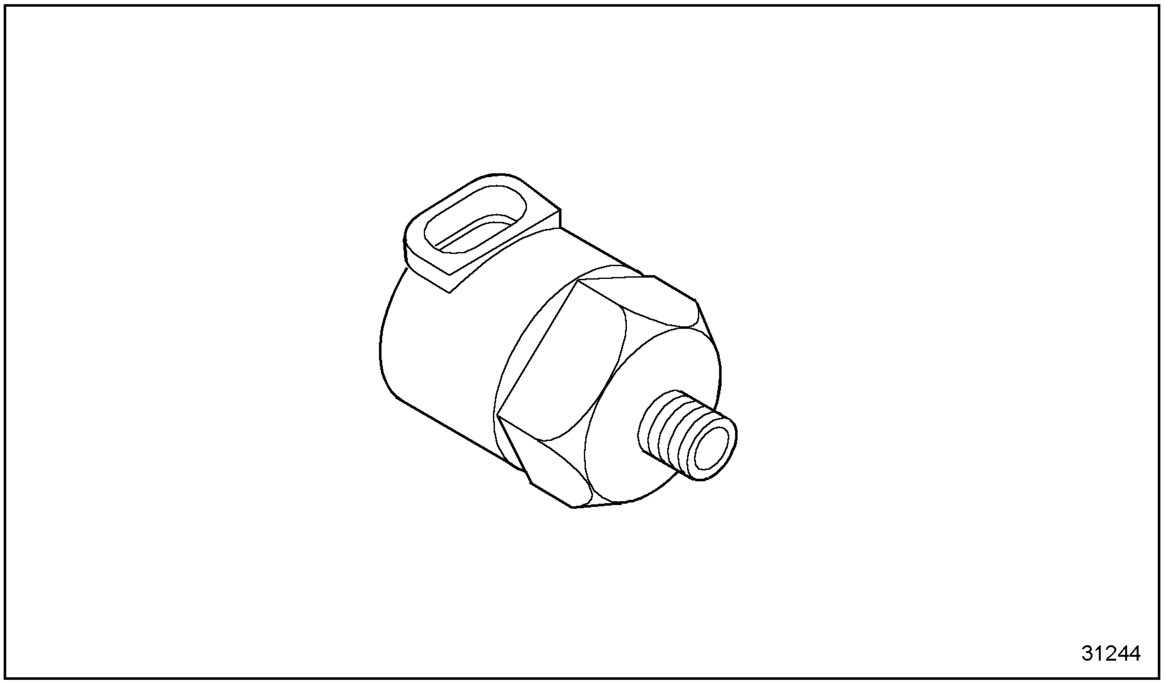


Figure 48-1 Fuel Pressure Sensor

48.1 DESCRIPTION OF FLASH CODE 48

Flash Code 48 indicates that the ECM has detected that the Fuel Pressure has dropped below a programmed limit. This condition is normally associated with a restriction in the fuel supply system:

- ☐ Plugged fuel filter
- ☐ Low fuel supply

NOTE:
Not all engines use a fuel pressure sensor, see Figure 48-1.

For gas engines, code 48 indicates that the air inlet pressure has dropped below a calibration limit.

48.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 48

The SAE J1587 equivalent code for Flash Code 48 is p 094/1, fuel pressure high.

The SAE J1587 equivalent code for Flash Code 48 is p 106/1, air inlet pressure low. (Gas-fueled engines)

48.3 TROUBLESHOOTING FLASH CODE 48

This code is a mechanical fault. Check for reasons for low fuel pressure. Refer to appropriate service manual, section 5.

This (Gas-fueled engine) code is a mechanical fault. Check for reasons for low air inlet pressure. Refer to appropriate service manual, section 6.

49 FLASH CODE 49

49.1 DESCRIPTION OF FLASH CODE 49

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

50 FLASH CODE 50

50.1 DESCRIPTION OF FLASH CODE 50

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

51 (CHG) FLASH CODE 51

51.1 DESCRIPTION OF FLASH CODE 51

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

52 (CHG) FLASH CODE 52 - ECM FAULT

52.1 DESCRIPTION OF FLASH CODE 52

Flash Code 52 indicates that the DDEC system ECMs internal Analog to Digital (A/D) Convertor device has malfunctioned. Intermittent diagnostic conditions of this type can be caused by faulty external electrical system.

52.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 52

The SAE J1587 equivalent code for Flash Code 52 is s 254 12.

52.3 TROUBLESHOOTING FLASH CODE 52

The following procedure will troubleshoot Flash Code 52.

52.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If active codes other than 254/12 are logged, service them first.
   [b] If active code 254/12 is logged, and no other codes are logged, hook up test ECM. If code clears, replace the ECM. If code is not cleared, contact Detroit Diesel Technical Service.

NOTE:
For information concerning ECM replacement, refer to section 2.9 in the service manual.

53 FLASH CODE 53 - ECM MEMORY FAULT

53.1 DESCRIPTION OF FLASH CODE 53

Flash Code 53 indicates that the ECM was unable to read a valid copy of an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

Flash Code 53 also indicates that the ECM was unable to update an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

53.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 53

The SAE J1587 equivalent code for Flash Code 53 is s 253 12, EEPROM write fail.

The SAE J1587 equivalent code for Flash Code 53 is s 253 2, nonvolatile checksum incorrect.

53.3 TROUBLESHOOTING FLASH CODE 53

The following procedure will troubleshoot Flash Code 53.

NOTE:
Inactive code 53 should be cleared with the DDR and the unit returned to service if ECM SW is greater than or equal to 7.00.

53.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Read active codes.
   [a] If codes other than 253/12 or 253/2 are logged, service them first.
   [b] If codes 253/12 or 253/2 are logged, and no other codes are logged, reprogram the ECM. Refer to section 53.3.2.

53.3.2 Test for Codes

Perform the following steps to test for codes.

1. Start and run the engine.
2. Read active codes with DDR.
   [a] If active code 253/2 is logged, and no other codes are logged, install a test ECM. Refer to section 53.3.3.

NOTE:
It is recommended that a "Test" ECM be tried first to determine the need to replace the ECM. For information concerning ECM replacement, refer to section 2.9 in the service manual.

   [b] If no codes are logged, troubleshooting is complete.

53.3.3 Verify Repairs

Perform the following steps to verify repairs.

1. Start and run the engine.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes are logged, contact Detroit Diesel Technical Service.

54 FLASH CODE 54 - VSS FAULT

54.1 DESCRIPTION OF FLASH CODE 54

Flash Code 54 indicates that during engine operation the vehicle speed that is measured by the Vehicle Speed Sensor (VSS) is less than the expected value for the current engine speed/conditions.

This diagnostic condition is typically:

- ☐ Open sensor signal circuit
- ☐ Conditions
  - ☐ Code is logged (without anti-tamper) when the mph >1500 and PW >15° and vehicle speed < 3 mph.
  - ☐ If code is logged (with or without anti-tamper) mph will be limited.

NOTE:
Code will not be logged for the first five hours of ECMs life (total engine hours).

54.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 54

The SAE J1587 equivalent code for Flash Code 54 is p 084 12.

54.3 TROUBLESHOOTING FLASH CODE 54

The following procedure will troubleshoot Flash Code 54.

54.3.1 Test Drive Vehicle

Take the vehicle for a test drive with an assistant.

1. View DDR; select vehicle speed.
   - [a] If mph reads 0 (zero), or stays steady with the vehicle in motion, refer to section 54.3.2.
   - [b] If speed appears correct, refer to section 54.3.11.

54.3.2 Speed Sensor Identification

Identify the speed sensor type - type one or type two.

1. The type one sensor is a magnetic pickup and may be located in one of the following locations: transmission tail shaft, wheel rim, mechanical speedometer cable. If you have a type one sensor, refer to section 54.3.3. (Verify with DDR signal type - magnetic.)
2. The type two sensor communicates with square wave input and output signals and requires the ECM to be configured correctly. Refer to section 54.3.12. (Verify with DDR signal type - switched.)

54.3.3 Check Vehicle Speed Sensor Circuit

Perform the following steps to check the vehicle speed sensor.

1. With ignition off, disconnect the vehicle harness connector.
2. Measure resistance of VSS circuit across vehicle harness connector pins, E2 to E3. See Figure 54-1.
   - [a] If the resistance measurement is less than 50 Ω, refer to section 54.3.4.
   - [b] If the resistance measurement is greater than 3,000 Ω or open, refer to section 54.3.6.

[c] If the resistance measurement is between 50 and 3,000 Ω, refer to section 54.3.7.

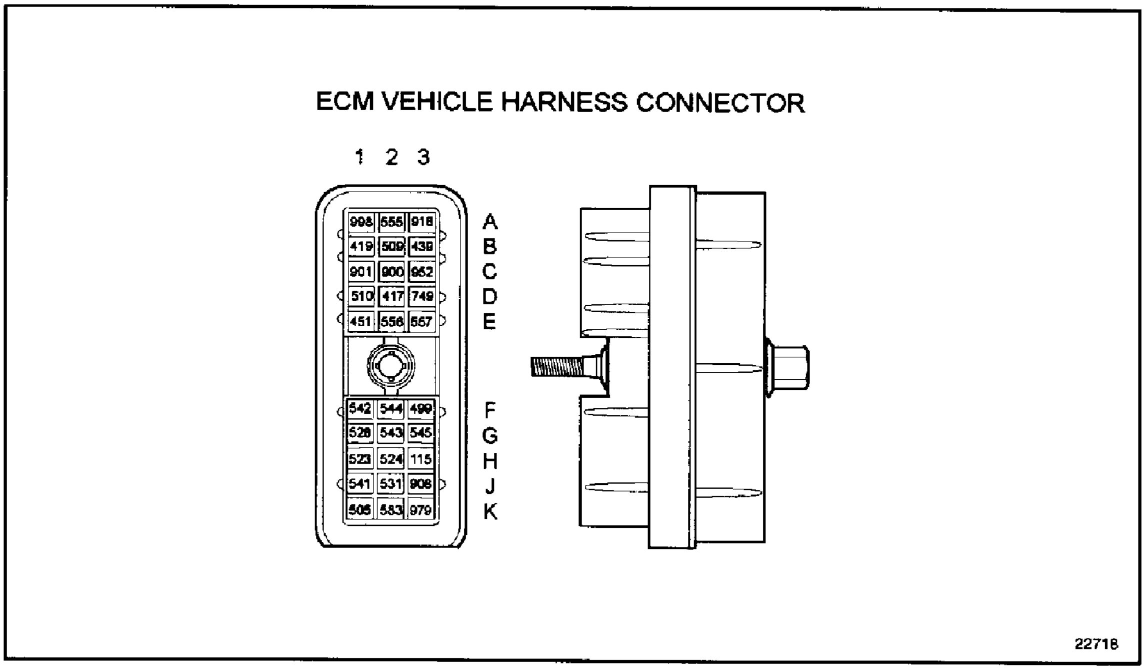


Figure 54-1 ECM Vehicle Harness Connector

54.3.4 Check for Short

Perform the following steps to check for short.

1. Disconnect VSS connector.
2. Measure resistance between vehicle harness connector terminals E2 and E3. See Figure 54-1.
   [a] If the resistance measurement is less than or equal to 1,000 Ω, the signal wire #556 or return wire #557, are shorted together. Repair the short; refer to section 54.3.13.
   [b] If the resistance measurement is greater than 1,000 Ω or open, refer to section 54.3.5.

54.3.5 Check Vehicle Speed Sensor

Perform the following steps to check the vehicle speed sensor.

1. Measure resistance of VSS across vehicle speed sensor connector pins. See Figure 54-1.
   [a] If the resistance measurement is less than 50 Ω, refer to section 54.3.8.
   [b] If the resistance measurement is greater than 3,000 Ω or open, refer to section 54.3.8.
   [c] If the resistance measurement is between 50 and 3,000 Ω, refer to section 54.3.10.

54.3.6 Check for Open

Perform the following steps to check for open.

1. Disconnect the ECM vehicle harness connector and VSS connector.
2. Install a jumper wire between sockets A and B of the VSS harness connector.
3. Measure resistance between sockets E2 and E3 on the ECM vehicle harness connector. See Figure 54-2.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 54.3.5.
   [b] If the resistance measurement is greater than 5 Ω or open, the VSS signal line #556 or return line #557 is open. Repair open and refer to section 54.3.13.

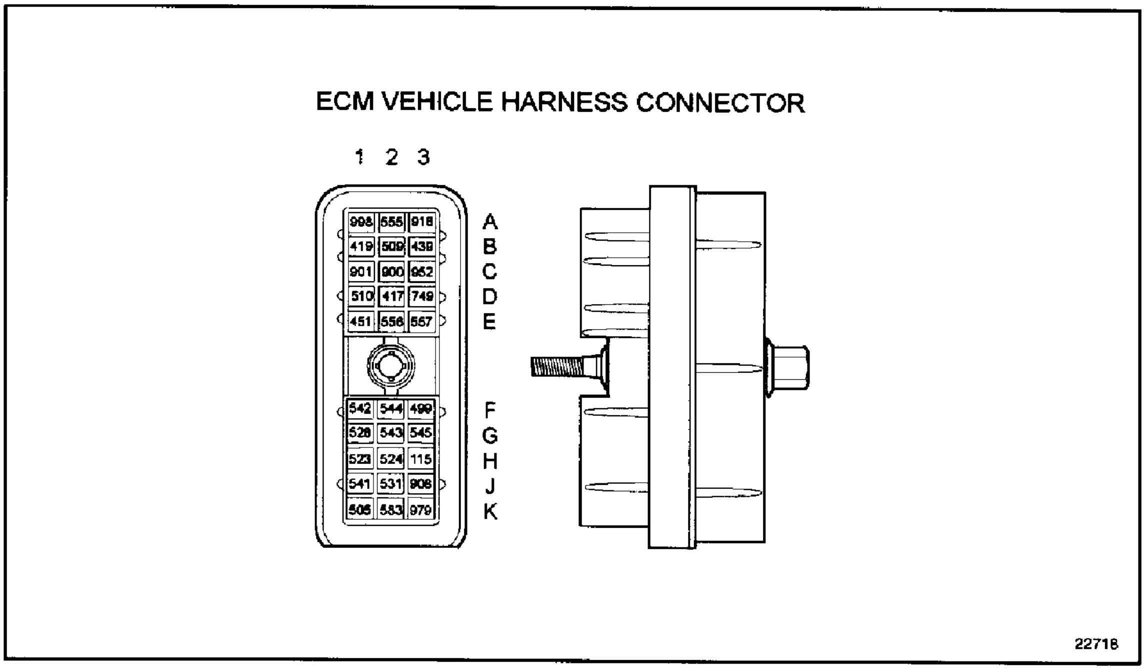


Figure 54-2 ECM Vehicle Harness Connector

54.3.7 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Measure resistance between sockets E2 and E3 and a good ground. See Figure 54-3.
   [a] If the resistance measurement is greater than 1,000 Ω or open, refer to section 54.3.9.

[b] If the resistance measurement is less than or equal to 1,000 Ω, the signal wire #556 or return wire #557, is shorted to ground, or wired to an unauthorized device. Repair the short; refer to section 54.3.13.

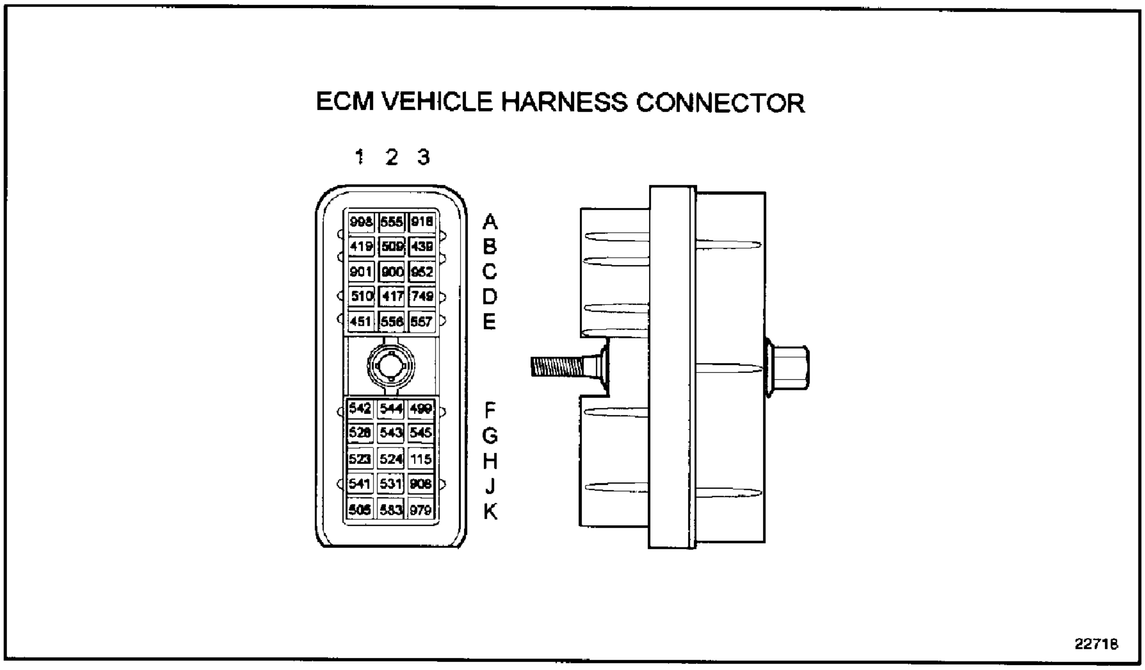


Figure 54-3 ECM Vehicle Harness Connector

54.3.8 Check Vehicle Speed Sensor Connectors

Perform the following steps to check the VSS connectors.

1. Check terminals at the VSS connectors (both sensor side and harness side) for bent, corroded, and unseated pins or sockets.

   [a] If the terminals and connectors are not damaged, replace the VSS.
   Refer to section 54.3.13.

   [b] If the terminals and connectors are damaged, repair them. Refer to section 54.3.13.

54.3.9 Check for Short to Power

Perform the following steps to check for short to power.

1. Turn ignition ON.
2. Measure voltage at the ECM vehicle harness connector between socket E3 (#557) and a good ground. Also measure voltage between socket E2 (#556) and a good ground. See Figure 54-4.

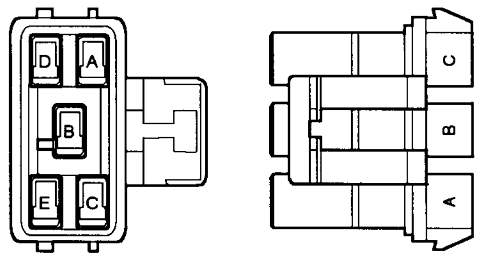
   [a] If both voltage measurements are less than 0.2 volts, refer to section 54.3.10.

[b] If either voltage measurement is greater than or equal to 0.2 volts, the VSS signal (#556) or VSS return line (#557) is shorted to the battery or some other source of voltage. Repair the short; refer to section 54.3.13.

WIRE NUMBER	CAVITY
240	A
150	D
151	B
150	E
241	C

CONNECTOR DESCRIPTION AND P/N

CONNECTOR	12124634
TERMINAL	12077413
CABLE SEAL	12015193
SECONDARY LOCK	12052816



5-WAY ECM POWER CONNECTOR

22710

Figure 54-4 5-Way ECM Power Connector

54.3.10 Check ECM Connectors

Perform the following steps to check ECM connectors.

1. Check the terminals at the ECM engine harness connectors for bent, corroded, and unseated pins or sockets, on both the ECM and harness sides. See Figure 54-5.

   [a] If the terminals and connectors are not damaged, refer to section 54.3.11.

[b] If the terminals and connectors are damaged, repair them. Refer to section 54.3.13.

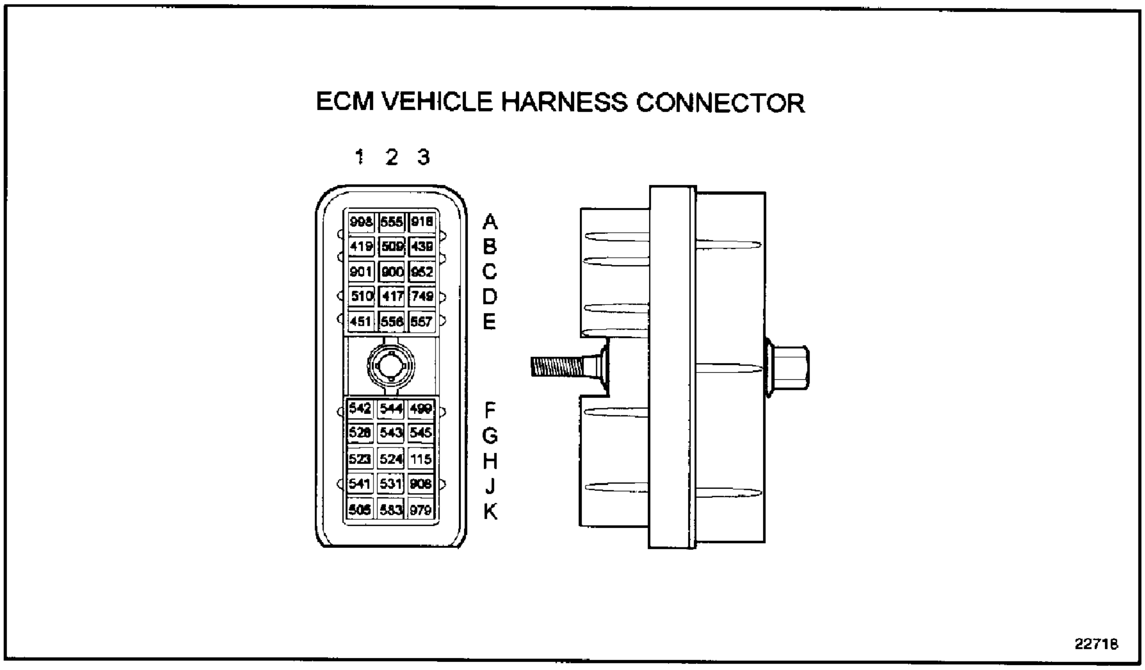


Figure 54-5 ECM Vehicle Harness Connector

54.3.11 Vehicle Speed Mechanical Checks

Perform the following vehicle speed mechanical checks.

1. Check for plugged fuel filters.
2. Check if any metal or debris is lodged between the VSS and the pulse wheel.
3. Check if the sensor is loose.
4. Ensure the VSS pulse wheel is in fixed position relative to magnetic pickup.
5. Check for proper air gap between magnetic pickup and pulse wheel.

   [a] If all mechanical checks are okay, contact Detroit Diesel Technical Service for review if anti-tamper = yes.

   [b] If all mechanical checks are not okay, repair the mechanical failure.
   Refer to section 54.3.13.

54.3.12 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn ignition OFF.
2. Disconnect the ECM vehicle harness connector.
3. Measure resistance between sockets E2 and a good ground. See Figure 54-6.

[a] If the resistance measurement is greater than 10,000 Ω or open, contact the component supplier for instructions. The wiring is okay, but the device may be defective. Refer to section 54.3.13.

[b] If the resistance measurement is less than or equal to 100 Ω, the VSS signal line (#556) is shorted to ground, Repair the short; refer to section 54.3.13.

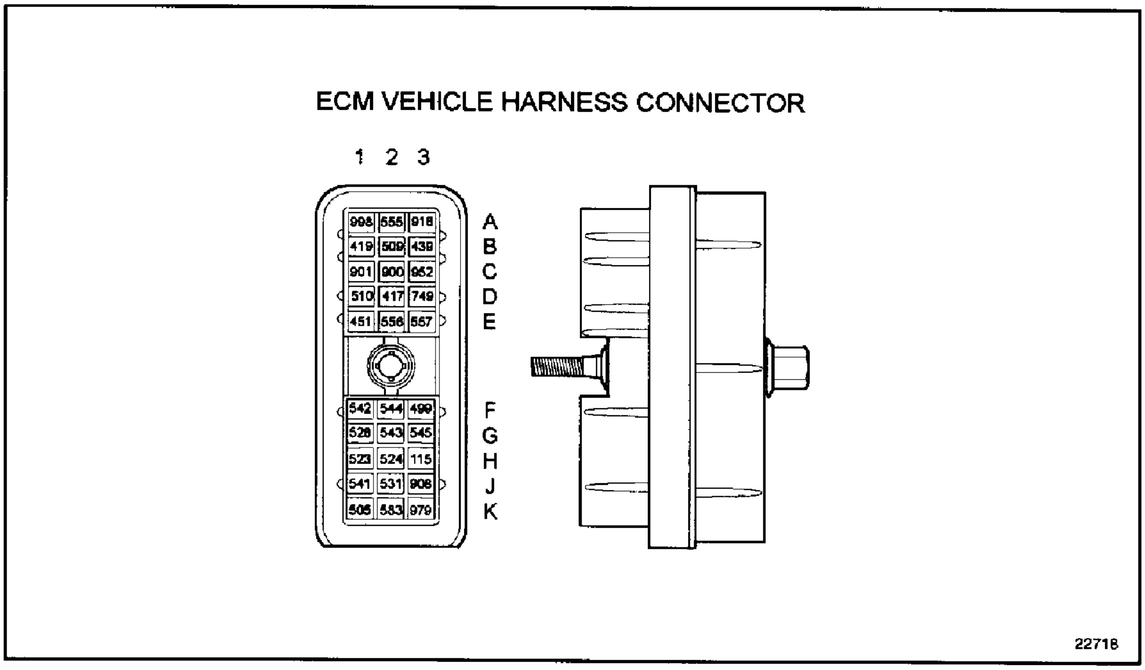


Figure 54-6 ECM Vehicle Harness Connector

54.3.13 Verify Repairs

Perform the following steps to verify repairs.

1. Turn the ignition OFF.
2. Reconnect all the connectors.
3. Turn the ignition ON.
4. Clear DDR codes.
5. Perform a road test with an assistant. Ensure the vehicle is loaded.
6. Stop the engine.
7. Check DDR for codes.

    [a] If no codes are logged, no further troubleshooting is required.

    [b] If code 84/12 is not logged, and other codes are logged, refer to section 9.1.

    [c] If code 84/12 is logged, and any other codes are logged, all system diagnostics are complete. To troubleshoot the error, refer to section 54.3.2 and perform tasks.

55 (CHG) FLASH CODE 55 - J1939 DATA LINK FAULT

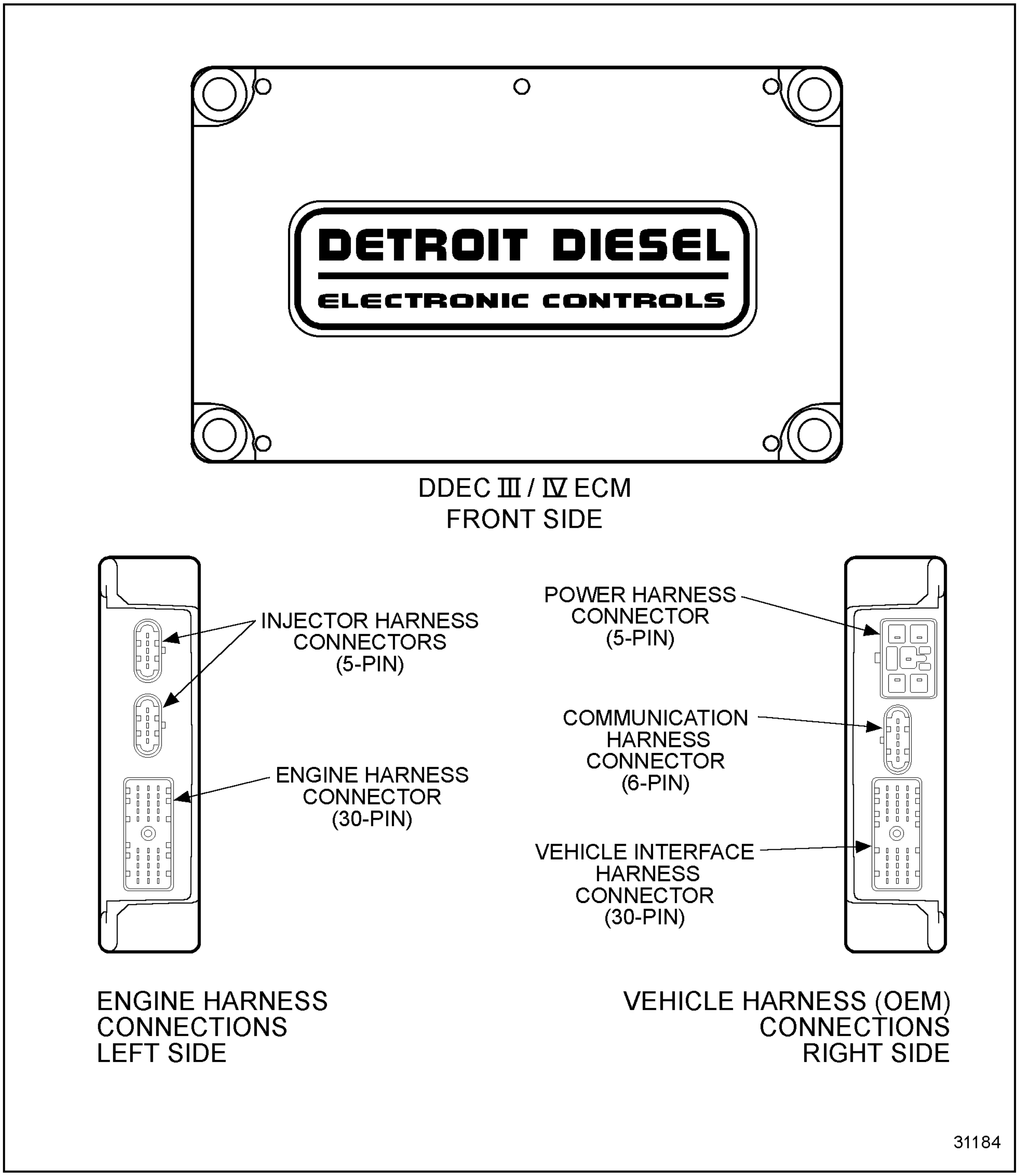


Figure 55-1 ECM

55.1 DESCRIPTION OF FLASH CODE 55

Flash Code 55 indicates the ECM, see Figure 55-1, has detected a fault in the J1939 Data Link.

- ☐ Incorrect programming
- ☐ Wiring fault, J1939 data link wires

55.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 55

The SAE J1587 equivalent code for Flash Code 55 is s 231/12.

55.3 TROUBLESHOOTING FLASH CODE 55

The following procedure will troubleshoot Flash Code 55.

55.3.1 Check J1939 Data Link

Perform the following steps to check for J1939 data link fault.

1. Is this a J1939 transmission/engine application?
   [a] If yes, contact Detroit Diesel Technical Service.
   [b] If no, use programming station and go to "update customer calibration" and select transmission to manual, or correct transmission. Save changes. Refer to section 55.3.2.

55.3.2 Verify Repairs

Perform the following steps to verify repairs.

1. Start engine.
2. Plug in DDR.
3. Read codes.
   [a] If active code 231/12 is not logged, troubleshooting is complete.
   [b] If active code 231/12 is logged, contact Detroit Diesel Technical Service. Check DDR software level. Update DDR software if current level is 1.2.

56 (CHG) FLASH CODE 56 - J1587 DATA LINK FAULT

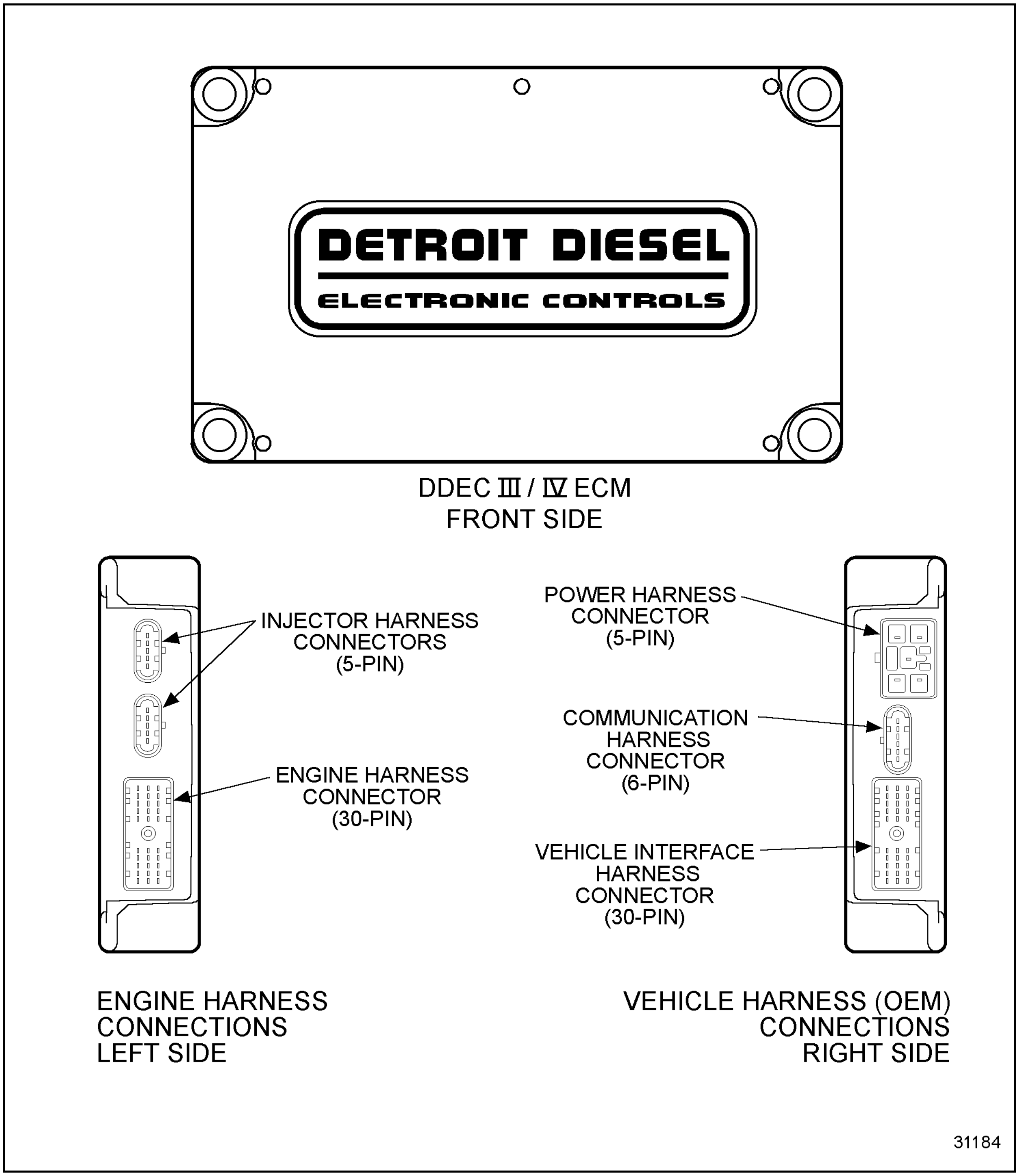


Figure 56-1 ECM

56.1 DESCRIPTION OF FLASH CODE 56

Flash Code 56 indicates that the J1587 (diagnostic) data link is no longer allowing the ECM, see Figure 56-1, to transmit data.

This diagnostic condition is typically:

- ☐ Either or both of the data link circuits are open at some point in the network.
- ☐ Either or both of the data link circuits are shorted to ground at some point in the network.
- ☐ Either or both of the data link circuits are shorted to battery (+) at some point in the network.
- ☐ The pair of data link circuits are shorted together.

56.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 56

The SAE J1587 equivalent code for Flash Code 56 is s 250 12.

56.3 TROUBLESHOOTING FLASH CODE 56

The following procedure will troubleshoot Flash Code 56.

56.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Visually check the DDR for codes.
   [a] If codes other than 250/12 are logged, service them first.
   [b] If code 250/12 is logged, and no other codes are logged, Refer to section 56.3.2.
   [c] If no data is logged, refer to section 9.1.

56.3.2 Clear Codes

Perform the following steps to clear codes.

1. Clear codes.
2. Start and run the engine.
3. Observe CEL/code.
   [a] If CEL is on with code 250/12 logged, refer to section 56.3.3.
   [b] If no CEL code is logged, refer to section 56.3.5.

56.3.3 Check for Devices of Original Equipment Manufacturer

Perform the following steps to check for OEM devices.

1. Turn vehicle ignition OFF.
2. Determine if any OEM equipment utilizes the J1587 data link. (ABS, ProDriver ®, satellite systems, etc.
   [a] If any OEM devices are installed, refer to section 56.3.4. Refer to step 1
   [b] If no OEM devices are installed, refer to section 56.3.4. Refer to step 2[a]

56.3.4 Disconnect Nodes (Data Link Devices)

Perform the following steps to disconnect the nodes.

1. Disconnect OEM installed devices, one at a time e.g. ABS, satellite systems, etc. Verify ABS switch is not in "Test" mode.

[a] If the disconnect does not solve the problem, continue the procedure. Refer to step 2[a]

[b] If the disconnect solved the problem, go to 4b.

2. Connect vehicle interface module, J 41005.
3. Start and run the engine.
4. Observe CEL codes.

[a] If CEL or codes displayed, and the CEL is on with code 250/12 logged, replace the ECM with a test ECM. Refer to section 56.3.5.

[b] If no CEL or codes are displayed, contact OEM for instructions on how to proceed. Refer to section 56.3.5.

56.3.5 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.
3. Start and run the engine.

[a] If the CEL or codes are displayed, and if code 250/12 is logged, all system diagnostics are complete. Review this section to find the error.

[b] If the CEL or codes are not displayed, troubleshooting is complete.

57 (CHG) FLASH CODE 57 - J1922 DATA LINK FAULT

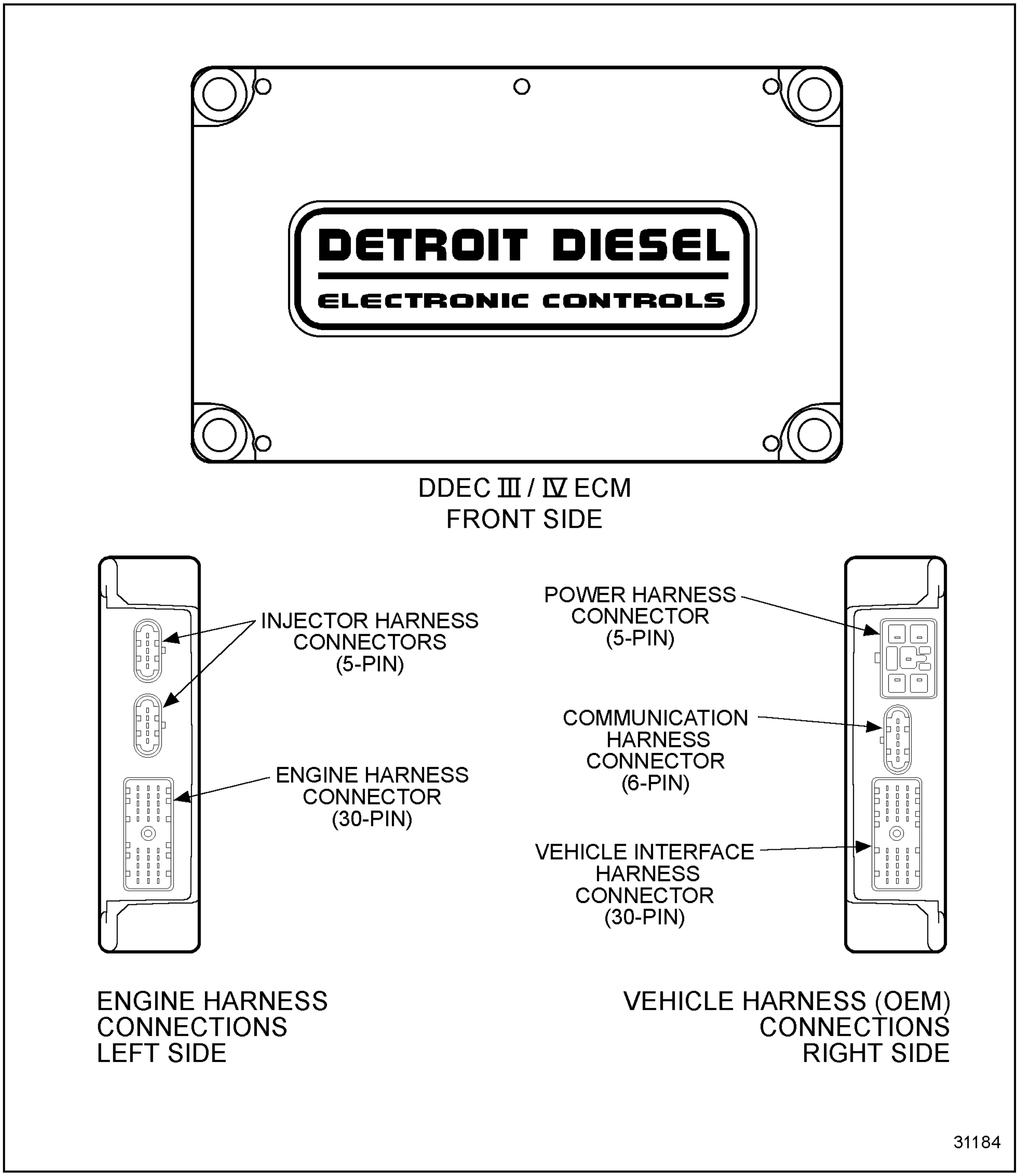


Figure 57-1 ECM

57.1 DESCRIPTION OF FLASH CODE 57

Flash Code 57 indicates that the J 1922 (Low Speed Powertrain) data link is no longer allowing the ECM, see Figure 57-1, to transmit data.

This diagnostic condition is typically:

- ☐ Either or both of the data link circuits are open at some point in the network.
- ☐ Either or both of the data link circuits are shorted to ground at some point in the network.
- ☐ Either or both of the data link circuits are shorted to battery (+) at some point in the network.
- ☐ The pair of data link circuits are shorted together.

57.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 57

The SAE J1587 equivalent code for Flash Code 57 is s 249 12.

57.3 TROUBLESHOOTING FLASH CODE 57

The following procedure will troubleshoot Flash Code 57.

57.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Visually check the DDR for codes.
   [a] If code 249/12 is logged, refer to section 57.3.2.
   [b] If no codes are logged, refer to section 9.1.
   [c] If code 254/12 is logged, and no other codes are logged, replace the ECM. Refer to section 9.1.

57.3.2 Verify Codes

Perform the following steps to verify codes.

1. Clear codes with DDR.
2. Start and run the engine for one minute.
3. Check CEL for codes.
   [a] If CEL is on with code 249/12 displayed, refer to section 57.3.3.
   [b] If CEL is not on and no codes are displayed, refer to section 57.3.5.

57.3.3 Check for OEM Devices

Perform the following steps to check for OEM devices.

1. Turn vehicle ignition OFF.
2. Determine if any OEM equipment utilizes the J 1922 data link. See Figure 57-2.
   [a] If no OEM devices are installed, refer to section 57.3.4. Refer to step 2

[b] If OEM devices are installed, refer to section 57.3.4. Refer to step 1

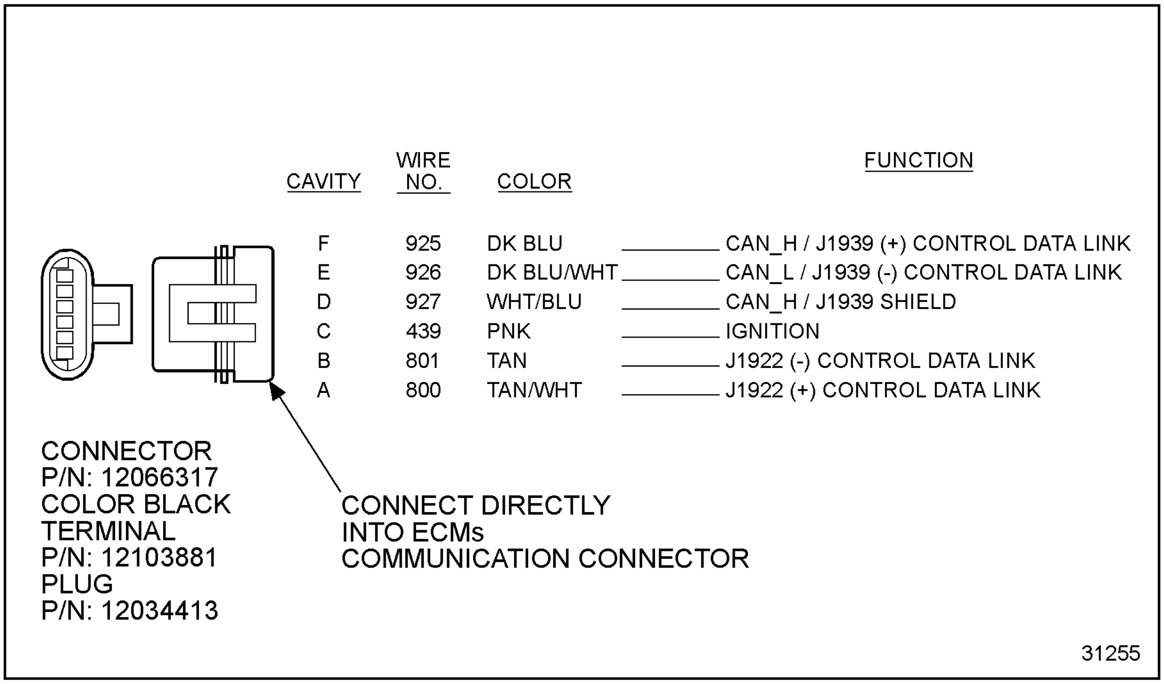


Figure 57-2 Communication Harness

57.3.4 Disconnect Nodes

Perform the following steps to disconnect nodes.

1. Start and run engine with OEM installed devices disconnected.
   - [a] If the disconnect does not solve the problem, continue the procedure. Refer to step 2
   - [b] If the disconnect solved the problem, Refer to step 44[a].
2. Connect vehicle interface module using J 41005.
3. Start and run engine.
4. Observe CEL codes.
   - [a] If no CEL or codes are displayed, contact OEM for instructions on how to proceed. Refer to section 57.3.5. Fault is in node/wiring.
   - [b] If CEL is on with code 249/12 logged, install a test ECM. Refer to section 57.3.5.

57.3.5 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition OFF.
2. Reconnect all connectors.

3. Turn ignition ON.
4. Clear codes with DDR.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for codes.
    [a] If no codes are displayed, troubleshooting is complete.
    [b] If CEL is on with code 249/12 logged, all system diagnostics are complete. To troubleshoot the error, refer to section 57.3.1.

58 (CHG) FLASH CODE 58

58.1 DESCRIPTION OF FLASH CODE 58

Flash Code 58 indicates a torque overload.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

58.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 58

The SAE J1587 equivalent code for Flash Code 58 is p 092/0.

59 FLASH CODE 59

59.1 DESCRIPTION OF FLASH CODE 59

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

60 FLASH CODE 60

60.1 DESCRIPTION OF FLASH CODE 60

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

61 (CHG) FLASH CODE 61 - INJECTOR RESPONSE LONG

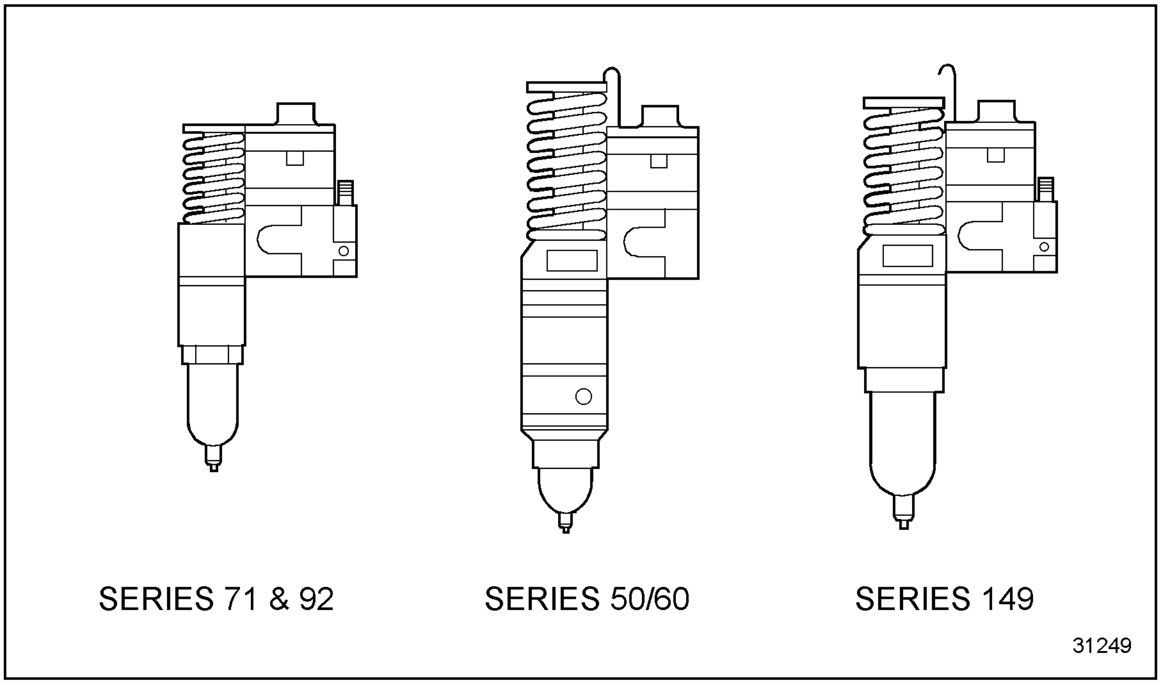


Figure 61-1 Injectors

61.1 DESCRIPTION OF FLASH CODE 61

Flash Code 61 indicates that the time it takes from when the DDEC III ECM requests an injector, see Figure 61-1, be turned on to when the injector solenoid valve actually closes is longer than the high limit of the expected range. Engine oil temperature must be greater than 87°F (30°C).

This diagnostic condition is typically:

- ☐ Bad injector harness and or connection (high resistance)
- ☐ Poor vehicle grounds
- ☐ Sticky solenoid valve

NOTE:
The injector diagnostic SID (Subsystem Identifier) indicates which cylinder number has an injector with a long response time. The injector number describes the cylinder and or bank which has the injector with a long response time. The DDR will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given r/min, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically +/- 0.2 msec) for one injector at a steady engine r/min may indicate an electrical problem (faulty alternator or voltage regulator, poor or broken ground cables, etc.).

61.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 61

The SAE J1587 equivalent code for Flash Code 61 is s 001 0, or s 002 0, or s 003 0, or s 004 0, or s 005 0 or s 006 0 (six cylinder engine).

61.3 TROUBLESHOOTING FLASH CODE 61

The following procedure will troubleshoot Flash Code 61.

61.3.1 Test Alternator Ground

Perform the following steps to test alternator ground.

1. Disable the alternator by removing the alternator belt.
2. Start and run the engine; warm to greater than 87°F (30°C).
3. Does the code return?
   - [a] If Flash Code 61 does not return, repair or replace the alternator grounds and refer to section 61.3.5.
   - [b] If the code(s) return, refer to section 61.3.2.

61.3.2 Determine Cylinders With Fault

The injector location that is logging the codes is listed in Table 61-1.

	#1	#2	#3	#4	#5	#6	
	(SID 1)	(SID 2)	(SID 3)	(SID 4)	(SID 5)	(SID 6)	
S55/60	1	5	3	6	2	4	cyl #
S50	1	3	4	2	-	-	cyl #

Table 61-1 Determine Cylinders With Fault

1. Disconnect the 5-pin injector harness connector at the ECM for those injectors logging the codes.
2. Establish a good ECM case ground by measuring the resistance across two points on the ECM. The resistance should measure less than or equal to 1 Ω.
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the five exposed male injector terminals on the ECM.
4. Measure the resistance. Repeat this procedure at each of the five terminals.
   - [a] If any terminals have a resistance of less than 1,000 Ω, replace the ECM. Refer to section 61.3.5.
   - [b] If all terminals have a resistance of greater than 1,000 Ω, refer to section 61.3.3.

61.3.3 Check for Short

Perform the following steps to check for a short.

1. Locate the injector harness connector terminals associated with the codes. See Figure 61-2.

2. Measure resistance between that cavity and the cylinder block.

   [a] If measured resistance is less than 10 Ω, the wire is shorted to the engine. Repair or replace the harness and refer to section 61.3.5.

   [b] If measured resistance is greater than 10 Ω, go to step 3.

3. Remove the valve cover to gain access to the cylinder associated with the code.

4. Remove the connector terminals at the injector solenoid(s).

5. Measure resistance between that cavity and the appropriate return cavity (G or E).

   [a] If measured resistance is less than 5 Ω, the wire is shorted to the return wire. Repair or replace the harness and refer to section 61.3.5.

[b] If measured resistance is greater than 5 Ω, refer to section 61.3.4.

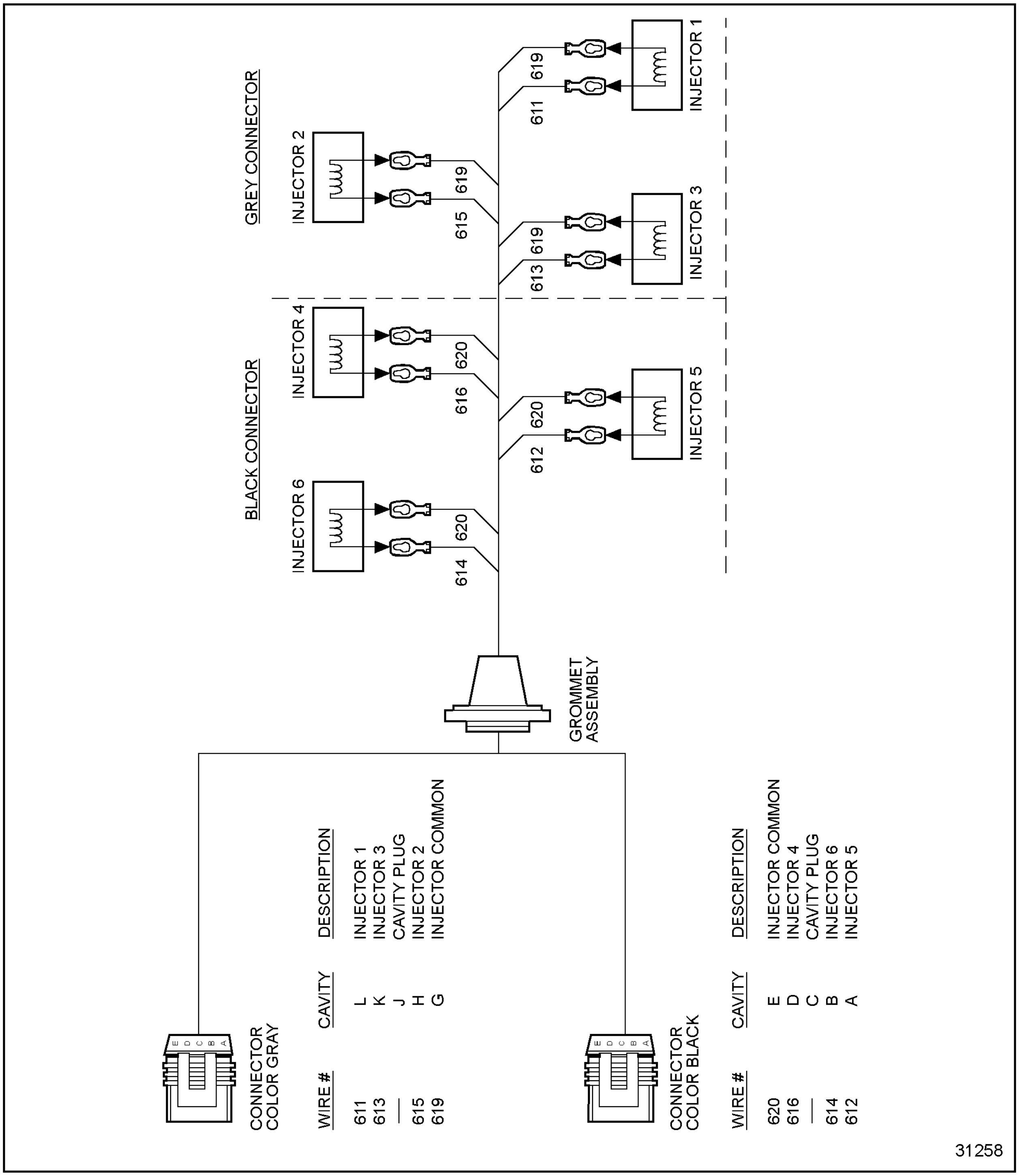


Figure 61-2 Injector Harness

61.3.4 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (G or E).
2. Measure resistance across the injector connectors (disconnected from injector solenoid).
   [a] If the measured resistance is greater than 5 Ω, the injector wire is open. Repair or replace the harness and refer to section 61.3.5.
   [b] If the measured resistance is less than 5 Ω, and the ECM software is less than 3.00, reprogram the ECM. Refer to section 61.3.5.

61.3.5 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine. Warm to 87°F (30°C).
2. Check DDR for codes.
   [a] If injector codes are logged, please review this section from the first step to find the problem. Refer to section 61.3.2.
   [b] If no codes are logged, no further troubleshooting is required.

62 FLASH CODE 62 - OUTPUT FAULT

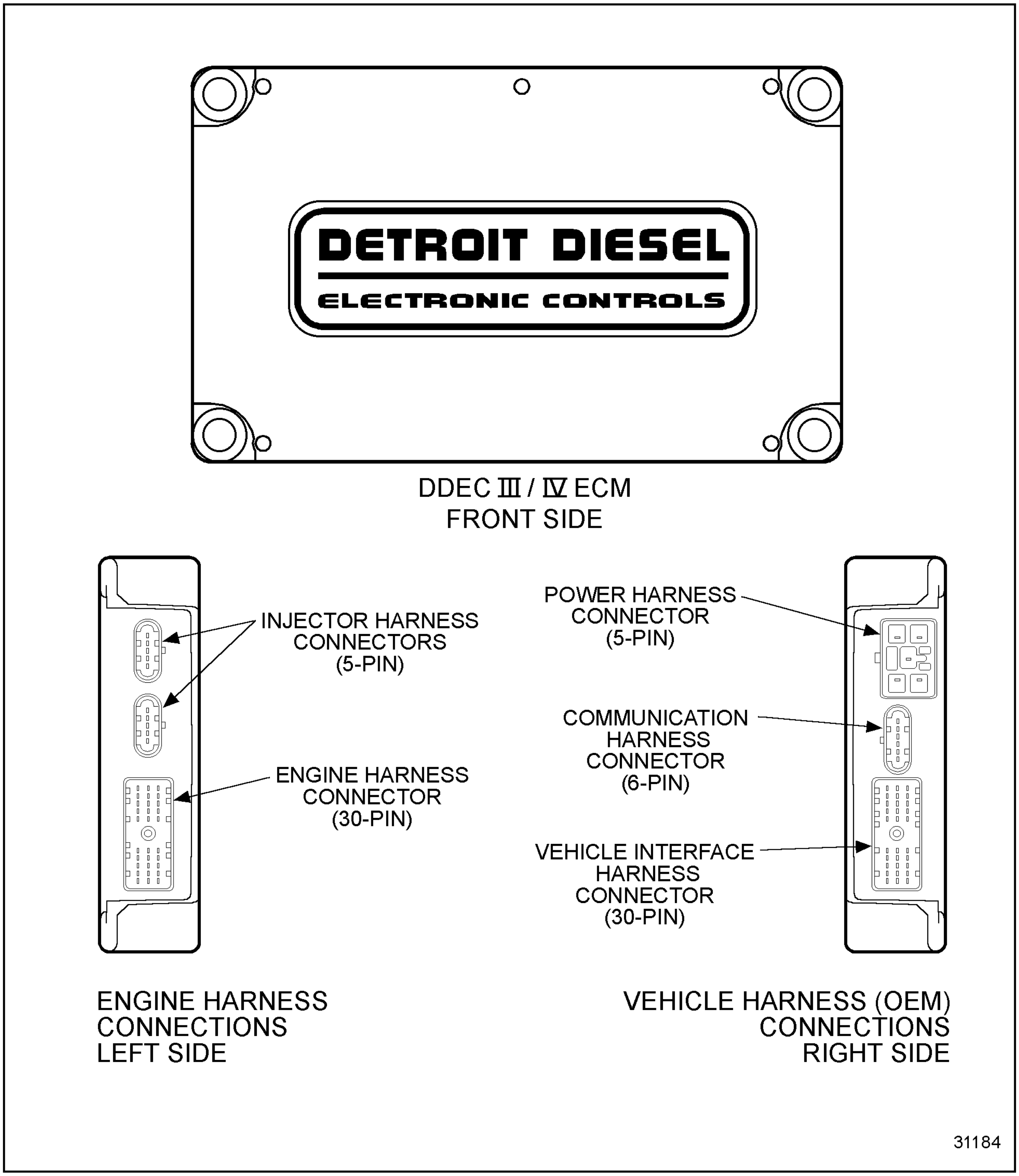


Figure 62-1 ECM

62.1 DESCRIPTION OF FLASH CODE 62

Flash Code 62 indicates that the function assigned to the Auxiliary Output #1, #2, #5, #6, #7 or #8 circuit output has an open circuit or short to battery (+). A short to battery (+) is detected when the DDEC ECM, see Figure 62-1, is unsuccessful in turning "ON" the configured function.

The DDEC III ECM supplies a switched ground to the AUXILIARY OUTPUT circuit to turn ON the function assigned.

Flash Code 62 may also indicate that the function assigned to the Auxiliary Output #1, #2, #5, #6, #7 or #8 circuit output is open, shorted to ground. This diagnostic condition is detected when the Auxiliary Output # "X" function is OFF and the DDEC III ECM measures a low voltage on the circuit output.

62.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 62

The SAE J1587 equivalent codes for Flash Code 62 are listed in Table 62-1.

SAE J1587 Code	Output Number	Fault
s 026 3	Auxiliary output #1	Short to battery
s 026 4	Auxiliary output #1	Open circuit
s 040 3	Auxiliary output #2	Short to battery
s 040 4	Auxiliary output #2	Open circuit
s 053 3	Auxiliary output #5	Short to battery
s 053 4	Auxiliary output #5	Open circuit
s 054 3	Auxiliary output #6	Short to battery
s 054 4	Auxiliary output #6	Open circuit
s 055 3	Auxiliary output #7	Short to battery
s 055 4	Auxiliary output #7	Open circuit
s 056 3	Auxiliary output #8	Short to battery
s 056 4	Auxiliary output #8	Open circuit

Table 62-1 Auxiliary Output Open or Short to Battery

62.3 TROUBLESHOOTING FLASH CODE 62

The following procedure will troubleshoot Flash Code 62.

62.3.1 Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in the diagnostic data reader (DDR).
3. Record codes logged.
4. Clear codes.
5. Start and run the engine for one minute.
   [a] If the code becomes active, refer to section 62.3.3.
   [b] If the code does not become active, refer to section 62.3.2.

62.3.2 Intermittent Code Check

Perform the following steps to check intermittent codes.

1. Perform road test.
   [a] If the code returns, refer to section 62.3.3.
   [b] If the code does not display again, return the vehicle to service, or refer to section 10.1.1.

62.3.3 Auxiliary Output Cavity Determination

Perform the following steps to determine which auxiliary output cavity is associated with the logged codes.

1. Determine which auxiliary output cavity is associated with the code or codes being logged. The SAE code descriptions of the flash codes and the DDC wire numbers are listed in Table 62-2. Continue troubleshooting. Refer to section 62.3.4.

SAE Code Description - Flash Code	DDC Wire Number	Cavity
Auxiliary Output #1 (026 3 or 026 4) 62	499	F3 (VIH)*
Auxiliary Output #2 (040 3 or 040 4) 62	555	A2 (VIH)
Auxiliary Output #5 (053 3 or 053 4) 62	563	W3 (ESH) †
Auxiliary Output #6 (054 3 or 053 4) 62	564	X3 (ESH)
Auxiliary Output #7 (055 3 or 055 4) 62	565	Y3 (ESH)
Auxiliary Output #8 (056 3 or 056 4) 62	988	A1 (VIH)

* Vehicle Interface Harness

† Engine Sensor Harness

Table 62-2 Auxiliary Output Cavities

62.3.4 Electrical Check

Perform the following steps to check connectors, dash light or vehicle power-down relay, or item being driven.

1. Check the connectors of the output wire associated with the code logged at the vehicle harness connector or engine sensor harness connector.
2. Check the connectors of the output wire associated with the code logged at the item being driven.
   [a] If the connectors are not good, repair or replace the terminals. Refer to section 62.3.6.
   [b] If the connectors are good and the items being driven (e.g. relay, light) are not in good condition, repair or replace the device. (Contact OEM for test procedure.) Refer to section 62.3.6.
   [c] If the connectors are good and the items being driven (e.g. relay, light, are in good condition, refer to section 62.3.5.

62.3.5 Measure Resistance

Perform the following steps to measure the resistance.

1. Turn ignition OFF.

2. Connect the engine sensor harness or vehicle interface harness (connector with output fault).
3. Disconnect the output wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM case.
   [a] If the reading is 47,000 Ω (± 3,000 Ω), contact Detroit Diesel Technical Service.
   [b] If the reading is less than 44,000 Ω or greater than 50,000 Ω, this wire is shorted to the battery or open. Repair or replace this wire. Refer to section 62.3.6.

62.3.6 Verify Repairs

Perform the following steps to verify repairs.

1. Reconnect all connectors.
2. Plug DDR into the connector.
3. Clear all codes.
4. Start and run the engine.
   [a] If the output code returns, refer to section 62.3.1.
   [b] If the output code does not return, troubleshooting is complete.

63 FLASH CODE 63 - PWM FAULT

63.1 DESCRIPTION OF FLASH CODE 63

Flash Code 63 indicates that the pulse width modulation (PWM) output(s) used is either shorted to battery positive or open-circuited.

63.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 63

The SAE J1587 equivalent code for Flash Code 63 is s 057 3, or s 057 4, or s 058 3, or s 058 4, or s 059 3, s 059 4, or s 060 3, or s 060 4.

(FMI 3 = Short to Battery; FMI 4 = Open Circuit)

63.3 TROUBLESHOOTING FLASH CODE 63

The following procedure will troubleshoot Flash Code 63.

63.3.1 Determine Assignment

Perform the following steps to determine assignment.

1. Turn ignition ON.
2. Plug in the DDR.
3. Select INs/OUTs. To what is PWM assigned? Write down assignment vs cavity and code, listed in Table 63-1.

Code	PWM	Wire Location	Wire #
S057	PWM #1	J3	#908
S058	PWM #2	Y1	#909
S059	PWM #3	E2	#910
S060	PWM #4	X2	#911

Table 63-1 PWM Assignments

4. Select code display.
5. Determine Failure Mode Identifier (FMI).
   [a] If FMI 3 displays, there is a short to the battery. Refer to section 63.3.2
   [b] If FMI 4 displays, refer to step 6
6. Verify function.
   [a] If there is a component wired to this position, refer to section 63.3.3.
   [b] If there is no component wired to this position, reprogram to eliminate the assigned function. (A change may be required to the DDC mainframe.) Refer to section 63.3.9.

63.3.2 Verify Short to Battery

Perform the following steps to verify a short to battery:

1. Turn ignition OFF.
2. Disconnect 30-pin connector: engine connector if PWM 2, 3 or 4; vehicle connector if PWM 1.
3. Measure voltage between the cavity with the code and the good ground.
   [a] If the voltage measurement is greater than 3 volts, the connector is shorted to the battery. Repair. Refer to section 63.3.9.

[b] If the voltage measurement is less than 3 volts, contact Detroit Diesel Technical Service.

63.3.3 Check Component Connections

Perform the following steps to check component connections:

1. Turn the vehicle ignition switch to the OFF position.
2. Inspect the connections of the PWM wire associated with the flash code logged at both harness connector and the item being driven.

   [a] If the connectors are damaged or broken, repair or replace the damaged terminals. Verify repairs. Refer to section 63.3.9.

   [b] If the connectors are not damaged or broken, ensure the item is connected to the pulse width modulation wire. If the item is not connected, repair or replace the connector. Verify repairs. Refer to section 63.3.9.

   [c] If the item is connected, measure the resistance. Refer to section 63.3.8.

   [d] If this is an Optimized Idle vehicle, refer to section 63.3.4.

63.3.4 Check Installation of the Starter Harness Overlay Kit

Perform the following steps to check for proper installation of the starter harness overlay kit when a Code 63 is logged and the engine does not start; see Figure 63-1.

1. Turn off ignition (Optimized Idle Applications).
2. Remove relay from relay block.
3. Measure voltage between terminal 85 on the relay block and a good ground.

   [a] If voltage measurement is less than 4 VDC, the power lead to the relay is open. Verify connection of wire #439 from the starter relay harness overlay to DDEC wire #439 in the cab.

   [b] If voltage measurement is more than 4 VDC, measure voltage between terminal 86 on the relay block and a good ground. If voltage is less than 4 VDC, the resistor built into the harness is defective. Replace the harness and verify repairs. Refer to section 63.3.5.

   [c] If voltage measurement is more than 4 VDC, measure voltage between terminal 86 on the relay block and a good ground. If voltage is more than 4 VDC, the circuit

between terminal 86 on the new relay and power side of Optimized Idle starter relay is open. Repair the open circuit and verify repairs. Refer to section 63.3.9.

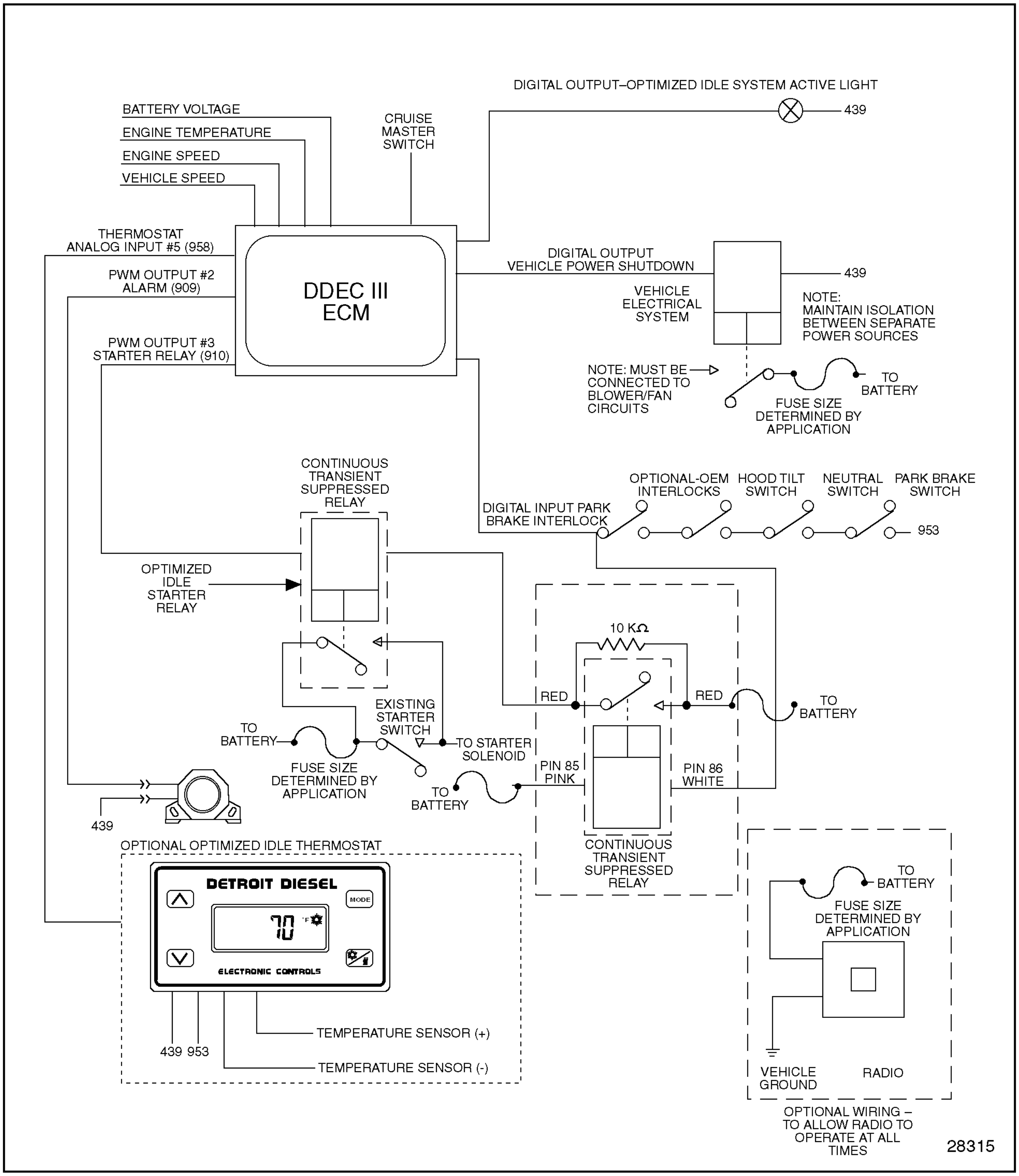


Figure 63-1 Optimized Idle Schematic

63.3.5 Verify Installation of Starter Relay Harness Overlay Service Kit

Use the following procedure to verify installation of the starter relay harness overlay service kit on Optimized Idle equipped vehicles only.

1. Turn ignition to ON position. Start engine.
2. Toggle cruise ON/OFF switch from OFF to ON. The Optimized Idle light should flash.
3. After the engine shuts down, turn the thermostat on by pressing any button.
4. Press UP or DOWN arrow until the heat or cool symbol begins to flash.
   [a] If the engine starts, the repairs are complete. Refer to section 63.3.9.
   [b] If the engine does not start, refer to section 63.3.6.

63.3.6 Engine Does Not Start in Optimized Idle Mode

Perform the following steps to start the engine.

1. Verify the hood is closed; the transmission is in neutral; the parking brake is set; and the vehicle wheels are blocked.

CAUTION:

To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.

2. Remove the overlay relay from the relay block.
3. Measure voltage between terminal 85 and terminal 86 of the relay block.
   [a] If voltage measurement is less than 4 VDC, the white wire in the overlay harness is open. Repair the open circuit between the overlay harness and the hood/cab switch. Refer to section 63.3.5.
   [b] If voltage measurement is more than 4 VDC, the relay is inoperative. Replace the relay. Refer to section 8.6.5 of the proper engine Service Manual. Verify the repairs. Refer to section 63.3.9.
   [c] If this is a Series 55 engine, refer to section 63.3.7.

63.3.7 Verify Harness

Perform the following steps to verify harness.

1. If this is a Series 55 engine, verify the engine harness is correct, especially PWM 3 and 4.
   [a] If the harness is not correct, replace it. Refer to section 63.3.9.

[b] If the harness is correct, refer to section 63.3.8.

63.3.8 Measure Resistance Between Connector and the Electronic Control Module Case

Perform the following steps to measure resistance between the connector and the ECM case:

1. Turn the vehicle ignition to the OFF position.
2. Ensure connector is installed on the engine harness side or vehicle harness side.
3. Disconnect the PWM wire associated with the code logged at the component.
4. Measure the resistance between the removed connector and the ECM case.
   [a] If the resistance measurement is between 46,000 and 48,000 Ω, verify the pin assignment with wiring - view with DDR. Refer to section 63.3.9.

   [b] If the resistance measurement is not between 46,000 and 48,000 Ω, the wire is open or shorted to battery. Repair or replace the wire. Verify repairs. Refer to section 63.3.9.

63.3.9 Verify Repairs

Perform the following steps to verify repairs for Flash Code 63. To check Optimized Idle, refer to *Optimized Idle Manual* 6SE518.

1. Reconnect all connectors.
2. Clear all codes from the DDR.
3. Plug in the DDR.
4. Turn vehicle ignition switch to the ON position.
   [a] If Flash Code 63 was not logged, no further troubleshooting is required.

   [b] If Flash Code 63 was logged, please review this section from the first step to find the error. Refer to section 63.3.1.

64 (CHG) FLASH CODE 64

64.1 DESCRIPTION OF FLASH CODE 64

Flash Code 64 is used to identify a turbo speed fault.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

64.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 64

The SAE J1587 equivalent code for Flash Code 64 is p 103/0, turbo overspeed, and p 103/8, turbo speed sensor input failure.

65 (CHG) FLASH CODE 65 - THROTTLE VALVE FAULT

65.1 DESCRIPTION OF FLASH CODE 65

For diesel-fueled engines, Flash Code 65 indicates that the air filter sensor input voltage has exceeded or dropped below the expected range.

This code is not covered in this manual (for diesel engines). If changes occur, notification will be sent from DDC.

For gas-fueled engines, Flash Code 65 indicates a fault in the throttle plate.

65.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 65

For diesel engines, the SAE J1587 equivalent codes for Flash Code 65 are 107/3, air filter sensor voltage high, and 107/4, air filter sensor voltage low.

For gas engines, the SAE J1587 equivalent codes for Flash Code 65 is one of the following:

- ☐ p 051/0 - Throttle plate above normal range
- ☐ p 051/1 - Throttle plate below normal range
- ☐ p 051/7 - Throttle plate not responding

65.3 TROUBLESHOOTING FLASH CODE 65

The following procedure will troubleshoot Flash Code 65.

65.3.1 Determine System and Failure

Determine system and failure as follows:

1. Is code 051/0 and system model year 1997 or older with a 24–volt power supply.
   [a] Yes to both — install jumper and refer to section 65.3.8.
   [b] No to either — for jumper harness already installed, refer to section 65.3.2.

65.3.2 Check for Voltage

Perform the following steps to check for voltage.

1. Unplug throttle actuator sensor harness connector. See Figure 65-1.
2. Turn ignition ON.
3. Measure voltage between cavity A and B of the connector.
   [a] If the battery voltage reading (12v/24v) is ± 2 volts, refer to section 65.3.3.

[b] If the voltage is low, refer to section 65.3.4.

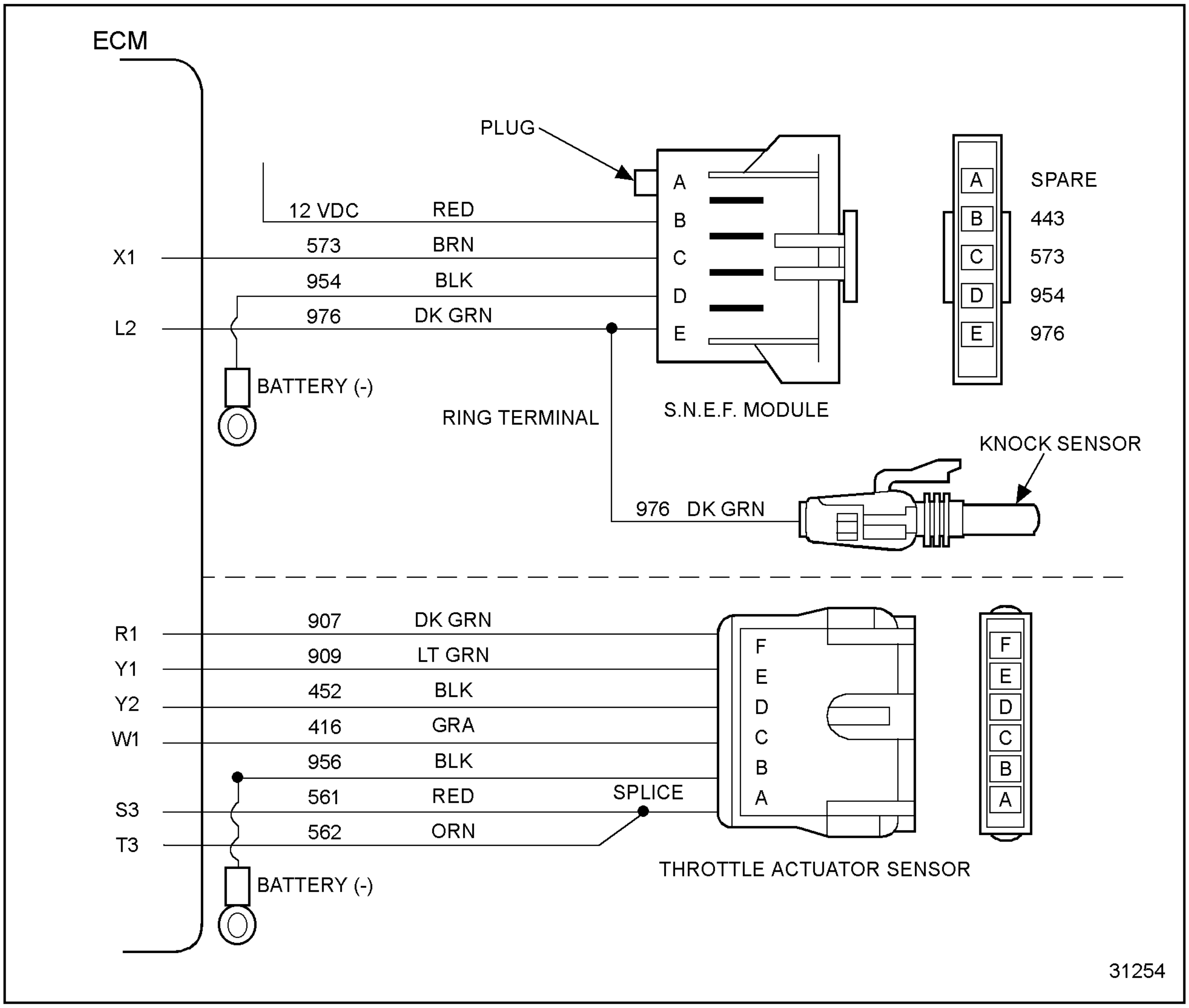


Figure 65-1 Series 50 Gas Engine Sensor Harness

65.3.3 Check for Ground

Perform the following steps to check for ground:

1. Turn ignition OFF.
2. Check ground wire from Cavity B to battery negative (-).
   [a] If the ground wire is okay, refer to section 65.3.5.
   [b] If the ground wire is bad, repair and refer to section 65.3.8.

65.3.4 Check for Supply

Perform the following steps to check for supply:

1. Turn ignition OFF.
2. Unplug engine sensor harness.
3. Install a jumper between wire cavity A and F of the throttle actuator connector.
4. Measure resistance between cavity R1 and S3, then R1 and T3 at the engine sensor harness.
   [a] If both readings are less than 1,000 Ω refer to section 65.3.5.
   [b] If either reading is greater than 1,000 Ω, it indicates the #561 or #562 wire is open. Repair or replace the wire and refer to section 65.3.8.

65.3.5 Check PWM #2

Perform the following steps to check PWM #2:

1. Move jumper to cavities E and F at the throttle activator.
2. Measure resistance between cavities R1 and Y1 of the engine sensor harness.
   [a] If the measurement is less than 1,000 Ω, refer to section 65.3.6.
   [b] If the measurement is greater than 1,000 Ω, the wire #909 (PWM#2) is open. Repair or replace the wire and refer to section 65.3.8.

65.3.6 Check Connectors

Perform the following steps to check the connectors.

1. Check both connectors for damaged, bent or broken pins or terminals.
   [a] If the connectors are not damaged, refer to section 65.3.7.
   [b] If the connectors are damaged, repair or replace the connectors. Refer to section 65.3.8.

65.3.7 Check for Short

Perform the following steps to check for a short.

1. Remove jumper.
2. Measure resistance between cavity Y1 and R1 on the engine sensor harness.
3. Measure resistance between Y1 and T3 of the engine sensor harness.
   [a] If the measured resistance is less than 1,000 Ω, the wires are shorted to each other. Repair or replace the wires and refer to section 65.3.8.
   [b] If the measured resistance is greater than 1,000 Ω, troubleshooting is complete. Review this section or contact Detroit Diesel Technical Service to replace the actuator. Refer to section 65.3.8.

65.3.8 Verify Repairs

Perform the following steps to verify repairs.

1. Connect all connectors.
2. With the ignition ON, plug in the DDR and clear the codes.
3. Throttle the engine through various speeds (r/min).
4. Shut the engine off.
5. Turn ignition ON.
6. Read the logged codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 65 is logged with any other codes, troubleshooting is complete. Review this section or contact Detroit Diesel Technical Service.

66 (CHG) FLASH CODE 66 - KNOCK SENSOR FAULT

66.1 DESCRIPTION OF FLASH CODE 66

Flash Code 66 indicates the oil filter sensor input to the ECM has exceeded or dropped below the allowed range.

This code is not covered in this manual (for diesel engines). If changes occur, notification will be sent from DDC.

For gasoline engines, Flash Code 66 indicates one or more faults have occurred in the engine knock level circuitry.

66.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 66

For diesel engines, the SAE J1587 equivalent code for Flash Code 66 is p 099/3, oil filter sensor input voltage high or p 099/4, oil filter sensor input voltage low.

For gasoline engines, the SAE J1587 equivalent code for Flash Code 66 is one of the following: s 076 0, s 076 7, s 076 3 or s 076 4.

66.3 TROUBLESHOOTING FLASH CODE 66

The following procedure will troubleshoot Flash Code 66.

66.3.1 Determine Failure

The following procedure will enable you to determine the failure.

1. Code s 076 0, knock level above normal range - A Failure Mode Identifier (FMI) of 0 is used to advise the user that the knock level is too high to allow the electronics to compensate for it. Troubleshoot this as a mechanical problem.
2. Code s 076 - 7, knock level torque reduction - An FMI of 1 is used to advise the user the loss of engine power is due to the engine electronics trying to adjust the fueling to further reduce the knock level. Clear the code and retest. If the code continues to occur, contact Detroit Diesel Technical Service.
3. For code s 076-3, knock sensor input voltage high, refer to section 66.3.2.
4. For code s 076-4, knock sensor input voltage low; refer to section 66.3.3.

66.3.2 Check Signal to Noise Enhancement Filter Module / Knock Sensor

Perform the following steps to check the Signal to Noise Enhancement Filter (SNEF) and knock sensor.

1. Unplug the SNEF module.
2. Turn ignition ON.
3. Plug in DDR. Read codes.
   [a] If code s 076-4 is logged, refer to section 66.3.4.
   [b] If code s 076-3 is logged, refer to section 66.3.5.

66.3.3 Check for Open

Perform the following steps to check for an open:

1. Unplug SNEF.
2. Install a jumper wire between cavity B and E.
3. Turn ignition ON.
4. Plug in DDR. Read codes.
   [a] If code s 076-3 is logged, refer to section 66.3.4.
   [b] If code s 076-4 is logged, refer to section 66.3.7.

66.3.4 Check Connectors

Perform the following steps to check the connectors.

1. Check connectors at ECM and SNEF module.
   [a] If the connectors are in good condition, replace the SNEF module. Refer to section 66.3.9.
   [b] If the connectors are damaged, repair and refer to section 66.3.9.

66.3.5 Check for Short to (+)

Perform the following steps to check for a short to positive (+).

1. Turn ignition OFF.
2. Disconnect the engine sensor harness. See Figure 66-1.

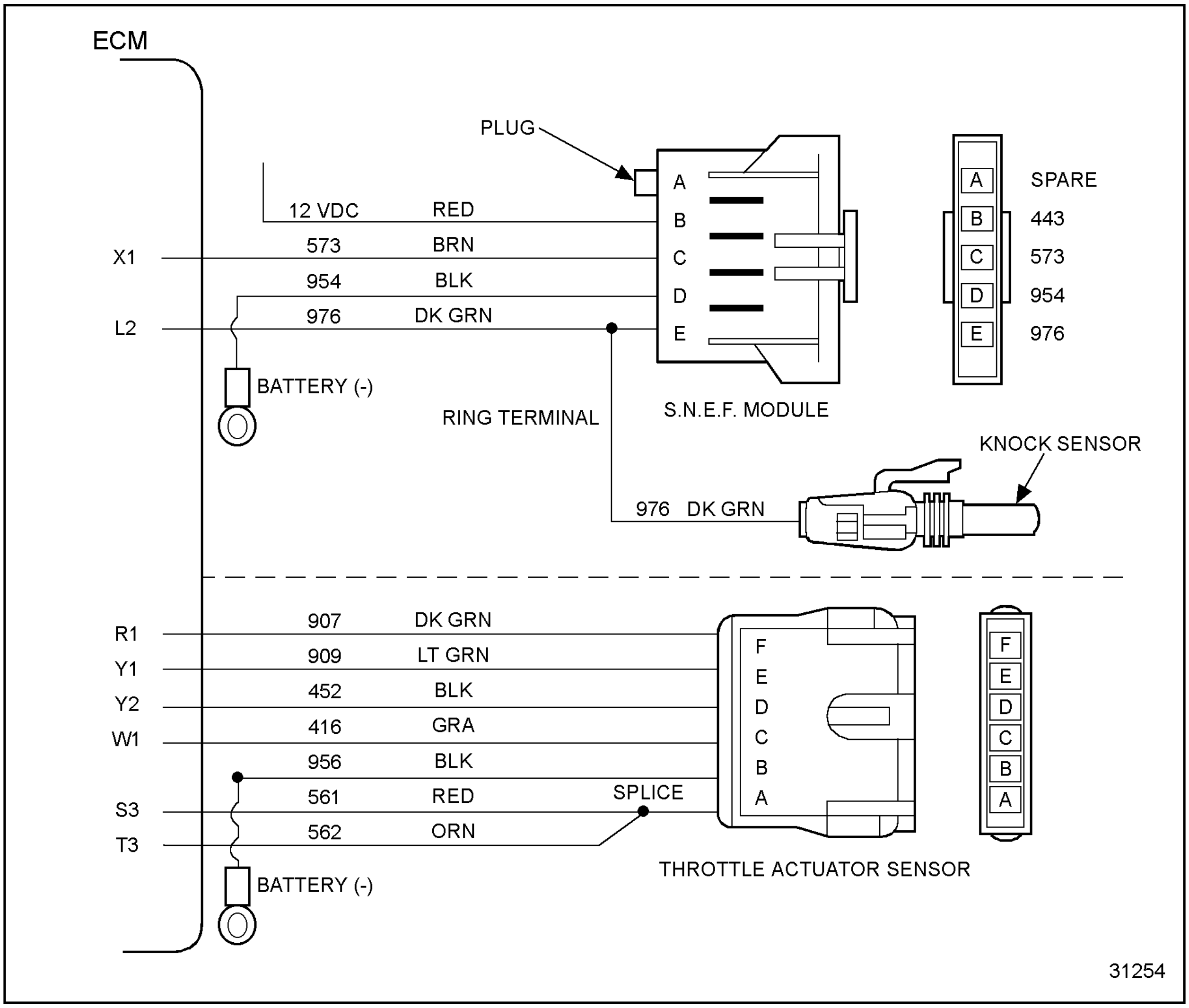


Figure 66-1 Series 50 Gas Engine Sensor Harness

3. Measure resistance between cavity A and E of the SNEF module connector.
   [a] If the measured resistance is less than 1,000 Ω, the wires are shorted to each other. Repair the wires and refer to section 66.3.9.
   [b] If the measured resistance is greater than 1,000 Ω, refer to section 66.3.6.

66.3.6 Check for Ground

Perform the following steps to check for a ground:

1. Measure resistance between cavity D and battery ground.
   [a] If the measured resistance is greater than 1,000 Ω, the ground wire is open. Repair the open and refer to section 66.3.9.
   [b] If the measured resistance is less than 1,000 Ω, replace the SNEF module and refer to section 66.3.9.

66.3.7 Check for Short to Ground

Perform the following steps to check for a short to ground.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Disconnect the engine harness connector.
4. Measure resistance between cavity A of the SNEF connector and a good ground.
   [a] If the measured resistance is less than 1,000 Ω, the signal wire (#976) is shorted to battery (-). Repair or replace the wire and refer to section 66.3.9.
   [b] If the measured resistance is greater than 1,000 Ω, replace the knock sensor and refer to section 66.3.8.

66.3.8 Check for Signal Open

Perform the following steps to check for a signal open.

1. Insert jumper wire between E and C of the SNEF module connector.
2. Unplug the engine sensor harness connector.
3. Measure resistance between L2 (#976) and X1 (#573).
   [a] If the measured resistance is greater than 1,000 Ω, wire #976 is open. Repair or replace the wire and refer to section 66.3.9.
   [b] If the measured resistance is less than 1,000 Ω, refer to section 66.3.4.

66.3.9 Verify Repairs

Perform the following steps to verify repairs.

1. Hook up all connectors.
2. Start and run the engine.
3. Operate under load. Road test.
4. Turn engine off.
5. Turn ignition ON.
6. Plug in DDR. Read logged codes.
    [a] If no codes are logged, troubleshooting is complete.
    [b] If code s 076-X is logged, all system diagnostics are complete. Please review this section from the first step to find the problem. Refer to section 66.3.1, or contact Detroit Diesel Technical Service.

67 (CHG) FLASH CODE 67 - MAP SENSOR FAULT

67.1 DESCRIPTION OF FLASH CODE 67

For diesel engines, Flash Code 67 indicates that the coolant pressure input voltage to the ECM has exceeded or dropped below the allowed range.

This code is not covered in this manual (for diesel engines). If changes occur, notification will be sent from DDC.

For gas engines, Flash Code 67 indicates that the input voltage to the ECM from the air inlet pressure sensor has dropped below 5%, or gone above 95% of the sensor supply voltage.

67.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 67

For diesel engines, the SAE J1587 equivalent codes for Flash Code 67 are 109/3, coolant pressure sensor input voltage high, and 109/4, coolant pressure sensor input voltage low.

For gas engines, the SAE J1587 equivalent codes for Flash Code 67 are p 106/3, air inlet pressure sensor input voltage high, and p 106/4, air inlet pressure sensor input voltage low.

67.3 TROUBLESHOOTING FLASH CODE 67

The following procedure will troubleshoot Flash Code 67.

67.3.1 Determine Failure

Perform the following steps to determine failure.

1. Turn ignition ON.
2. Plug in DDR.
3. Read codes.
   [a] If code 106/3 is logged, refer to section 33.3.2.
   [b] If code 106/4 is logged, refer to section 34.3.2.

NOTE:
Turbo Boost Sensor (TBS) references = air inlet pressure MAP (Manifold Air Pressure) sensor for troubleshooting codes 106/3 and 106/4. The wire numbers are the same.

68 FLASH CODE 68 - IDLE VALIDATION FAULT

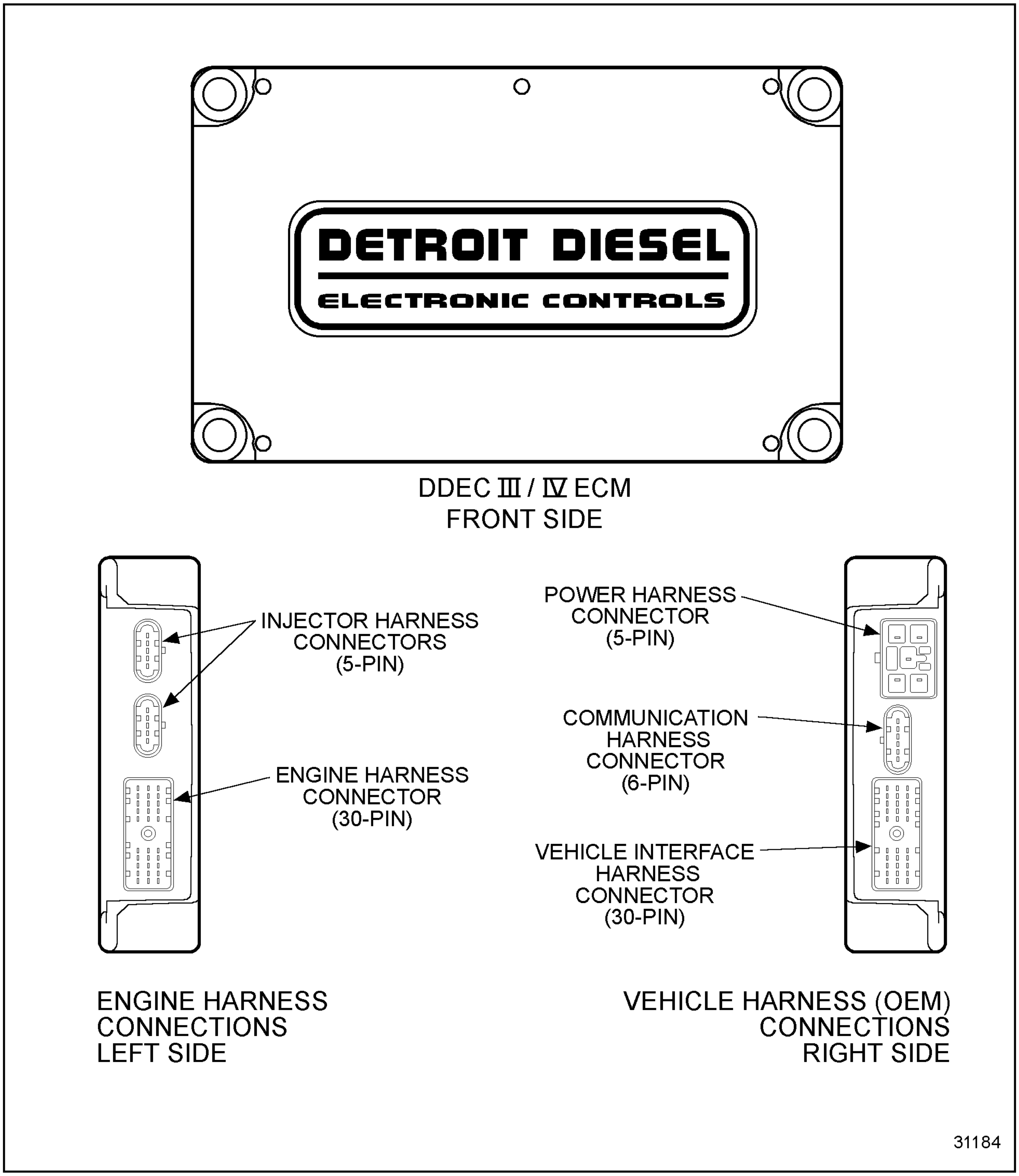


Figure 68-1 ECM

68.1 DESCRIPTION OF FLASH CODE 68

Flash Code 68 indicates that the ECM, see Figure 68-1, has detected a fault in the idle validation switch (IVS) logic.

68.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 68

The SAE J1587 equivalent code for Flash Code 68 is s 230 5 (open circuit) or s 230 6 (short to ground).

NOTE:
Code 230/5 (open) is set when TPS counts are less than 120 and IVS input is opened.

NOTE:
Code 230/6 (short to ground) is set when TPS counts are greater than 282 and IVS input is grounded to battery (-).

68.3 TROUBLESHOOTING FLASH CODE 68

The following procedure will troubleshoot Flash Code 68.

68.3.1 Check for Idle Validation Switch Code

Perform the following steps to check for IVS active code:

1. Turn ignition ON.
2. Plug in DDR.
3. Cycle foot pedal; then read codes.
   [a] If the IVS code is open (FMI=5), validate the throttle pedal application. Refer to section 68.3.4.
   [b] If the IVS code is grounded (FMI=6), check the IVS switch. Refer to section 68.3.2.

68.3.2 Check the Idle Validation Switch

Perform the following step to check the idle validation switch:

1. Turn the vehicle ignition switch to the ON position.

CAUTION:

To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.

2. Start and run the engine.

NOTE:
Vehicle need not be moving to perform this check.

3. Plug in DDR.
4. Compare idle validation switch input status (switch light status) with the throttle position sensor counts.
   [a] If the IVS status is ON with the TPS count being greater than 282, measure for resistance. Refer to section 68.3.3.
   [b] If the IVS status is OFF with the TPS count being greater than 282, clear inactive codes. No further troubleshooting is required. Refer to section 68.3.7.

68.3.3 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to measure resistance:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.
2. Move TPS so counts are greater than 285.
3. Measure resistance between the ECM input (IVS) at the TPS and battery ground using a volt-ohm meter.
    [a] If the resistance was less than 100 Ω, the idle validation input/switch is grounded or defective. Contact OEM for repair procedure. Refer to section 68.3.7.
    [b] If the resistance was greater than 100 Ω, the fault condition no longer exists. No further troubleshooting is required. Refer to section 68.3.7.

68.3.4 Check for Throttle Pedal Application

Perform the following steps to determine which type of TPS is being used:

1. Visually check to determine which throttle pedal has been installed that utilizes the IVS function.
    [a] If the throttle pedal has an idle validation switch installed, verify TPS count. Refer to section 68.3.5.
    [b] If the throttle pedal has no idle validation switch installed, update customer calibration using a programming station. Change the settings from idle validation to "No Function" and save changes. Verify repairs. Refer to section 68.3.7.

68.3.5 Determine Throttle Position Sensor Counts / Idle Validation Switch Status

Perform the following steps to determine TPS counts:

1. Turn vehicle ignition to the ON position. Refer to OEM guidelines.

CAUTION:
To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.

2. Plug in DDR.

NOTE:
Vehicle need not be moving to determine TPS counts.

3. Compare idle validation switch status (switch light status) with the throttle position sensor counts.
    [a] If the IVS input is ON with the TPS count being less than 120, the problem no longer exists. Refer to section 68.3.7.

[b] If the IVS input is OFF with the TPS count being less than 120, refer to section 68.3.6.

68.3.6 Check Resistance Between Idle Validation Switch Contacts

Perform the following steps to determine resistance:

1. Turn vehicle ignition switch to the ON position.
2. Measure resistance between the ECM input at the TPS/IVS end of the harness and battery ground.
   [a] If the resistance is less than 100 Ω, the IVS is defective. Replace the switch. (Contact the OEM for procedure.) Verify repairs. Refer to section 68.3.7.
   [b] If the resistance is greater than 100 Ω, either the IVS input or #953 wire is open or the IVS is defective. Replace the switch. (Contact the OEM for procedure.) Verify repairs. Refer to section 68.3.7.

68.3.7 Verify Repairs

Perform the following steps to verify repairs:

1. Clear inactive codes.

CAUTION:

To avoid personal injury, before starting and running the engine, be sure that the vehicle is parked on a level surface and that the wheels are properly blocked.

2. Start and run the engine.
3. Depress foot pedal to at least half throttle (>290 counts).
4. Release foot pedal and allow the engine to idle.
5. Visually observe the check engine light (CEL) and DDR.
   [a] If the CEL comes on, no further troubleshooting is required.
   [b] If code 68 is logged, refer to section 68.3.1 to troubleshoot Flash Code 68 again.

69 FLASH CODE 69

69.1 DESCRIPTION OF FLASH CODE 69

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

70 FLASH CODE 70

70.1 DESCRIPTION OF FLASH CODE 70

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

71 (CHG) FLASH CODE 71 - INJECTOR RESPONSE SHORT

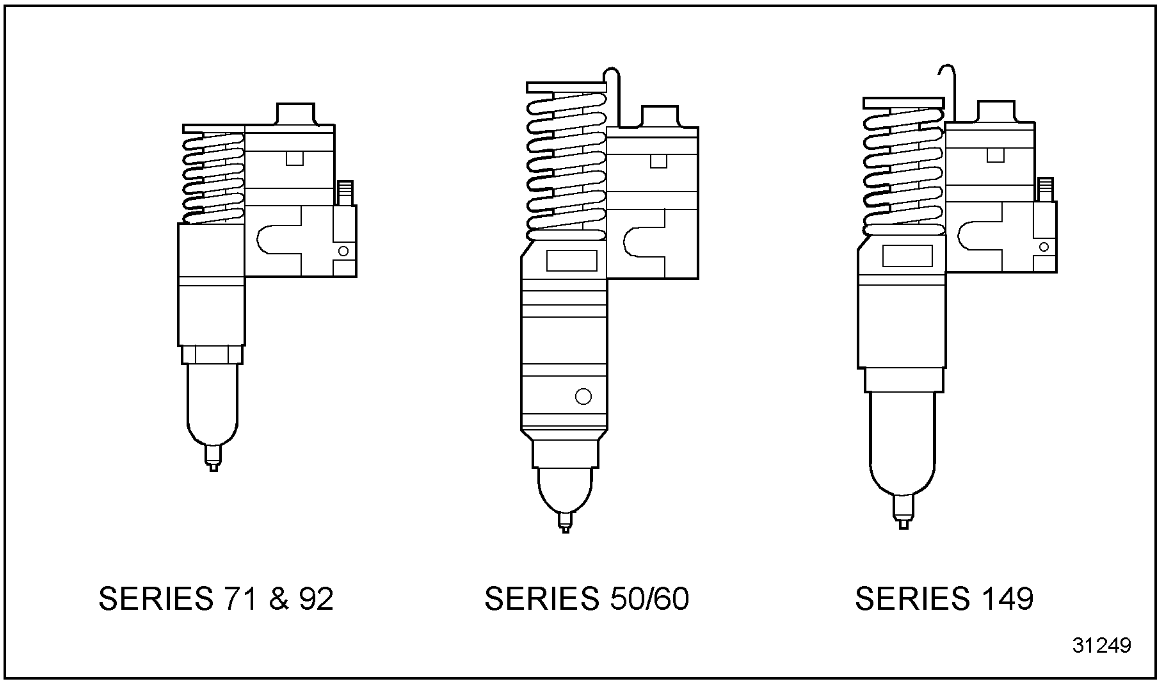


Figure 71-1 Injectors

71.1 DESCRIPTION OF FLASH CODE 71

Flash Code 71 indicates that the time it takes from when the DDEC ECM, see Figure 71-1, requests an injector be turned on when the injector solenoid valve actually closes is shorter than the lower limit of the expected range.

This diagnostic condition is typically:

- ☐ Aerated fuel system
- ☐ High system battery (+) supply voltage
- ☐ Mechanical injector failure
- ☐ Failed solenoid

NOTE:
The injector diagnostic SID (Subsystem Identifier) indicates which cylinder number has an injector with a short response time. The injector number describes the cylinder and bank that has the injector with a short response time. The DDR will display the injector text description.

Injector response times generally increase with low battery supply voltage and decrease with high battery supply voltage. Although injector response times vary from injector to injector at a given r/min, each individual injector response time should remain relatively consistent from one firing to the next. Wide variations in response time (typically ± 0.2 ms) for one injector at a steady engine r/min may indicate an electrical problem (faulty alternator or regulator, poor or broken ground cables, etc.).

71.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 71

The SAE J1587 equivalent code for Flash Code 71 is s 001 1, or s 002 1, or s 003 1, or s 004 1, or s 005 1, or s 006 1.

71.3 TROUBLESHOOTING FLASH CODE 71

The following procedure will troubleshoot Flash Code 71.

71.3.1 Determine Cylinders With Fault

The injector location that is logging the codes is listed in Table 71-1.

	#1	#2	#3	#4	#5	#6	
	(SID 1)	(SID 2)	(SID 3)	(SID 4)	(SID 5)	(SID 6)	
S55/60	1	5	3	6	2	4	cyl #
S50	1	3	4	2	-	-	cyl #

Table 71-1 Determine Cylinders With Fault

1. Disconnect the 5-pin injector harness connector at the ECM for those injectors logging the codes.
2. Establish a good ECM case ground by measuring the resistance across two points on the ECM. The resistance should measure less than or equal to 1 Ω.
3. Once a good case ground is established, keep one of the measurement probes in place and move the other probe to one of the five exposed male injector terminals on the ECM.
4. Measure the resistance. Repeat this procedure at each of the five terminals.
   [a] If any terminals have a resistance of less than 1000 Ω, replace the ECM. Refer to section 71.3.5.
   [b] If all terminals have a resistance of greater than 1000 Ω, refer to section 71.3.5.

71.3.2 Check for Short

Perform the following steps to check for a short. See Figure 71-2.

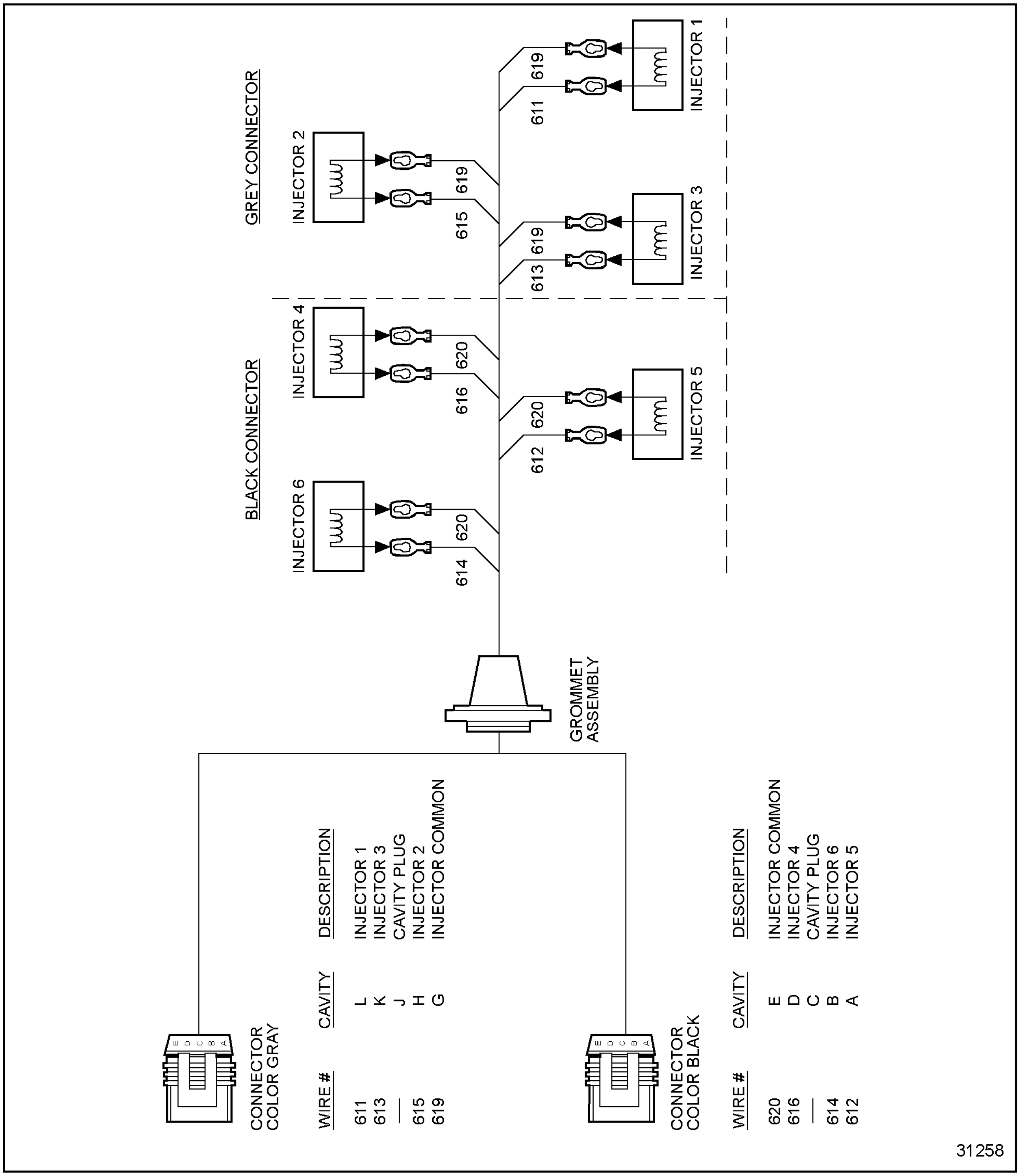


Figure 71-2 Injector Harness

1. Locate the injector harness connector terminals associated with the codes.

2. Measure resistance between that cavity and the cylinder block.
3. Also, measure resistance between that cavity and the appropriate return cavity (G or E).
   [a] If measured resistance is less than 5 Ω, the wire is shorted. Repair or replace the harness and refer to section 71.3.5.
   [b] If measured resistance is greater than 5 Ω, refer to section 71.3.3.

71.3.3 Check for Open

Perform the following steps to check for an open.

1. Insert a jumper wire between the cavity associated with the code and the return for that connector (G or E).
2. Remove the valve cover to gain access to the cylinder associated with the code.
3. Remove the connector terminals at the injector solenoid.
4. Measure resistance between the terminal plugs.
   [a] If the measured resistance is greater than 5 Ω, the injector wire is open. Repair or replace the harness and refer to section 71.3.5.
   [b] If the measured resistance is less than 5 Ω, and the ECM software is less than 3.00, reprogram the ECM. Refer to section 71.3.5.
   [c] If the measured resistance is less than 5 Ω, and the ECM software is 3.00 or higher, remove the alternator belt to disable the actuator and refer to section 71.3.4.

71.3.4 Assemble

Perform the following steps to assemble the components.

1. Connect the connectors.
2. Install the valve cover.
3. Start and run the engine.
4. Stop engine.
5. Does the code return?
   [a] If the code does not return, repair or replace the alternator grounds and refer to section 71.3.5.
   [b] If the codes return, replace the injector and solenoid. Refer to section 71.3.5.

71.3.5 Verify Repairs

Perform the following steps to verify repairs:

1. Start and run the engine.
2. Stop engine.

3. Check DDR for codes.
   [a] If no codes are logged, no further troubleshooting is required.
   [b] If injector codes are logged, all system diagnostics are complete. Please review this section from the first step to find the error. Refer to section 71.3.1.

72 FLASH CODE 72 - VEHICLE OVERSPEED

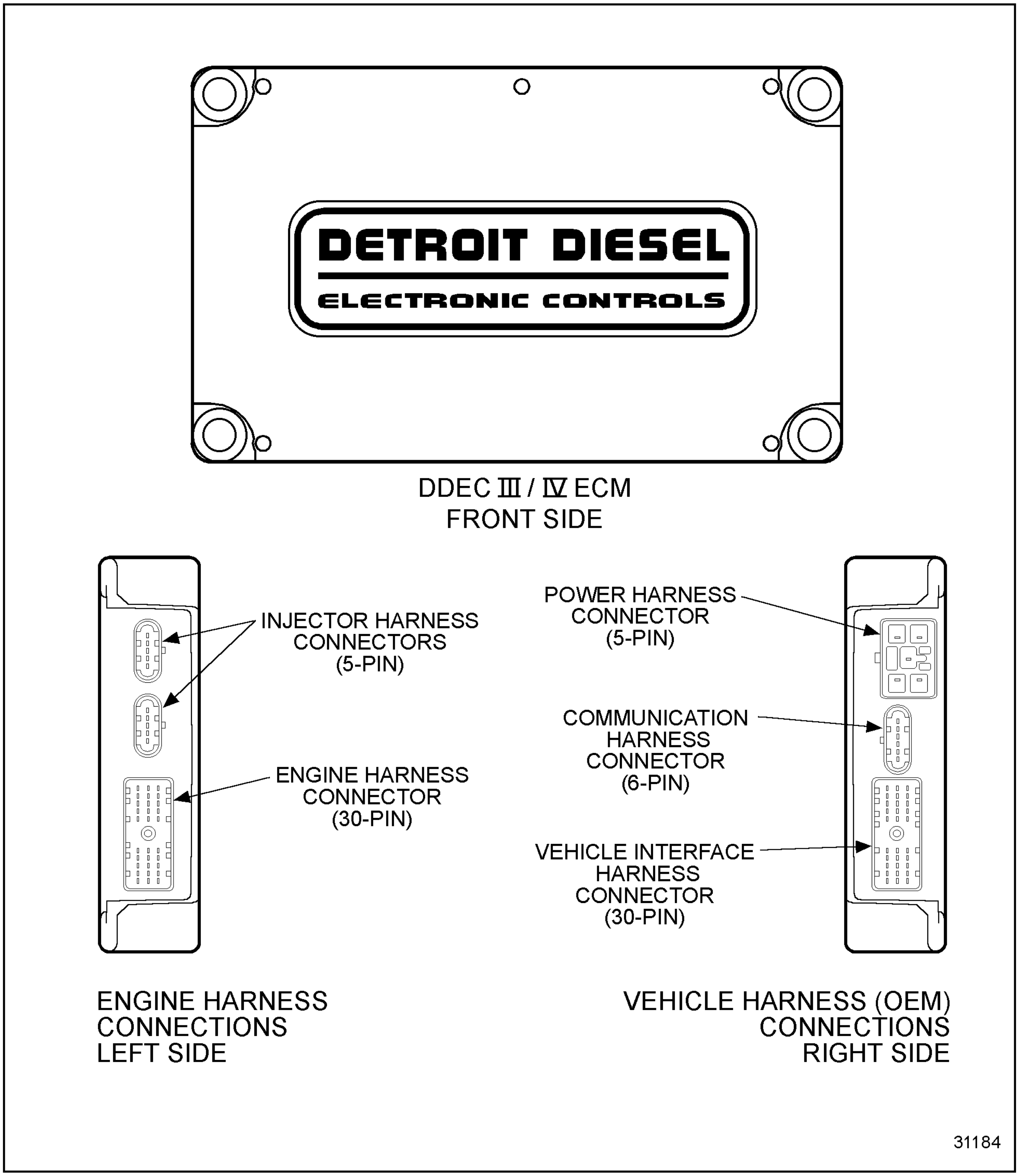


Figure 72-1 ECM

72.1 DESCRIPTION OF FLASH CODE 72

Flash Code 72 indicates that the vehicle speed signal to the ECM (with fueling to the engine) has exceeded the vehicle speed limit that is defined in the ECM calibration. See Figure 72-1.

Flash Code 72 also may indicate that the vehicle speed signal to the ECM (without fueling to the engine) has exceeded a secondary vehicle speed limit that is defined in the ECM calibration.

72.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 72

The SAE J1587 equivalent code for Flash Code 72 is p 084 0 or p 084 11.

72.3 TROUBLESHOOTING FLASH CODE 72

The following procedure will troubleshoot Flash Code 72.

72.3.1 Overspeed

Perform the following steps to troubleshoot overspeed.

1. These codes indicate the vehicle speed has exceeded the limits programmed into the ECM. Verify cruise control and VSS information.
   [a] Code 84/0 - Overspeed with fuel limit has been exceeded.
   [b] Code 84/11 - Overspeed without fuel limit has been exceeded.
2. Limits are a reasonable distance above the road speed limit.
   [a] If the limits are a reasonable distance, go to step 3
   [b] If the limits are not a reasonable distance above the road speed limit, change the limits and perform the test. Refer to section 72.3.2.

NOTE:
For information regarding overspeed limits, refer to section 7.1.29.

3. Fuel Economy Incentive feature configured recently.
   [a] If configured recently, review the limits. W/FEI limits may need to be increased.
   [b] If not configured recently, the conditions are normal. The vehicle has exceeded speed limits set.

72.3.2 Test

Perform the following steps to troubleshoot overspeed.

1. Start and run the engine.
2. Perform a road test.
   [a] If the overspeed condition has disappeared, troubleshooting is complete.
   [b] If the overspeed condition still exists, review this section from the beginning to find the error. Refer to section 72.3.1.

73 FLASH CODE 73

73.1 DESCRIPTION OF FLASH CODE 73

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

74 FLASH CODE 74

74.1 DESCRIPTION OF FLASH CODE 74

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

75 FLASH CODE 75 - BATTERY VOLT HIGH

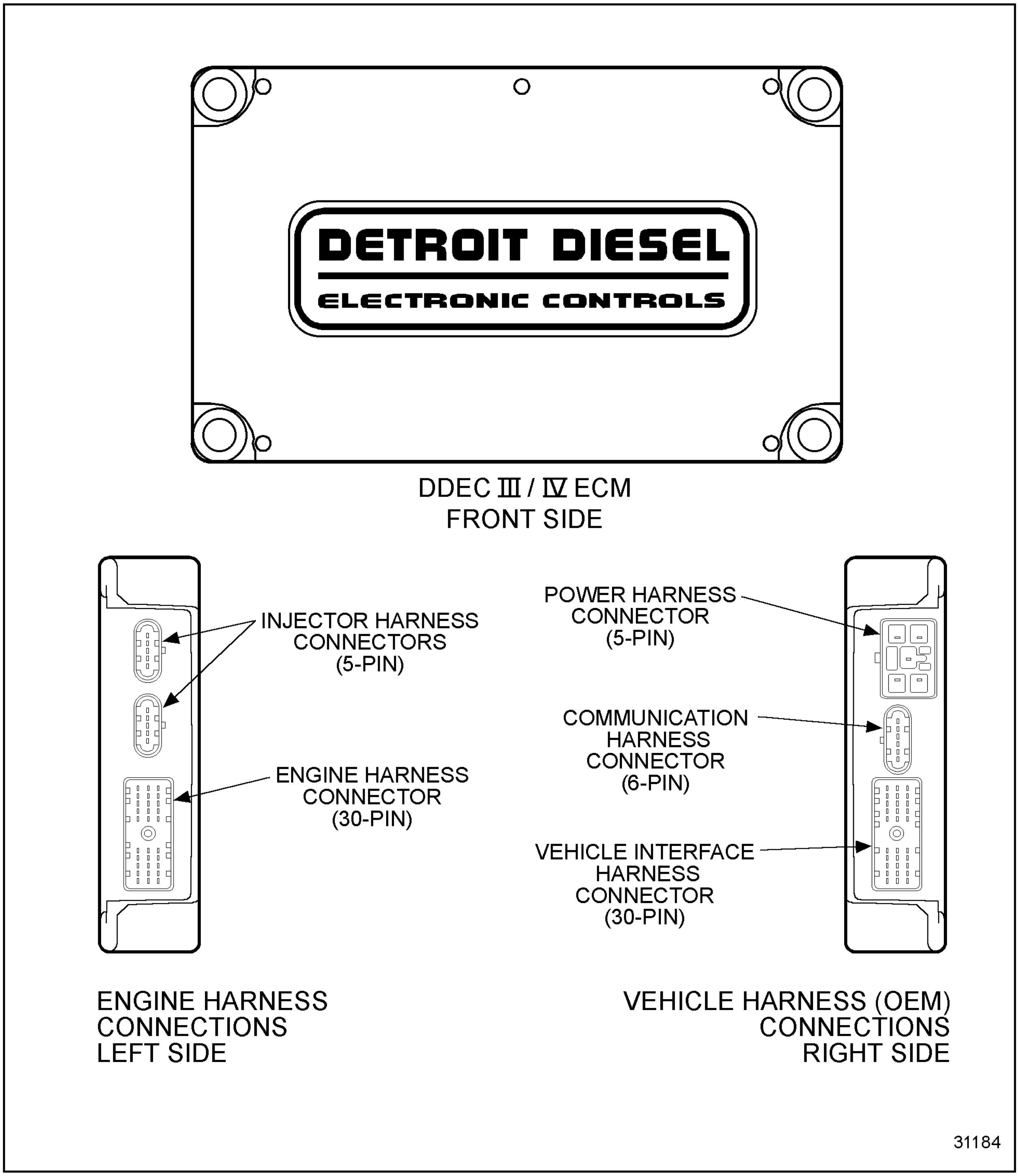


Figure 75-1 ECM

75.1 DESCRIPTION OF FLASH CODE 75

Flash Code 75 indicates that the DDEC® ECM, see Figure 75-1, has detected that the main battery supply voltage to the ECM has exceeded the recommended operating range.

75.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 75

The SAE J1587 equivalent code for Flash Code 75 is p 168 0.

75.3 TROUBLESHOOTING FLASH CODE 75

The following procedure will troubleshoot Flash Code 75.

75.3.1 High Voltage

Perform the following steps to troubleshoot high voltage.

1. Turn ignition ON.
2. Plug in the diagnostic data reader (DDR).
3. Read logged codes.
   [a] If any codes other than 168/0 are received, service the other codes first.
   [b] If code 168/0 and no other codes are logged, the voltage to the ECM is too high. Check batteries and/or vehicle charging system.

76 FLASH CODE 76 - ENGINE OVERSPEED / BRAKE

76.1 DESCRIPTION OF FLASH CODE 76

Flash Code 76 indicates the engine speed exceeded a calibration limit, and the engine brake output was active at the time the condition occurred.

76.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 76

The SAE J1587 equivalent code for Flash Code 76 is p 121/0, Engine Overspeed with Engine Brake.

76.3 TROUBLESHOOTING FLASH CODE 76

Perform the following steps to troubleshoot Flash Code 76.

76.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn vehicle ignition switch ON.
2. Plug in the diagnostic data reader (DDR).
3. Visually check the DDR for codes.
   [a] If codes other than 121/0 are logged, service them first.
   [b] If code 121/0 is logged, and no other codes are logged, there was an engine running condition at which the engine r/min exceeded a calibration limit during engine brake operation.

NOTE:
Determine the reason the engine r/min went too high.

77 FLASH CODE 77 - FUEL TEMP HIGH

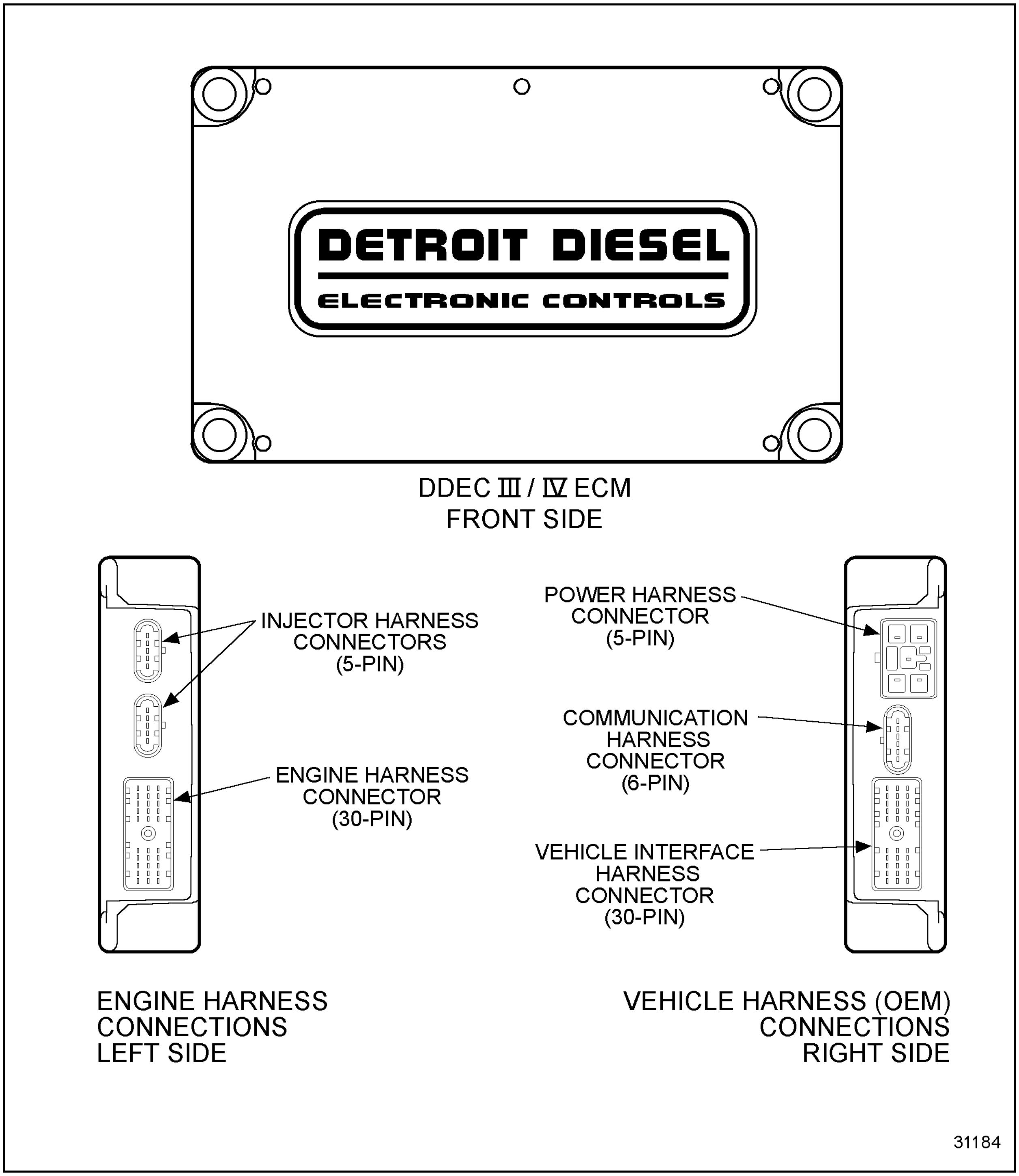


Figure 77-1 ECM

77.1 DESCRIPTION OF FLASH CODE 77

Flash Code 77 indicates that the fuel temperature has exceeded a calibration limit set by DDC in the ECM, see Figure 77-1.

At this time, this code is logged without illuminating a CEL.

77.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 77

The SAE J1587 equivalent code for Flash Code 77 is p 174 0.

77.3 TROUBLESHOOTING FLASH CODE 77

There is no established procedure to troubleshoot Flash Code 77.

- □ The code is used to determine if high fuel temperature may be a cause of reduced power levels.
- □ High fuel temperature will reduce available horsepower.
- □ Refer to the recommendations of the vehicle manufacturer regarding the possible need for additional fuel cooling.

78 (CHG) FLASH CODE 78

78.1 DESCRIPTION OF FLASH CODE 78

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

79 FLASH CODE 79

79.1 DESCRIPTION OF FLASH CODE 79

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

80 FLASH CODE 80

80.1 DESCRIPTION OF FLASH CODE 80

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

81 (CHG) FLASH CODE 81

81.1 DESCRIPTION OF FLASH CODE 81

Flash Code 81 is used to identify oil level, crankcase pressure, dual fuel BOI, or exhaust temperature voltage high.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

81.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 81

The SAE J1587 equivalent code for Flash Code 81 is p 098 3, oil level sensor input voltage high; p 101 3, crankcase pressure sensor input voltage high, or s 020 3, dual fuel BOI input voltage high.

82 (CHG) FLASH CODE 82

82.1 DESCRIPTION OF FLASH CODE 82

Flash Code 82 is used to identify oil level, crankcase pressure, dual fuel BOI, or exhaust temperature voltage low.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

82.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 82

The SAE J1587 equivalent code for Flash Code 82 is p 098 4, oil level sensor input voltage low; p 101 4, crankcase pressure sensor input voltage low, or s 020 4, dual fuel BOI input voltage low.

83 (CHG) FLASH CODE 83

83.1 DESCRIPTION OF FLASH CODE 83

Flash Code 83 is used to identify oil level, crankcase pressure, exhaust temperature, or external pump pressure high.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

83.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 83

The SAE J1587 equivalent code for Flash Code 83 is p 098 0, oil level high; p 101 0, crankcase pressure high; p 173 0, exhaust temperature high; and p 173 3, 4, exhaust temperature sensor input.

84 (CHG) FLASH CODE 84

84.1 DESCRIPTION OF FLASH CODE 84

Flash Code 84 is used to identify oil level or crankcase pressure low.

This code is not covered in this manual. If changes occur, notification will be sent from DDC.

84.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 84

The SAE J1587 equivalent code for Flash Code 84 is p 098/1, oil level low and p 101/1, crankcase pressure low.

85 FLASH CODE 85 - ENGINE OVERSPEED

85.1 DESCRIPTION OF FLASH CODE 85

Flash Code 85 indicates that an engine overspeed condition exists.

85.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 85

The SAE J1587 equivalent code for Flash Code 85 is p 190 0, engine overspeed.

85.3 TROUBLESHOOTING FLASH CODE 85

The following procedure will troubleshoot Flash Code 85.

85.3.1 Code Information

Perform the following steps to gather information. This code is logged whenever the engine has been operating over 2500 r/min for at least two seconds.

1. Turn ignition ON.
2. Plug diagnostic data reader (DDR) into the diagnostic data link (DDL). For vehicle harness connector.
3. Select inactive codes.
4. Part of the display will read as follows:
   - [a] First Occurrence
   - [b] Last Occurrence
   - [c] Total Number
   - [d] Total Time
5. If necessary, refer to section 6.2

86 FLASH CODE 86 - PGS SENSOR HIGH

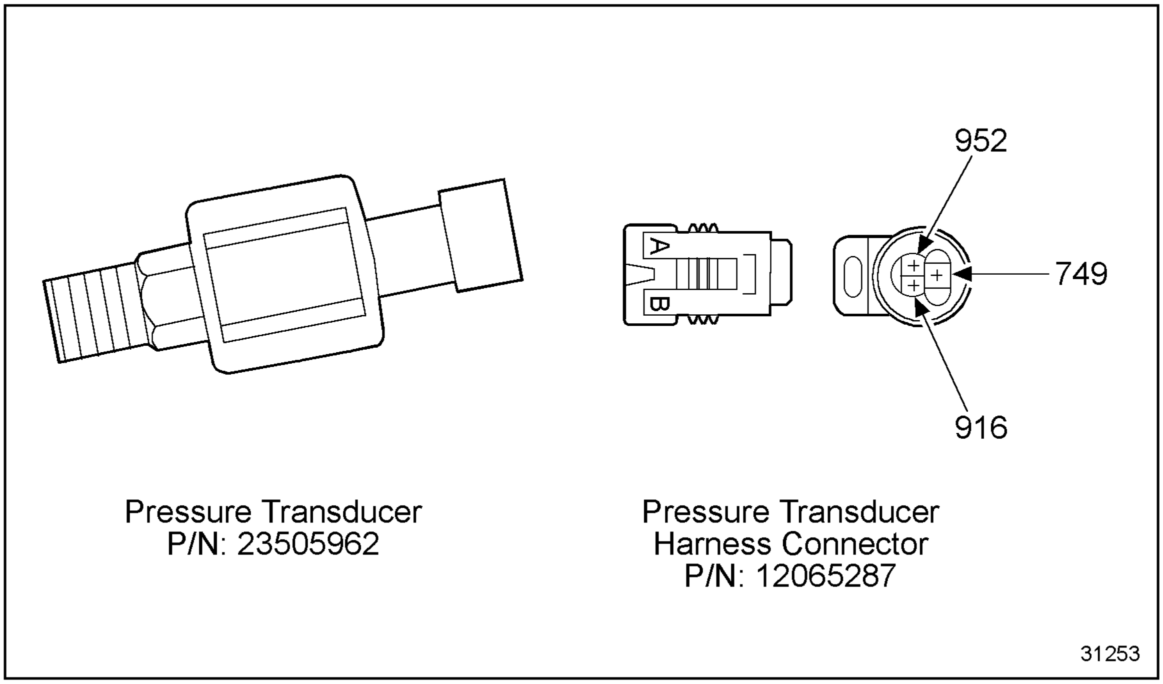


Figure 86-1 Pressure Transducer

86.1 DESCRIPTION OF FLASH CODE 86

Flash Code 86 indicates that the pump pressure circuit failed high (below). For pressure transducer and connector, see Figure 86-1,

86.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 86

The SAE J1587 equivalent code for Flash Code 86 is p 073 3.

86.3 TROUBLESHOOTING FLASH CODE 86

The following procedure will troubleshoot Flash Code 86.

86.3.1 Multiple Code Check

Perform the following steps to check for multiple codes.

1. Turn ignition ON.
2. Plug in DDR.
3. Read active codes.
   [a] If active code 73/3 was logged, and no other codes were logged, refer to section 86.3.2.
   [b] If active code 73/4 and any other codes were logged, refer to section 86.3.3.
   [c] If any codes other than 73/3 were logged, refer to section 91.1.

86.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect the Pressure Governor System (PGS) sensor connector.
3. Turn ignition ON.
4. Start engine and operate the PGS in the PRESSURE mode.
5. Read active codes.
   [a] If active code 73/3 and any other codes were logged, refer to section 86.3.5.
   [b] If active code 73/4 and any other codes except 73/3 were logged, refer to section 86.3.3.

86.3.3 Return Circuit Check

Perform the following steps to check the return circuit.

1. Turn vehicle ignition OFF.
2. Disconnect the vehicle harness connector at the ECM. See Figure 86-2.
3. Install a jumper wire between pins A and B of the PGS sensor harness connector.
4. Measure resistance between sockets D3 and C3 on the vehicle harness connectors.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 86.3.4.

[b] If the resistance measurement is greater than 5 Ω, or open, the return line (circuit #952) is open. Repair the open and refer to section 86.3.9.

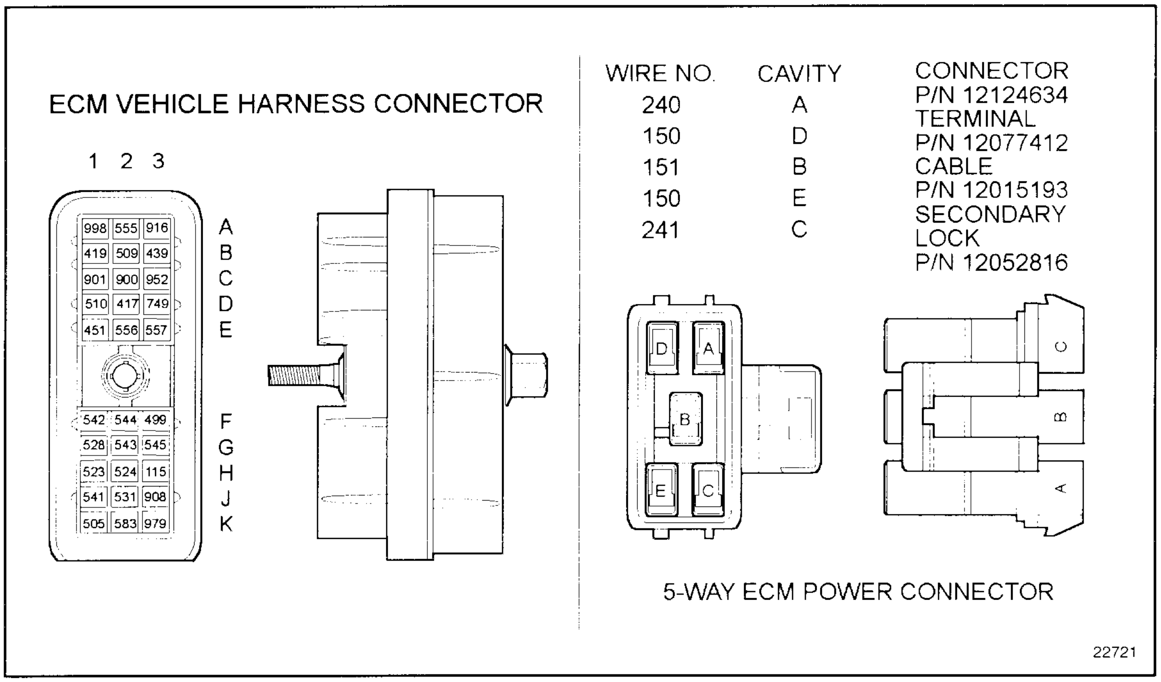


Figure 86-2 ECM Vehicle Harness Connector

86.3.4 Check Pressure Governor System Connectors

Perform the following steps to check the PGS connectors.

1. Inspect terminals at the PGS sensor connector (both the sensor and harness side) for damage: bent, corroded, and unseated pins or sockets.

    [a] If the terminals and connectors are damaged, repair them and refer to section 86.3.9.

    [b] If the terminals and connectors are not damaged, replace the PGS sensor and refer to section 86.3.9.

86.3.5 Check for Short to +5 Volts

Perform the following steps to check for a short to the +5 volts.

1. Turn ignition OFF.
2. Disconnect the vehicle harness connectors at the ECM.
3. Measure resistance between sockets A3 and D3 on the engine harness connector.

    [a] If the resistance measurement is greater than 100 Ω or open, refer to section 86.3.6.

    [b] If the resistance measurement is less than or equal to 100 Ω, the signal line (#749) is shorted to the engine +5 volt line (#916). Repair the short and refer to section 86.3.9.

86.3.6 Check for Short to Battery +

Perform the following steps to check for a short to battery.

1. Remove both fuses to the ECM.
2. Disconnect the vehicle harness and 5-way power connectors at the ECM.
3. Measure resistance between socket D3 on the engine harness connector and battery (+).
4. Measure resistance between socket D3 of the engine harness connector, and the 5-way power harness sockets A and C.
   - [a] If the resistance measurement for all readings is greater than 100 Ω or open, refer to section 86.3.7.
   - [b] If the resistance measurement is less than or equal to 100 Ω, a short exists between the signal line (circuit #749) and battery (+). Repair short and reinsert fuses. Refer to section 86.3.9.

86.3.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Inspect terminals at the ECM connectors (both ECM and harness side) for damage: bent, corroded, and unseated pins or sockets.
   - [a] If terminals and connectors are damaged, repair them. Refer to section 86.3.9.
   - [b] If terminals and connectors are not damaged, install a test ECM. Refer to section 86.3.8.

86.3.8 Final Check

Perform the following steps to do a final check.

1. Reconnect all connectors.
2. Turn vehicle ignition ON.
3. Clear codes.
4. Start and run the engine for one minute.
5. Stop engine.
6. Check DDR for active codes.
   - [a] If no codes are logged, troubleshooting is complete.
   - [b] If active code 73/3 is logged, install a test ECM. Refer to section 86.3.9.
   - [c] If any codes except code 73/3 are logged, refer to section 9.1, to service other codes.

86.3.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn ignition switch OFF.
2. Reconnect all connectors.
3. Turn ignition ON.
4. Clear codes.
5. Start and run the engine for one minute.
6. Stop engine.
7. Check DDR for inactive codes.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If code 73/3 is not logged, and other codes are logged, refer to section 9.1, to service other codes.
   [c] If code 73/3 is logged, and other codes are logged, all system diagnostics are complete. Review this section from the first step to find the problem. Refer to section 86.3.1.

87 FLASH CODE 87 - PGS SENSOR LOW

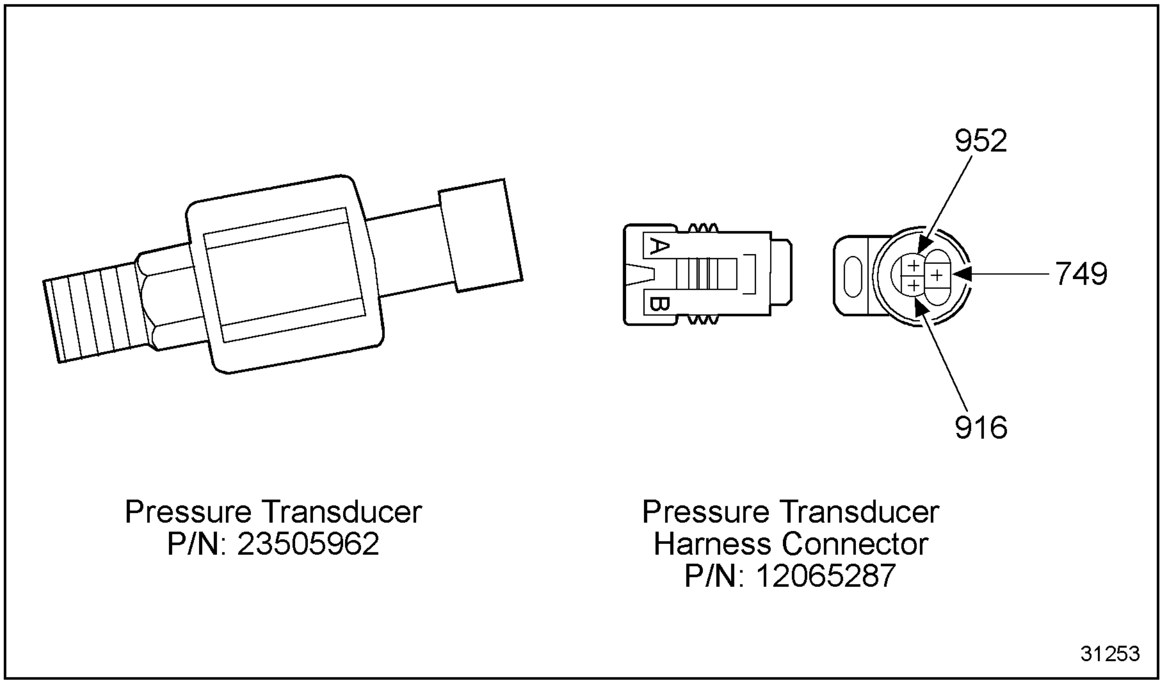


Figure 87-1 Pressure Transducer

87.1 DESCRIPTION OF FLASH CODE 87

Flash Code 87 indicates pump pressure sensor input voltage low.

The signal volts dropped below 5% (normally = <0.25 volts) of the sensor supply. For pressure transducer and connector, see Figure 87-1.

87.2 SAE J1587 EQUIVALENT CODE FOR FLASH CODE 87

The SAE J1587 equivalent code for Flash Code 87 is p 073/4.

87.3 TROUBLESHOOTING FLASH CODE 87

The following procedure will troubleshoot Flash Code 87.

87.3.1 Multiple Code Check

Perform the following steps to check for codes.

1. Turn vehicle ignition ON.
2. Plug in DDR. Read the codes.
   - [a] If codes p 73/4, 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4 are logged, refer to section 91.1.
   - [b] If code 073/4 is logged and no other codes are logged, refer to section 87.3.2.
   - [c] If code 073/4 is logged, and none of the following codes are logged: 100/3 or 4, 102/3 or 4, 110/3 or 4, 174/3 or 4 or 175/3 or 4, refer to section 87.3.2.

87.3.2 Sensor Check

Perform the following steps to check the sensor.

1. Turn ignition OFF.
2. Disconnect the pump pressure sensor connector and install a jumper between sockets B and C of the pump pressure sensor transducer connector.
3. Turn ignition ON.
4. Start engine and operate the Pressure Governor System (PGS) in the PRESSURE mode.
5. Read active codes.
   - [a] If code p 73/3 and any other code except p 73/4 display, check to ensure the ECM and PGS sensor connectors are wired properly. If wired properly, refer to section 87.3.3.
   - [b] If code p 73/4 and any other codes display, refer to section 87.3.4.

87.3.3 Check Pressure Governor System Sensor Connectors

Perform the following steps to check the pressure governor system (PGS) sensor connectors.

1. Turn ignition OFF.
2. Inspect terminals at the pump pressure sensor connectors (sensor and harness side) for damaged, bent, corroded, and unseated pins or sockets.
   - [a] If the terminals and connectors are not damaged, replace the PGS sensor. Refer to section 87.3.7.
   - [b] If the terminals and connectors are damaged, repair them. Refer to section 87.3.7.

87.3.4 Check for Short to Return

Perform the following steps to check for a short.

1. Turn ignition OFF.
2. Remove jumper wire.
3. Remove vehicle interface harness connector (30-pin).
4. Turn ignition ON.
5. Measure resistance between C3 (#952) and D3 (#749).
   - [a] If the measured resistance is less than 1,000 Ω, the wires are shorted to each other. Replace the harness.
   - [b] If the measured resistance is greater than 1,000 Ω, refer to section 87.3.5.

87.3.5 Check for Short to Battery (-)

Perform the following steps to check for a short to the battery (-).

1. Measure resistance between D3 (#749) and battery ground.
   - [a] If the measured resistance is less than 1,000 Ω, the #749 wire is shorted to the battery. Replace the harness and refer to section 87.3.7.
   - [b] If the measured resistance is greater than 1,000 Ω, refer to section 87.3.6.

87.3.6 Check for 5 Volt Open

Perform the following steps to check for a 5 volt open.

1. Plug in the 30-pin connector for the vehicle sensor harness.
2. Turn ignition ON.
3. Measure voltage between cavity B (#952) and A (#916) of the transducer connector.
   - [a] If the measurement is less than 4.5 volts, wire #916 is open. Repair the open or replace the harness. Refer to section 87.3.7.
   - [b] If the measurement is between 4.5 and 5.5 volts, the signal wire (#749) is open. Repair the wire and refer to section 87.3.7.

87.3.7 Verify Repairs

Perform the following steps to verify repairs.

1. Plug in all connectors.
2. Start and run the engine.
3. Plug in DDR and read the codes.
   - [a] If no codes are logged, troubleshooting is complete.

[b] If code p 073/4 is logged, review this section to find the error. Then, contact Detroit Diesel Technical Services.

88 (CHG) FLASH CODE 88

88.1 DESCRIPTION OF FLASH CODE 88

Flash Code 88 is used to identify coolant pressure low.

This code currently is not covered in this manual. If changes occur, notification will be sent from DDC.

89 FLASH CODE 89

89.1 DESCRIPTION OF FLASH CODE 89

This manual was designed to have the section number equal to the Flash Code for troubleshooting. This section is intentionally left blank.

No DDEC code is currently assigned to this number. If changes occur, notification will be sent from DDC.

90 (CHG) ENGINE SENSOR HARNESS

90.1 DESCRIPTION OF ENGINE SENSOR HARNESS

Referral to this section indicates a fault within the Engine Sensor Harness affecting signals of various sensors used by the DDEC system.

90.2 TROUBLESHOOTING ENGINE SENSOR HARNESS

The following procedure will troubleshoot the engine sensor harness.

90.2.1 Check for Low Battery Voltage

Perform the following steps to check for low battery voltage.

1. Plug in the diagnostic data reader (DDR).
   [a] If Flash Code 168/1 is logged, refer to section 46.3.
   [b] If code 168/1 is not logged, refer to section 90.2.2.

90.2.2 Check for +5 Volts

Perform the following steps to check for +5 volts.

1. Turn vehicle ignition switch OFF.
2. Disconnect the Oil Pressure Sensor (OPS) and Turbo Boost Sensor (TBS) connectors.
3. If applicable, disconnect the Fuel Pressure Sensor (FPS).
4. Turn vehicle ignition switch ON.
5. At each sensor harness connector, measure voltage between socket C (red lead) and socket A (black lead).
   [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 90.2.3.
   [b] If the voltage measurement is less than 4.7 volts at any or all connectors, refer to section 90.2.4.
   [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 90.2.6.

90.2.3 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Check terminals at the ECM engine harness connector (both the ECM and harness side) for damaged, bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are not damaged, check all sensors, especially OPS, TBS, and TPS (on vehicle system), this indicates that there is no problem on the engine sensor harness. Refer to section 91.1.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 90.2.7.

90.2.4 Check for +5 volts or Return Open

Perform the following steps to check for +5 volts or return open.

1. Turn vehicle ignition switch OFF.
2. Disconnect the engine harness connector at the ECM.
3. Install a jumper wire between sockets A and C of any sensor connector that reads less than 4.7 volts. Refer to section 90.2.2.
4. Measure resistance between sockets W1 and Y2 of the engine harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 90.2.5.
   [b] If the resistance measurement is greater than 5 Ω or open, either the engine +5 volt line (#416), or the return line (#452) is open. Repair the open and refer to section 90.2.7.

90.2.5 Check for Short to Ground

Perform the following steps to check for short to ground.

1. Turn vehicle ignition switch OFF.
2. Remove jumper wire.
3. Measure resistance between sockets A and C of the sensor connector.
4. Measure resistance between socket C of the sensor connector and a good ground.
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 90.2.3.
   [b] If either resistance measurement is less than or equal to 1,000 Ω, the engine +5 volt line (#416) is shorted to either the sensor return line (#452) or to chassis ground. Repair the short and refer to section 90.2.7.

90.2.6 Check for Short to Battery

Perform the following steps to check for a short to battery.

1. Turn vehicle ignition switch OFF.
2. Remove both fuses to the ECM.
3. Disconnect all five connectors at the ECM.
4. Measure resistance between socket W1 on the engine harness connector and B3 on the vehicle harness connector.
5. Measure resistance between socket W1 on the engine harness connector and the battery (+).
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 90.2.3.

[b] If either resistance measurement is less than or equal to 1,000 Ω, a short exists between sockets where reading was taken. Repair the short and refer to section 90.2.7.

90.2.7 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Check Engine Light (CEL) does not stay on, start engine and run for one minute
7. Stop engine.
8. Read inactive codes with the DDR.

   [a] If no codes are logged, troubleshooting is complete.

   [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 90.2.1.

   [c] If codes except those which brought you to this section are logged, refer to section 9.1.

91 (CHG) VEHICLE HARNESS

91.1 DESCRIPTION OF VEHICLE HARNESS +5 VOLT SUPPLY

Referral to this section indicates a fault within the vehicle interface harness.

NOTE:
It is suggested that the vehicle interface module be installed for test. If the fault(s) clear, you may wish to contact the vehicle manufacturer for instructions on troubleshooting. Otherwise, continue with this section.

91.2 TROUBLESHOOTING VEHICLE HARNESS +5 VOLT SUPPLY

The following procedure will troubleshoot vehicle harness.

91.2.1 Check for Low Battery Voltage

Perform the following steps to check for low battery voltage.

1. Plug in the diagnostic data reader (DDR).
   [a] If code 168/1 is logged, refer to section 46.3.1.
   [b] If code 168/1 is not logged, refer to section 91.2.2.

91.2.2 Check for +5 Volts

Perform the following steps to check for +5 volts at the Throttle Position Sensor (TPS).

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS (disconnect the VSG and PGS, if applicable).
3. Turn vehicle ignition switch ON.
4. Measure voltage on the TPS and VSG harness connector, pin C (#916) (red lead) to pin A (#952) (black lead), and pin A to pin B at the PGS connector, if applicable.
   [a] If the voltage measurement is between 4.7 and 5.2 volts, the voltage reading is correct. Check voltage at the next connector. If all connector voltage readings are correct, refer to section 91.2.5.
   [b] If the voltage measurement is less than 4.7 volts, refer to section 91.2.3.
   [c] If the voltage measurement is greater than 5.2 volts at all connectors, refer to section 91.2.8.

91.2.3 Check for +5 volts or Return Open

Perform the following steps to check for +5 volts or return open.

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM.
3. Install a jumper wire between pins A and C of the TPS harness connector.
4. Measure resistance between sockets A3 and C3 of the vehicle harness connector.
   [a] If the resistance measurement is less than or equal to 5 Ω, refer to section 91.2.4.
   [b] If the resistance measurement is greater than 5 Ω or open, either the vehicle +5 volt line (#916) or the sensor return line (#952) is open. Refer to section 91.2.9.

91.2.4 Check for +5 Short to Ground

Perform the following steps to check for +5 short to ground.

1. Remove jumper wire.
2. Measure resistance between pins A and C of the TPS harness connector.
3. Measure resistance between pin C of the TPS harness connector and a good ground (battery-).
   [a] If the resistance measurement for both readings is greater than 1,000 Ω, or open, refer to section 91.2.7.
   [b] If either resistance measurement is less than or equal to 1,000 Ω, wire (#916) is shorted to wire (#952), or battery ground. Repair the short and refer to section 91.2.9.

91.2.5 Vehicle Harness 5V Check TPS

Perform the following steps to check TPS.

1. Turn vehicle ignition switch OFF.
2. Reconnect the TPS connector.
3. Turn vehicle ignition switch ON.
4. Select Throttle Sensor percentage on the DDR.
5. Observe throttle percentage at both no throttle and full throttle (engine not running).
   [a] If the percentage is between 0 and 100%, refer to section 91.2.7.
   [b] If not getting a reading between 0 and 100%, refer to section 91.2.6.

91.2.6 Vehicle Harness 5V Check Throttle Position Sensor Connectors

Perform the following steps to check TPS connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the TPS.
3. Inspect terminals at the TPS connectors (sensor side and harness side) for damage; bent, corroded and unseated pins or sockets.
   [a] If the terminals and connectors are not damaged, replace TPS. Refer to section 91.2.9.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 91.2.9.

91.2.7 Check ECM Connectors

Perform the following steps to check the ECM connectors.

1. Turn vehicle ignition switch OFF.
2. Disconnect the vehicle harness connector at the ECM (if not already disconnected).

3. Check terminals at the ECM vehicle harness connector (both the ECM and harness side) for damage; bent, corroded and unseated pins or sockets (especially terminals #952, #916, #417 and #510). Install new terminal if in doubt.
   [a] If the terminals and connectors are not damaged, refer to section 90.2.2.
   [b] If the terminals and connectors are damaged, repair them. Refer to section 91.2.9.

91.2.8 Check for Short to Battery (+)

Perform the following steps to check for a short to battery (+).

1. Turn vehicle ignition switch OFF.
2. Remove both fuses or circuit breakers to the ECM.
3. Disconnect the vehicle harness and the 5-pin power harness connectors at the ECM.
4. Measure resistance between sockets A3 and B3 on the vehicle harness connector.
5. Measure resistance between socket A3 on the vehicle harness connector and the battery (+).
   [a] If the resistance measurement for all readings is greater than 1,000 Ω, or open, refer to section 91.2.7.
   [b] If the resistance measurement is less than 1,000 Ω, a short exists between the vehicle +5 volt line (#916) and the lines where less than 1,000 was read (either circuit #240, #241 or #439). Repair the short and refer to section 91.2.9.

91.2.9 Verify Repairs

Perform the following steps to verify repairs.

1. Turn vehicle ignition switch OFF.
2. Reconnect all connectors.
3. Reconnect fuses (or circuit breakers) if previously disconnected.
4. Turn ignition ON.
5. Clear codes.
6. If Check Engine Light (CEL) does not stay on, start engine and run for one minute.
7. Stop engine.
8. Read inactive codes with the DDR.
   [a] If no codes are logged, troubleshooting is complete.
   [b] If codes that brought you to this section are still logged, all system diagnostics are complete. Review this section from the first step to find the error. Refer to section 91.2.1.
   [c] If codes except those which brought you to this section are logged, refer to section 9.1.

92 (CHG) ENGINE WIRING SCHEMATICS

92.1 INJECTOR HARNESS WIRING SCHEMATIC - SERIES 50 ENGINES WITH JAKE BRAKE

The following wire schematics support the injector harness; see Figure 92-1.

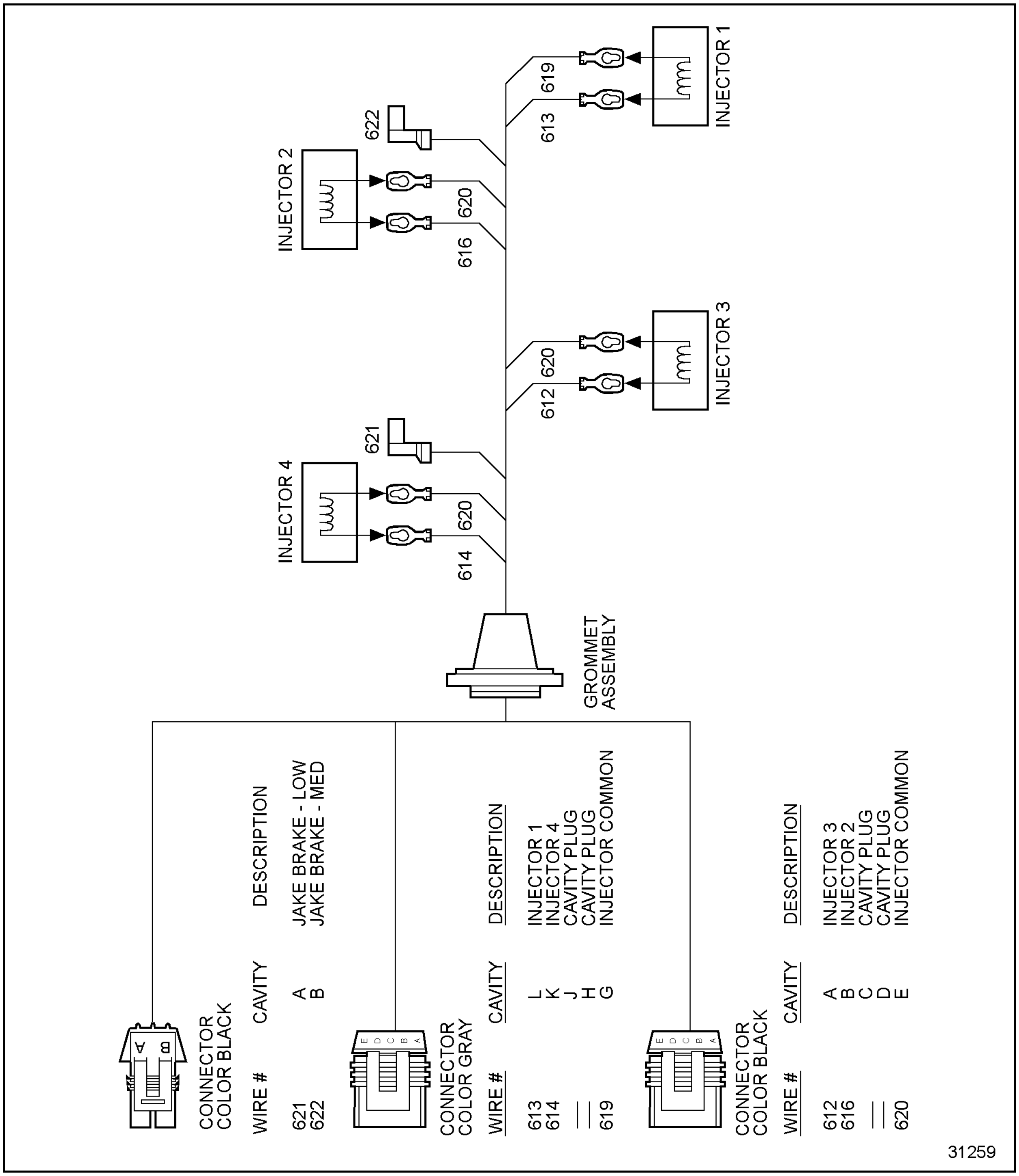
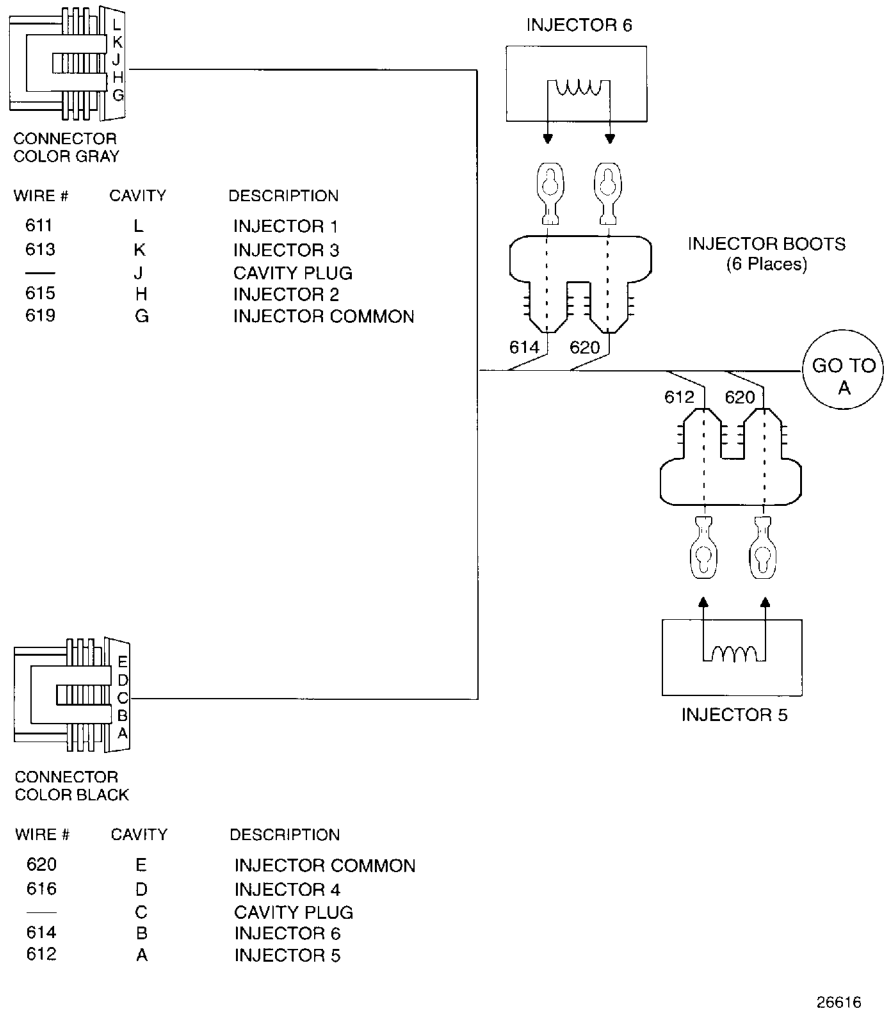


Figure 92-1 Injector Harness - Series 50 Engines With Jake Brake

92.2 INJECTOR HARNESS WIRING SCHEMATIC - SERIES 60 ENGINES

The following wire schematics support the injector harness; see Figure 92-2.



For "Go To A", see Figure 92-3.

Figure 92-2 Injector Harness (Sheet 1-2) (Series 60 Shown)

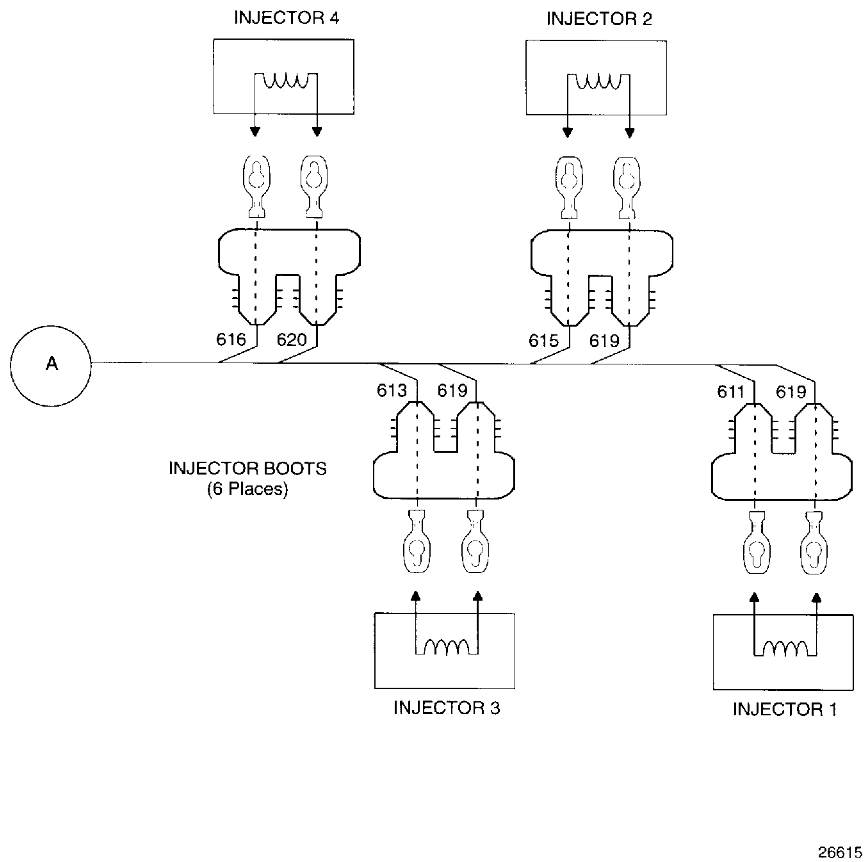


Figure 92-3 Injector Harness (Sheet 2-2)

92.3 INJECTOR HARNESS WIRING SCHEMATIC - SERIES 6V92 ENGINES

The following wire schematics support the injector harness; see Figure 92-4.

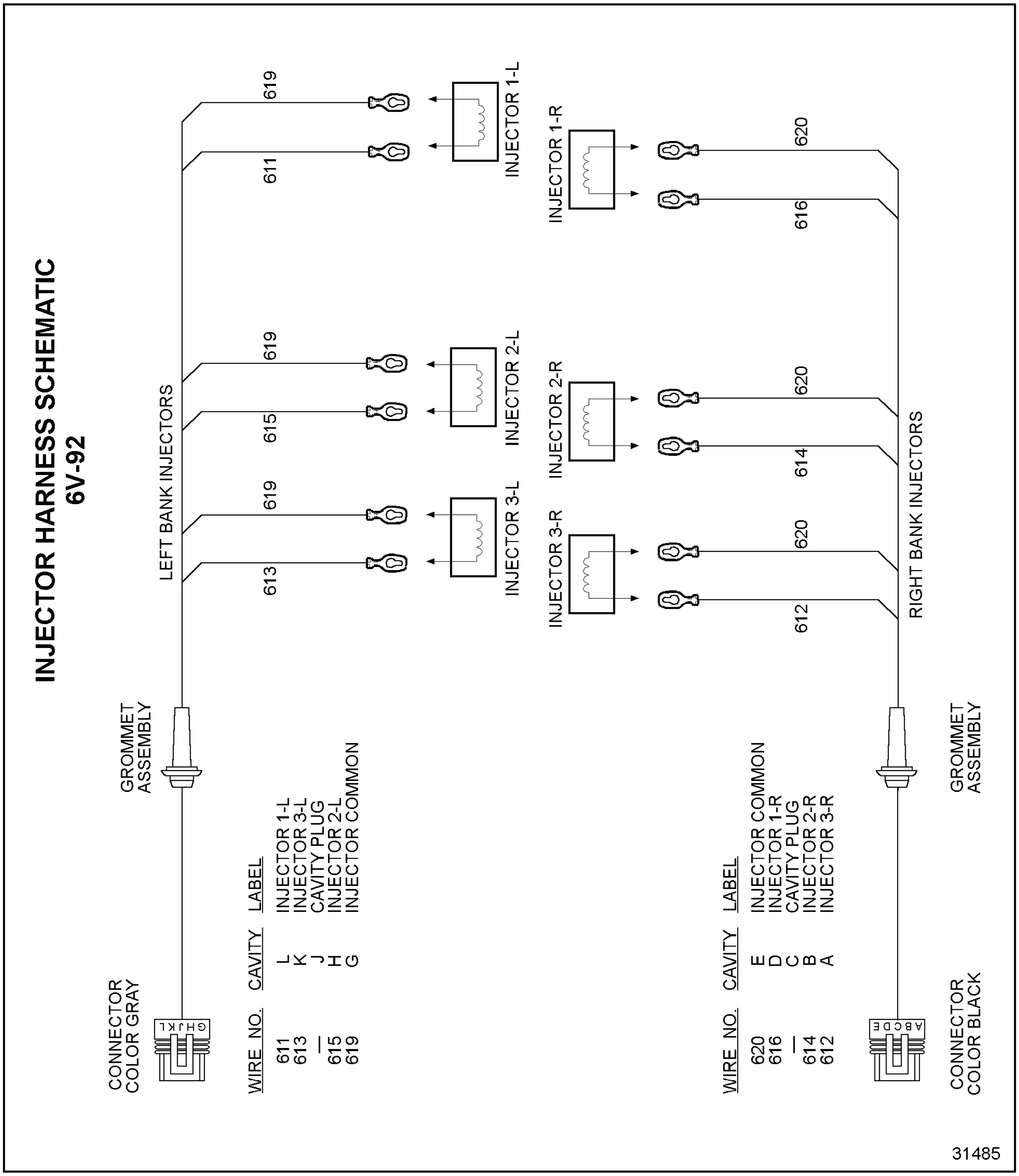


Figure 92-4 Injector Harness - Series 6V92 Engines

92.4 INJECTOR HARNESS WIRING SCHEMATIC - SERIES 8V92 AND 8V149 ENGINES

The following wire schematics support the injector harness; see Figure 92-5.

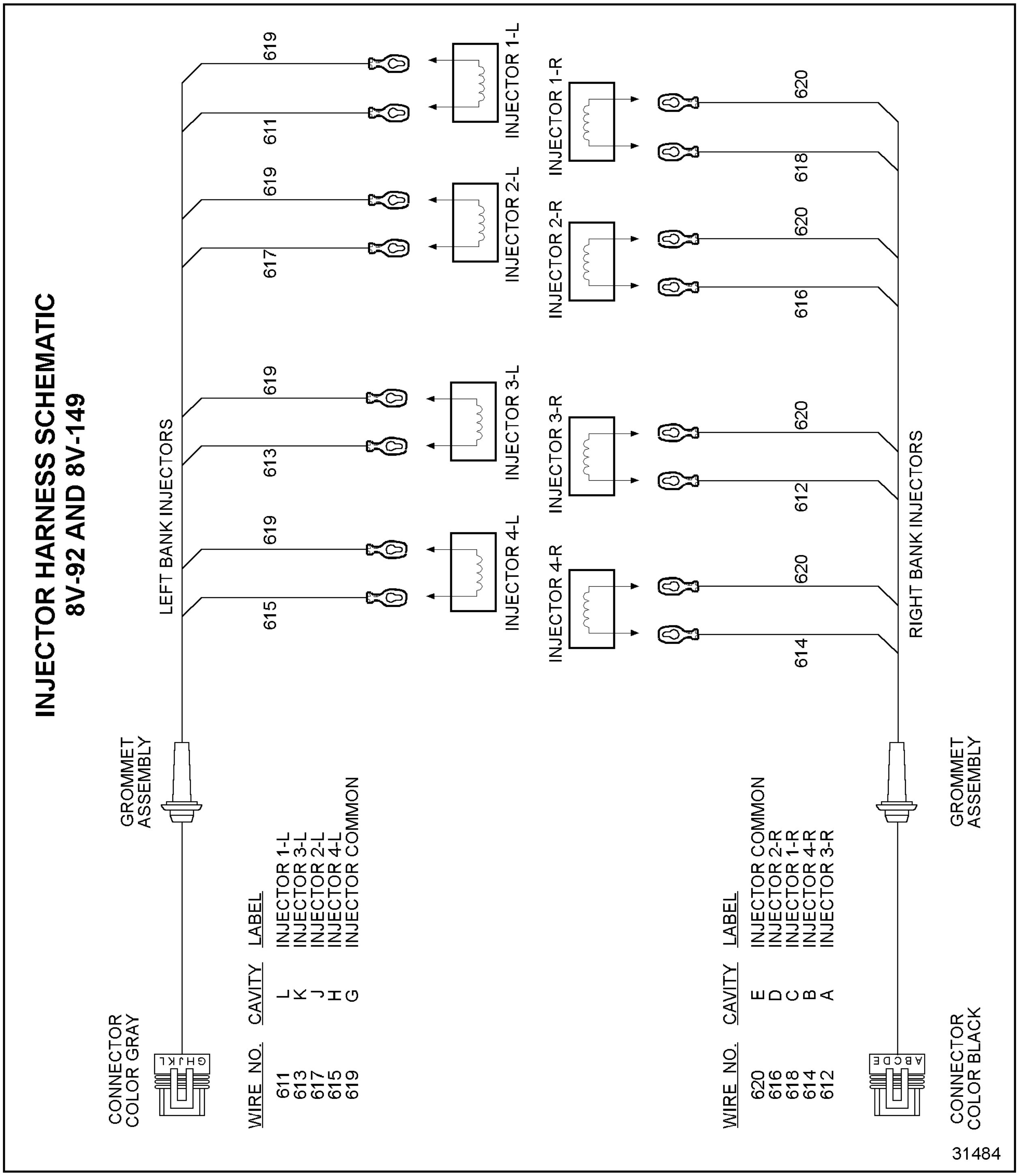
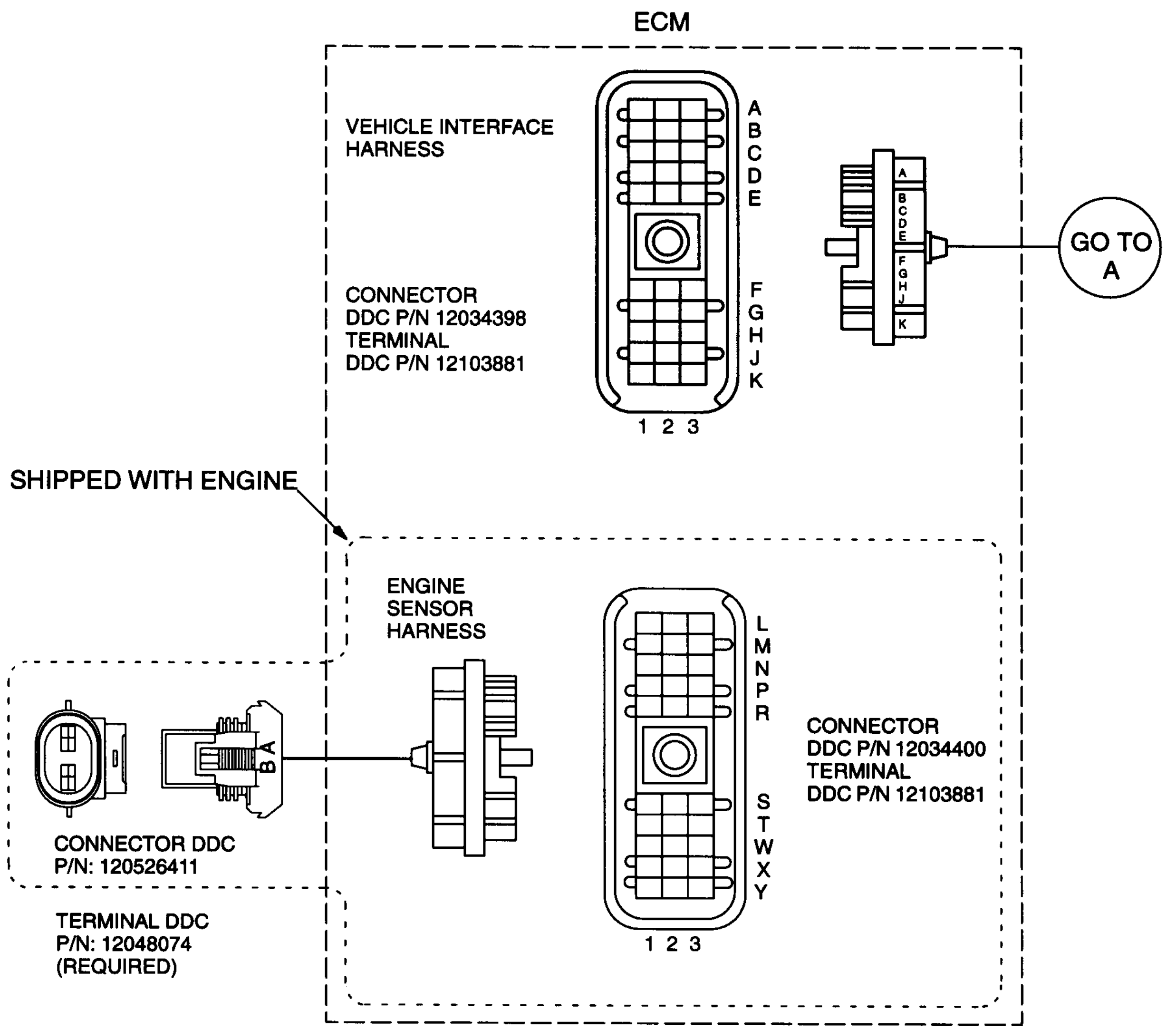


Figure 92-5 Injector Harness - Series 8V92 and 8V149 Engines

92.5 INTERNAL ENGINE BRAKE FOR ECM/WORLD TRANSMISSION INTERFACE

The following wire schematics support the internal engine brake for ECM/World transmission interface; see Figure 92-6.



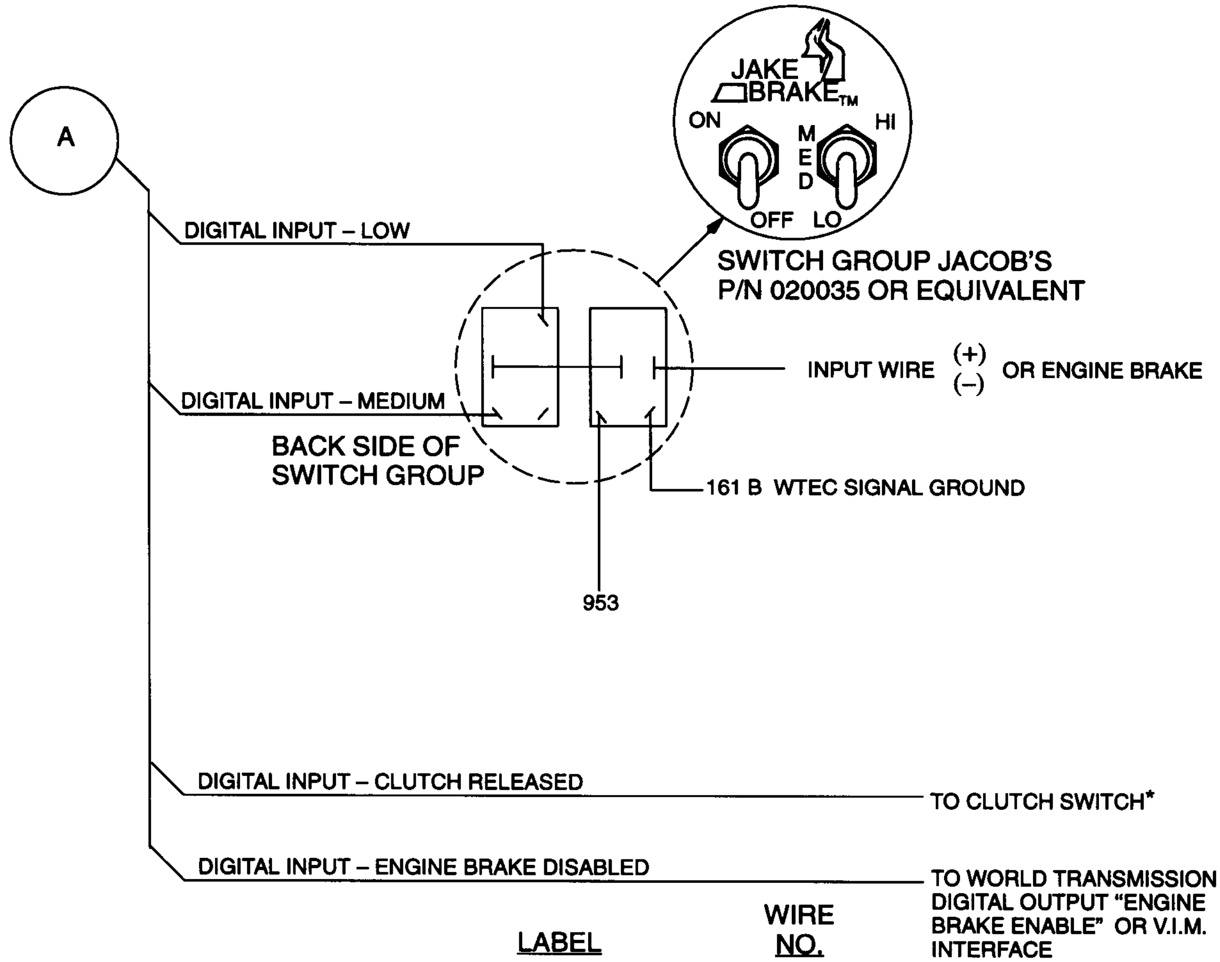
LABEL	WIRE NO.	DDEC CAVITY	COLOR	ENGINE CONN.
ENG BRAKE LOW CTL	562	T–3	LT GRN	A
ENG BRAKE MED CTL	561	S–3	LT BLU	B

*

24627

For "Go To A", see Figure 92-7.

Figure 92-6 Internal Engine Brake ECM/World Transmission Interface (Sheet 1-2)

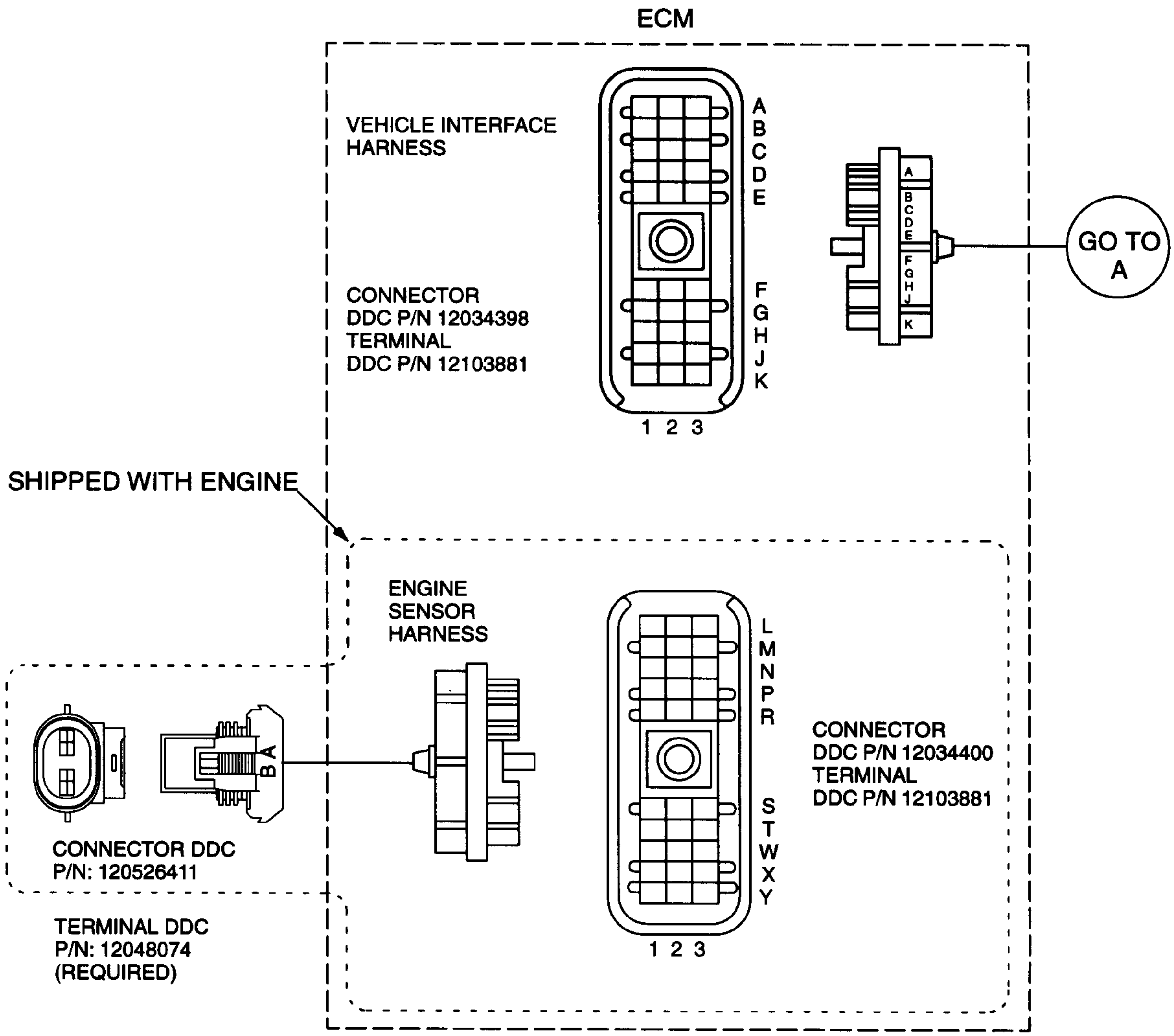


LABEL	WIRE NO.
ENG BRAKE LOW	DIGITAL IN
ENG BRAKE MED	DIGITAL IN
ENG BRAKE DISABLED	DIGITAL IN
*CLUTCH RELEASED	DIGITAL IN

Figure 92-7 Internal Engine Brake ECM/World Transmission Interface (Sheet 2-2)

92.6 INTERNAL ENGINE BRAKE FOR DDEC SYSTEM ECM

The following wire schematics support the internal engine brake; see Figure 92-8.



LABEL	WIRE NO.	DDEC CAVITY	COLOR	ENGINE CONN.
ENG BRAKE LOW CTL	562	T–3	ORN	A
ENG BRAKE MED CTL	561	S–3	RED	B

24622

For "Go To A", see Figure 92-9.

Figure 92-8 Internal Engine Brake (Sheet 1-2)

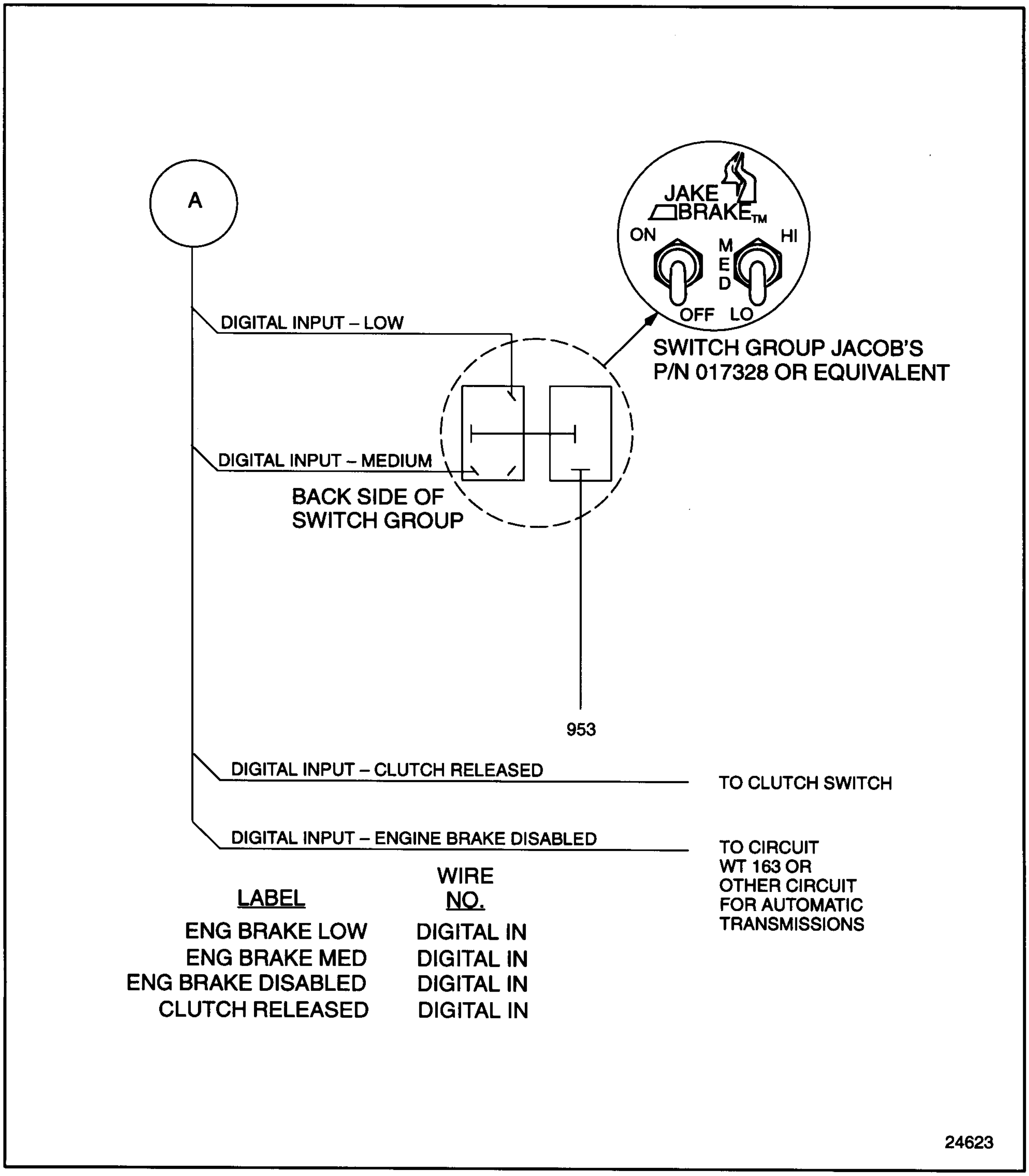


Figure 92-9 Internal Engine Brake (Sheet 2-2)

92.7 ENGINE HARNESS

The following wire schematics support the engine harness; see Figure 92-10.

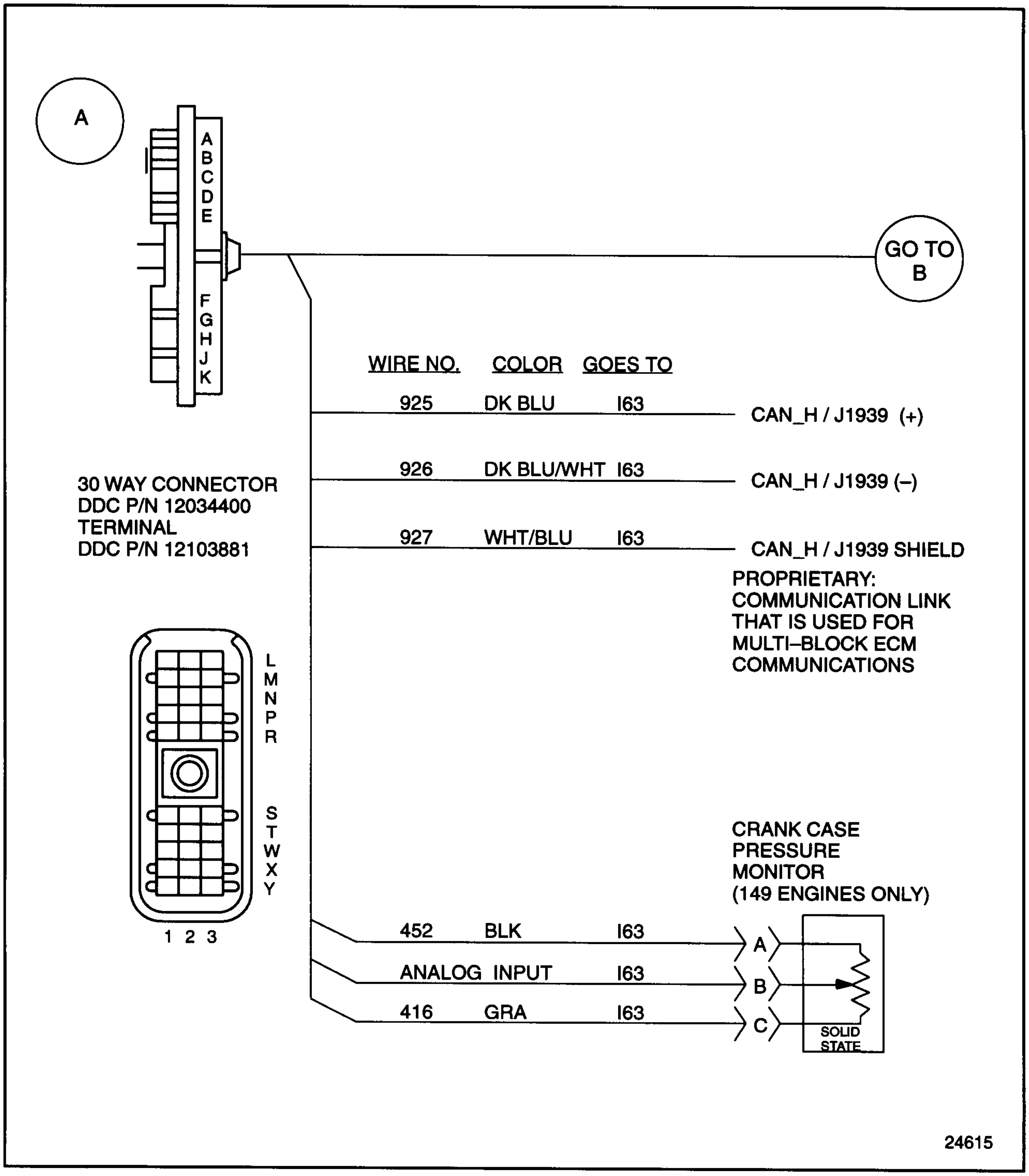
LABEL	WIRE NO	CAVITY	COLOR
TRS (–)	109	T–1	PPL
TRS (+)	110	T–2	DK GRN
SRS (+)	111	S–2	LT BLU
SRS (–)	112	S–1	WHT
OIL TEMPERATURE	120	R–2	TAN
AIR TEMPERATURE	132	N–2	YEL/RED
COOLANT TEMP	133	P–3	PNK
SENSOR SUPPLY (5VDC)	416	W–1	GRA
TURBO BOOST	432	P–1	ORN
SENSOR RETURN (ENGINE)	452	Y–2	BLACK
FUEL TEMP	472	R–3	ORN
OIL PRESSURE	530	P–2	BRN
ENGINE BRAKE MED	561	S–3	LT BLU
ENGINE BRAKE LO	562	T–3	LT GRN
DIGITAL OUTPUT W–3	563	W–3	YEL
DIGITAL OUTPUT X–3	564	X–3	TAN/BLK
DIGITAL OUTPUT Y–3	565	Y–3	RED
TIMED INPUT	573	X–1	BRN
BARO PRESSURE	904	L–1	PPL/WHT
FUEL PRESSURE	905	M–1	YEL
ANALOG INPUT #3	906	N–1	ORN
ANALOG INPUT #6	907	R–1	DK GRN
PWM OUT #2	909	Y–1	LT GRN/YEL
PWM OUT #3	910	W–2	ORN
PWM OUT #4	911	X–2	PNK
J1939 (+)	925	L–3	DK BLU
J1939 (–)	926	M–3	DK BLU/WHT
J1939 SHIELD	927	N–3	WHT/BLU
ANALOG INPUT #5	958	M–2	BLU
ANALOG INPUT #4	976	L–2	DK GRN

GO TO A

24614

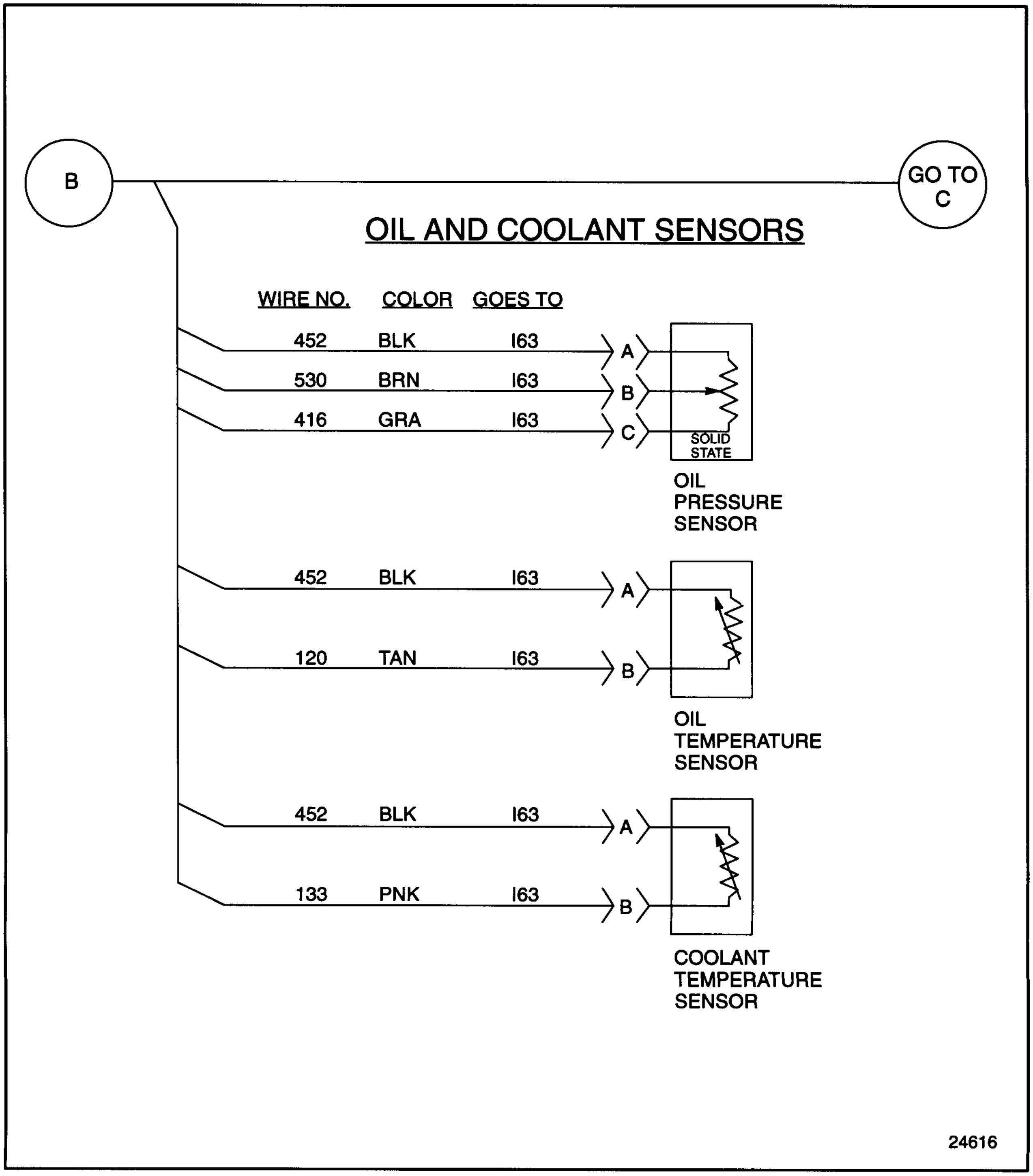
For "Go To A", see Figure 92-11.

Figure 92-10 Engine Harness (Sheet 1-7)



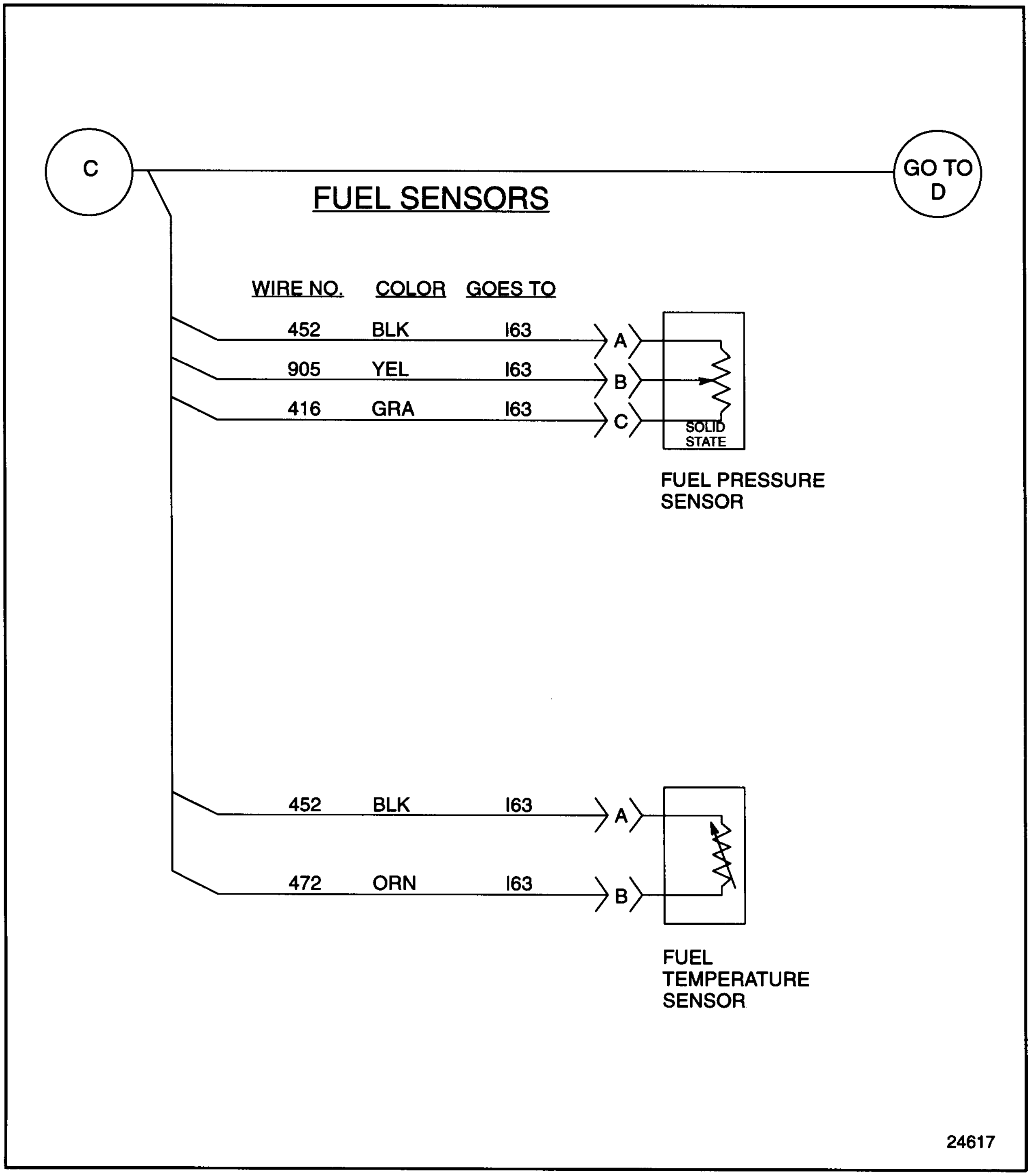
For "Go To B", see Figure 92-12.

Figure 92-11 Engine Harness (Sheet 2-7)



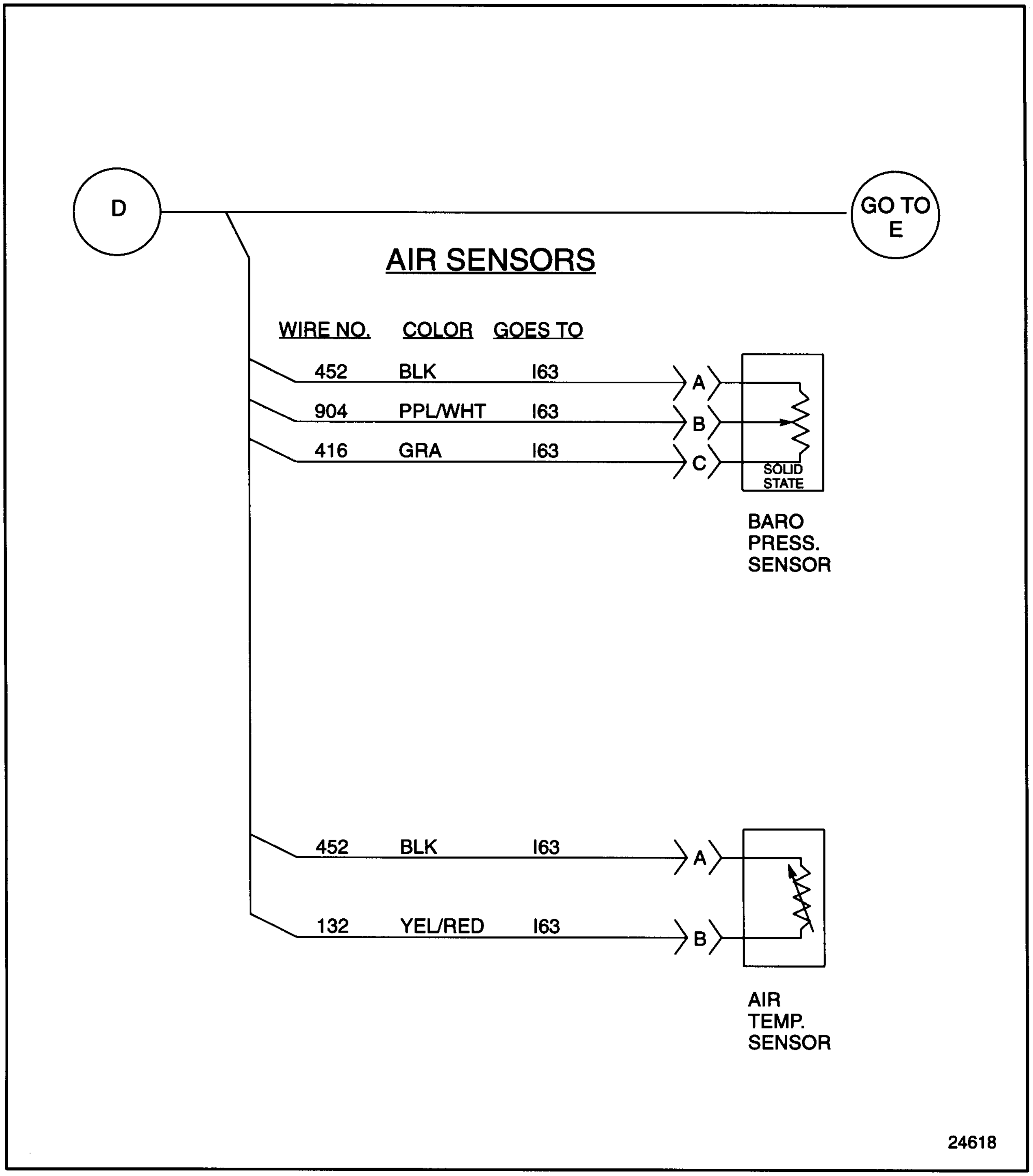
For "Go To C", see Figure 92-13.

Figure 92-12 Engine Harness (Sheet 3-7)



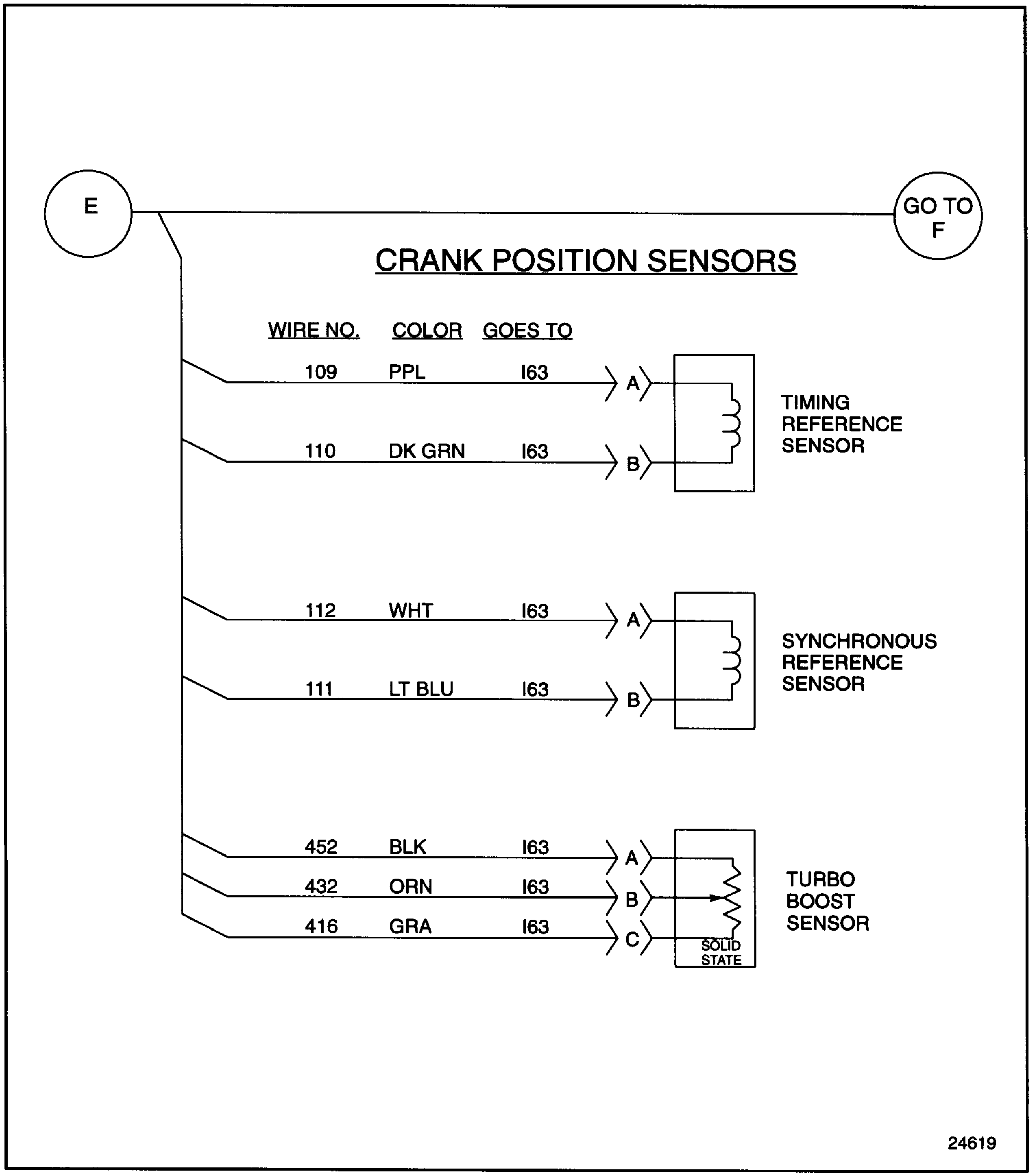
For "Go To D", see Figure 92-14.

Figure 92-13 Engine Harness (Sheet 4-7)



For "Go To E", see Figure 92-15.

Figure 92-14 Engine Harness (Sheet 5-7)



For "Go To F", see Figure 92-16.

Figure 92-15 Engine Harness (Sheet 6-7)

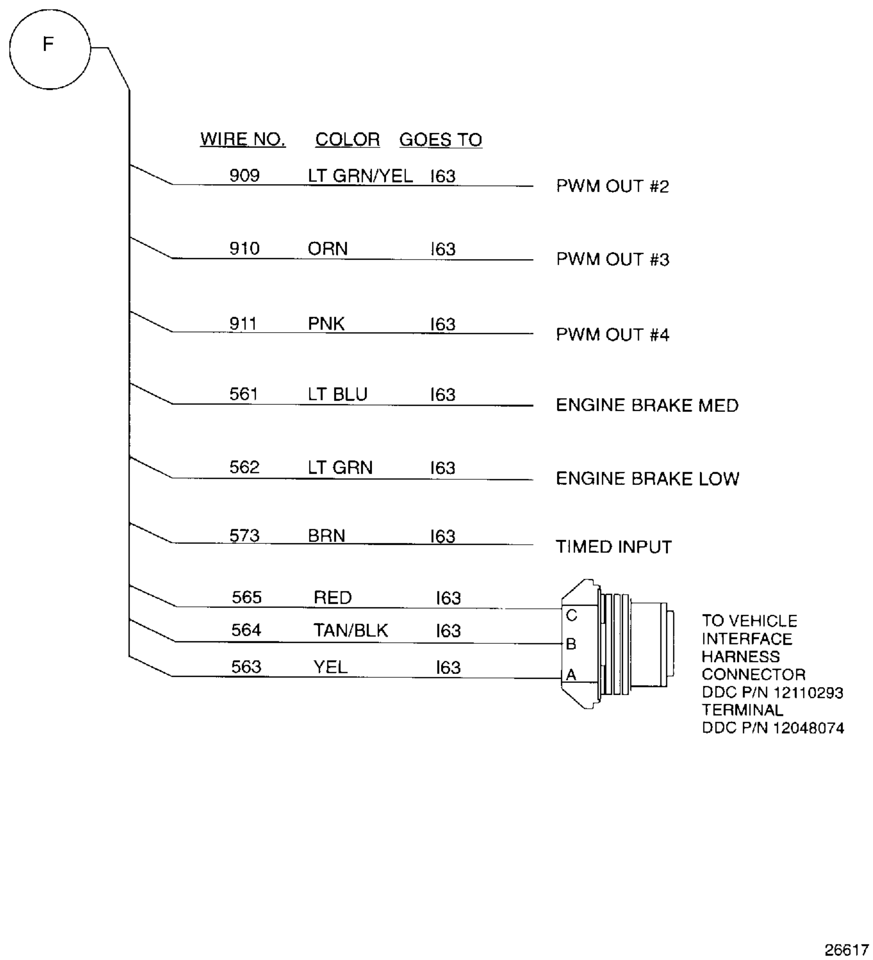


Figure 92-16 Engine Harness (Sheet 7-7)

93 (CHG) VEHICLE WIRING SCHEMATICS

93.1 VEHICLE INTERFACE HARNESS

The following wire schematics support the vehicle interface harness; see Figure 93-1.

LABEL	WIRE NO	CAVITY	COLOR
COOLANT LEVEL	115	H–3	ORN
LIMITING SPEED GOVERNOR	417	D–2	DK BLUE
CHECK ENGINE LIGHT	419	B–1	PPL/WHT
IGNITION	439	B–3	PNK
DIGITAL INPUT E–1	451	E–1	LT GRN
DIGITAL OUTPUT F–3	499	F–3	LT BLU
TACHOMETER DRIVE	505	K–1	GRA
STOP ENGINE LIGHT	509	B–2	PPL
VARIABLE SPEED GOVERNOR	510	D–1	BRN
DIGITAL INPUT H–1	523	H–1	GRA/RED
DIGITAL INPUT H–2	524	H–2	GRA
DIGITAL INPUT G–1	528	G–1	BRN/RED
DIGITAL INPUT J–2	531	J–2	ORN
DIGITAL INPUT J–1	541	J–1	YEL/RED
DIGITAL INPUT F–1	542	F–1	YEL
DIGITAL INPUT G–2	543	G–2	ORN/BLK
DIGITAL INPUT F–2	544	F–2	BRN/WHT
DIGITAL INPUT G–3	545	G–3	LT BLUE/YEL
DIGITAL OUTPUT A–2	555	A–2	TAN
VEHICLE SPEED (+)	556	E–2	LT BLUE/BLK
VEHICLE SPEED (–)	557	E–3	LT BLUE/ORN
DIGITAL INPUT K–2	583	K–2	LT BLUE/BLK
ANALOG INPUT #7	749	D–3	YEL
DATA LINK (+)	900	C–2	DK GREEN/YEL
DATA LINK (–)	901	C–1	DK GREEN
PWM #1 OUTPUT	908	J–3	WHT
SENSOR SUPPLY (5VDC)	916	A–3	RED/BLK
SENSOR RETURN	952	C–3	BLK
DIGITAL INPUT K–3	979	K–3	WHT
DIGITAL OUTPUT A–1	988	A–1	GRA

GO TO A

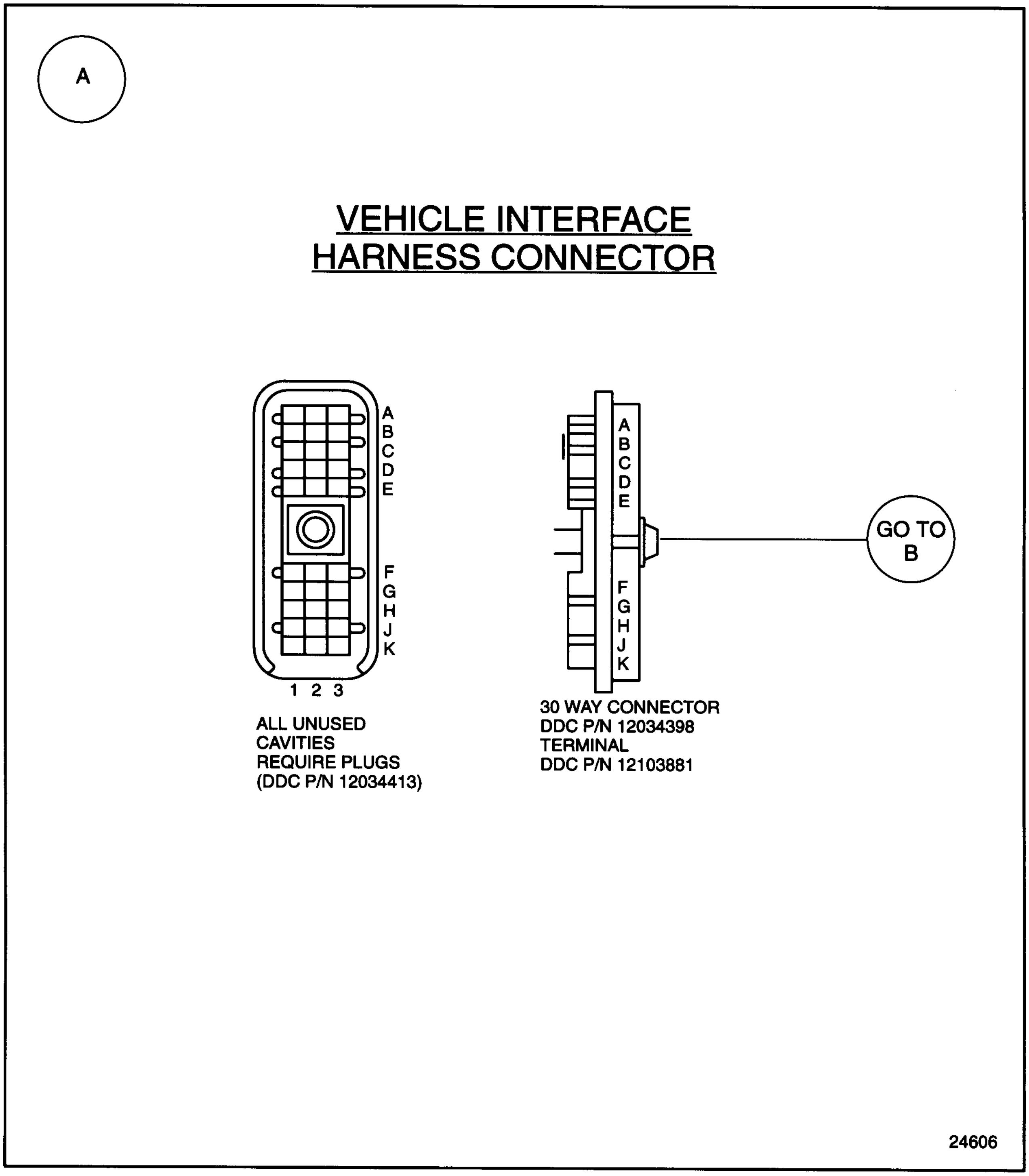
IGNITION CONNECTOR

LABEL	WIRE NO	CAVITY	COLOR
+12 V FROM BATTERY	440	A	ORN
BATTERY GROUND	953	B	BLK/WHT

24605

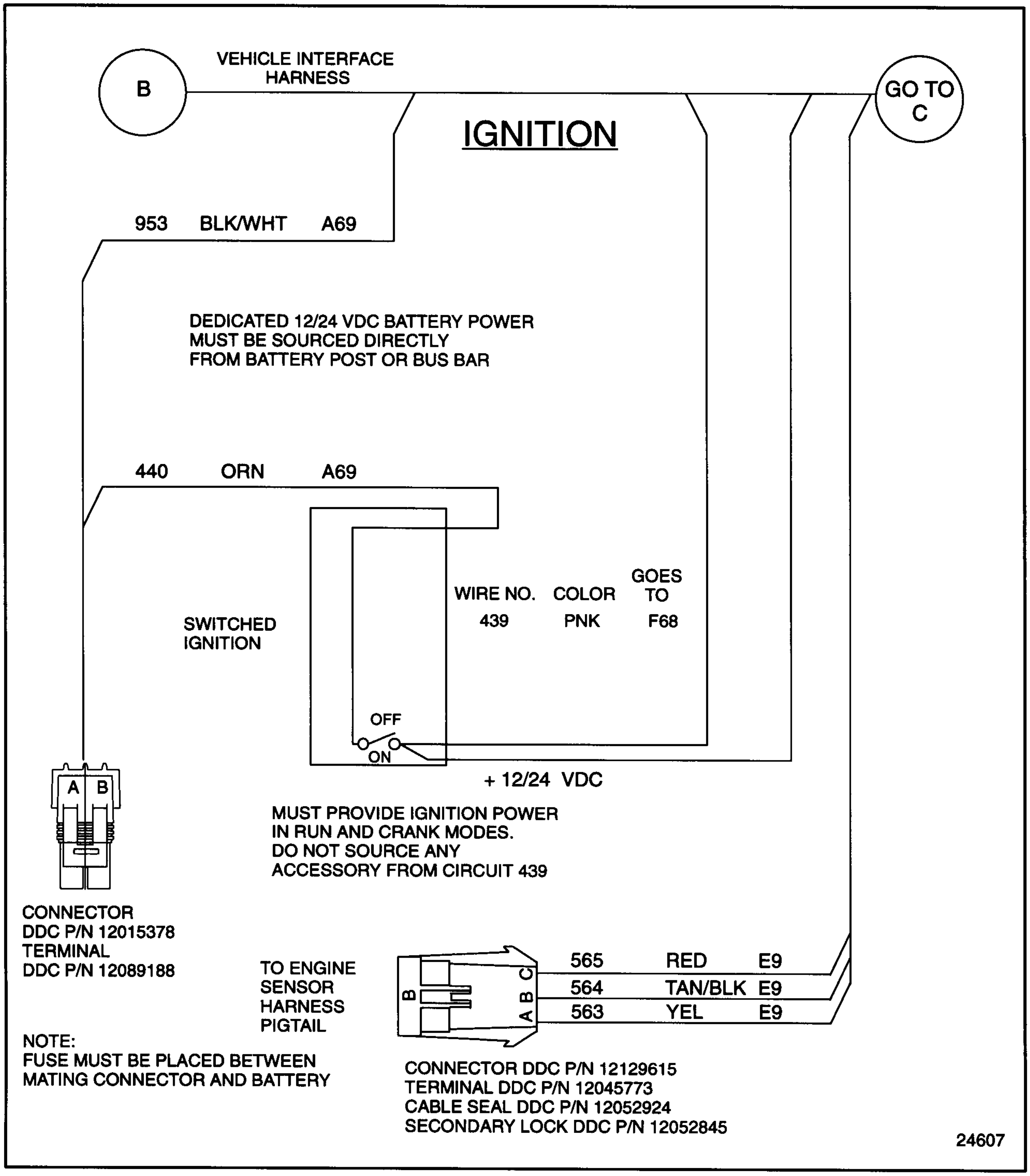
For "Go To A", see Figure 93-2.

Figure 93-1 Vehicle Interface Harness (Sheet 1-9)



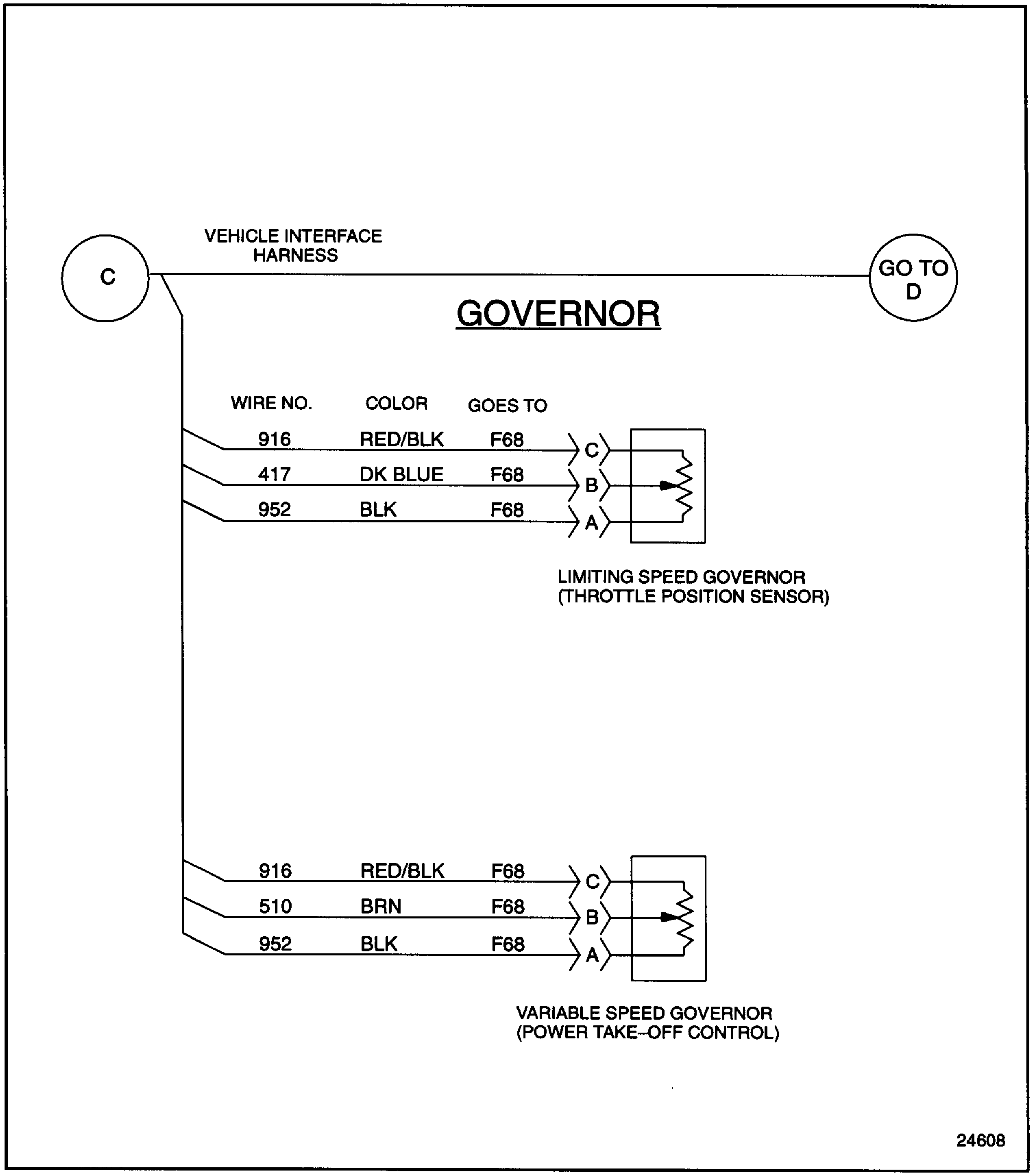
For "Go To B", see Figure 93-3.

Figure 93-2 Vehicle Interface Harness (Sheet 2-9)



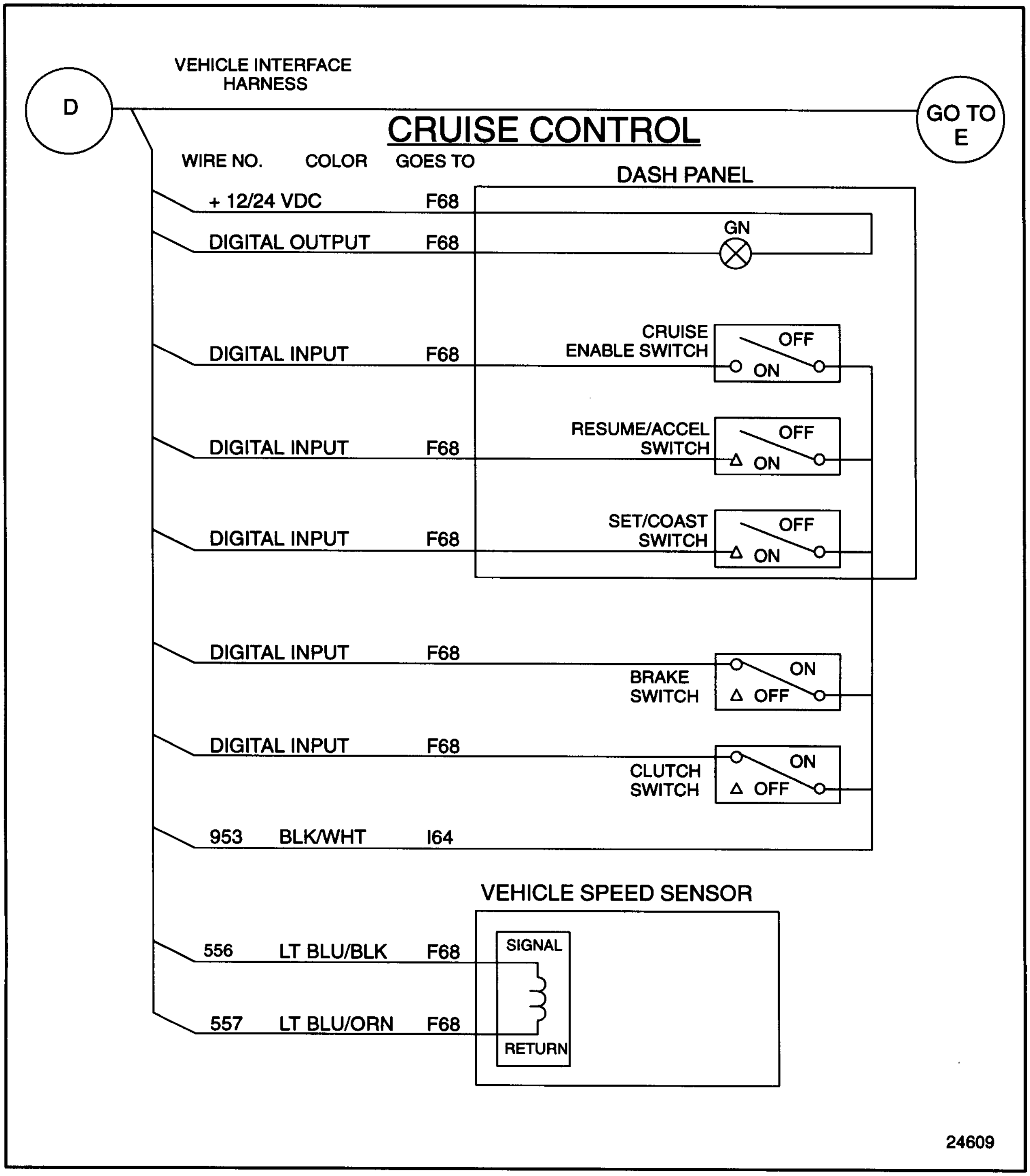
For "Go To C", see Figure 93-4.

Figure 93-3 Vehicle Interface Harness (Sheet 3-9)



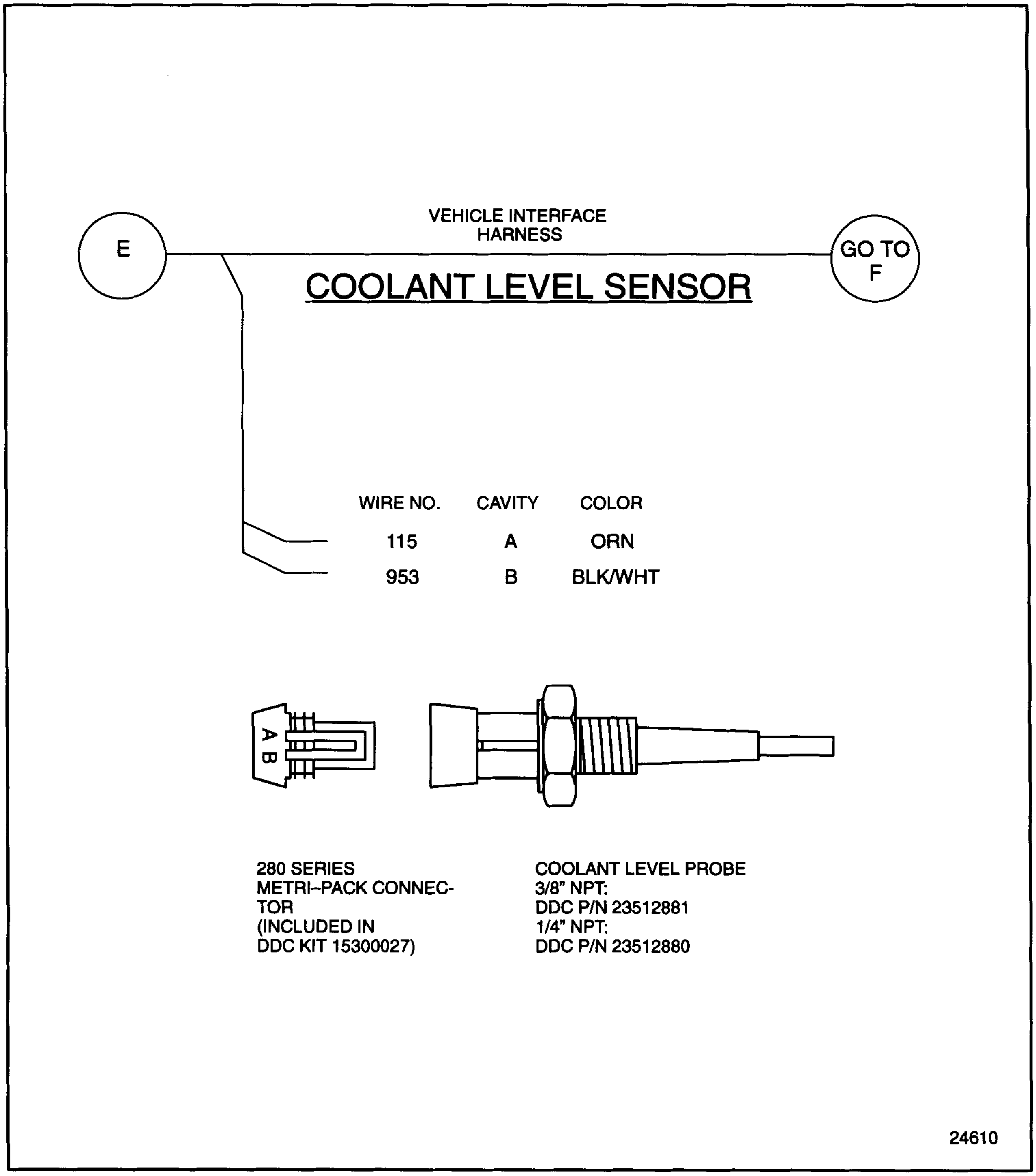
For "Go To D", see Figure 93-5.

Figure 93-4 Vehicle Interface Harness (Sheet 4-9)



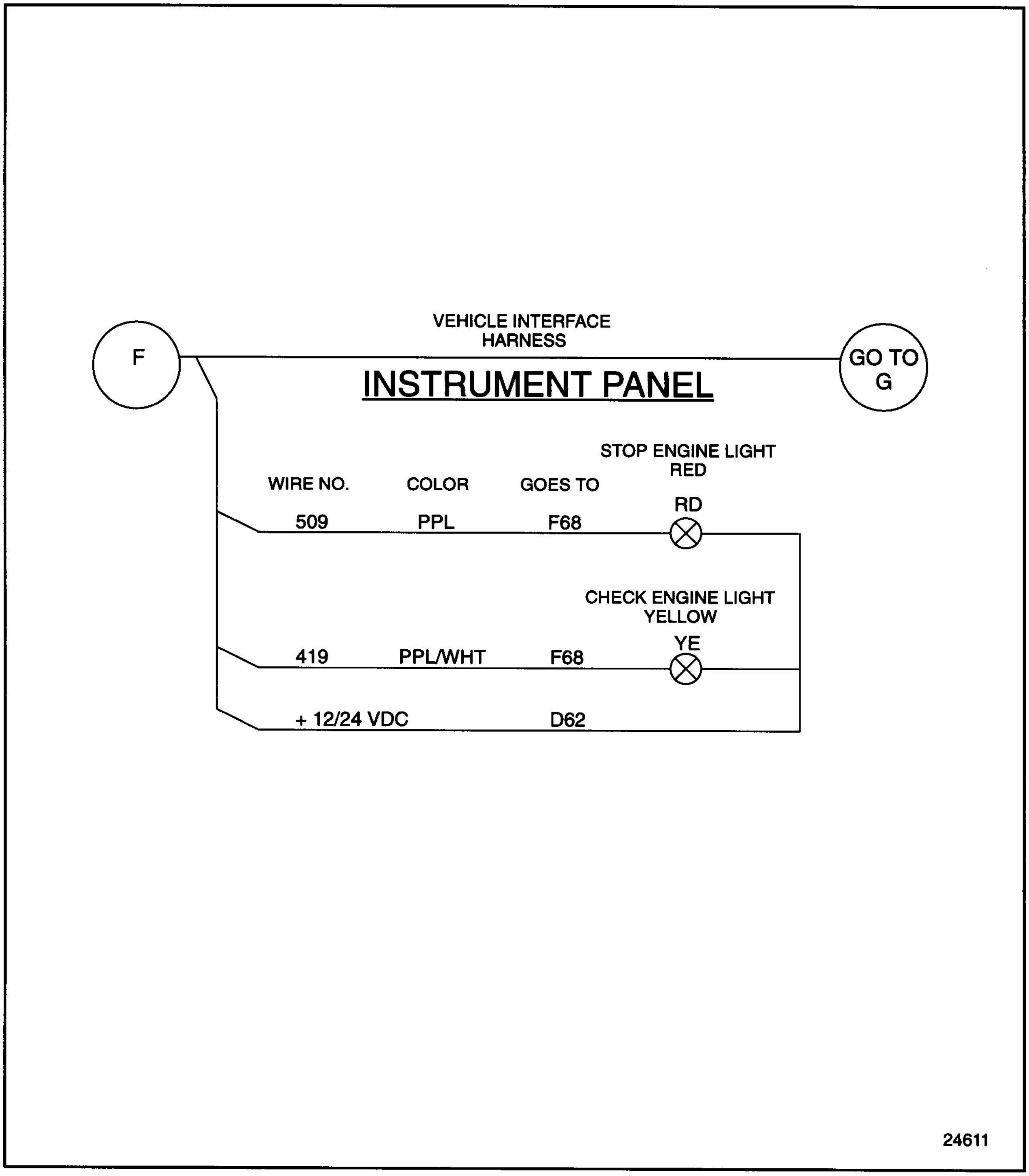
For "Go To E", see Figure 93-6.

Figure 93-5 Vehicle Interface Harness (Sheet 5-9)



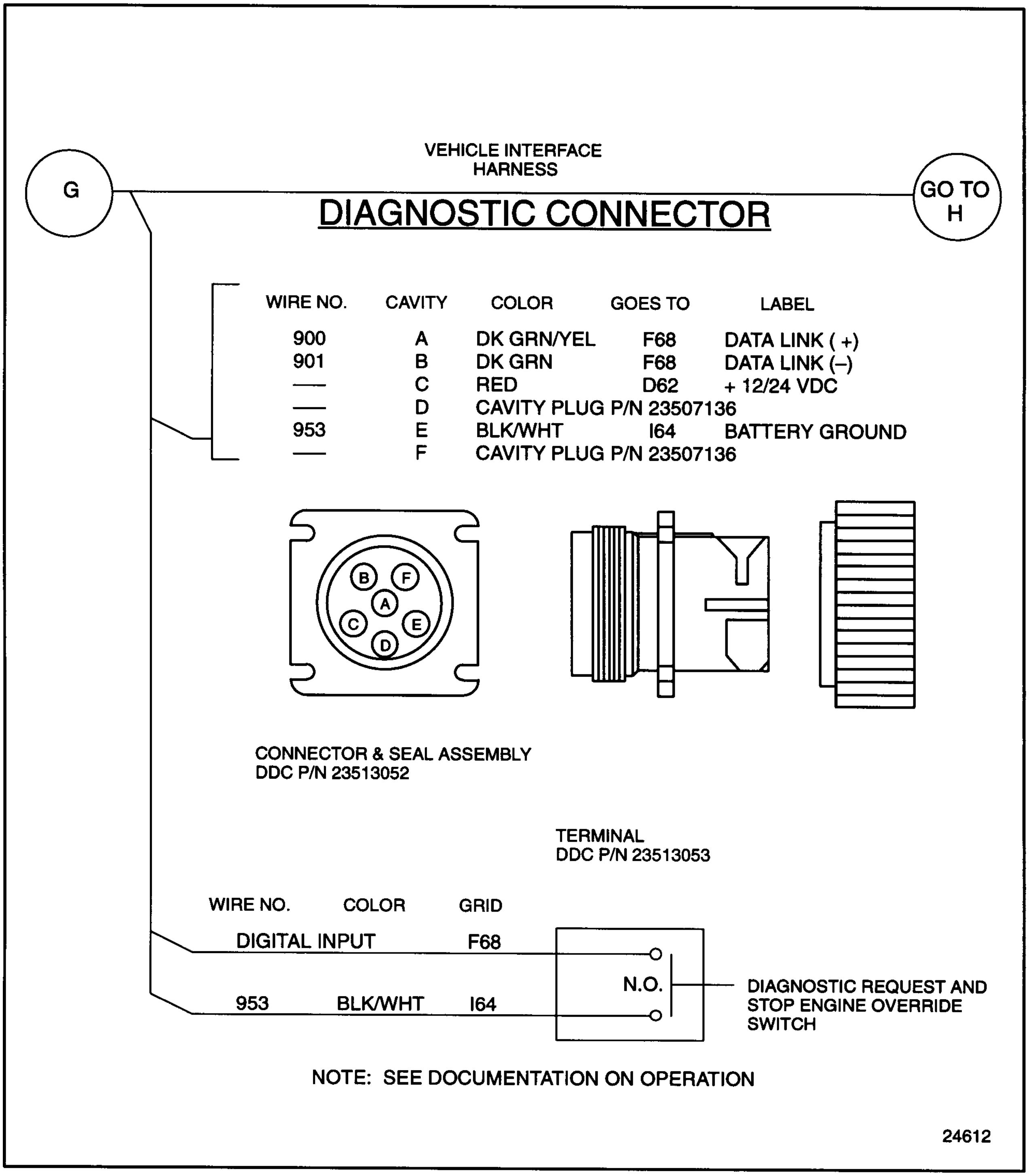
For "Go To F", see Figure 93-7.

Figure 93-6 Vehicle Interface Harness (Sheet 6-9)



For "Go To G", see Figure 93-8.

Figure 93-7 Vehicle Interface Harness (Sheet 7-9)



For "Go To H", see Figure 93-9.

Figure 93-8 Vehicle Interface Harness (Sheet 8-9)

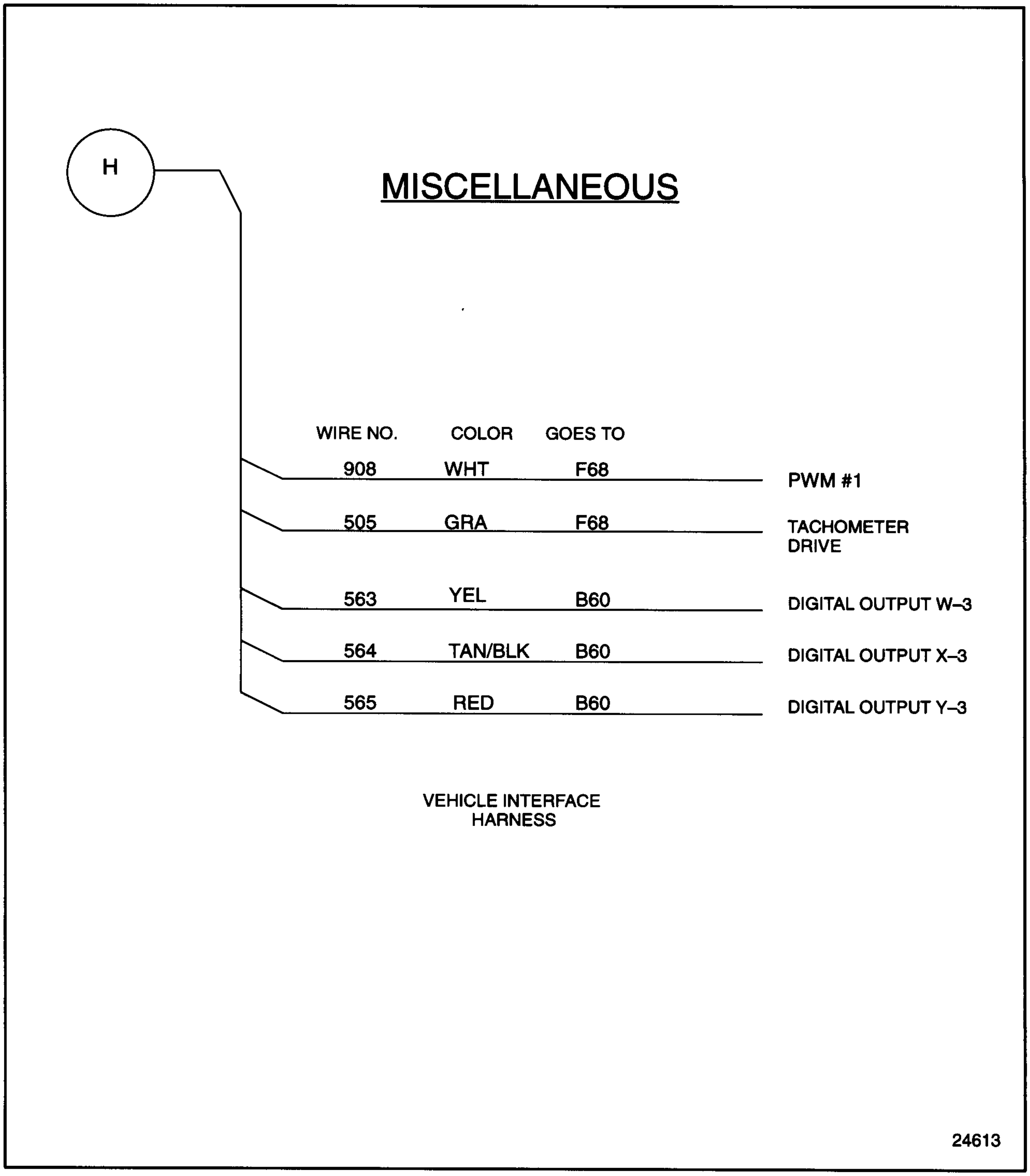


Figure 93-9 Vehicle Interface Harness (Sheet 9-9)

93.2 PRESSURE GOVERNOR SYSTEM - VEHICLE INTERFACE HARNESS CONNECTOR

The following wire schematics support the Pressure Governor System (PGS) vehicle interface harness connector; see Figure 93-10.

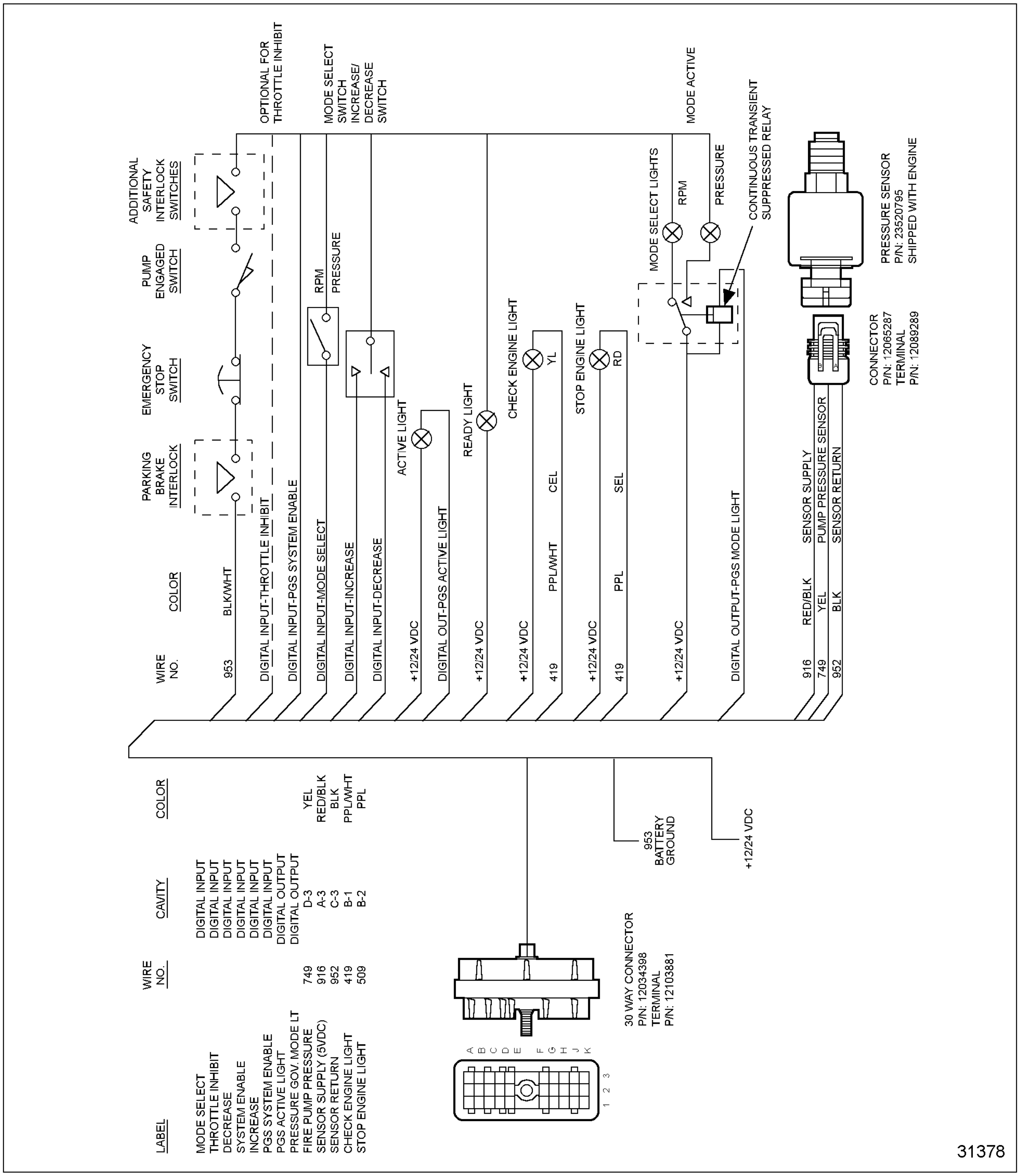


Figure 93-10 Pressure Governor System Vehicle Interface Harness Connector

93.3 ELECTRONIC FIRE COMMANDER HARNESS

The following wire schematics support the electronic fire commander harness; see Figure 93-11.

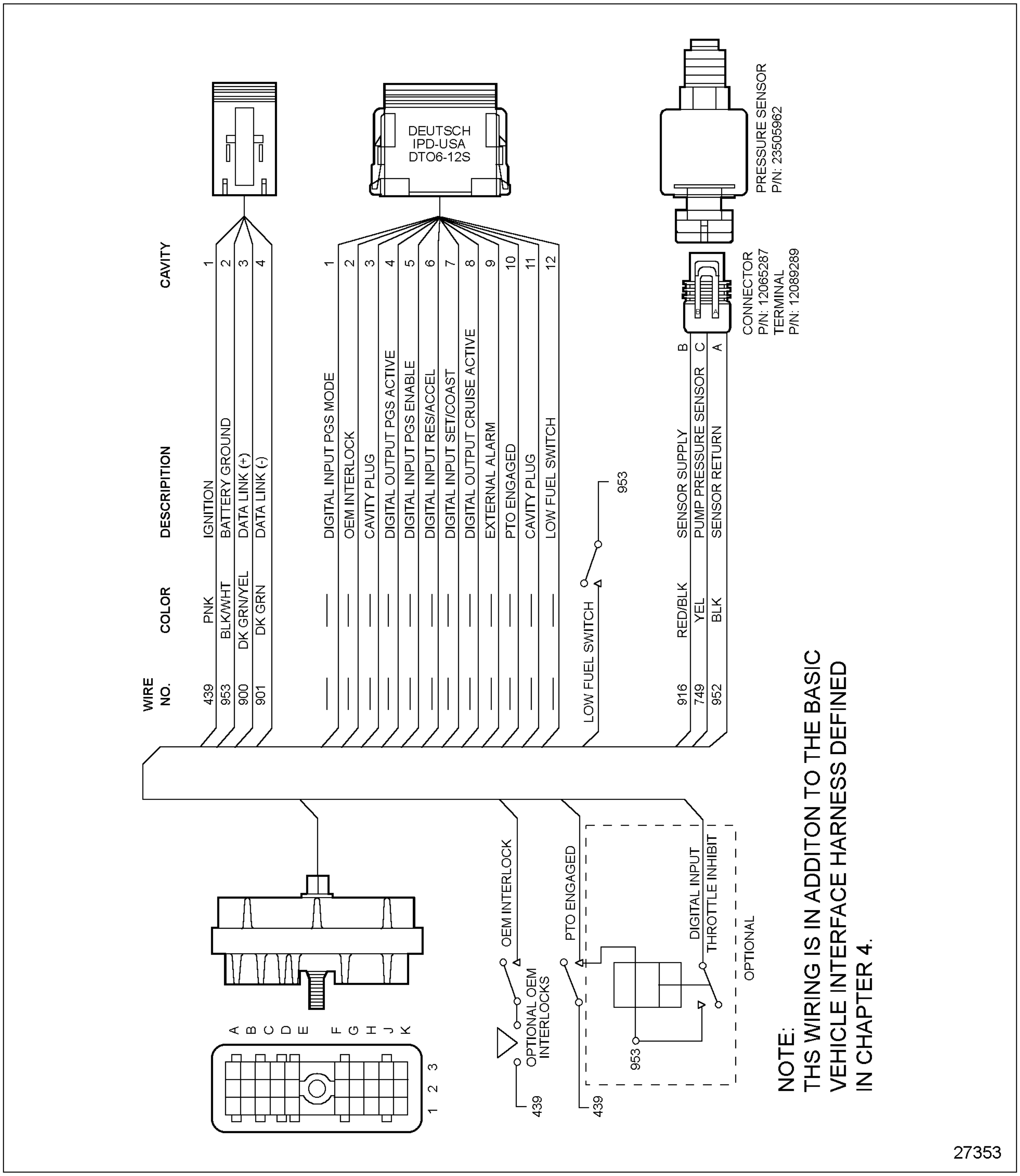


Figure 93-11 Electronic Fire Commander Harness

93.4 POWER HARNESS - SINGLE ECM, SINGLE FUSE

The following wire schematics support the vehicle interface harness; see Figure 93-12.

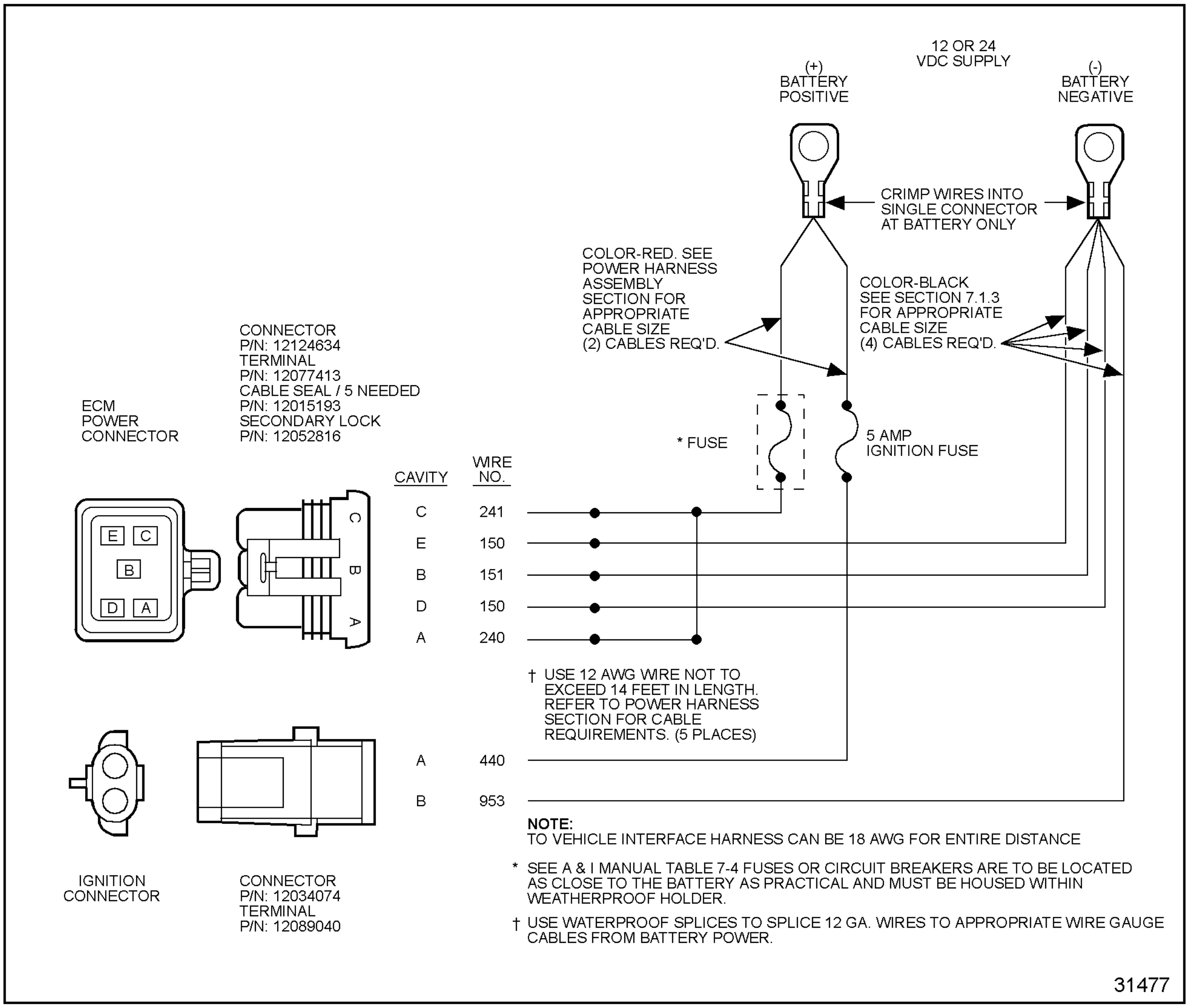


Figure 93-12 Power Harness - Single ECM, Single Fuse

93.5 POWER HARNESS - SINGLE ECM, DUAL FUSES

The following wire schematics support the vehicle interface harness; see Figure 93-13.

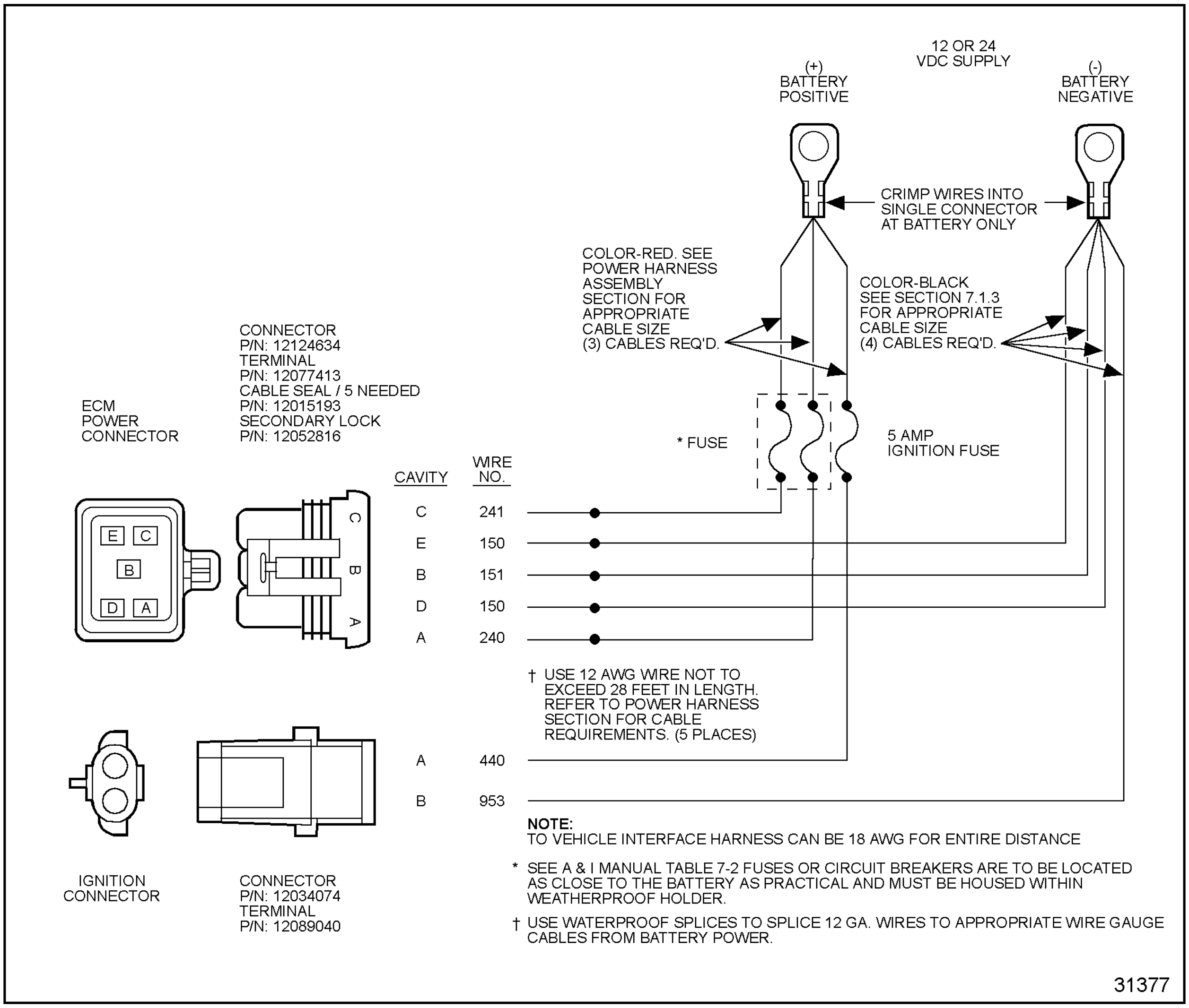


Figure 93-13 Power Harness - Single ECM, Dual Fuses

93.6 DDEC DIGITAL OUTPUT

The following wire schematics support the DDEC digital outputs; see Figure 93-14.

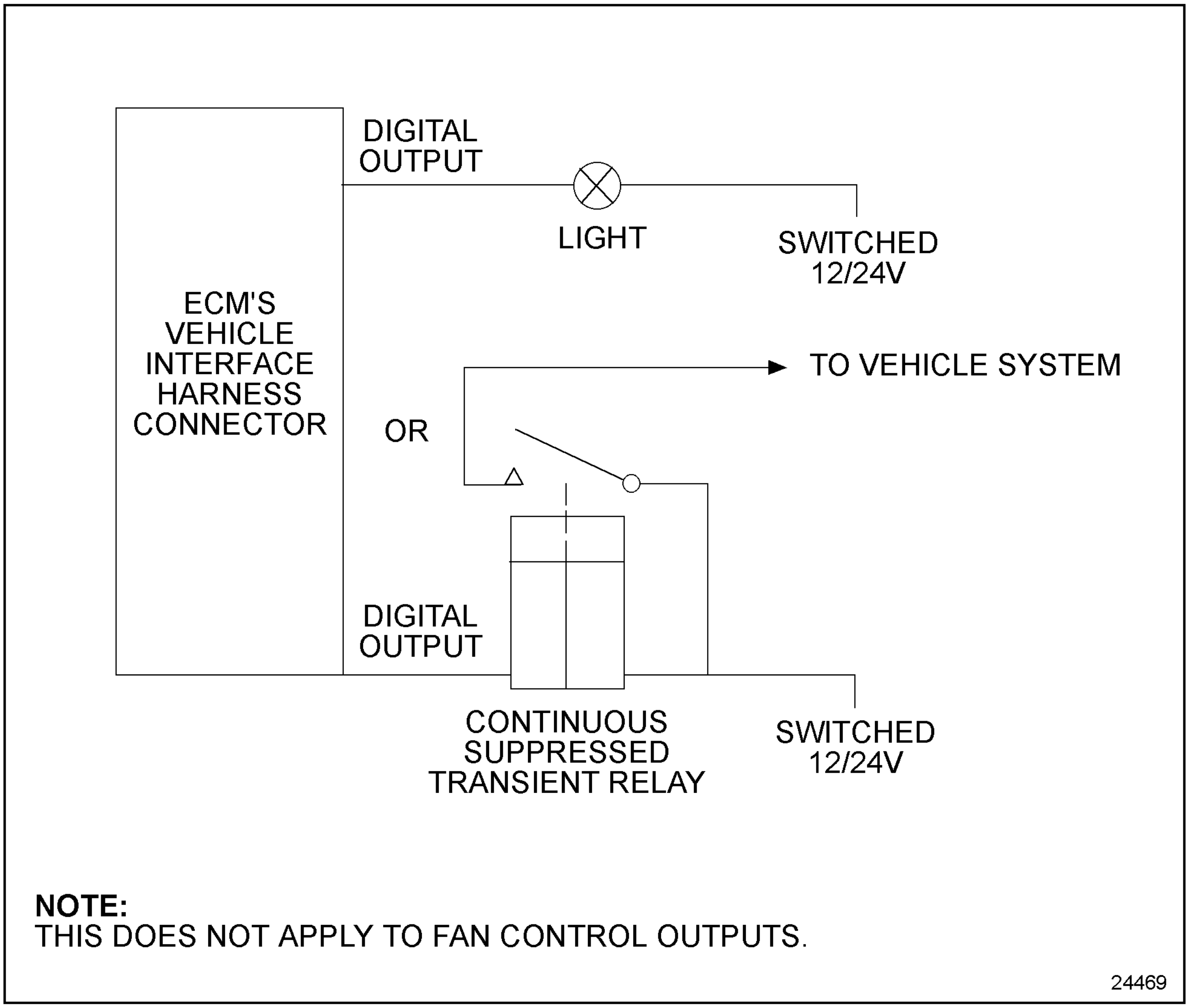


Figure 93-14 DDEC Digital Outputs

93.7 COMMUNICATION HARNESS

The following wire schematics support the communication harness; see Figure 93-15.

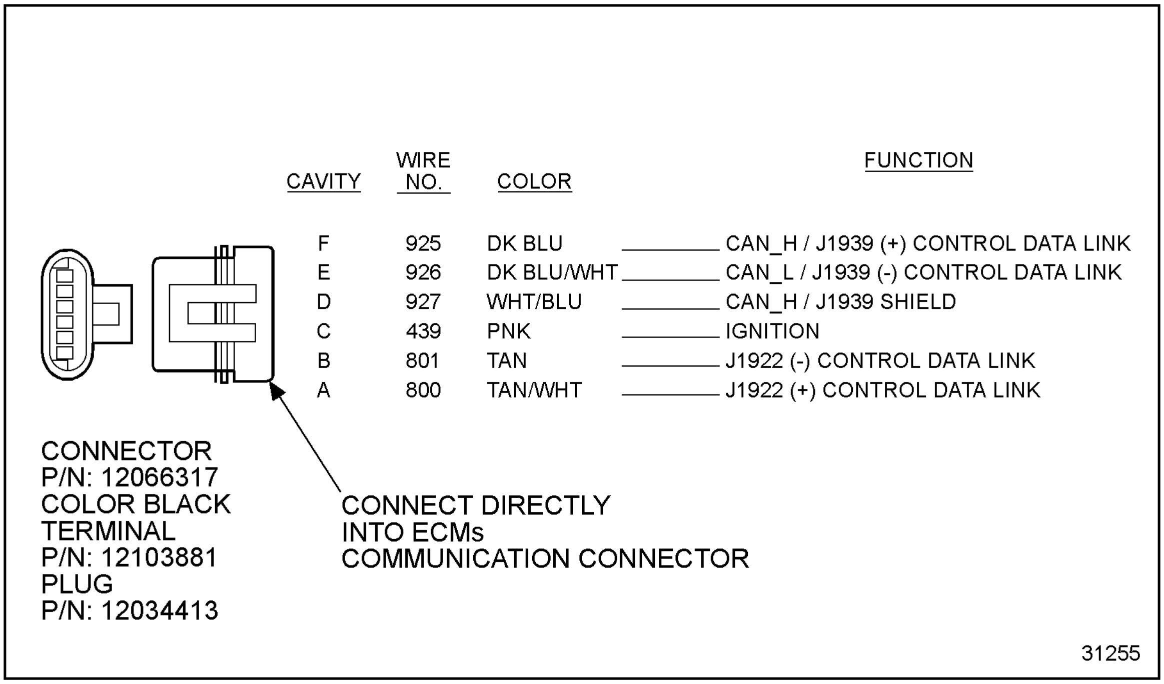


Figure 93-15 Communication Harness

94 (CHG) DDEC PRO-LINK OPERATION

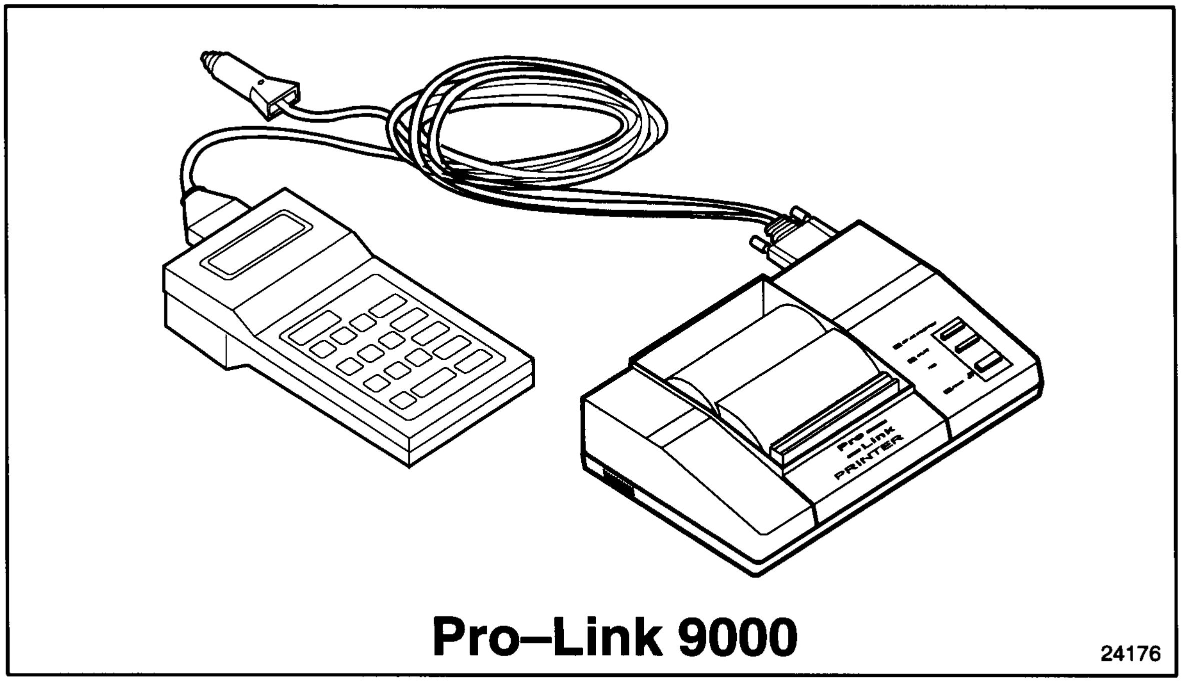


Figure 94-1 Pro-Link

94.1 DDEC PRO-LINK OPERATION

The following procedure will suggest several ways to use the Pro-Link ® on the DDEC system, see Figure 94-1,

94.1.1 Diagnostic Codes

Start with the Menu Selection screen.

1. To call up active codes:
   - [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
   - [a] Select ENGINE and ENTER twice.
   - [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
   - [a] Select ENGINE and push ENTER twice.
   - [b] Go down and select CLEAR CODES and ENTER.
   - [c] Left to YES, and ENTER.
   - [d] Wait and then push FUNC three times.
   - [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

94.1.2 Cylinder Cutout Sequence

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down and select FUEL INJECTOR INFO and ENTER.
3. Go to CYLINDER CUTOUT and ENTER.
4. Select NEW TEST and ENTER, or REVIEW LAST TEST and ENTER.
5. Select IDLE and ENTER or 1000 RPM and ENTER.
6. Select AUTO and ENTER, or MANUAL and ENTER three times.
7. Test is now in progress.

NOTE:
Test results stay stored in the Pro-Link memory as long as the DDR remains powered up.

94.1.3 Injector Calibration Update

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Go down to FUEL INJECTOR INFO and ENTER.
3. Go down to CAL UPDATE and ENTER.
4. Select VIEW and ENTER or select UPDATE and ENTER.
5. Enter password: 0000 or xxxx and ENTER twice.
6. Enter new CAL # and ENTER. Use UP/DN arrow keys to select line.
7. When finished, select FUNC, select YES, ENTER and wait.
8. ENTER to continue.

94.1.4 Reprogram Calibration

Start with the Menu Selection screen.

1. Select ENGINE and ENTER.
2. Down to CALIBRATION CHANGE and ENTER.
3. Select REPROGRAM CAL and ENTER.
4. Enter password: 0000 or xxxx and ENTER (xxxx=1 to 9 and A to Z).
5. Select menu to be changed with UP/DN arrow keys and ENTER twice.
6. Use RT/LT arrow keys to change a word or put in a new # and ENTER.
7. When finished, select FUNC.
8. SELECT ANOTHER MENU: left to YES and ENTER, or NO and ENTER.
9. Left to YES and ENTER.
10. Wait and then ENTER to continue.

94.1.5 Snapshot Sequence

Start with the Menu Selection screen.

1. Select PRO-LINK and ENTER.
2. Go up to SNAPSHOT and ENTER.
3. Go down to DATA UPDATE RATE and ENTER.
4. Type in NEW RATE and ENTER (.0 to 9.9 seconds); (90 frames will be recorded).
5. Up to TRIGGER SETUP and ENTER.
6. Select TRIGGER SOURCE and ENTER:
   - [a] Any Numeric Key
   - [b] Any code
   - [c] Specific PID

[d] Specific SID

7. Adjust TRIGGER POINT: NO, or select YES and ENTER; change trigger point with RT/LT arrow keys. ENTER.
8. WAITING FOR TRIGGER. When ready to take SNAPSHOT, apply the trigger. ANY NUMERIC KEY overrides all other triggers.
9. PROCESSING TRIGGER; Filling remaining frames (90 frames max). When all frames are filled, the first three lines of the TRIGGER FRAME, T, will display.

[a] To do SNAPSHOT after setup is done, do items 1, 2, and 8 only, or go to QUICK TRIGGER and ENTER.

[b] SNAPSHOT DATA stays stored in Pro-Link memory as long as the DDR remains powered up.

94.1.6 Print Function

Print custom data list of snapshot. The printer is attached to the DDR.

1. Select PROLINK. ENTER.
2. Select RS-232 SERIAL PORT. ENTER.
3. Select PRINTER OUTPUT. ENTER.
4. Arrow up or down to SNAPSHOT DATA. ENTER.
5. Right to CUSTOM. ENTER twice.
6. Select six items from data list using arrow up or down. ENTER after each selection.
   - FUNC.
7. Type 001; ENTER; 090; ENTER.

EXHAUST SYSTEM TROUBLESHOOTING 0008 00

THIS WORK PACKAGE COVERS

Exhaust System Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Exhaust System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Exhaust Gases Enter Passenger Compartment.	1. Check for faulty muffler.	Replace muffler (WP 0044 00).
	2. Check for loose, broken clamp or fasteners.	Replace clamps and/or fasteners (WP 0044 00 or WP 0045 00).
	3. Check for broken exhaust pipe(s) or engine exhaust manifold.	Replace exhaust pipe(s) if broken (WP 0045 00). If engine exhaust manifold is broken, notify Direct Support Maintenance.

END OF WORK PACKAGE

COOLING SYSTEM TROUBLESHOOTING 0009 00

THIS WORK PACKAGE COVERS

Cooling System Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Cooling System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Loss of Coolant.	1. Check for deteriorated or collapsed hose(s).	Replace as required (WP 0047 00 or WP 0048 00).
	2. Check for structural cracks or fracture of radiator.	Replace radiator (WP 0052 00).
2. Coolant Temperature Gage Indicates Engine is Overheating.	Ensure coolant filter knobs are fully open.	Open coolant filter knobs (WP 0057 00).

END OF WORK PACKAGE

ELECTRICAL SYSTEM TROUBLESHOOTING 0010 00

THIS WORK PACKAGE COVERS

Electrical Troubleshooting

INITIAL SETUP

Tools and Special Tools

Multimeter, digital (Item 28, WP 0306 00)

Tool kit, general mechanic's (Item 50, WP 0306 00)

References

Foldout Schematics

Equipment Conditions

Master battery switch in OFF position (TM 9-2320-302-10)

INTRODUCTION

1. When performing electrical troubleshooting, refer to schematic foldouts in rear of manual for pin identification and location.
2. Ensure master battery switch is in proper position prior to performing electrical troubleshooting procedures.

Table 1. Electrical System Troubleshooting Procedures .

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Engine and Related Circuits		
1. Engine Brake (Jake Brake) Inoperative or Operates Erratically.	1. Check operation of other dash panel gages.	If other dash panel gages do not operate, replace INSTRUMENTS 15A fuse F4 (WP 0084 00). If all dash panel gages operate, proceed.
	2. With LO switch in ON position, check for continuity between pins E and F, and B and C.	If continuity is present, proceed. If continuity is not present, replace switch (WP 0076 00).
	3. With MED switch in ON position, check for continuity between pins E and F, and B and C.	If continuity is present, proceed. If continuity is not present, replace switch (WP 0076 00).
	4. Disconnect connector from LO switch and check for +12 VDC at pin E of lead 81C.	If +12 VDC is present, replace switch (WP 0076 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
2. Engine Fan Does Not Operate or Fails to Start at 190°F - 210°F (87°C - 98°C).	1. With ignition ON and engine OFF or at idle, press CHK ENG button and observe CHK ENG light.	Perform DDEC system troubleshooting. Refer to section number that matches flash code logged (WP 0007 00). If no codes are present, proceed.
	2. Check fan clutch air line for leaks.	If leaking or damaged line is found, replace (WP 0056 00).
	3. Check FAN/DRYER 15A fuse F5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	4. Disconnect connector from fan clutch solenoid and check for +12 VDC at lead 234.	If +12 VDC is present, replace fan clutch solenoid (WP 0055 00). If +12 VDC is not present, repair lead 234 (WP 0151 00).
3. No Throttle Response or Erratic Throttle Response.	With ignition ON and engine OFF or at idle, press CHK ENG button and observe CHK ENG light.	Perform DDEC system troubleshooting (WP 0007 00). Refer to section that matches flash code logged. If codes are present, replace throttle position sensor (WP 0088 00).
Battery and Charging System Circuits		
1. Batteries Fail to Maintain Charge.	1. Check level of electrolyte in batteries.	Service batteries as required (WP 0023 00).
	2. Check battery posts and cables for corrosion.	Service batteries as required (WP 0023 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Battery and Charging System Circuits - Continued		
1. Batteries Fail to Maintain Charge - Continued.	3. Inspect for loose or damaged battery cables.	Tighten loose or replace damaged battery cables (WP 0145 00 or WP 0146 00). Service batteries as required (WP 0023 00).
2. Batteries Require Frequent Filling.	1. Inspect battery cases for signs of damage or leakage.	Replace damaged or leaking batteries (WP 0143 00).
	2. With engine running at 1200 rpm, monitor voltmeter.	If indicator is above green area on gage, proceed to alternator troubleshooting.
3. System Overcharging (Voltmeter to Right of Green Band).	1. Inspect for loose connections at alternator/voltage regulator and batteries.	Tighten loose electrical connections at alternator (WP 0065 00 or WP 0066 00), voltage regulator (WP 0069 00 or WP 0070 00), and batteries (WP 0145 00 or WP 0146 00). If connections are okay, proceed.
	2. Check voltage regulator for +24 VDC at power lead (red).	If +24 VDC is present, proceed. If +24 VDC is not present, replace voltage regulator (WP 0069 00 or WP 0070 00).
	3. Check for failed battery equalizer.	Place master battery switch in ON position, turn ignition switch to ON position, turn headlights or heater motor to HIGH position. Green light on battery equalizer should come on immediately. If green light comes on, proceed. If green light does not come on, replace battery equalizer (WP 0071 00).
	4. If electrical system is still overcharging, replace failed alternator (WP 0065 00 or WP 0066 00).	
4. System Undercharging (Voltmeter to Left of Green Band).	1. Inspect for loose connections at alternator/voltage regulator and batteries.	Tighten loose electrical connections at alternator (WP 0065 00 or WP 0066 00), voltage regulator (WP 0069 00 or WP 0070 00), and batteries (WP 0145 00 or WP 0146 00). If connections are okay, proceed.
	2. Inspect condition and tension of alternator belt.	Replace worn or damaged alternator belt (WP 0062 00 or WP 0063 00). If belt is okay, proceed.

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Battery and Charging System Circuits - Continued		
4. System Undercharging (Voltmeter to Left of Green Band) - Continued.	3. Inspect automatic belt tensioner for looseness or damage.	Tighten loose or replace damaged belt tensioner (WP 0064 00). If belt tensioner is okay, proceed.
	4. Check voltage regulator for +24 VDC at power lead (red).	If +24 VDC is present, proceed. If +24 VDC is not present, replace voltage regulator (WP 0069 00 or WP 0070 00).
	5. Check for failed battery equalizer.	Place master battery switch in ON position, turn ignition switch to ON position, turn headlights or heater motor to HIGH position. Green light on battery equalizer should come on immediately. If green light comes on, proceed. If green light does not come on, replace battery equalizer (WP 0071 00).
	6. If electrical system is still undercharging, replace failed alternator (WP 0065 00 or WP 0066 00).	.
5. System Not Charging at All (Voltmeter to Left of Green Band).	1. Inspect for loose electrical connections at alternator/ voltage regulator and batteries.	Tighten loose electrical connections at alternator (WP 0065 00 or WP 0066 00), voltage regulator (WP 0069 00 or WP 0070 00), and batteries (WP 0145 00 or WP 0146 00). If connections are okay, proceed.
	2. Inspect condition and tension of alternator belt.	Replace worn or damaged alternator belt (WP 0065 00 or WP 0066 00). If belt is okay, proceed.
	3. Inspect automatic belt tensioner for looseness or damage.	Tighten loose or replace damaged belt tensioner (WP 0064 00). If belt tensioner are okay, proceed.
	4. Check voltage regulator for +24 VDC at power lead (red).	If +24 VDC is present, proceed. If +24 VDC is not present, replace voltage regulator (WP 0069 00 or WP 0070 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Battery and Charging System Circuits - Continued		
5. System Not Charging at All (Voltmeter to Left of Green Band) - Continued.	5. Check for failed battery equalizer.	Place master battery switch in ON position, turn ignition switch to ON position, turn headlights or heater motor to HIGH position. Green light on battery equalizer should come on immediately. If green light comes on, proceed. If green light does not come on, replace battery equalizer (WP 0071 00).
	6. If system is still not charging, replace failed alternator (WP 0065 00 or WP 0066 00).	
6. No Vehicle Power When Master Battery Switch is in ON Position.	1. Check for loose or damaged battery cable connections.	Tighten or repair battery cable connections (WP 0145 00 or WP 0146 00).
	2. Check for loose or damaged master battery switch cable connections.	Tighten or repair switch cable connections (WP 0086 00).
	3. Check that battery voltage is 22-26 volts.	If voltage is below 22 volts, service batteries (TM 9-6140-200-14). If voltage is okay, replace master battery switch (WP 0086 00).
	4. With master switch in ON position, check for +12 VDC at 12V terminal and +24 VDC at 24V terminal.	If correct voltage at each terminal is indicated, proceed. If incorrect voltage is indicated at either terminal, replace master battery switch (WP 0086 00).
7. No Instrument Response When Ignition Switch is Turned On.	1. Check for loose or damaged battery cable connections.	Tighten or repair battery cable connections (WP 0145 00 or WP 0146 00).
	2. Check that battery voltage is 22-26 VDC.	If voltage is below 22 VDC, service batteries (TM 9-6140-200-14). If voltage is okay, proceed.
	3. Check IGN SW 25A fuse D1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	4. Check INSTRUMENT 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	5. Disconnect connector to ignition switch, check for continuity between pins B, C, and A with ignition switch in start position.	If continuity is not present through switch, replace ignition switch (WP 0077 00). If continuity is present, proceed.

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Battery and Charging System Circuits - Continued		
7. No Instrument Response When Ignition Switch is Turned On - Continued.	6. Disconnect connector at ignition switch and check for +12 VDC at connector Pin B and a known ground.	If +12 VDC is present, replace ignition switch (WP 0077 00). If +12 VDC is not present, repair lead 52 between ignition switch and fuse D1 connector on fuse panel (WP 0115 00).
Headlight Circuits		
1. Neither Headlight Operates When Switch Is Turned On.	1. Check L/H HDLT 15A CB D2 and R/H HDLT 15A CB D4.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed.
	2. Check LIGHT SW PWR 25A CB D8.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed.
	3. Disconnect lead 420M from vehicular light switch. Check for +12 VDC at pin M.	If +12 VDC is present at vehicular light switch, proceed. If voltage is not present at vehicular light switch, replace vehicular light switch (WP 0076 00).
	4. Disconnect left headlight power relay B3 from connector. Check for +12 VDC at connector 85.	If +12 VDC is present, replace left and right headlight power relay (WP 0084 00). If voltage is not present at connector 85, repair lead 420M (WP 0151 00).
2. Left/Right Headlight Fails to Operate When Switch Is Turned On.	1. Inspect headlight bulb.	Replace bulb if broken or defective (WP 0097 00). If bulb is okay, proceed.
	2. Check LH HEADLIGHT 15A CB D2.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed.
	3. Check LIGHT SW PWR 25A CB D8.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed.
	4. Disconnect lead 14 from LH HEADLIGHT 15A CB D2. Check for +12 VDC at lead 14.	If +12 VDC is present, proceed. If voltage is not present, repair lead 14 (WP 0151 00).
	5. Disconnect ground lead from left/right headlight. Check for +12 VDC at ground lead to left/right headlight.	If +12 VDC is present, repair ground lead (WP 0151 00). If voltage is not present, proceed.
	6. Disconnect LH/RH PWR relays B3 and C3 from connector. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Headlight Circuits - Continued		
2. Left/Right Headlight Fails to Operate When Switch Is Turned On - Continued.	7. Disconnect LH/RH PWR relays B3 and C3 from connector. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If voltage is not present, repair lead 20 (WP 0151 00).
	8. Disconnect LH/RH LO/HI BEAM relays B5 and C5 from connector. Check for +12 VDC at connector 30.	If +12 VDC is present, replace left low/high beam relay B5 (WP 0084 00). If voltage is not present, proceed.
	9. Check for continuity between connector 87 from LH HDLT PWR relay B3 and connector 30 from LH LO/HI BEAM relay B5.	If continuity is indicated, replace relay B3 (WP 0084 00). If continuity is not indicated, repair lead 20L (WP 0151 00).
3. Neither Headlight Low/High Beam Operates When Turn Signal Switch Lever Is Set.	1. Disconnect ground lead from dimmer switch lever. Check for continuity between lead and ground.	If continuity is present, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	2. Disconnect lead 222 from dimmer switch lever. Check for continuity between terminals of switch in both positions.	If continuity is present, proceed. If continuity is not indicated, replace dimmer switch lever (WP 0087 00).
	3. Disconnect LH LO/HI BEAM relay B5 from connector. Check for continuity between connector 86 and lead 222.	If continuity is present, replace relay (WP 0084 00). If continuity is not indicated, repair lead 222 (WP 0151 00).
4. Left/Right Highbeam Does Not Operate.	1. Inspect headlight bulb.	Replace bulb if broken or defective (WP 0097 00).
	2. Disconnect connector from left headlight. Check for continuity between ground and connector on left headlight at lead 21/21D.	If continuity is present, proceed. If no continuity is indicated, replace left headlight (WP 0097 00).
	3. Disconnect LH/RH LO/HI BEAM relays B5 and C5 from connector. Check for continuity between lead 21/21D and connector 87.	If continuity is present, replace relay (WP 0084 00). If no continuity is indicated, repair lead 21/21D (WP 0151 00).
5. Left/Right Lowbeam Does Not Operate.	1. Inspect headlight bulb.	Replace bulb if broken or defective (WP 0097 00).
	2. Disconnect connector from left headlight. Check for continuity between ground and connector on left/right headlight at lead 22/22D.	If continuity is present, proceed. If continuity is not indicated, replace left headlight (WP 0097 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Headlight Circuits - Continued		
5. Left/Right Lowbeam Does Not Operate - Continued.	3. Disconnect LH/RH LO/HI BEAM relays B5 and C5 from connector. Check for continuity between lead 22/22D and connector 87A.	If continuity is present, replace relay (WP 0084 00). If continuity is not indicated, repair lead 22/22D (WP 0151 00).
6. Daytime Running Light(s) Do Not Operate (M915A3 New Model, M916A3, M917A2).	1. Check that parking brake is released.	Release parking brake.
	2. Check operation of headlights.	If headlights do not operate, replace headlamps (WP 0097 00). If headlights are okay, proceed.
	3. Check operation of dash gages.	If other dash gages and daytime running lights are not operating, proceed to step 3. If daytime running lights are only item not operating, proceed to step 5.
	4. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	5. Disconnect connector from daytime running light control module and check for +12 VDC at lead 379.	If +12 VDC is present, replace daytime running light control module (WP 0124 00). If +12 VDC is not present, repair lead 379 (WP 0151 00).
	6. Disconnect connector from parking brake pressure switch and check for +12 VDC at lead 81C.	If +12 VDC is present, replace parking brake pressure switch (WP 0093 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
Marker and Taillight Circuits		
1. None of Marker and Taillights Operate.	1. Check TRCTR TAIL/MARKER 15A fuse I1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector on vehicular light switch. Install jumper wire between connector 420F and pin F on switch. Check for +12 VDC at pin H.	If +12 VDC is present, repair lead 420F (WP 0151 00). If voltage is not present at vehicular light switch, replace switch (WP 0076 00).
2. Left/Right Front Marker Light Does Not Operate.	1. Check TRCTR TAIL/MRKR 15A fuse I1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Inspect marker light.	Replace broken or defective marker light (WP 0103 00 or WP 0104 00). If marker light is okay, proceed.
	3. Remove lamp from socket. Check for continuity between contacts of lamp.	If continuity is indicated, proceed. If continuity is not indicated, replace marker light (WP 0103 00 or WP 0104 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Marker and Taillight Circuits - Continued		
2. Left/Right Front Marker Light Does Not Operate - Continued.	4. Check for continuity between socket and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Disconnect lead 46E/46F from lead 46. Check for +12 VDC at lead 46.	If +12 VDC is present, repair lead 46E/46F. If voltage is not present, repair lead 46 (WP 0151 00).
3. One or More Cab Marker Lights Does Not Operate.	1. Inspect marker light(s).	Replace broken or defective marker lights (WP 0103 00 or WP 0104 00).
	2. Remove light(s) from defective circuit(s). Check for continuity between socket and ground.	If continuity is indicated, proceed. If continuity is not indicated, replace marker lights (WP 0103 00 or WP 0104 00).
	3. Disconnect ground lead from marker light(s). Check for continuity between ground lead(s) and ground.	If continuity is indicated, repair lead(s) 46. If continuity is not indicated, repair ground lead(s) (WP 0151 00).
4. Both Taillights Do Not Operate, But All Marker Lights Operate.	1. Inspect taillights.	Replace broken or defective taillight(s) (WP 0101 00 or WP 0102 00).
	2. Disconnect lead 23A from taillight terminal. Check for +12 VDC at lead 23A.	If +12 VDC is present, repair terminal connector (WP 0151 00). If voltage is not present, repair lead 23A (WP 0151 00).
Blackout Light Circuits		
1. None of Blackout (B/O) Lights Operate.	Check B/O LTS 24V 15A CB G5.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, repair harness (WP 0151 00).
2. None of Blackout (B/O) Stoplights Operate.	1. Inspect stop lights.	Replace broken or defective bulb (WP 0101 00) or replace taillight (WP 0102 00).
	2. Disconnect 24V B/O STOP LT relay K7 from connector. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If voltage is not present, repair lead connector 421V (WP 0151 00).
	3. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If voltage is not present, repair lead 420N (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Blackout Light Circuits - Continued		
2. None of Blackout (B/O) Stoplights Operate - Continued.	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at stoplights relay contact 87.	If +24 VDC is present, repair lead 421F (WP 0151 00). If voltage is not present, replace relay K7 (WP 0084 00).
3. One or None of Blackout (B/O) Marker Lights Operate.	1. Check B/O LTS 24V 15A CB G5.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed
	2. Inspect marker lights.	Replace broken or defective bulb (WP 0099 00 or WP 0100 00) or taillight (WP 0102 00).
	3. Disconnect 24V B/O MKR LT relay L7 from connector. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If no voltage is present, repair lead 421V (WP 0151 00).
	4. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If voltage is not present, repair lead 420E (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	6. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421A (WP 0151 00). If +24 VDC is not present, replace relay L7 (WP 0084 00).
4. One or None of Blackout (B/O) Drive Lights Operate.	1. Check B/O LTS 24V 15A CB G5.	Press to reset or allow to cool and retry. Replace defective CB (WP 0084 00). If CB is okay, proceed.
	2. Inspect drive lights.	Replace broken or defective light(s) (WP 0098 00).
	3. Disconnect 24V B/O DRV LT relay M7 from connector. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If voltage is not present, repair lead 421V (WP 0151 00).
	4. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If voltage is not present, repair lead 420D (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Blackout Light Circuits - Continued		
4. One or None of Blackout (B/O) Drive Lights Operate - Continued.	6. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at stoplights relay contact 87.	If +24 VDC is present, repair lead 421D or lead 421V (WP 0151 00). If voltage is not present, replace relay M7 (WP 0084 00).
	7. Check for +24 VDC at connector 421K at trailer receptacle(s).	If +24 VDC is present, troubleshoot trailer circuit(s) (see applicable trailer TM). If voltage is not present, repair lead(s) 421K (WP 0151 00).
Turn Signal and Stoplight Circuits		
1. Stoplights Do Not Operate.	1. Check STOP LTS 20A fuse H1.	Replace fuse if defective (WP 0084 00).
	2. Disconnect leads 420A and 420K from stoplight switch. Check for continuity between switch contacts while pressing switch.	If continuity is indicated, proceed. If continuity is not indicated, replace stoplight switch (WP 0130 00).
	3. Disconnect leads 420A and 420K from vehicular light switch. Check for continuity between leads 420A and 420K with stoplight switch closed.	If continuity is indicated, proceed. If continuity is not indicated, repair lead 420A or 420K (WP 0151 00).
	4. Disconnect lead 420C from vehicular light switch. Disconnect lead 36C from turn signal switch. Check for continuity between lead 420C and 36C.	If continuity is indicated, proceed. If continuity is not indicated, repair lead 420C or lead 36C (WP 0130 00).
	5. Disconnect lead 36C from vehicular light switch. Check for +12 VDC in lead 36C with stoplight switch closed.	If +12 VDC is present, replace turn signal switch (WP 0087 00). If voltage is not present, replace vehicular light switch (WP 0076 00).
2. Left/Right Stoplight Does Not Operate.	1. Inspect bulb (M915A3 Old Model) or taillight assembly (M915A3 New Model, M916A3, M917A2).	Replace broken or defective bulb (WP 0101 00) or taillight assembly (WP 0102 00).
	2. Remove bulb from left stoplight. Check for continuity between contact points.	If continuity is indicated, proceed. If continuity is not indicated, replace bulb (WP 0101 00).
	3. Remove left/right stoplight lamp. Check for continuity between socket and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Turn Signal and Stoplight Circuits - Continued		
2. Left/Right Stoplight Does Not Operate - Continued.	4. Check for +24 VDC at turn signal switch at lead 38B/39B contact point.	If +24 VDC is present, replace turn signal switch (WP 0087 00). If voltage is not present, repair lead 38B/39B (WP 0151 00).
3. Flasher Lights Do Not Operate.	1. Inspect bulb (M915A3 Old Model) or LED (M915A3 New Model, M916A3, M917A2).	Replace bulb (WP 0103 00) or LED (WP 0104 00). If bulb or LED is okay, proceed.
	2. Check TURN SIGNAL 25A fuse D3.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Check DOME/AUX/FLSHR 15A fuse I2.	Replace defective use (WP 0084 00). If fuse is okay, proceed.
	4. Disconnect 24 VDC LH FLASHER relay K3 from connector. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If voltage is not present, repair lead 421 (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	6. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If voltage is not present, repair lead 38B (WP 0151 00).
	7. Set turn signal switch in turn mode. Install jumper leads between connectors 30, 85, and 86 to their respective connectors at 24 VDC LH FLASHER relay K3. Check for +24 VDC at relay connector 87.	If +24 VDC is present, proceed. If voltage is not present, replace relay (WP 0084 00).
	8. Set turn signal switch in turn mode. Check for +24 VDC at trailer receptacle connectors.	If voltage is not present, repair leads (WP 0151 00).
4. Turn Signal Lights Do Not Operate.	1. Inspect bulb (M915A3 Old Model) or LED (M915A3 New Model, M916A3, M917A2).	Replace bulb (WP 0103 00) or LED (WP 0104 00). If bulb or LED is okay, proceed.
	2. Check TURN SIG 25A fuse D3.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Disconnect connector from turn signal light and check for +12 VDC at lead 60 or 61.	If +12 VDC is present, replace turn signal light (WP 0103 00 or WP 0104 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Turn Signal and Stoplight Circuits - Continued		
5. Turn Signal Indicator Light(s) Does Not Operate, But Turn Signals Operate Normally.	1. Check operation of other lights on control module.	If multiple lights do not operate, replace control module (WP 0079 00). If turn signal light(s) is only light that does not operate, proceed.
	2. Disconnect lead 60A from control module. Check for +24 VDC at lead 60A.	If +24 VDC is present, replace control module (WP 0079 00). If voltage is not present, repair lead 60A (WP 0151 00).
Dome Light Circuits		
1. Dome Lights Do Not Operate.	1. Check DOME/AUX/FLSHR 15A fuse I2.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect lead 420J from DOME/AUX/FLSHR 15A fuse I2. Check for +12 VDC at lead 420J.	If +12 VDC is present, repair lead 420J (WP 0151 00). If voltage is not present, proceed.
	3. Disconnect connector from vehicular light switch. Check for +12 VDC at pin J.	If +12 VDC is present, repair lead 420J (WP 0151 00). If voltage is not present, replace vehicular light switch (WP 0076 00).
2. One Dome Light Operates, But Other Dome Light Does Not Operate in Either Mode.	1. Inspect light bulb.	Replace bulb if broken or defective (WP 0110 00).
	2. Disconnect lead 41 from defective dome light. Check for continuity from dome light ground lead to ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0110 00).
	3. Disconnect lead 41 from defective dome light. Check for +12 VDC at lead 41.	If +12 VDC is present, replace dome light assembly (WP 0110 00). If voltage is not present, repair lead 41 (WP 0151 00).
Auxiliary Light Circuits		
1. Auxiliary Lights or Accessory Circuits Do Not Operate.	1. Check DOME/AUX/FLSHR 15A fuse I2.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check START/AUX 15A fuse G1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Disconnect AUX LIGHTS POWER relay I5. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JC (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Auxiliary Light Circuits - Continued		
1. Auxiliary Lights or Accessory Circuits Do Not Operate - Continued.	4. Check for +12 VDC at AUX LIGHTS POWER relay connector 85.	If +12 VDC is present, proceed. If voltage is not present, check DOME/AUX/FLSHR 15A fuse I2. If defective, replace fuse (WP 0084 00). Check for continuity in lead 420JA and lead 420J. If continuity is not indicated, repair lead 420JA or 420J (WP 0151 00). If +12 VDC is still not present at connector 85, replace vehicular light switch (WP 0076 00).
	5. Disconnect AUX LTS ACC L/O relay I7. Check for +12 VDC at connector 87.	If +12 VDC is present, proceed. If voltage is not present, check lead 420JB for continuity. If continuity is not indicated, repair lead 420JB (WP 0151 00). If voltage is still not present at connector 87, replace AUX LTS POWER relay (WP 0084 00).
	6. Disconnect AUX LTS ACC L/O relay I7. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If voltage is not present, check START/AUX 15A fuse G1. If defective, replace fuse (WP 0084 00). Check for continuity in lead 71AA and lead 71A. If continuity is not indicated, repair lead 71AA and lead 71A (WP 0151 00). If voltage is still not present at connector 85, replace vehicular light switch (WP 0076 00).
	7. Disconnect AUX LTS ACC L/O relay I7. Check for continuity in connectors 30 and 86 to ground.	If continuity is indicated, proceed. If continuity is not indicated, repair connector lead 30 or connector lead 86 to ground (WP 0151 00).
	8. Check for +12 VDC at auxiliary light power bus.	If +12 VDC is not present, check for continuity in lead 420JD. If continuity is indicated, replace AUX LIGHTS POWER relay I5 (WP 0084 00).
2. No Power to Auxiliary Heater Fan Power Relay (If Equipped).	1. Check START/AUX 15A fuse G1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for continuity at AUX HEATER ON/OFF switch.	If continuity is indicated, proceed. If continuity is not indicated, replace switch (WP 0080 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Auxiliary Light Circuits - Continued		
2. No Power to Auxiliary Heater Fan Power Relay (If Equipped) - Continued.	3. Disconnect 24V AUX HTR PWR relay L5 from connector. Check for +24V at lead 422 pin 30.	If +24V is present, proceed. If +24V is not present, repair lead 422 (WP 0151 00).
	4. Disconnect AUX LTS ACC L/O relay C1. Check for continuity at lead 58E.	If continuity is indicated, replace HTR FAN PWR relay C1 (WP 0084 00). If continuity is not indicated, repair lead 58E (WP 0151 00).
Utility Power Receptacle Circuits		
1. Worklight Power Receptacles Do Not Operate.	1. Check WORK LT RCPTS 15A fuse H7.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for +12 VDC at lead 420JD from auxiliary light power bus.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JD (WP 0151 00).
	3. Check for +12 VDC at lead 73F for left and right worklight power receptacles.	If +12 VDC is present, repair ground lead (WP 0151 00) from worklight power receptacles. If voltage is not present, repair lead 73F (WP 0151 00).
2. One Worklight Power Receptacle Does Not Operate, But Other Receptacle Operates Normally.	1. Check for +12 VDC at lead 73F to worklight power receptacle.	If +12 VDC is present, proceed. If voltage is not present, repair lead 73F (WP 0151 00).
	2. Check for continuity between receptacle and ground.	If continuity is indicated, replace defective receptacle (WP 0091 00). If continuity is not indicated, repair ground lead (WP 0151 00).
3. Trailer Taillight(s) Do Not Operate.	1. If one trailer taillight does not operate, inspect bulb.	Replace broken or defective bulb (see applicable trailer TM). If bulb is okay, proceed.
	2. Check TRLR TAILS 25A fuse E8.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.
	3. Disconnect TRLR TAIL LTS relay C7. Check for +12 VDC at lead 23*.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 23* (WP 0151 00).
	4. Check for +12 VDC at lead 420H*.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 420H* (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Utility Power Receptacle Circuits - Continued		
3. Trailer Taillight(s) Do Not Operate - Continued.	6. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 23* or lead 420H* (WP 0151 00). If +12 VDC is not present, replace relay C7 (WP 0084 00).
	7. Check for +24 VDC at trailer electrical receptacle.	If +24 VDC is present, troubleshoot trailer electrical circuit (see applicable trailer TM). If +24 VDC is not present, replace trailer electrical receptacles (WP 0092 00).
Backup Light Circuits		
1. Backup Lights Do Not Operate.	1. Check BACKUP LTS 15A fuse H8.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Inspect light bulbs (M915A3 Old Model) or taillight assembly (M915A3 New Model, M916A3, M917A2).	Replace bulbs if broken or defective (WP 0101 00) or taillight assembly (WP 0102 00).
	3. Disconnect lead 420JD from BACKUP LTS 15A fuse. Check for +12 VDC at lead 420JD.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JD (WP 0151 00).
	4. Disconnect lead 120 from backup light switch. Check for +12 VDC at lead 120.	If +12 VDC is present, proceed. If voltage is not present, repair lead 120 (WP 0151 00).
	5. Disconnect lead 120B from backup light switch. Press backup light switch. Check for continuity between switch contacts.	If continuity is indicated, proceed. If continuity is not indicated, replace backup light switch (WP 0132 00).
	6. Disconnect lead 120B from chassis harness. Check for +12 VDC at lead 120B.	If +12 VDC is present, proceed. If voltage is not present, repair lead 120B between chassis and backup light switch (WP 0151 00).
	7. Check for +12 VDC at backup receptacle socket 120B connector.	If +12 VDC is present, repair receptacle socket ground leads to ground (WP 0151 00). If voltage is not present, repair lead 120B to chassis wiring harness (WP 0151 00).
2. Right/Left Backup Light Does Not Operate.	1. Check light bulb (M915A3 Old Model) or backup light (M915A3 New Model, M916A3, M917A2).	Replace defective bulb (WP 0101 00) or backup light (WP 0107 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Backup Light Circuits - Continued		
2. Right/Left Backup Light Does Not Operate - Continued.	2. Check for continuity between socket and ground.	If continuity is indicated, replace backup light (WP 0101 00) (M915A3 Old Model) or backup light (WP 0107 00) (M915A3 New Model, M916A3, M917A2). If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect lead from backup light. Check for +12 VDC at red lead.	If voltage is not present, repair red lead (WP 0151 00). If voltage is present, replace backup light (WP 0132 00).
Utility Light Circuits (M915A3, M916A3)		
1. Utility Lights Do Not Operate.	1. Disconnect leads 420JD and 73 from UTILITY LTS 15A fuse H6. Check for continuity between contacts of 15A fuse.	If continuity is indicated, proceed. If continuity is not indicated, replace defective fuse (WP 0084 00).
	2. Inspect light bulbs.	Replace bulbs if broken or defective (WP 0108 00 or WP 0109 00). If bulbs are okay, proceed.
	3. Check for +12 VDC at lead 420JD from auxiliary light power bus.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JD (WP 0151 00).
	4. Disconnect lead 73 from utility light switch. Check for +12 VDC at lead 73.	If +12 VDC is present, proceed. If voltage is not present, repair lead 73 (WP 0151 00).
	5. Disconnect lead 73B from utility light switch. Activate switch. Check for continuity between switch contacts.	If continuity is indicated, repair lead 73B (WP 0151 00). If continuity is not indicated, replace utility light switch (WP 0077 00).
2. Only One Utility Light Operates.	1. Disconnect lead 73B from defective utility light. Check for +12 VDC at lead 73B.	If +12 VDC is present, proceed. If voltage is not present, repair lead 73B (WP 0151 00).
	2. Check for continuity between socket and ground.	If continuity is indicated, replace utility light (WP 0108 00 or WP 0109 00). If continuity is not indicated, repair ground lead (WP 0151 00).
3. Utility Light Indicator Light Does Not Operate, But Utility Lights Operate Normally.	Disconnect lead 73A from pin D16 of control module. Check for +12 VDC at lead 73A.	If +12 VDC is present, replace control module (WP 0079 00). If voltage is not present, repair lead 73A (WP 0151 00).
Electric Horn Circuits		
Electric Horn Does Not Operate.	1. Check HORN 15A fuse H3.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Electric Horn Circuits - Continued		
Electric Horn Does Not Operate - Continued.	2. Check for +12 VDC at lead 420JD from auxiliary light power bus.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JD (WP 0151 00).
	3. Disconnect HORN relay A3 from connector. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If voltage is not present, repair lead 24 (WP 0151 00).
	4. Disconnect HORN relay A3. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If voltage is not present, repair lead 24 (WP 0151 00).
	5. Disconnect lead 25 from horn button. Check for +12 VDC at lead 25.	If +12 VDC is present, proceed. If voltage is not present, replace horn relay (WP 0084 00).
	6. Disconnect ground lead from horn button. Check for continuity between ground lead and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0084 00).
	7. Disconnect lead 25 from horn button. Press horn switch. Check for continuity between switch contacts.	If continuity is indicated, proceed. If continuity is not indicated, replace horn button (WP 0142 00).
	8. Disconnect lead 26 from horn. Check for +12 VDC at lead 26 with horn button pressed.	If +12 VDC is present, proceed. If voltage is not present, replace horn button (WP 0142 00).
	9. Remove HORN relay A3 and check for continuity between connector 87 and lead 26.	If continuity is indicated, replace relay (WP 0084 00). If continuity is not indicated, repair lead 26 (WP 0151 00).
	10. Disconnect ground lead from horn. Check for continuity between ground lead and ground.	If continuity is indicated, replace horn (WP 0142 00). If continuity is not indicated, repair ground lead (WP 0151 00).
Tractor Beacon Light Circuits		
Tractor Beacon Light Does Not Operate.	1. Check TRCTR BCN LT 15A fuse H5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect lead 254A from tractor beacon light. Check for +12 VDC at lead 254A with beacon light switch in ON position.	If voltage is not present, proceed. If +12 VDC is present, check for continuity between socket and ground. If continuity is indicated, refer to TM 9-2320-302-24P for repair parts. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Tractor Beacon Light Circuits - Continued		
Tractor Beacon Light Does Not Operate - Continued.	3. Remove TRCTR BCN LT 15A fuse H5. Check for +12 VDC at lead 420JD fuse connector from auxiliary light power bus.	If +12 VDC is present, proceed. If voltage is not present, repair lead 420JD (WP 0151 00).
	4. Disconnect lead 254 from beacon light switch. Check for +12 VDC at lead 254.	If +12 VDC is present, proceed. If voltage is not present, repair lead 254 (WP 0151 00).
	5. Disconnect lead 254 and lead 254A from switch. Activate switch. Check for continuity between contacts of switch.	If continuity is indicated, proceed. If continuity is not indicated, replace beacon light switch (WP 0078 00).
	6. Disconnect lead 254A from tractor beacon light. Check for +12 VDC at lead 254A.	If voltage is present, refer to TM 9-2320-302-24P for repair parts. If voltage is not present, repair lead 254A between beacon lights and beacon light switch (WP 0151 00).
Panel Lights and Alarm Circuits		
1. Panel Lights Do Not Operate.	1. Check PANEL LTS 15A fuse H2.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect lead 420B from electronic dimmer switch. Check for +12 VDC at lead 420B from dimmer switch.	If +12 VDC is present, repair lead 420B (WP 0151 00). If voltage is not present, proceed.
	3. Disconnect ground lead from dimmer switch. Check for continuity between ground lead and ground.	If continuity is indicated, replace electronic dimmer switch (WP 0077 00). If continuity is not indicated, repair ground lead (WP 0151 00).
2. Heater Control Light Does Not Operate, But Other Heater Circuits Operate Normally.	1. Check heater control lamp.	Replace defective lamp (WP 0080 00). If lamp is okay, proceed.
	2. Check for continuity between socket and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect lead 29A from heater control light. Check for +12 VDC at lead 29A from panel fuse.	If +12 VDC is present, repair lead 29A to heater control light (WP 0151 00). If voltage is not present, repair lead 29A from fuse (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Panel Lights and Alarm Circuits - Continued		
3. One or More Gage Lights Do Not Operate.	1. Check panel gage lamp(s).	Replace defective lamp(s) (WP 0074 00 and WP 0075 00). If lamp(s) are okay, proceed.
	2. Disconnect lead 29A from inoperative lamp(s) and check for +12 VDC.	If +12 VDC is present, replace lamp(s) (WP 0074 00 and WP 0075 00). If voltage is not present repair lead 29A (WP 0151 00).
4. Fiber Optics Do Not Operate.	1. Check fiber optic light source lamp.	Replace defective lamp(s) (WP 0082 00). If lamp(s) are okay, proceed.
	2. Check for continuity between lamp socket and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect power lead 29A to fiber optic light source. Check for +12 VDC at power lead.	If +12 VDC is present, replace fiber optic light source light (WP 0082 00). If voltage is not present, repair power lead 29A (WP 0151 00).
5. Panel Lights Do Not Dim.	Disconnect lead 420L from electronic dimmer switch. Check for +12 VDC at lead 420L with main light switch in dim mode.	If voltage is present, replace electronic dimmer switch (WP 0077 00). If +12 VDC is not present, repair lead 420L (WP 0151 00).
6. Panel Lights Do Not Brighten.	Disconnect lead 420B from electronic dimmer switch. Check for +12 VDC at lead 420B with main light switch in bright mode.	If +12 VDC is present, replace dimmer switch (WP 0076 00). If +12 VDC is not present, repair lead 420B (WP 0151 00).
7. Transfer Case (AWD) Indicator Light Does Not Come On, But Transfer Case is Engaged (M916A3, M917A2).	1. Check transfer case air lines and fittings for damage and air leakage.	Tighten or replace air lines and fittings (WP 0298 00).
	2. Remove transmission shift tower access panel and check air lines and fittings at floor for damage and air leakage and all-wheel drive switch for damage.	Tighten or replace air lines and fittings (WP 0298 00).
	3. Disconnect connector from all-wheel drive switch and check for +12 VDC.	If +12 VDC is present, replace all-wheel drive switch (WP 0153 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Panel Lights and Alarm Circuits - Continued		
8. Trailer Lights Do Not Operate.	1. Check +24V TRLR LTS 15A fuse G6.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for +24 VDC at trailer electrical receptacle.	If +24 VDC is present, troubleshoot trailer electrical circuit (see applicable trailer TM). If +24 VDC is not present, replace trailer electrical receptacles (WP 0092 00).
9. Dash Panel 12V Receptacle Does Not Operate.	1. Check DASH/RCPT 15A fuse E3.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.
	2. Disconnect connector from +12V power receptacle and check for +12 VDC at lead 57.	If +12 VDC is present, replace 12V power receptacle (WP 0076 00 or WP 0081 00). If +12 VDC is not present, repair lead 57 (WP 0151 00).
10. TRAILER ABS Indicator Light (M915A3, M916A3) Does Not Come On When Ignition Switch is Turned ON.	1. Check TRLR/BCN 30A fuse E2.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect TRAILER ABS relay K0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 376 (WP 0151 00).
	3. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 81C (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 376 or lead 81C (WP 0151 00). If +12 VDC is not present, replace relay K0 (WP 0084 00).
	6. Disconnect connector from light and check for +12 VDC.	If +12 VDC is present, replace indicator light (WP 0074 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).
	7. Refer to trailer troubleshooting (see applicable trailer TM).	

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Panel Lights and Alarm Circuits - Continued		
11.TRACTOR ABS Indicator Light Does Not Come On When Ignition Switch is Turned ON.	1. Check TRACTOR ABS 30A fuse E1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from light and check for +12 VDC at lead 339.	If +12 VDC is present, replace indicator light (WP 0074 00). If +12 VDC is not present, repair lead 339 (WP 0151 00).
	3. Refer to ABS troubleshooting (WP 0013 00).	
12.PARK BRAKE Indicator Light Does Not Come On, but Park Brakes Are Applied.	Disconnect connector from light and check for +12 VDC at lead 125.	If +12 VDC is present, replace indicator light (WP 0074 00). If +12 VDC is not present, repair lead 125 (WP 0151 00).
Radio and Chemical Detector Circuits		
1. Power Source for 24 VDC Radio Does Not Operate.	1. Check RADIO 24V 20A fuse G4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Remove RADIO 24V 20A fuse G4. Check for +24 VDC at lead 421W fuse connector.	If +24 VDC is present, proceed. If voltage is not present, repair lead 421W to 24 VDC constant power bus (WP 0151 00).
	3. Check for continuity between ground lead and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	4. Check for +24 VDC at lead 421R from radio power source connector.	If +24 VDC is not present, repair lead 421R (WP 0151 00).
2. Power Source for Chemical Detector Does Not Operate.	1. Check 24V CHEM DET 10A fuse G3.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.
	2. Disconnect chassis connector and check for +24 VDC at lead 421S.	If +24 VDC is present, troubleshoot chemical detector (see applicable TM). If +24 VDC is not present, repair lead 421S (WP 0151 00).
Instrument Wiring Circuits		
1. Instruments on Dashboard Do Not Operate.	1. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for +12 VDC at ignition run power bus connector.	If +12 VDC is present, repair lead 81C. If voltage is not present, repair connector on ignition run power bus (WP 00151 00).
2. Water Temperature Gage Does Not Operate.	1. Disconnect lead 81C from water temperature gage. Check for +12 VDC at lead 81C.	If +12 VDC is present, proceed. If voltage is not present, repair lead 81C (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
2. Water Temperature Gage Does Not Operate - Continued.	2. Disconnect ground lead from water temperature gage. Check for continuity between lead and ground.	If continuity is present, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect lead 119 from water temperature gage. Check for +8 to +12 VDC at water temperature gage.	If +8 to +12 VDC is present, proceed. If voltage is not present, replace water temperature gage (WP 0073 00).
	4. Disconnect lead 119 from water temperature gage sensor. Check for +8 to +12 VDC at lead 119.	If +8 to +12 VDC is present, replace water temperature gage sensor (WP 0116 00). If voltage is not present, repair lead 119 (WP 0151 00).
3. Transmission Oil Temperature Gage Does Not Operate.	1. Disconnect lead 81C from transmission oil temperature gage. Check for +12 VDC at lead 81C.	If +12 VDC is present, proceed. If voltage is not present, repair lead 81C (WP 0151 00).
	2. Disconnect ground lead from transmission oil temperature gage. Check for continuity between lead and ground.	If continuity is present, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect lead 30 from transmission oil temperature gage. Check for +8 to +12 VDC at transmission oil temperature gage.	If +8 to +12 VDC is present, proceed. If voltage is not present, replace transmission oil temperature gage (WP 0075 00).
	4. Disconnect lead 30 from transmission oil temperature gage sensor. Check for +8 to +12 VDC at lead 30.	If +8 to +12 VDC is present, replace transmission oil temperature gage sensor (WP 0114 00). If voltage is not present, repair lead 30 (WP 0151 00).
4. Fuel Level Gage Does Not Operate.	1. Disconnect lead 81C from fuel level gage. Check for +12 VDC at lead 81C.	If +12 VDC is present, proceed. If voltage is not present, repair lead 81C (WP 0151 00).
	2. Disconnect ground lead from fuel level gage. Check for continuity between ground lead and ground.	If continuity is present, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	3. Disconnect lead 47 from fuel level gage. Check for +8 to +12 VDC at fuel level gage.	If +8 to +12 VDC is present, proceed. If voltage is not present, replace fuel level gage (WP 0075 00).
	4. Disconnect lead 47 from fuel level sensor. Check for +8 to +12 VDC at lead 47.	If +8 to +12 VDC is present, replace fuel level gage sensor (WP 0094 00). If voltage is not present, repair lead 47 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
5. Voltmeter Does Not Operate.	1. Check VLTMTR/DGNSTC 10A fuse D5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect lead 19A from voltmeter. Check for +12 VDC at lead 19A.	If +12 VDC is present, proceed. If voltage is not present, repair lead 19A (WP 0151 00).
	3. Disconnect ground lead from voltmeter. Check for continuity between ground lead and ground.	If continuity is indicated, replace voltmeter (WP 0076 00). If continuity is not indicated, repair ground lead (WP 0151 00).
6. Axle Lock Indicator Light Does Not Operate (M915A3).	1. Disconnect lead 81C from axle lock pressure switch. Check for +12 VDC at lead 81C.	If +12 VDC is present, proceed. If voltage is not present, repair lead 81C (WP 0151 00).
	2. Disconnect leads 87 and 81C from axle lock pressure switch. Check for continuity between contacts of switch.	If continuity is indicated, proceed. If continuity is not indicated, replace axle lock pressure switch (WP 0076 00).
	3. Disconnect lead 87 from axle lock pressure switch. Check for continuity between lead 87 and ground.	If no continuity is indicated, repair lead 87 (WP 0151 00).
7. No Response When CHK ENG Button is Pressed.	1. Check ENGINE ECU 10A fuse F7.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. With button pressed, check for continuity through check engine button at leads D528 and D953.	If continuity is not indicated, replace button (WP 0083 00). If continuity is indicated, refer to DDEC system troubleshooting to section number that matches flash codes logged (WP 0007 00).
8. Windshield Wipers Do Not Operate.	1. Check WIPERS 15A fuse E6.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for continuity through wiper switch.	If continuity is not present, replace switch (WP 0080 00). If switch is okay, proceed.
	3. Disconnect ELECTRIC WIPERS relay L0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 279D (WP 0151 00).
	4. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 81C (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
8. Windshield Wipers Do Not Operate - Continued.	6. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 81C or lead 279D (WP 0151 00). If +12 VDC is not present, replace relay L0 (WP 0084 00).
9. Windshield Washer Does Not Dispense Fluid.	1. Check WIPERS 15A fuse E6.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from reservoir pump and check for +12 VDC at lead 320.	If +12 VDC is present, replace reservoir pump (WP 0279 00). If +12 VDC is not present, replace wiper/washer switch (WP 0080 00).
10.Air Conditioner Does Not Operate.	1. Check A/C CLUTCH 15A fuse D7.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect A/C CLUTCH relay B7. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 98A (WP 0151 00).
	3. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 98Z (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 98A or lead 98Z (WP 0151 00). If +12 VDC is not present, replace relay B7 (WP 0084 00).
	6. Perform A/C troubleshooting (WP 0017 00).	
11.L/H Mirror Does Not Move Using MIRROR PWR Switch (M915A3 New Model, M916A3, M917A2).	1. Check MIRRORS 15A fuse E5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for damage and continuity through mirror power switch.	If continuity is not indicated, replace switch (WP 0078 00). If continuity is indicated, proceed.
	3. Disconnect connector from L/H mirror power switch and check for +12 VDC at lead 157.	If +12 VDC is present, replace L/H mirror power switch (WP 0078 00). If +12 VDC is not present, repair lead 157 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
11.L/H Mirror Does Not Move Using MIRROR PWR Switch (M915A3 New Model, M916A3, M917A2) - Continued.	4. Disconnect connector from L/H mirror and check for +12 VDC.	If +12 VDC is present, replace L/H mirror (WP 0276 00). If +12 VDC is not present, repair lead (WP 0151 00).
12.R/H Mirror Does Not Move Using MIRROR PWR Switch (M915A3 New Model, M916A3, M917A2).	1. Check MIRRORS 15A fuse E5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check for damage and continuity through mirror power switch.	If continuity is not indicated, replace switch (WP 0078 00). If continuity is indicated, proceed.
	3. Disconnect connector from R/H mirror power switch and check for +12 VDC at lead 157.	If +12 VDC is present, replace R/H mirror power switch (WP 0078 00). If +12 VDC is not present, proceed.
	4. Disconnect connector from R/H mirror and check for +12 VDC.	If +12 VDC is present, replace R/H mirror (WP 0276 00). If +12 VDC is not present, repair lead (WP 0151 00).
13.Mirror(s) Does Not Receive Heat.	1. Check MIRRORS 15A fuse E5.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect MIRROR HEAT relay F0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 80C (WP 0151 00).
	3. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 81C (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 80C or lead 81C (WP 0151 00). If +12 VDC is not present, replace relay B7 (WP 0084 00). If malfunction still exists, proceed.
	6. Check for damage and continuity through mirror heat switch.	If switch is damaged or continuity is not present, replace switch (WP 0080 00). If switch is okay, proceed.
	7. Disconnect connector from mirror and check for +12 VDC.	If +12 VDC is present, replace mirror (WP 0276 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
14.Oil Pressure Gage Does Not Operate.	1. With ignition ON, press CHK ENG button and observe CHK ENG light for flash codes.	Perform DDEC system troubleshooting (WP 0007 00). Refer to section that matches flash code logged. If no codes are present, proceed.
	2. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Disconnect connector from oil pressure gage and check for +12 VDC at lead 81C.	If +12 VDC is present, replace oil pressure gage (WP 0073 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
15.Tachometer Does Not Operate.	1. With ignition ON, press CHK ENG button and observe CHK ENG light for flash codes.	Perform DDEC system troubleshooting (WP 0007 00). Refer to section that matches flash code logged. If no codes are present, proceed.
	2. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Disconnect connector from tachometer and check for +12 VDC at lead 81C.	If +12 VDC is present, replace tachometer (WP 0074 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
16.Speedometer Does Not Operate.	1. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from speedometer and check for +12 VDC at lead 81C.	If +12 VDC is present, replace speedometer (WP 0074 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
	3. If speedometer still does not operate, refer to transmission troubleshooting (WP 0011 00).	
17.Transfer Case Oil Temperature Gage (M916A3, M917A2) Does Not Operate.	1. Check INSTRUMENTS 15A fuse F4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from transfer case oil temperature gage and check for +12 VDC at lead 81C.	If +12 VDC is present, replace transfer case oil temperature gage (WP 0075 00). If +12 VDC is not present, repair lead 81C (WP 0151 00).
	3. Disconnect connector from transfer case oil temperature sending unit and check for +12 VDC.	If +12 VDC is present, replace transfer case oil temperature sending unit (WP 0164 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
18.PTO Does Not Operate (M916A3, M917A2).	1. Check FOGLTS/PTO 15A fuse E4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from PTO and check for +12 VDC.	If +12 VDC is present, notify Direct Support Maintenance to replace PTO. If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).
	3. Disconnect PTO LOCKOUT relay C0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 200D (WP 0151 00).
	4. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 445A (WP 0151 00).
	5. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	6. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87A.	If +12 VDC is present, repair lead 200D or lead 445A (WP 0151 00). If +12 VDC is not present, replace relay B7 (WP 0084 00).
	7. Disconnect PTO relay D0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 200F (WP 0151 00).
	8. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead E112 (WP 0151 00).
	9. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	10. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 200F or lead E112 (WP 0151 00). If +12 VDC is not present, replace relay B7 (WP 0084 00).
	11. Disconnect PTO NEUTRAL L/O relay E0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead D953 (WP 0151 00).
	12. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 125 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
18.PTO Does Not Operate (M916A3, M917A2) - Continued.	13. Check for +12 VDC connector 86.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead E114 (WP 0151 00).
	14. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead D953, lead 125, or lead 98Z (WP 0151 00). If +12 VDC is not present, replace relay B7 (WP 0084 00).
	15. Disconnect connector from PTO switch and check for +12 VDC.	If +12 VDC is present, replace PTO switch (WP 0076 00). If +12 VDC is not present, inspect and repair harness as necessary (WP 0151 00).
19.Material Control System (MCS) (M917A2 w/ MCS) Gate(s) Does Not Operate.	1. Check for loose or damaged electrical connector(s) at MCS gate(s).	Tighten loose connector(s) or repair as necessary (WP 0151 00). If electrical connector(s) is okay, proceed.
	2. Check EVT/MAT'L CTL 15A fuse F8.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Disconnect MATERIAL CONTROL relay M3. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 448 (WP 0151 00).
	4. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 81C (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, and connector 85 and relay. Check for +12 VDC at relay contact 87A.	If +12 VDC is present, repair lead 448 or lead 81C (WP 0151 00). If +12 VDC is not present, replace relay M3 (WP 0084 00).
20.Collision Warning System (CWS) (M915A3, M916A3) Driver's Display Unit Does Not Power-Up.	1. Check VORAD 5A fuse H4.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect connector from CWS CPU and check for +12 VDC at lead 444K.	If +12 VDC is present, replace CWS CPU (WP 0135 00 or WP 0136 00). If +12 VDC is not present, repair lead 444K (WP 0151 00).
	3. Disconnect connector from CWS DDU and check for +12 VDC at lead 444E.	If +12 VDC is present, replace CWS DDU (WP 0137 00). If +12 VDC is not present, repair lead 444E (WP 0151 00).
	4. Refer to CWS troubleshooting (WP 0018 00).	

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Instrument Wiring Circuits - Continued		
21.CTIS (M916A3, M917A2) Does Not Operate.	1. Check 24V CTIS 15A fuse G8.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect CTIS/TRLR AUX relay J0. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 446F (WP 0151 00).
	3. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 81C (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 446F or lead 81C (WP 0151 00). If +24 VDC is not present, replace relay J0 (WP 0084 00).
	6. Disconnect connector from CTIS control panel and check for +24 VDC.	If +24 VDC is present, replace CTIS control panel (WP 0137 00). If +24 VDC is not present, inspect and repair harness as necessary (WP 0151 00).
	7. Refer to CTIS troubleshooting (WP 0020 00).	
22.No Lights Operate When Main Light Switch is Placed in an Operational Position.	1. Check LIGHT SW PWR 25A fuse D8.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.
	2. Disconnect connector from main light switch and check for +12 VDC at lead 420F.	If +12 VDC is present, replace main light switch (WP 0076 00). If +12 VDC is not present, repair lead 420F (WP 0151 00).
23.Lights, Horn, Backup Alarm (M917A2) Functions with Main Light Switch in B/O Position.		Replace main light switch (WP 0076 00).
Ether Cold-Start Circuit		
Ether Cold-start Does Not Operate When Container Has Ether (Engine Will Not Start in Cold Temperature).	1. Check ether control relay light.	If ether control relay light is on, replace fuel cylinder (WP 0039 00). If light is not on, proceed.
	2. Disconnect jumper harness connector from ECU harness connector and check ether 15A fuse.	Replace defective fuse (WP 0149 00). If fuse is okay, proceed.
	3. Remove ether 15A fuse. Check for +12 VDC at fuse connector from ignition run power bus.	If +12 VDC is present, proceed. If voltage is not present, repair circuit 18 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Ether Cold-Start Circuit - Continued		
Ether Cold-start Does Not Operate When Container Has Ether (Engine Will Not Start in Cold Temperature) - Continued.	4. Disconnect lead 166 from ether switch. Check for +12 VDC at lead 166.	If +12 VDC is present, proceed. If voltage is not present, repair lead 166 (WP 0151 00).
	5. Disconnect lead 166A at cab/chassis connection. Check for +12 VDC at lead 166A.	If +12 VDC is present, proceed. If voltage is not present, repair lead 166A (WP 0151 00).
	6. Disconnect lead 166A from ether solenoid. Check for +12 VDC at lead 166A.	If +12 VDC is present, proceed. If voltage is not present, repair lead 166A (WP 0151 00).
	7. Disconnect ground lead from ether solenoid. Check for continuity between ground lead and ground.	If continuity is indicated, replace ether solenoid (WP 0039 00). If continuity is not indicated, repair ground lead (WP 0151 00).
Air Dryer Heater Circuit		
Air Dryer Heater Does Not Operate.	1. Check reservoir heater/power take-off 15A fuse.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Disconnect lead 94 from air dryer drain valve heater. Check for +12 VDC at lead 94.	If +12 VDC is present, proceed. If voltage is not present, repair lead 94 (WP 0151 00).
	3. Disconnect ground lead from air dryer drain valve heater. Check for continuity between lead and ground.	If continuity is indicated, replace air dryer drain valve heater. If continuity is not indicated, repair ground lead (WP 0151 00).
Standard Heater Circuits		
Heater Fan Does Not Operate at Any Speed.	1. Check HEATER FAN 30A fuse D6.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	2. Check START/AUX 15A fuse G1.	Replace defective fuse (WP 0084 00). If fuse is okay, proceed.
	3. Remove HEATER FAN 30A fuse D6. Check for +12 VDC at lead 14 fuse connector.	If +12 VDC is present, proceed. If voltage is not present, repair lead 14 to 12-volt constant power bus (WP 0151 00).
	4. Remove START/AUX 15A fuse G1. Check for +12 VDC at lead 71A fuse connector.	If +12 VDC is present, proceed. If voltage is not present, repair lead 71A (WP 0151 00).
	5. Disconnect HTR FAN PWR relay C1 from connector. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If voltage is not present, repair lead 98 (WP 0151 00).
	6. Disconnect HTR FAN PWR relay C1 from connector. Check for +12 VDC at connector 87.	If +12 VDC is present, proceed. If voltage is not present, repair lead 98 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Standard Heater Circuits - Continued		
Heater Fan Does Not Operate at Any Speed - Continued.	7. Check for continuity between connector 86 and ground for both relays.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	8. Disconnect HTR FAN PWR relay C1 from connector. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. If voltage is not present, repair lead 71A (WP 0151 00).
	9. Disconnect lead 98 from heater fan control. Check for +12 VDC at lead 98.	If +12 VDC is present, proceed. If voltage is not present, disconnect HTR FAN PWR relay C1. Check for continuity in lead 98. If continuity is indicated, replace relay (WP 0084 00). If continuity is not indicated, repair lead 98 (WP 0151 00).
	10. Disconnect lead 98L from heater fan control. Check for +12 VDC at heater fan control connector (D) with heater fan control in high mode.	If +12 VDC is present, proceed. If voltage is not present, replace heater fan control (WP 0080 00).
	11. Disconnect HTR FAN HI relay B1 from connector. Check for +12 VDC at connector 85 with heater fan control in high mode.	If +12 VDC is present, proceed. If voltage is not present, repair lead 98L (WP 0151 00).
	12. Disconnect lead 98T from heater fan motor. Check for +12 VDC at lead 98T with heater fan control in high mode.	If +12 VDC is present, proceed. If voltage is not present, disconnect HTR FAN HI relay B1 from connector. Check for continuity in lead 98T between connector 30 and heater fan motor. If continuity is indicated, replace relay (WP 0084 00). If continuity is not indicated, repair lead 98T (WP 0151 00).
	13. Disconnect ground lead from heater fan motor. Check for continuity between ground lead and ground.	If continuity is indicated, replace heater fan motor (WP 0289 00). If continuity is not indicated, repair ground lead (WP 0151 00).
Trailer Circuits (M915A3/M916A3)		
1. Trailer Marker Light(s) Do Not Operate.	1. If one marker light does not operate, inspect bulb.	Replace broken or defective bulb (see applicable trailer TM). If bulb is okay, proceed.
	2. Check TRLR MRKR LTS 25A fuse E7.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Trailer Circuits (M915A3/M916A3) - Continued		
1. Trailer Marker Light(s) Do Not Operate - Continued.	3. Check 24V TRLR LTS 15A fuse G5.	Replace defective fuse (WP 0084 00). If relay is okay, proceed.
	4. Disconnect TRLR MRKR LTS relay A7. Check for +12 VDC at connector 30.	If +12 VDC is present, proceed. If +12 VDC is not present, repair lead 46A* (WP 0151 00).
	5. Check for +12 VDC at connector 85.	If +12 VDC is present, proceed. IF +12 VDC is not present, repair lead 420H* (WP 0151 00).
	6. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	7. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +12 VDC at relay contact 87.	If +12 VDC is present, repair lead 46A* or lead 420H* (WP 0151 00). If +12 VDC is not present, replace relay A7 (WP 0084 00).
	8. Disconnect 24V TRLR MRKR LTS relay L3. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 421 (WP 0151 00).
	9. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. IF +24 VDC is not present, repair lead 420H* (WP 0151 00).
	10. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	11. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421 or lead 420H* (WP 0151 00). If +24 VDC is not present, replace relay L3 (WP 0084 00).
	12. Check for +24 VDC at trailer electrical receptacle.	If +24 VDC is present, troubleshoot trailer electrical circuit (see applicable trailer TM). If +24 VDC is not present, replace trailer electrical receptacles (WP 0092 00).
2. Trailer Stop Light(s) Do Not Operate.	1. If one trailer stop light does not operate, inspect bulb.	Replace broken or defective bulb (see applicable trailer TM). If bulb is okay, proceed.
	2. Disconnect 24V TRLR STP LTS relay L1. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 421 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Trailer Circuits (M915A3/M916A3) - Continued		
2. Trailer Stop Light(s) Do Not Operate - Continued.	3. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 420C* (WP 0151 00).
	4. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	5. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421 or lead 420C* (WP 0151 00). If +24 VDC is not present, replace relay L1 (WP 0084 00).
	6. Disconnect 24V TRLR MRKR LTS relay L3. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 421 (WP 0151 00).
	7. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 420H* (WP 0151 00).
	8. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	9. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421 or lead 420H* (WP 0151 00). If +24 VDC is not present, replace relay L3 (WP 0084 00).
	10. Disconnect 24V L/H FLASHER relay K3. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 421 (WP 0151 00).
	11. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 38B (WP 0151 00).
	12. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	13. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421 or lead 38B (WP 0151 00). If +24 VDC is not present, replace relay K3 (WP 0084 00).
	14. Disconnect 24V R/H FLASHER relay K5. Check for +24 VDC at connector 30.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 421 (WP 0151 00).

Table 1. Electrical System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Trailer Circuits (M915A3/M916A3) - Continued		
2. Trailer Stop Light(s) Do Not Operate - Continued.	15. Check for +24 VDC at connector 85.	If +24 VDC is present, proceed. If +24 VDC is not present, repair lead 39B (WP 0151 00).
	16. Check for continuity between connector 86 and ground.	If continuity is indicated, proceed. If continuity is not indicated, repair ground lead (WP 0151 00).
	17. Install jumper wires between connector 30 and relay, connector 85 and relay, and connector 86 and relay. Check for +24 VDC at relay contact 87.	If +24 VDC is present, repair lead 421 or lead 39B (WP 0151 00). If +24 VDC is not present, replace relay K5 (WP 0084 00).
	18. Check for +24 VDC at trailer electrical receptacle.	If +24 VDC is present, troubleshoot trailer electrical circuit (see applicable trailer TM). If +24 VDC is not present, replace trailer electrical receptacles (WP 0092 00).

END OF WORK PACKAGE

TRANSMISSION, TRANSFER CASE, AND DRIVELINE SYSTEMS TROUBLESHOOTING 0011 00

THIS WORK PACKAGE COVERS

Transmission, Transfer Case, and Driveline Systems Troubleshooting Procedures, WTEC III Electronic Controls Troubleshooting Manual

INITIAL SETUP

Tools and Special Tools

PC Card, transmission (Item 32, WP 0306 00)

Tester, Pro-link, diagnostic reader (Item 46, WP 0306 00)

NOTE

In addition to the transmission troubleshooting located in Table 1 below, the *Allison Transmission Troubleshooting Manual* is duplicated in its entirety and is located beginning on page 0011 00-7. An index of troubleshooting diagnostic codes is on page 0011 00-36.

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures .

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Transmission		
1. Shift Selector Display Is Blank.	1. Check if VIM fuse is blown.	Replace VIM fuse (WP 0084 00).
	2. Check for damaged or loose battery connections.	Tighten or repair battery connections (WP 0145 00 or WP 0146 00).
	3. Check for blown fuse or fusible link at battery.	Replace battery fuse or fusible link (WP 0084 00).
2. Vehicle Does Not Start (Engine Does Not Crank).	1. Check that shift selector is in N (Neutral).	Press N (Neutral) on shift selector and restart vehicle (TM 9-2320-302-10).
	2. Check for dead battery.	Recharge battery as necessary (TM 9-6140-200-14).
	3. Check for damaged or loose battery connections.	Tighten or repair battery connections (WP 0145 00 or WP 0146 00).
	4. Faulty starter circuit.	Repair vehicle starter circuit (WP 0010 00).
	5. Faulty neutral start relay.	Replace neutral start relay (WP 0084 00).
	6. Faulty wiring in neutral start circuit.	Repair wiring (WP 0151 00).

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Transmission - Continued		
2. Vehicle Does Not Start (Engine Does Not Crank) - Continued.	7. Voltage to ECU too low.	Check battery and charging system voltage (WP 0010 00).
	8. Faulty shift selector.	Replace shift selector (WP 0152 00 or WP 0153 00).
	9. Lack of battery voltage on circuit 123 from ECU when in neutral.	Repair circuit 123 (WP 0151 00) or replace ECU (WP 0157 00).
3. All Display Segments on Both Sides of Display Lighted.	No calibration installed in ECU. Voltage to ECU too low.	Check battery and charging system voltage (WP 0010 00). Notify Direct Support Maintenance.
Transmission Shifting		
1. ECU Will Not Turn Off When Ignition Switch Is Turned Off.	Faulty ignition switch.	Replace ignition switch (WP 0010 00). Notify Direct Support Maintenance.
2. Transmission Will Not Shift to Forward or Reverse (Stays In Neutral).	1. Engine RPM too high.	Reduce engine RPM.
	2. Low transmission fluid level.	Add fluid to proper level (TM 9-2320-302-10).
	3. Transmission fluid temperature too low.	Warm transmission fluid.
	4. Throttle position sensor set-up is incorrect.	Refer to throttle position sensor for correct set-up (WP 0006 00).
	5. Voltage to ECU too low.	Check vehicle battery and charging system (WP 0010 00).
	6. Shift selector is not functioning properly.	Replace shift selector (WP 0152 00 or WP 0153 00).
	7. Disconnected or dirty connectors.	Perform connector checkout.
	8. Faulty wiring harnesses.	Repair harness (WP 0151 00).
	9. Faulty ECU.	Replace ECU (WP 0157 00).
3. Transmission Will Not Stay in Forward or Reverse.	Auto-neutral or quick-to-neutral circuit (input function) faulty.	Notify Direct Support Maintenance.
4. Transmission Will Not Make a Specific Shift.	1. Low engine power.	Correct engine problem (WP 0006 00).
	2. Incorrect transmission fluid level.	Correct fluid level (TM 9-2320-302-10).
	3. Extreme transmission fluid temperature.	Inspect cooling system and fluid level (WP 0006 00).
	4. Faulty shift selector.	Replace shift selector (WP 0152 00 or WP 0153 00).

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Transmission Shifting - Continued		
4. Transmission Will Not Make a Specific Shift - Continued.	5. Faulty ECU.	Replace ECU (WP 0157 00). Notify Direct Support Maintenance.
5. Transmission Does Not Shift Properly (Rough Shifts, Shifts Occurring at Too Low or Too High Speed).	1. Engine idle speed too fast (neutral to range shift).	Adjust engine idle speed (WP 0006 00).
	2. ECU input voltage low.	Check power, ground, charging system, and battery function (WP 0010 00).
	3. Incorrect transmission fluid level	Correct fluid level (TM 9-2320-302-10).
	4. Intermittent problems.	Check wiring harnesses and connectors (WP 0151 00). Notify Direct Support Maintenance.
Abnormal Activities or Responses from Transmission		
1. Excessive Creep in First and Reverse Gears.	Engine idle speed too high.	Adjust to correct idle speed between 500-800 RPM (WP 0006 00).
2. No Response to Shift Selector.	1. Shift selector not properly connected.	Check shift selector response with diagnostic tool. If no response, check remote connection and replace if necessary (WP 0152 00 or WP 0153 00).
	2. Faulty shift selector.	Replace shift selector (WP 0152 00 or WP 0153 00).
	3. Incorrect transmission fluid level.	Correct fluid level (TM 9-2320-302-10).
3. Vehicle Moves Forward in Neutral.	C1 clutch failed or not released.	Notify Direct Support Maintenance.
4. Vehicle Moves Backward in Neutral.	C3 clutch failed or not released.	Notify Direct Support Maintenance.
5. Engine Overspeed on Full-throttle Upshifts.	1. TPS adjustment: - Overstroke	Adjust TPS (WP 0006 00).
	2. ECU input voltage low.	Check electrical system and all connections from battery and ECU (WP 0010 00 or WP 0151 00).
	3. Incorrect transmission fluid level.	Correct fluid level (TM 9-2320-302-10).
	4. Piston seals leaking or clutch plates slipping in range involved.	Notify Direct Support Maintenance.

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Abnormal Activities or Responses from Transmission - Continued		
6. Excessive Slippage and Clutch Chatter.	1. Incorrect calibration.	Verify calibration. Notify Direct Support Maintenance.
	2. ECU input voltage low.	Check power, ground, charging system, and battery functions (WP 0010 00).
	3. Throttle position sensor out of adjustment or failed.	Adjust or replace throttle position sensor (WP 0006 00).
	4. Incorrect transmission fluid level.	Correct fluid level (TM 9-2320-302-10).
7. Abnormal Stall Speeds (Stall in All Ranges).		
High Stall Speeds.	1. Not in gear.	Select D (Drive).
	2. Low fluid level, aerated fluid.	Add fluid to proper level (TM 9-2320-302-10).
	3. Clutch slipping.	Notify Direct Support Maintenance.
Low Stall Speeds.	Engine not performing efficiently (may be due to plugged or restricted injectors, high altitude conditions, dirty air filters, out of time, throttle linkage, electronic engine controls problem).	Refer to Engine Troubleshooting (WP 0006 00). Notify Direct Support Maintenance.
8. Overheating in All Ranges.	1. Aerated fluid - incorrect fluid level.	Adjust fluid to proper level (TM 9-2320-302-10).
	2. Engine overheat.	Correct overheat situation (WP 0006 00).
	3. Inaccurate temperature gage.	Replace gage (WP 0075 00).
	4. Fluid cooler lines restricted.	Remove restrictions, clean or replace lines (WP 0155 00). Notify Direct Support Maintenance.
9. Fluid Comes out Fluid Fill Tube and/or Breather.	1. Dipstick loose.	Tighten cap. Replace if necessary (WP 0154 00).
	2. Transmission fluid level too high.	Drain to proper level (TM 9-2320-302-10).
	3. Transmission fluid level too low.	Add fluid to proper level (TM 9-2320-302-10).
	4. Breather clogged.	Clean or replace breather (WP 0163 00).
	5. Transmission fluid contaminated with foreign liquid.	Drain and replace fluid (WP 0023 00). Locate and repair source of contaminating fluid.
	6. Dipstick or fill tube seal worn.	Replace seals or dipstick (WP 0154 00).

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Abnormal Activities or Responses from Transmission - Continued		
10. Noise Occurring Intermittently (Buzzing).	1. Low transmission fluid level.	Add fluid to proper level (TM 9-2320-302-10).
	2. Air leak in oil suction screen canister.	Replace oil suction screen canister (WP 0156 00).
	3. Clogged filters.	Replace filters (WP 0156 00).
	4. Aerated fluid causes noisy pump.	Correct fluid level (TM 9-2320-302-10). Notify Direct Support Maintenance.
11. Leaking Fluid (Output Shaft).	Faulty or missing seal at output flange.	Notify Direct Support Maintenance
12. Transmission Leaks (Input).	1. Front seal leaks	Notify Direct Support Maintenance.
	2. Converter leaks.	Notify Direct Support Maintenance.
13. Dirty Transmission Fluid.	1. Failure to change fluid and filters.	Change fluid and install new filters (WP 0156 00).
	2. Damaged fluid filter/seals.	Replace oil filter/seals (WP 0156 00).
Forward-rear Axle and Rear-rear Axle Driveline Assemblies		
1. No Drive at Forward-rear Axle and/or Rear-rear Axle.	1. Check driveline and universal joints from transmission rear output to forward-rear axle for broken universal joint(s) and broken or damaged tube, splines or yoke(s).	Replace any defective universal joint(s) (WP 0166 00 or WP 0167 00). Replace defective driveline (WP 0165 00 or WP 0166 00).
	2. Check drivelines and universal joints from forward-rear axle to rear-rear axle for broken universal joint(s) and broken or damaged tubes, splines or yoke(s).	Replace any defective universal joint(s) (WP 0166 00 or WP 0167 00). Replace defective driveline (WP 0165 00 or WP 0166 00).
	3. Check forward-rear axle and rear-rear axle for broken axle shaft(s).	Notify Direct Support Maintenance.
2. Vibration or Noise During or While Driving.	1. Check drivelines and universal joints for obvious wear or damage.	Replace any defective universal joint(s) (WP 0166 00 or WP 0167 00). Replace defective driveline (WP 0165 00 or WP 0166 00).
	2. Check wheels for looseness and obvious damage.	Tighten any loose wheel lug nuts (WP 0206 00). Replace any damaged wheel(s).
	3. If problem still exists, notify Direct Support Maintenance.	

Table 1. Transmission, Transfer Case, and Driveline Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Forward-rear Axle and Rear-rear Axle Driveline Assemblies - Continued		
3. No Drive at Front Axle (M916A3, M917A2).	Check driveline and universal joints from transfer case to forward axle for broken universal joints or propeller shaft.	Replace defective universal joint(s) (WP 0166 00 or WP 0167 00). Replace defective driveline (WP 0165 00 or WP 0166 00).
Transfer Case (M916A3, M917A2)		
1. Transfer Case Does Not Engage.	1. Check function of all-wheel drive switch.	Refer to WP 0010 00.
	2. Check air line and fitting connections at transfer case for leaks or damage.	Tighten or replace air lines and fittings (WP 0186 00 or WP 0187 00).
	3. If problem still exists, notify Direct Support Maintenance.	
2. Transfer Case Overheats.	1. Check for proper fluid level.	If fluid level is okay, notify Direct Support Maintenance.
	2. Check for metal particles in oil.	If metal particles are found in oil, notify Direct Support Maintenance.

END OF WORK PACKAGE

FOREWORD — How to Use This Manual

This manual provides troubleshooting information for Allison Transmission Division, MD/HD/B Series On-Highway Transmissions. Service Manuals SM2148EN and SM2457EN, plus Parts Catalogs PC2150EN and PC2456EN may be used in conjunction with this manual.

This manual includes:

- Description of the WTEC III electronic control system.
- Description of the electronic control system components.
- Description of diagnostic codes, system responses to faults, and troubleshooting.
- Wire, terminal, and connector repair information.

Specific instructions for using many of the available or required service tools and equipment are not included in this manual. The service tool manufacturer will furnish instructions for using the tools or equipment.

Additional information may be published from time to time in Service Information Letters (SIL) and will be included in future revisions of this and other manuals. Please use these SILs to obtain up-to-date information concerning Allison Transmission products.

This publication is revised periodically to include improvements, new models, special tools, and procedures. A revision is indicated by a letter suffix added to the publication number. Check with your Allison Transmission service outlet for the currently applicable publication. Additional copies of this publication may be purchased from authorized Allison Transmission service outlets. Look in your telephone directory under the heading of Transmissions — Truck, Tractor, etc.

Take time to review the Table of Contents and the manual. Reviewing the Table of Contents will aid you in quickly locating information.

NOTE: Allison Transmission is providing for service of wiring harnesses and wiring harness components as follows:

- Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.
- Repair parts for the external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes ATD, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI will have parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:

St. Clair Technologies, Inc.
1050 Old Glass Road
Wallaceburg, Ontario, Canada, N8A 3T2
Phone: (519) 627-1673
Fax: (519) 627-4227

St. Clair Technologies, Inc.
1111 Mikesell Street
Charlotte, Michigan 48813
Phone: (517) 541-8166
Fax: (517) 541-8167

St. Clair Technologies, Inc.
c/o Mequilas Tetakawi
Carr. Internationale KM 1969
Guadalajara – Nogales, KM2
Empalme, Sonora, Mexico
Phone: 011-52-622-34661
Fax: 011-52-622-34662

- St. Clair Technologies, Inc. stocks a WTEC III external harness repair kit, P/N 29532362, as a source for some external harness repair parts. SCTI is the source for external harness repair parts.

TRADEMARKS USED IN THIS MANUAL

IMPORTANT SAFETY NOTICE

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions used in this manual. These warnings and cautions advise against using specific service procedures that can result in personal injury, equipment damage, or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Consequently, Allison Transmission has not undertaken any such broad evaluation. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service procedures used.

Also, be sure to review and observe WARNINGS, CAUTIONS, and NOTES provided by the vehicle manufacturer and/or body builder before servicing the Allison transmission in that vehicle.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission and described in this manual are effective methods for performing troubleshooting operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The WARNINGS, CAUTIONS, and NOTES in this manual apply only to the Allison transmission and not to other vehicle systems which may interact with the transmission. Be sure to review and observe any vehicle system information provided by the vehicle manufacturer and/or body builder at all times the Allison transmission is being serviced.

WARNINGS, CAUTIONS, AND NOTES

Three types of headings are used in this manual to attract your attention:

WARNING!	**Is used when an operating procedure, practice, etc., which, if not correctly followed, could result in injury or loss of life.**

CAUTION:	Is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE: ***Is used when an operating procedure, practice, etc., is essential to highlight.***

Trademarks Used In This Manual

The following trademarks are the property of the companies indicated:

- DEXRON® is a registered trademark of General Motors Corporation.
- LPS® Cleaner is a registered trademark of LPS Laboratories.
- Loctite® is a registered trademark of the Loctite Corporation.
- Teflon® is a registered trademark of the DuPont Corporation.
- Pro-Link® is a registered trademark of MicroProcessor Systems, Inc.

SHIFT SELECTOR TERMS AND DISPLAY INDICATIONS

Shift selector terms and displays are represented in this manual as follows:

- Button Names —⇑, ⇓, “display mode”, **MODE**, etc.
- Transmission Ranges — **D** (Drive), **N** (Neutral), **R** (Reverse), **1** (First), **2** (Second), etc.
- Displays — “**o**, **L**”; “**o**, **K**”, etc. (Display occurs one character at a time.)

TABLE OF CONTENTS

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SECTION 1 — GENERAL DESCRIPTION

1–1. TRANSMISSION

The World Transmission Electronic Controls (WTEC III) system features closed-loop clutch control to provide superior shift quality over a wide range of operating conditions. MD 3000, HD 4000, and B Series configurations can be programmed to have up to six forward ranges, neutral, and one reverse range. The MD 3070 and HD 4070 have up to seven forward ranges and one reverse range.

Figure 1–1 is a block diagram of the basic system inputs and outputs.

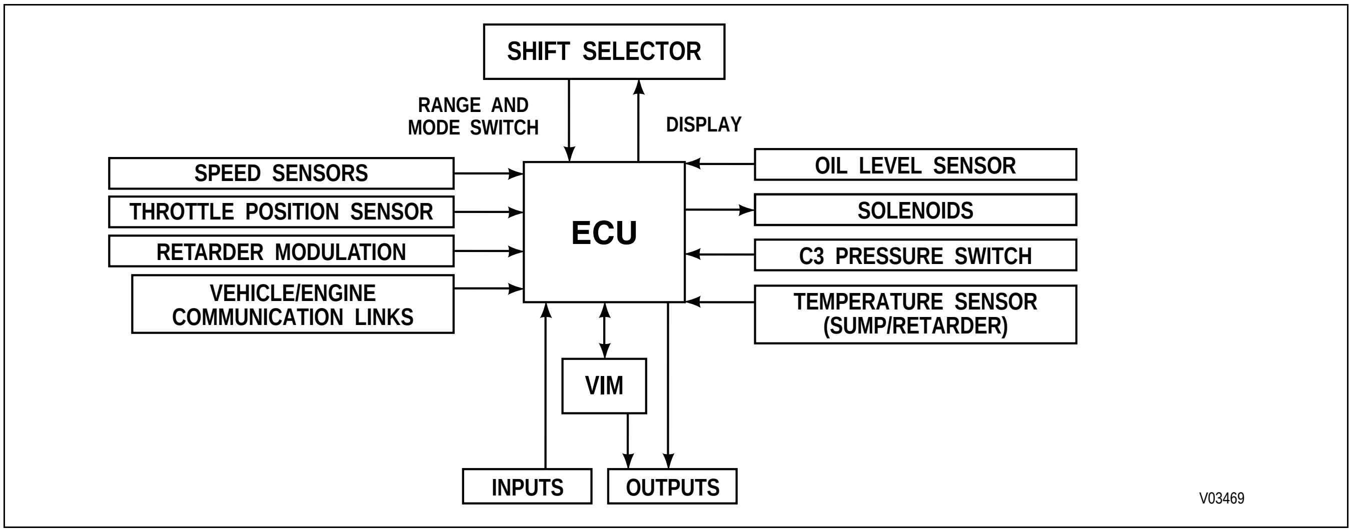


Figure 1–1. Electronic Control Unit Block Diagram

Figure 1–2 shows WTEC III electronic control components.

WTEC III Electronic Controls consist of the following elements:

- Remote 12/24V Max Feature Sealed Electronic Control Unit (ECU)
- Remote Pushbutton or Lever Shift Selector
- Optional Secondary Shift Selector
- Throttle Position Sensor (TPS) (or electronic engine throttle data or PWM signal)
- Engine, Turbine, and Output Speed Sensors
- Control Module (Electro-Hydraulic Valve Body)
- Wiring Harnesses
- Vehicle Interface Module (VIM)
- Autodetect Feature
- TransID Feature
- Optional Retarder Controls
- Optional Engine Coolant Temperature Input

NOTE:
- ***All external harnesses are OEM supplied***
- ***Some OEMs may supply their own shift selector***
- ***The VIM is an OEM option***

GENERAL DESCRIPTION

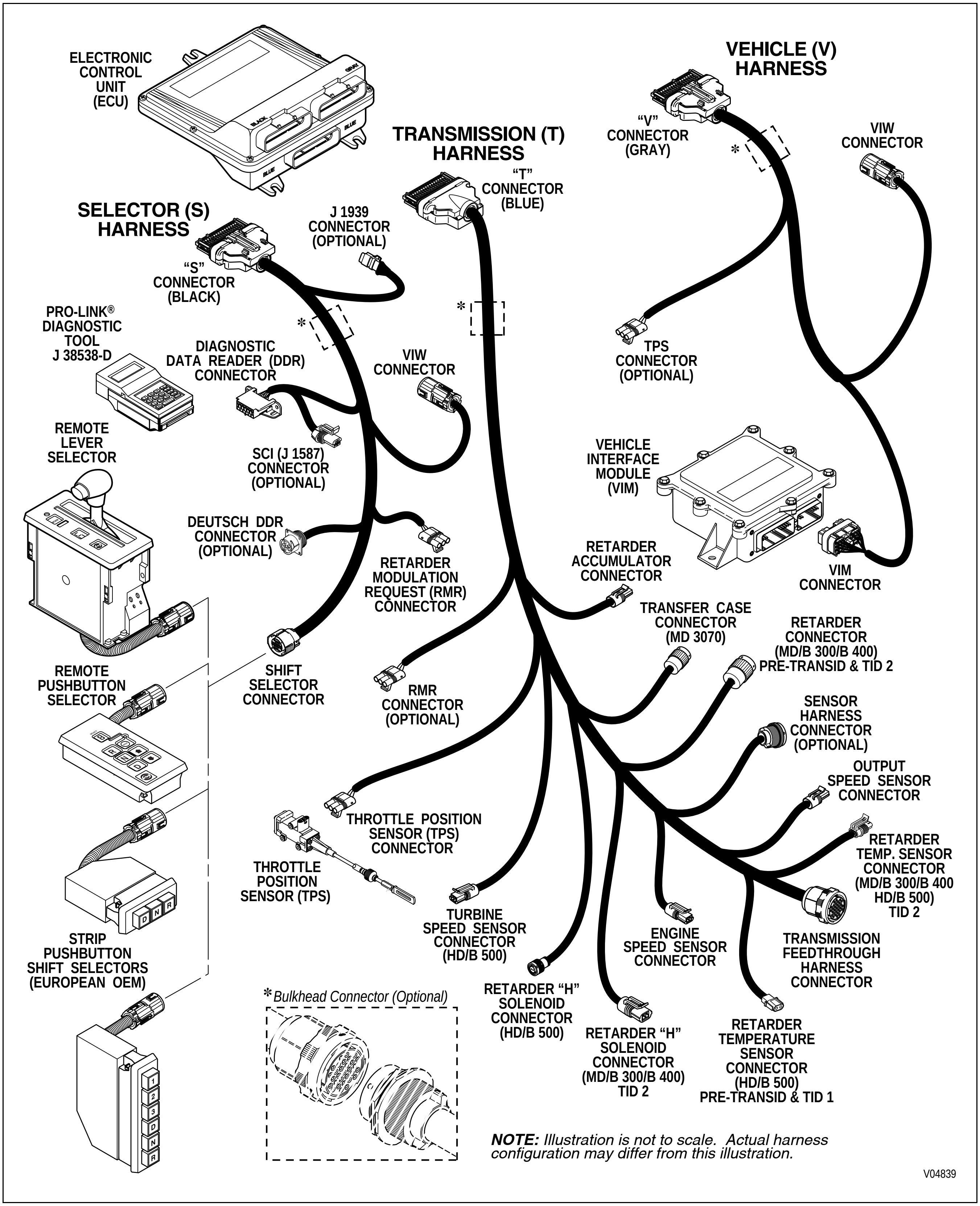


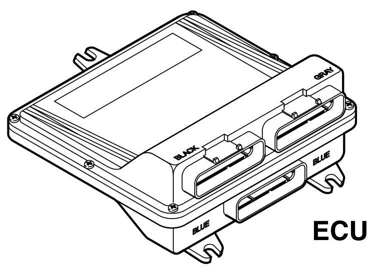
Figure 1–2. WTEC III Electronic Control Components

GENERAL DESCRIPTION

1–2. ELECTRONIC CONTROL UNIT (ECU)

The ECU (Figure 1–3) contains the microcomputer which is the brain of the control system. The ECU receives and processes information defining: shift selector position, throttle position, sump/retarder temperature, engine speed, turbine speed, and transmission output speed. The ECU uses the information to control transmission solenoids and valves, supply system status, and provide diagnostic information.

Each ECU has a date code stamped on the label which is attached to the outer case of the ECU. This is the date when the ECU passed final test. This date is commonly used to denote the change configuration level of the ECU. It is normal for the ECU date displayed electronically to be a few days prior to the date shown on the label.



NOTE: *ECU wiring harness connector retainers are individually keyed and color-coded to ensure that the proper connector is attached to the correct ECU socket. The color of the connector retainer should match the color of the connector strain relief (see Appendix E, Paragraph 1–1).*

V03352.01

Figure 1–3. Electronic Control Unit (ECU)

1–3. SHIFT SELECTOR

Pushbutton and lever shift selectors for the WTEC III Series are remote mounted from the ECU and connected to the ECU by a wiring harness. Both of these shift selectors have a single digit LED display and a mode indicator (LED). During normal transmission operation, illumination of the LED indicator shows that a secondary or special operating condition has been selected by pressing the **MODE** button. During diagnostic display mode, illumination of the LED indicator shows that the displayed diagnostic code is active. Display brightness is regulated by the same vehicle potentiometer that controls dash light display brightness. More information on both types of shift selectors is continued below.

A. Pushbutton Shift Selector *(Figure 1–4)*

There is a full-function pushbutton shift selector and a strip pushbutton shift selector. Strip pushbutton shift selectors are used by European OEMs. A full-function shift selector has a **MODE** button and diagnostic display capability through the single digit LED display. The strip pushbutton shift selector does not have a **MODE** button, diagnostic capability, or adjustable illumination. The full-function pushbutton shift selector has six (6) pushbuttons which are **R** (Reverse), **N** (Neutral), **D** (Drive), ⇓ (Down), ⇑ (Up), and **MODE**. Manual forward range downshifts and upshifts are made by pressing the ⇓ (Down) or ⇑ (Up) arrow buttons after selecting **D** (Drive). The **N** (Neutral) button has a raised lip to aid in finding it by touch. The **MODE** button is pressed to select a secondary or special operating condition, such as ECONOMY shift schedule. Diagnostic information is obtained by pressing the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time. The strip pushbutton shift selector has either three or six range selection positions as shown in Figure 1–4. When a strip pushbutton shift selector is used, diagnostic information must be obtained by using the Pro-Link® 9000 or a customer-furnished remote display.

GENERAL DESCRIPTION

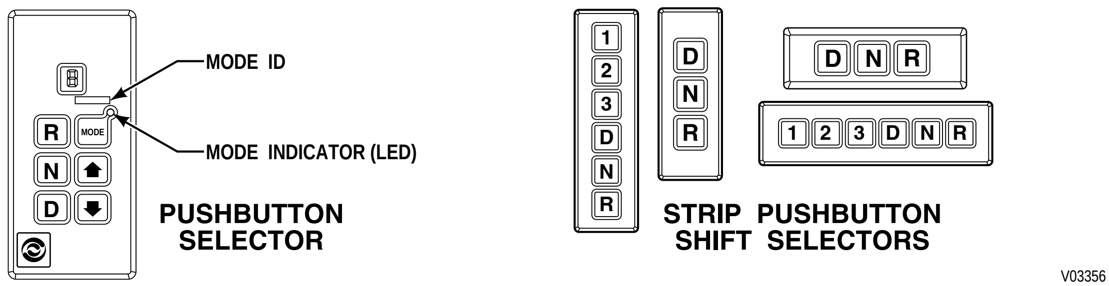


Figure 1–4. Pushbutton Shift Selectors

1–4. SPEED SENSORS *(Figure 1–5)*

Three speed sensors — engine speed, turbine speed, and output speed — provide information to the ECU. The engine speed signal is generated by ribs on the shell of the torque converter pump. The turbine speed signal is generated by the rotating-clutch housing spline contours. The output speed signal is generated by a toothed member attached to the output shaft (except for the MD 3070, where the toothed member is the transfer case idler gear). The speed ratios between the various speed sensors allow the ECU to determine if the transmission is in the selected range. Speed sensor information is also used to control the timing of clutch apply pressures, resulting in the smoothest shifts possible. Hydraulic problems are detected by comparing the speed sensor information for the current range to that range's speed sensor information stored in the ECU memory.

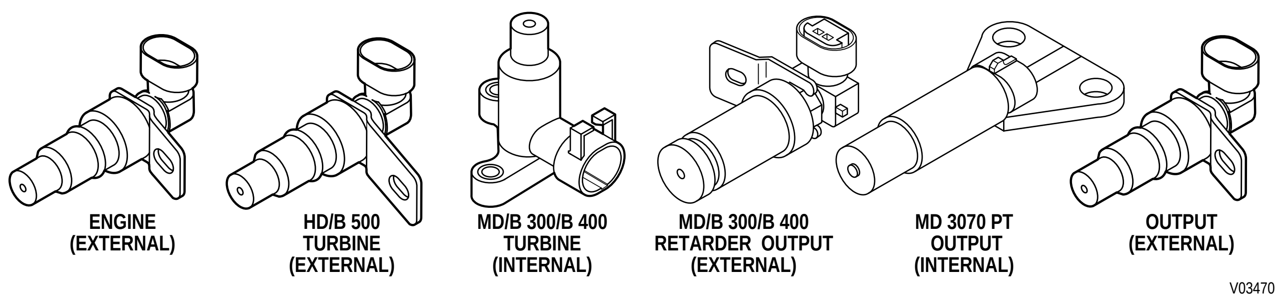


Figure 1–5. Speed Sensors

GENERAL DESCRIPTION

1–5. CONTROL MODULE *(Figure 1–6)*

The WT Series transmission control module contains a channel plate on which is mounted: the main valve body assembly, the stationary-clutch valve body assembly, and the rotating-clutch valve body assembly. For valve locations, refer to SIL 27-WT-93, Rev. A. Pulse width modulated solenoids are used in the valve bodies. The rotating-clutch valve body assembly contains A (C1), B (C2), and F (lockup) solenoids, solenoid regulator valves controlled by the solenoids, and the C3 pressure switch. The stationary-clutch valve body assembly contains C (C3), D (C4), and E (C5) solenoids and solenoid regulator valves controlled by the solenoids and the C3 accumulator relay valve. The main valve body assembly contains G solenoid and the C1 and C2 latch valves controlled by the solenoid, the main and lube regulator valves, the control main and converter regulator valves, and the converter flow valve and exhaust backfill valves. The low valve body assembly (MD 3070PT and HD 4070) contains N and J solenoids.

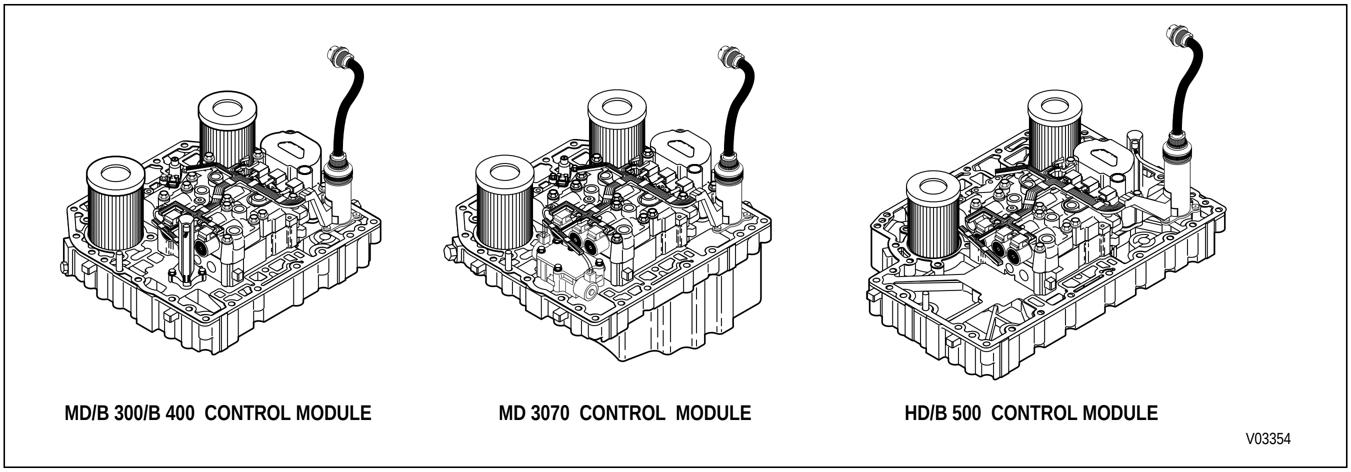


Figure 1–6. WTEC III Control Module

A temperature sensor (thermistor) is located in the internal wiring harness. Changes in sump fluid temperature are indicated by changes in sensor resistance which changes the signal sent to the ECU (see chart in Section 5, Code 24).

The oil level sensor is a float type device, mounted on the control module channel plate, which senses transmission fluid level by electronically measuring the buoyancy forces on the float. The sensor operates on 5 VDC supplied by the ECU. The oil level sensor is required on all models with a shallow sump but is optional on other models. The oil level sensor is not available on the MD 3070.

The C3 pressure switch is mounted on the rotating-clutch valve body assembly and indicates when pressure exists in the C3 clutch-apply passage. An accumulator/relay valve is in-line ahead of the C3 pressure switch and prevents high frequency hydraulic pulses generated by the C3 solenoid from cycling the C3 pressure switch.

Also mounted in the control module is the turbine speed sensor for the MD/B 300/B 400 models. The turbine speed sensor is directed at the rotating-clutch housing. (The turbine speed sensor on the HD/B 500 models is located on the outside of the main housing.)

GENERAL DESCRIPTION

1–6. WIRING HARNESSES

A. External Wiring Harness *(Figure 1–7)*

WTEC III uses three external wiring harnesses to provide a connection between the ECU, the transmission (including engine, turbine, and output speed sensors), the throttle position sensor, the vehicle interface module (VIM), retarder control module, shift selectors, diagnostic tool connector, retarder, retarder temperature sensor, accumulator, and vehicle interface. Many harnesses will include a bulkhead fitting to separate cab and chassis components. Also, many different styles and materials for harnesses are likely to be encountered.

GENERAL DESCRIPTION

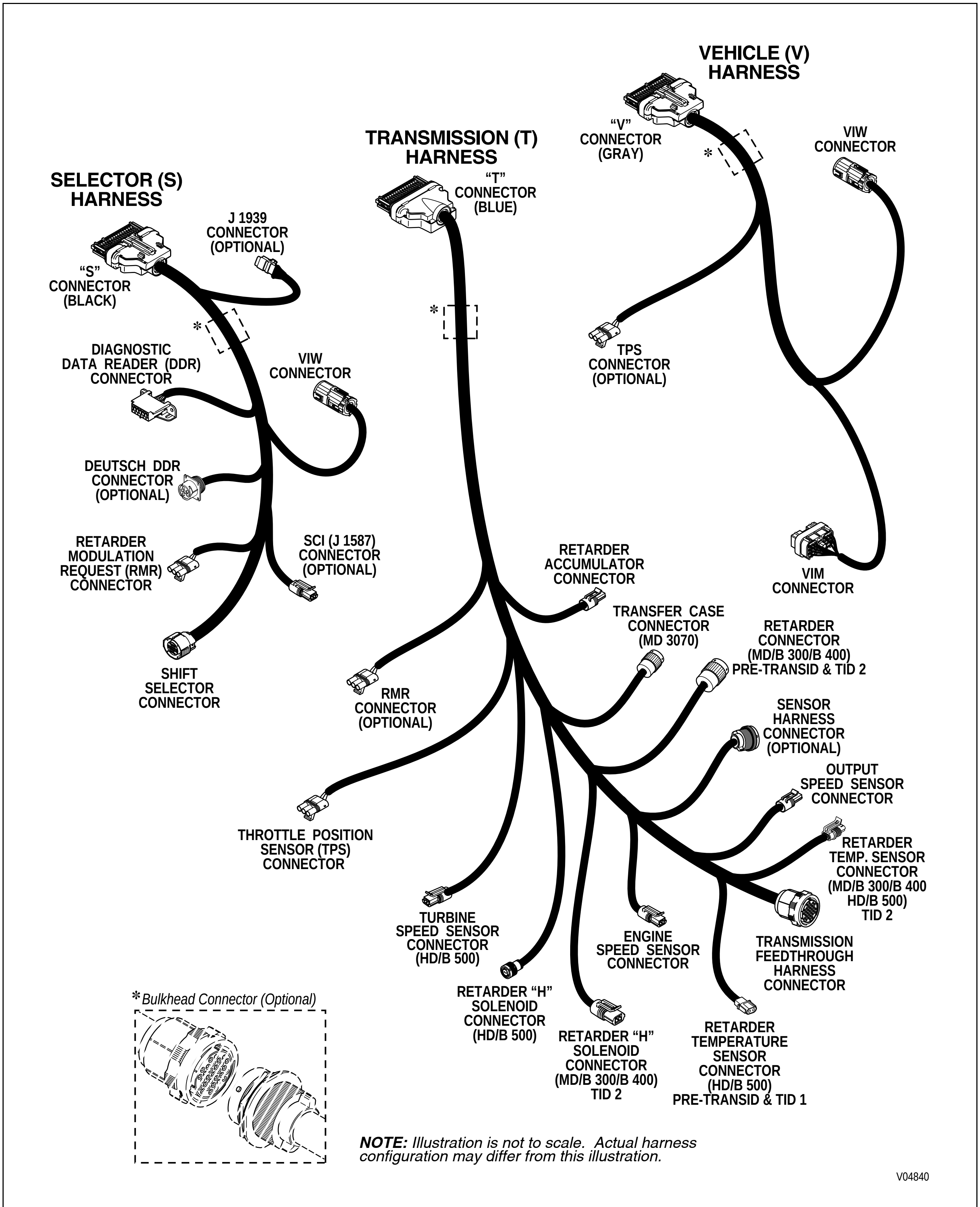


Figure 1–7. WTEC III External Wiring Harnesses

GENERAL DESCRIPTION

B. Internal Wiring Harness *(Figure 1–8)*

The internal wiring harness provides connection between the external harness, the pulse width modulated solenoids, oil level sensor, C3 pressure switch, and the temperature sensor.

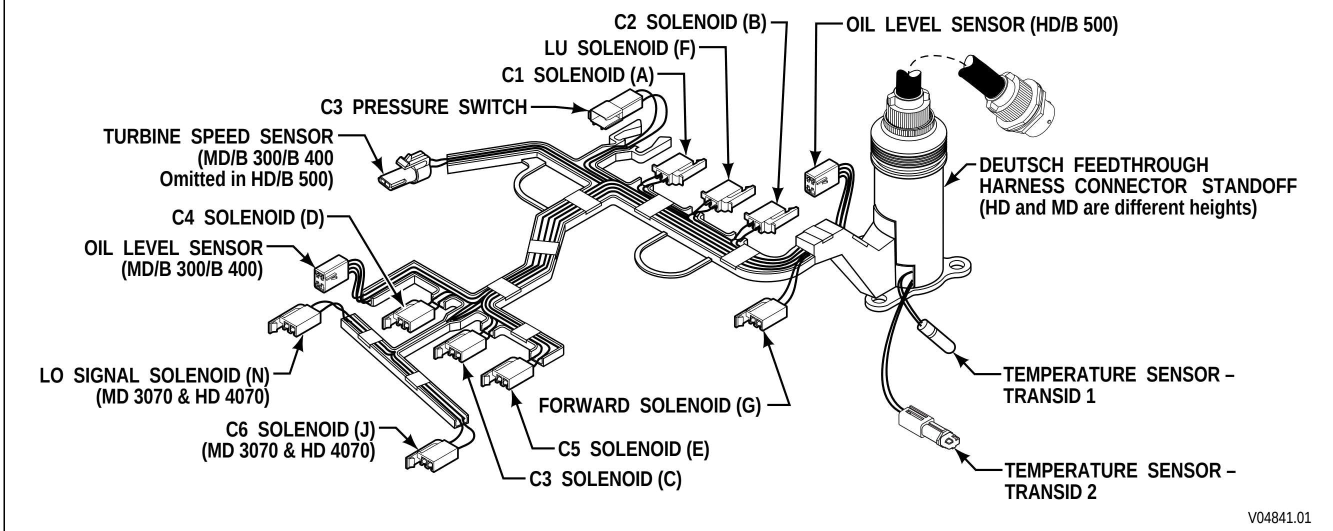


Figure 1–8. WTEC III Internal Wiring Harness

1–7. VEHICLE INTERFACE MODULE *(Figure 1–9)*

The vehicle interface module (VIM) provides relays, fuses, and connection points for interface with the output side of the vehicle electrical system. VIMs are available for both 12V and 24V electrical systems. The VIM for 12V systems uses all 12V relays. The VIM for 24V systems has all 24V relays. Refer to the Parts Catalog for the transmission assembly number that you are servicing for detailed parts information. Refer to Pages D–23 and D–24 for VIM wire number and terminal information.

Some OEMs may provide their own equivalent for the VIM which performs the same functions as the VIM shown in Figure 1–9.

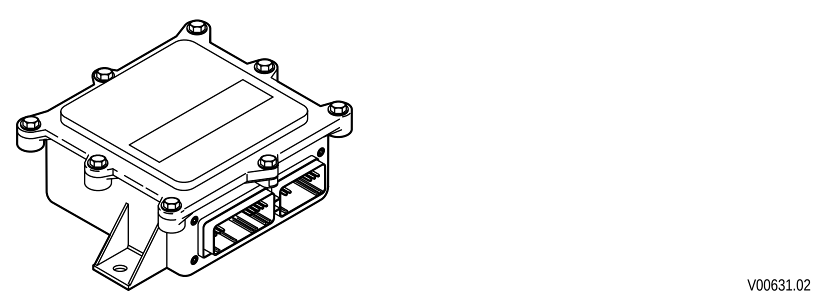


Figure 1–9. Vehicle Interface Module (VIM)

SECTION 2 — DEFINITIONS AND ABBREVIATIONS

2–1. CHECK TRANS LIGHT

When the ECU detects a serious fault, the **CHECK TRANS** light (usually located on the vehicle instrument panel) illuminates and action is automatically taken to protect operator, vehicle, and the transmission. A diagnostic code will nearly always be registered when the **CHECK TRANS** light is on; however, not all diagnostic codes will turn on the **CHECK TRANS** light. Codes related to the **CHECK TRANS** light are detailed in the code chart (refer to Section 6).

Illumination of the **CHECK TRANS** light indicates that a condition was detected that requires service attention. Operation may or may not be restricted but even when restricted will allow the vehicle to reach a service assistance location. Depending upon the cause for the **CHECK TRANS** light illumination, the ECU may or may not respond to shift selector requests. The transmission may be locked in a range. That range will be shown on the shift selector display. Both upshifts and downshifts may be restricted when the **CHECK TRANS** light is illuminated. Seek service assistance as soon as possible.

Each time the engine is started, the **CHECK TRANS** light illuminates briefly and then goes off. This momentary lighting shows the light circuit is working properly. If the light does not come on during engine start, request service immediately.

2–2. DIAGNOSTIC DATA READER *(Figure 2–1)*

The current Diagnostic Data Reader (DDR) is the Pro-Link® 9000 diagnostic tool which is available through Kent-Moore Heavy-Duty Division. A portable microcomputer-based receiver/transmitter/display unit, the Pro-Link® transmits and receives data to and from the ECU, processes the data, and displays appropriate information. Use the Pro-Link® during installation checkout and troubleshooting. There is a new Pro-Link® cartridge needed for use with WTEC III controls. The new Multi-Protocol Cartridge (MPC) contains a programmed PCMCIA card which allows for reprogramming of GPI/GPO packages. Reprogramming includes selection of a GPI/GPO package, enabling/disabling of wires and modification of certain data parameters. Operating instructions are supplied with each Pro-Link® and further information is also included in Appendix N of this manual. Connect the Pro-Link® 9000 to the diagnostic connector provided in the selector wiring harness.

Tool part numbers for the Pro-Link® are as follows:

- Diagnostic Kit J 38538D + J 38500–313 (PROM Update) = J 38538E
- Diagnostic Cartridge J 38500-302 + J 38500–313 = J 38500–303
- MPC J 38500–1500C
- PCMCIA (Diagnostic And Reprogramming) J 38500–1700B
- PCMCIA (Diagnostic Only) J 38500–1800A

NOTE: The new MPC is usable with WTEC II controls but the old WTEC II reprogramming cartridge will not display the WTEC III new information. The new MPC must be used to reprogram WTEC III systems.

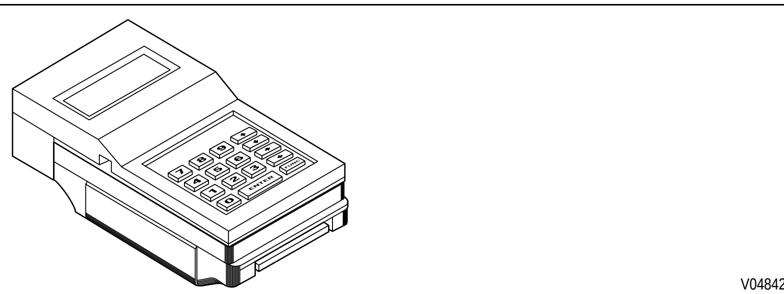


Figure 2–1. Pro-Link® 9000 Diagnostic Tool

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS

A/N	**A**ssembly **N**umber
ABS	**A**nti-lock **B**rake **S**ystem — OEM-provided means to detect and prevent wheel stoppage to enhance vehicle handling. Retarder and engine brakes will not apply when ABS is active.
Amp	Unit of electrical current.
C3PS	**C3 P**ressure **S**witch — Pressure switch to signal the presence or absence of pressure in the C3 clutch-apply circuit.
CAN	**C**ontroller **A**rea **N**etwork — A network for all SAE J1939 communications in a vehicle (engine, transmission, ABS, etc.)
COP	**C**omputer **O**perating **P**roperly — Hardware protection which causes the ECU to reset if software gets lost.
CT	**C**losed **T**hrottle
DDR	**D**iagnostic **D**ata **R**eader — Diagnostic tool; most current version is the Pro-Link® 9000 made by MicroProcessor Systems, Inc. Used to interrogate the ECU for diagnostic information and for reprogramming I/O packages in a calibration.
DNA	**D**oes **N**ot **A**dapt — Adaptive shift control is disabled.
DNS	**D**O **N**OT **S**HIFT — Refers to the **DO NOT SHIFT** diagnostic response during which the **CHECK TRANS** light is illuminated and the transmission will not shift and will not respond to the Shift Selector.
DVOM	**D**igital **v**olt/**o**hm**m**eter
ECU	**E**lectronic **C**ontrol **U**nit (also commonly referred to as the “computer”)
GPI	**G**eneral **P**urpose **I**nput — Input signal to the ECU to request a special operating mode or condition.
GPO	**G**eneral **P**urpose **O**utput — Output signal from the ECU to control vehicle components (such as PTOs, backup lights, etc.) or allow a special operating mode or condition.
J1587	Engine/transmission serial data communications link.
J1939	High-speed vehicle serial data communications link.
LED	**L**ight-**E**mitting **D**iode — Electronic device used for illumination.
NNC	**N**eutral **N**o **C**lutches — Neutral commanded with no clutches applied.
NVL	**N**eutral **V**ery **L**ow — The ECU has sensed turbine speed below 150 rpm when output speed is below 100 rpm and engine speed is above 400 rpm when **N** (Neutral) was selected. This is usually caused by a dragging C1 or C3 clutch or a failed turbine speed sensor. NVL is attained by turning D solenoid “ON” (in addition to E solenoid) and the C4 and C5 clutches are applied to lock the transmission output.
OEM	**O**riginal **E**quipment **M**anufacturer — Maker of vehicle or equipment.
Ohm	Unit of electrical resistance.
OL	**O**ver **L**imit or **O**il **L**evel — For **O**ver **L**imit see “×”. Indicates **O**il **L**evel is being displayed on a shift selector.

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS (CONTINUED)

OLS	**O**il **L**evel **S**ensor — Electronic device (optional) on control module for indicating transmission fluid level.
PCCS	**P**ROM **C**alibration **C**onfigurator **S**ystem
PCMCIA	**P**ersonal **C**omputer **M**emory **C**ard **I**nternational **A**ssociation — Memory device for use with Pro-Link® containing Allison Transmission programming and diagnostics.
PROM	**P**rogrammable **R**ead **O**nly **M**emory
PSS	**P**rimary **S**hift **S**elector — Main shift selector in a two-selector control system.
PTO	**P**ower **T**ake**o**ff
PWM Solenoid	**P**ulse **W**idth **M**odulated **Solenoid** — Solenoids are controlled by pulse width modulation. Solenoid control of clutch pressures is based on the solenoid's duty cycle. Duty cycle is determined by the ratio of solenoid's on-time to off-time.
RMR	**R**etarder **M**odulation **R**equest — Signal from a retarder control device.
RPR	**R**eturn to **P**revious **R**ange — Diagnostic response in which the transmission is commanded to return to previously commanded range.
SCI	**S**erial **C**ommunication **I**nterface — Used to transmit data and messages between the diagnostic tool and the ECU and other systems such as electronically-controlled engines.
SOL OFF	All **SOL**enoids **OFF**
SPI	**S**erial **P**eripheral **I**nterface — The means of communication between the microprocessor and the interface circuits.
SSS	**S**econdary **S**hift **S**elector — Alternate shift selector in a two-selector control system.
TID	**T**rans**ID** — A feature which allows the ECU to know the transmission configuration and provide the corresponding calibration required.
TPS	**T**hrottle **P**osition **S**ensor — Potentiometer for signaling the position of the engine fuel control lever.
V	**V**ersion — Abbreviation used in describing ECU software levels.
VDC	**V**olts **D**irect **C**urrent (DC)
VIM	**V**ehicle **I**nterface **M**odule — A watertight box containing relays and fuses — interfaces the transmission electronic control system with components on the vehicle.
VIW	**V**ehicle **I**nterface **W**iring — Interfaces ECU programmed input and output functions with the vehicle wiring.
Volt	Unit of electrical force.
VOM	**V**olt/**o**hm**m**eter
WOT	**W**ide **O**pen **T**hrottle
WT	**W**orld **T**ransmission
×	Infinity — Condition of a circuit with higher resistance than can be measured, effectively an open circuit.

SECTION 3 — BASIC KNOWLEDGE

3–1. BASIC KNOWLEDGE REQUIRED

To service WTEC III Electronic Controls, the technician must understand basic electrical concepts. Technicians need to know how to use a volt/ohmmeter (VOM) to make resistance and continuity checks. Most troubleshooting checks consist of checking resistance, continuity, and checking for shorts between wires and to ground. The technician should be able to use jumper wires and breakout harnesses and connectors. Technicians unsure of making the required checks should ask questions of experienced personnel or find instruction.

The technician should also have the mechanical aptitude required to connect pressure gauges or transducers to identified pressure ports used in the troubleshooting process. Pressure tap locations and pressure values are shown in Appendix B — Checking Clutch Pressures.

Input power, ground, neutral start circuitry, etc., can cause problems with electronic controls or vehicle functioning and may not generate a diagnostic code. A working knowledge of WT Series Electronic Controls vehicle installation is necessary in troubleshooting installation-related problems.

Refer to Section 8 for information concerning performance complaints (non-code) troubleshooting. A complete wiring schematic is shown in Appendix J. Refer to the WTEC III Controls and General Information Sales Tech Data Book for information concerning electronic controls installation and the Installation Checklist. Reliable transmission operation and performance depend upon a correctly installed transmission. Review the Installation Checklist in the MD, HD, B 300/B 400, and B 500 Sales Tech Data Books to ensure proper installation.

3–2. USING THE TROUBLESHOOTING MANUAL

Use this manual as an aid to troubleshooting the WTEC III Electronic Controls. Every possible problem and its solution cannot be encompassed by any manual. However, this manual does provide a starting point from which most problems can be resolved.

Once a problem solution is discovered in the manual do not look further for other solutions. It is necessary to determine *why* a problem occurred. For example, taping a wire that has been rubbing on a frame rail will not correct the problem unless the rubbing contact is eliminated.

3–3. SYSTEM OVERVIEW

WTEC III Electronic Control functions are controlled by the ECU. The ECU reads shift selector range selection, output speed, and throttle position to determine when to command a shift. When a shift occurs, the ECU monitors turbine speed, output speed, and throttle position to control the oncoming and off-going clutches during the shift.

When the ECU detects an electrical fault, it logs a diagnostic code indicating the faulty circuit and may alter the transmission operation to prevent or reduce damage.

When the ECU detects a non-electrical problem while trying to make a shift, the ECU may try that shift a second or third time before setting a diagnostic code. Once that shift has been retried, and a fault is still detected, the ECU sets a diagnostic code and holds the transmission in a fail-to-range mode of operation.

BASIC KNOWLEDGE

3–4. IMPORTANT INFORMATION IN THE TROUBLESHOOTING PROCESS

Before beginning the troubleshooting process, read and understand the following:

- WTEC III wire identification presents the wire number followed by the ECU terminal source (i.e., 157-S30). If there is a letter suffix following the wire number, there is a splice between the ECU source and wire destination (i.e., 136A-S16).
- Shut off the engine and ignition before any harness connectors are disconnected or connected.
- Remember to do the following when checking for shorts and opens:
  - — Minimize movement of wiring harnesses when looking for shorts. Shorts involve wire-to-wire or wire-to-ground contacts and moving the harnesses may eliminate the problem.
  - — Wiggle connectors, harnesses, and splices when looking for opens. This simulates vehicle movements which occur during actual operation.
- When disconnecting a harness connector, be sure that pulling force is applied to the connector itself and **not the wires** extending from the connector.
- Resistance checks involving the wiring between the ECU connectors and other components adds about one ohm of resistance to the component resistance shown.

BASIC KNOWLEDGE

- Inspect all connector terminals for damage. Terminals may have bent or lost the necessary tension to maintain firm contact.

- Clean dirty terminals or connectors with isopropyl alcohol and a cotton swab, or a good quality, non-residue, non-lubricating, cleaning solvent such as LPS Electro Contact Cleaner® or LPS NoFlash Electro Contact Cleaner®.

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware. Cleaner trapped in the connector can affect the connector seal. (Refer to SIL 17-TR-94 for detailed information on the recommended cleaners.)

CAUTION:	Care should be taken when welding on a vehicle equipped with electronic controls. Refer to Appendix E, Paragraph 1–1.

- Diagnostic codes displayed after system power is turned on with a harness connector disconnected, can be ignored and cleared from memory. Refer to Section 5, Diagnostic Codes, for the code clearing procedure.

3–5. BEGINNING THE TROUBLESHOOTING PROCESS

NOTE: ***Whenever a transmission is overhauled, exchanged, or has undergone internal repairs, the Electronic Control Unit (ECU) must be "RESET TO UNADAPTED SHIFTS." See Service Information Letter 16-WT-96, Revision A availability from Freightliner dealer for further details.***

1. Begin troubleshooting by checking the transmission fluid level and ECU input voltage. Remember that some problems may be temperature related. Do troubleshooting at the temperature level where the problem occurs. Check diagnostic codes by:

   - Using the shift selector display. (See Paragraph 5–2 for code reading.)
   - Using the Pro-Link® 9000 diagnostic tool.

2. When a problem exists but a diagnostic code is not indicated, refer to Transmission and Driveline Troubleshooting WP 0011 00 for a listing of various problems, their causes, and remedies.

3. If a diagnostic code is found in the ECU memory, record all available code information and clear the active indicator (refer to Section 5).

4. Test drive the vehicle to confirm a diagnostic code or performance complaint.

   - If the code reappears, refer to the Diagnostic Code section (Section 5) and the appropriate code chart. The Diagnostic Code section lists diagnostic codes and their description. Locate the appropriate troubleshooting chart and follow the instructions.

BASIC KNOWLEDGE

- If the code does not reappear, it may be an intermittent problem. Use the Pro-Link® and the code display procedure described in Section 5. The code display procedure will indicate the number of times the diagnostic code has occurred. Refer to the troubleshooting chart for possible cause(s) of the problem.
- Appendix A deals with the identification of potential circuit problems. Refer to Appendix A if a circuit problem is suspected.

SECTION 4 — WIRE CHECK PROCEDURES

4–1. CHECKING OPENS, SHORTS BETWEEN WIRES, AND SHORTS-TO-GROUND
(Use Digital Volt/Ohmmeter J 34520-A and Jumper Wire Set J 39197)

NOTE: Please refer to Paragraph 3–5 to begin the troubleshooting process.

1. Make sure all connectors are tightly connected and re-check the circuit.

2. Disconnect and inspect all connectors.

3. Thoroughly clean corroded or dirty terminals. If dirty or corroded terminals are the probable cause of the problems, reconnect the clean connectors and operate the vehicle normally. If the problem recurs, proceed with Step (4).

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware.

4. Review the WTEC III wire numbering system described in Paragraph 3–4.

5. If all connectors are clean and connected correctly, determine which wires in the chassis harness are indicated by the diagnostic code. For example, Code 41 12, indicates an open or short-to-ground in the solenoid A circuit — wires 102-T1 and 120-T4.

   a. Check continuity of wires 102-T1 and 120-T4 by performing the following (refer to Figure 4–1):

      (1) Disconnect the blue "T" connector from the ECU and disconnect the harness from the transmission main connector. At one end of the harness, using jumper wire kit J 39197 and connector probes in J 39775-CP, connect wire 102-T1 and 120-T4 to each other, being careful not to distort the terminals. Jumping the wires together creates a circuit between wires 102-T1 and 120-T4.

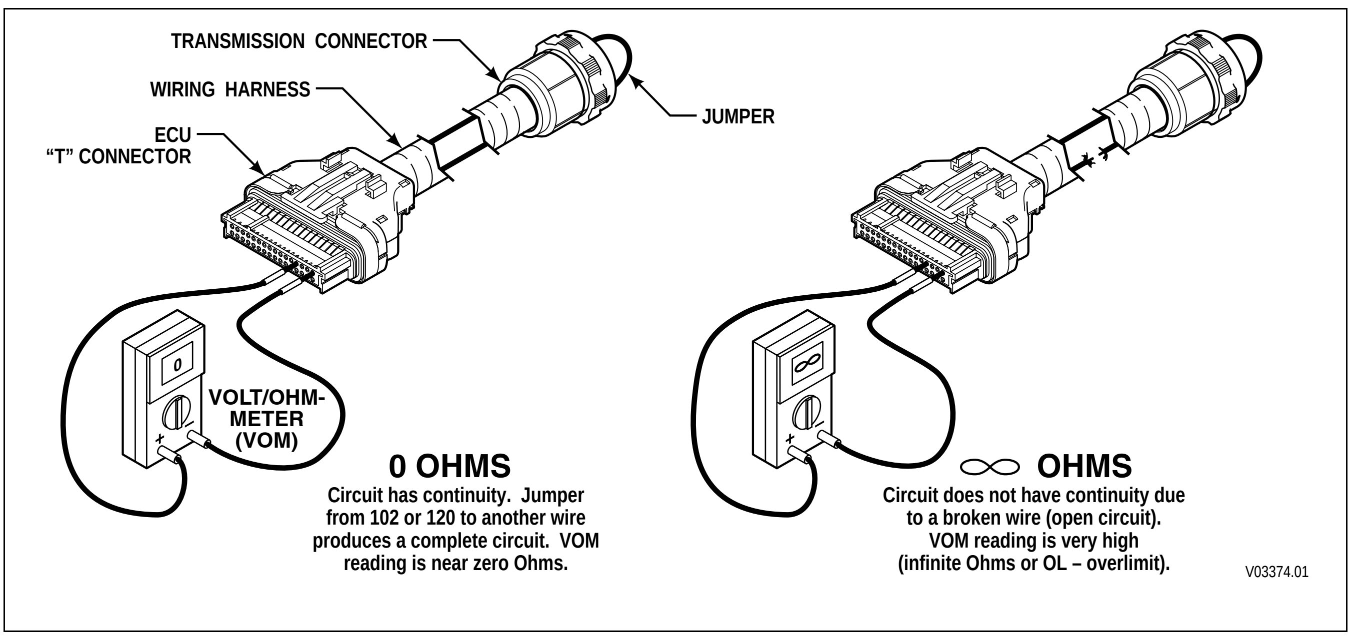


Figure 4–1. Open Circuit

WIRE CHECK PROCEDURES

(2) On the opposite end of the harness, check the continuity of the jumpered pair. No continuity in a jumpered pair circuit (infinite resistance reading) indicates an open in the wire being tested. Locate and repair the damaged portion of the wire.

b. If the continuity check is good (0–2 Ohms resistance), remove the jumpers. Check the harness for shorts between wires and shorts-to-ground by performing the following (refer to Figure 4–2):

(1) At the ECU end of the harness, touch one VOM probe to one wire of the circuit being tested and touch the other probe to each terminal in the same connector, then touch the probe to chassis ground and to the transmission main housing. Do this for both wires in the circuit being tested.

(2) If at any time the VOM shows zero to low resistance, or the meter's continuity beeper sounds, there is a short between the two points being probed — wire-to-wire or wire-to-ground. Isolate and repair the short.

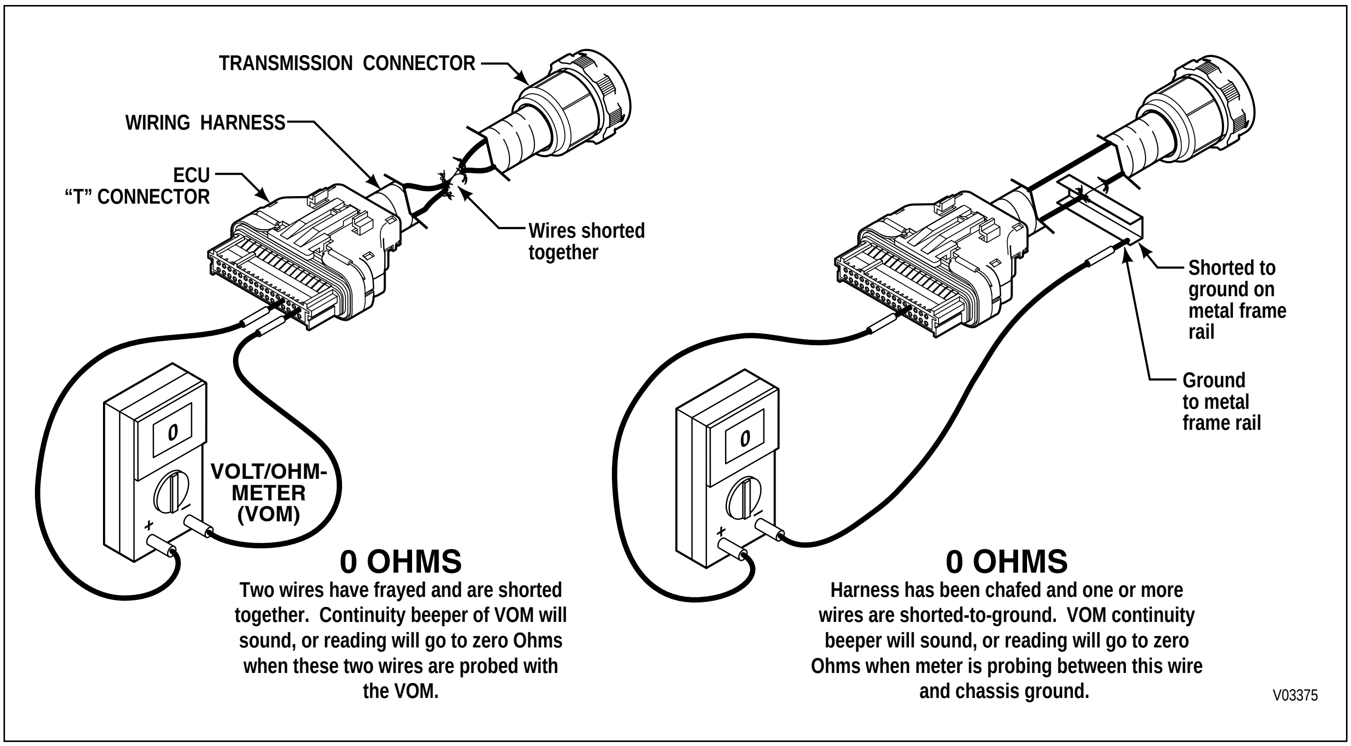


Figure 4–2. Short Between Wires and to Ground

4–2. CHECKING AT TRANSMISSION CONNECTOR AND THE INTERNAL HARNESS FOR OPENS, SHORTS BETWEEN WIRES, AND SHORTS-TO-GROUND

1. Disconnect the external wiring harness from the transmission.

2. Inspect the connectors. Any terminals which are corroded or dirty must be thoroughly cleaned.

3. If the connectors are clean and connected correctly, determine which wires in the harness to test. Use the diagnostic code system schematic to locate the wire terminals. For this example, Code 41 12 indicates an open or short-to-ground in solenoid "A" circuit — wires 102-T1 and 120-T4 (refer to Figure 4–3 and 4–4).

WIRE CHECK PROCEDURES

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware. Cleaner trapped in the connector can affect the connector seal.

a. At the transmission connector, check the resistance of the A solenoid circuit. Resistance of a solenoid circuit should be 2.4–5 Ohms — covering a temperature range of –18°C to 149°C (0°F to 300°F). No continuity in the circuit (infinite resistance) indicates an open in the internal harness, the feedthrough connector, or the solenoid coil. Locate and repair the open in the internal harness or replace the internal harness, replace the feedthrough connector, or replace the solenoid.

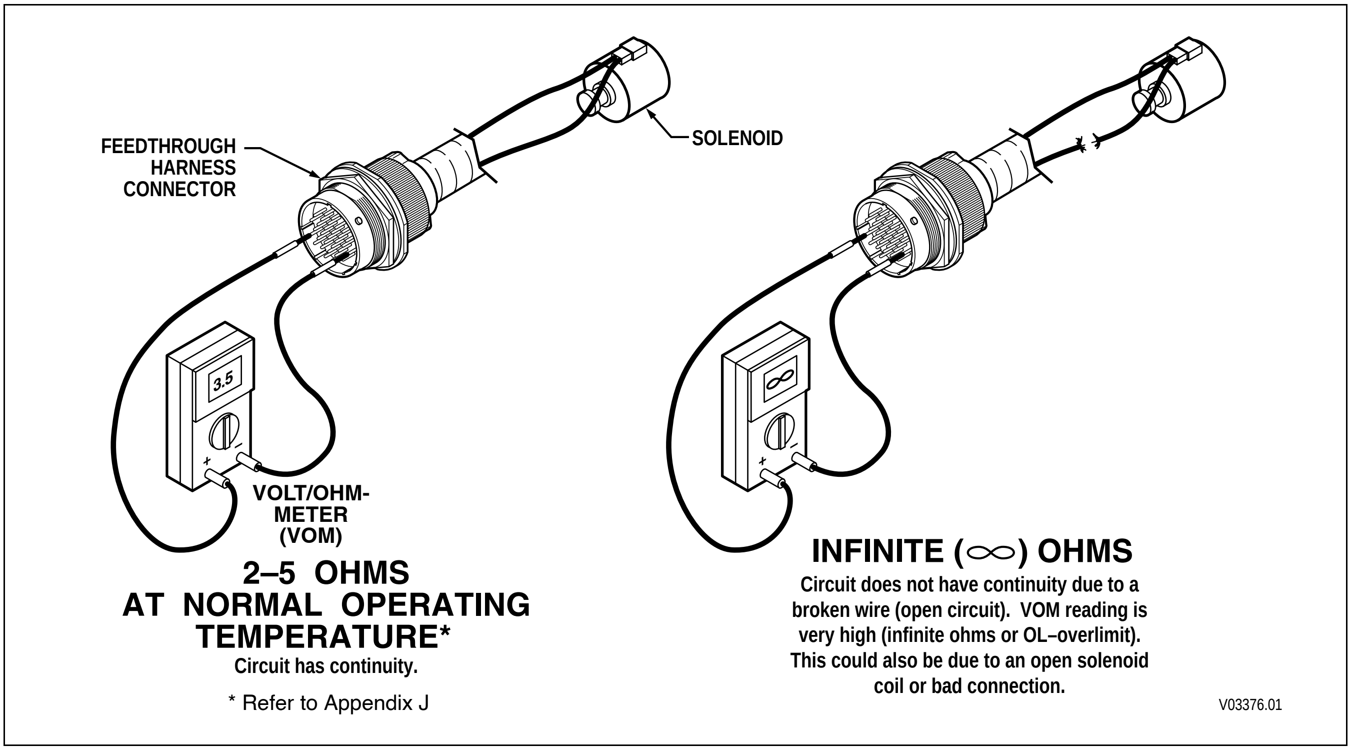


Figure 4–3. Checking Continuity

b. If the resistance check is good, check the harness for shorts between wires and to ground by performing the following (refer to Figure 4–4):

(1) At the transmission connector, touch one probe of the VOM to one wire of the circuit being tested and touch the other probe to each terminal in the connector and to chassis ground and the transmission main housing. Do this for both wires in the circuit being tested.

(2) If the VOM shows zero to low resistance, or the continuity beeper sounds, there is a short between the two points being probed, wire-to-wire or wire-to-ground. An indication of a short may be caused by a splice to the wire being checked. Check the wiring diagram in Appendix J for splice locations. If the short is not a splice, then isolate and repair the short.

WIRE CHECK PROCEDURES

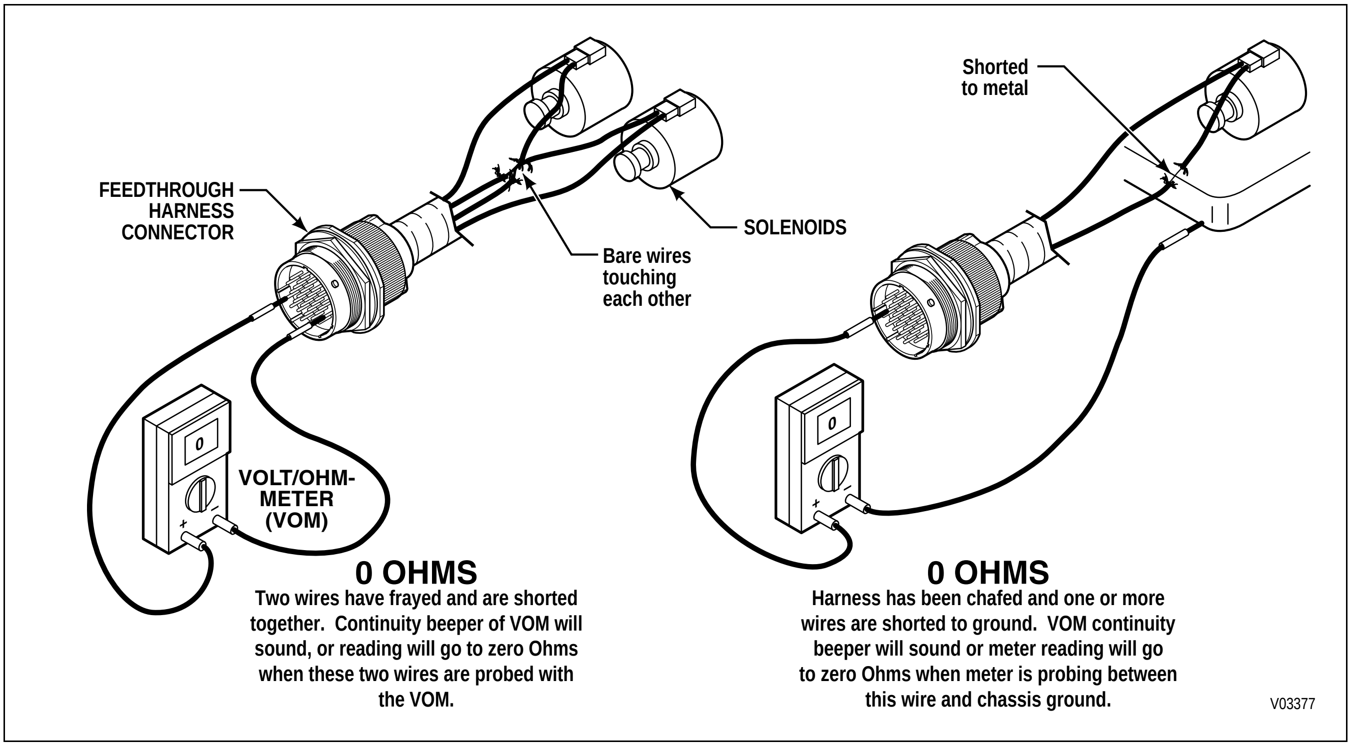


Figure 4–4. Short Between Wires and to Ground

NOTE: *When conducting circuit checks that include the external harness, add one (1) Ohm to the values shown. Speed sensor resistance is 270–330 Ohms. C3 pressure switch resistance is two (2) Ohms maximum when switch is closed and 20,000 Ohms minimum when switch is open.*

SECTION 5 — DIAGNOSTIC CODES

5–1 DIAGNOSTIC CODE MEMORY

Diagnostic codes are logged in a list in memory (sometimes referred to as the queue), listing the most recently occurring code first and logging up to five codes. The codes contained in the list have information recorded as shown in the table below (codes are examples). Access to the code list position, main code, subcode and active indicator is through either the shift selector display or the Pro-Link® diagnostic tool. Access to ignition cycle counter and event counter information is through the diagnostic tool only. Further detail on the use of Pro-Link® 9000 DDR is presented in Appendix G of this manual.

Table 5–1. Code List

Code List Position	Main Code	Subcode	Active Indicator	Ignition Cycle Counter	Event Counter
d1	21	12	YES	00	10
d2	41	12	YES	00	04
d3	23	12	NO	08	02
d4	34	12	NO	13	01
d5	56	11	NO	22	02
Displayed on shift selector and diagnostic tool d = "diagnostic"			YES = LED indicator illuminated	Not available on shift selector display	

The following paragraphs define the different parts of the code list.

A. **Code List Position.** The position which a code occupies in the code list. Positions are displayed as "d1" through "d5" (Code List Position #1 through Code List Position #5).

B. **Main Code.** The general condition or area of fault detected by the ECU.

C. **Subcode.** The specific area or condition related to the main code in which a fault is detected.

D. **Active Indicator.** Indicates when a diagnostic code is active. The MODE indicator LED on the shift selector is illuminated or the diagnostic tool displays **YES**.

E. **Ignition Cycle Counter.** Determines when inactive diagnostic codes are automatically cleared from the code list. The counter is increased by one each time a normal ECU power down occurs (ignition turned off). Inactive codes are cleared from the code list after the counter exceeds 25.

F. **Event Counter.** Counts the number of occurrences of a diagnostic code. If a code is already in the code list and the code is again detected, that code is moved to position d1, the active indicator is turned on, the Ignition Cycle Counter is cleared, and 1 is added to the Event Counter.

5–2. CODE READING AND CODE CLEARING

Diagnostic codes can be read and cleared by two methods: by using the Pro-Link® 9000 diagnostic tool or by entering the diagnostic display mode and using the shift selector display. The use of the Pro-Link® 9000 diagnostic tool is described in the instruction manual furnished with each tool and briefly in Appendix G of this manual. The method of reading and clearing codes described in this section refers to entering the diagnostic display mode by the proper button movements on the shift selector.

DIAGNOSTIC CODES

The diagnostic display mode may be entered for viewing of codes at any speed. Active codes can only be cleared when the output speed = 0 and no output speed sensor failure is active.

A. Reading Codes. Enter the diagnostic display mode by pressing the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time on a pushbutton selector, or by momentarily pressing the "display mode" button on a lever shift selector.

NOTE: If a DO NOT SHIFT condition is present (CHECK TRANS light illuminated) at this time, the shift selector may or may not respond to requested range changes.

NOTE: If an oil level sensor is present, then fluid level will be displayed first. Diagnostic code display is achieved by simultaneously depressing the ⇑ (Up) and ⇓ (Down) arrow buttons a second time or the "display mode" button a second time.

The code list or queue position is the first item displayed, followed by the main code and the subcode. Each item is displayed for about one second. The display cycles continuously until the next code list position is accessed by pressing the **MODE** button. The following list represents the display cycle using code 25 11 as an example:

1. Code list position — **d**, **1**
2. Main code — **2**, **5**
3. Subcode —**1**, **1**
4. Cycle repeats — **d**, **1**, **2**, **5**, **1**, **1**

To view the second, third, fourth, and fifth positions (d2, d3, d4, and d5), momentarily press the **MODE** button as explained above.

Momentarily press the **MODE** button after the fifth position is displayed to restart the sequence of code list positions.

An active code is indicated by the illumination of the LED indicator when a code position is displayed while in the diagnostic display mode. In the normal operating mode, the LED indicator illuminates to show a secondary mode operation.

Any code position which does not have a diagnostic code logged will display "–" for both the main and subcodes. No diagnostic codes are logged after an empty code position.

B. Clearing Active Indicators. A diagnostic code's active indicator can be cleared, which allows the code inhibit to be cleared but remains in the queue as inactive.

The active indicator clearing methods are:

1. Power down — All active indicators, except code 69 34 (refer to the code chart), are cleared at ECU power down.
2. Self-clearing — Some codes will clear their active indicator when the condition causing the code is no longer detected by the ECU.

DIAGNOSTIC CODES

3. Manual — Some active indicators can be cleared manually, while in the diagnostic display mode, after the condition causing the code is corrected.

CAUTION:	If an active indicator is cleared while the transmission is locked in a forward range or reverse (fail-to-range), the transmission will remain in the forward range or reverse after the clearing procedure is completed. Neutral must be manually selected.

C. Manually Clearing Codes and Active Indicators from the Code List. To clear active indicators or all codes:

1. Enter the diagnostic display mode.
2. Press and hold the **MODE** button for approximately three seconds until the LED indicator flashes. All active indicators are cleared. To remove all inactive codes, press and hold the **MODE** button for about ten seconds until the LED indicator flashes again. All active indicators will be cleared at ECU power down.
3. Codes that cannot be manually cleared will remain.

D. Exiting the diagnostic display mode. Exit the diagnostic display mode using one of the following procedures:

1. On a pushbutton shift selector, press the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time or press any range button, **D**, **N**, or **R**. The shift (**D**, **N**, or **R**) is commanded if not inhibited by an active code.
2. On a lever shift selector, momentarily press the “display mode” button or move the shift lever to any shift position other than the one it was in when the diagnostic display mode was activated. If the shift is inhibited, the ECU will continue to command the current transmission range attained and the lever should be returned to its original position.
3. Wait until timeout (approximately 10 minutes) and the system will automatically return to the normal operating mode.
4. Turn off power to the ECU (turn off the vehicle engine at the ignition switch).

5–3. DIAGNOSTIC CODE RESPONSE

The following ECU responses to a fault provide for safe transmission operation:

- **D**o **N**ot **S**hift (DNS) Response
  - — Release lockup clutch and inhibit lockup operation.
  - — Inhibit all shifts.
  - — Turn on the **CHECK TRANS** light.
  - — Display the range attained.
  - — Ignore any range selection inputs from the pushbutton or lever shift selector.
- **D**o **N**ot **A**dapt (DNA) Response
  - — The ECU stops adaptive shift control while the code is active. Do not adapt shifts when a code with the DNA response is active.

DIAGNOSTIC CODES

- **SOL**enoid **OFF** (SOL OFF) Response
  - — All solenoids are commanded off (turning solenoids “A” and “B” off electrically causes them to be on hydraulically).
- **R**eturn to **P**revious **R**ange (RPR) Response
  - — When the speed sensor ratio or C3 pressure switch tests associated with a shift are not successful, the ECU commands the same range as commanded before the shift.
- **N**eutral **N**o **C**lutches (NNC) Response
  - — When certain speed sensor ratio or C3 pressure switch tests are not successful, the ECU commands a neutral condition with no clutches applied.

5–4. SHIFT SELECTOR DISPLAYS RELATED TO ACTIVE CODES

- “Cateye” — The forward slash segments and the middle horizontal segments (-\-) may be on under the following conditions:
  - — RSI link fault is active (code 23 12 or 23 14)
  - — When two COP timeouts occur within two seconds of each other (reference code 69 33)
  - — Shift selector display line fault is active (23 16)

- All Segments Displayed — All display segments will be illuminated if a severity 1 diagnostic code is present during initialization, or if an electrical code for solenoids A, B, C, D, E, or G is logged before initialization completes.

5–5. DIAGNOSTIC CODE LIST AND DESCRIPTION

Table 5–2. WT Series Diagnostic Codes

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
13 (0011 00-50)	12	ECU input voltage, low	Yes	DNS, DNA, SOL OFF (hydraulic default)
	13	ECU input voltage, medium low	No	DNA
	23	ECU input voltage, high	Yes	DNS, SOL OFF (hydraulic default)
14	12	Oil level sensor, failed low	No	None
(0011 00-53)	23	Oil level sensor, failed high	No	None
21	12	Throttle position sensor, failed low	No	Use throttle default values, DNA
(0011 00-56)	23	Throttle position sensor, failed high	No	Use throttle default values, DNA
22 (0011 00-59)	14	Engine speed sensor reasonableness test	No	Use default engine speed, DNA
	15	Turbine speed sensor reasonableness test	Yes	DNS, lock in current range, DNA
	16	Output speed sensor reasonableness test	Yes (1)	DNS, lock in current range, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
23 (0011 00-62)	12	Primary shift selector or RSI link fault	No	Hold in last valid direction. May cause “cateye” display.
	13	Primary shift selector mode function fault	No	Mode change not permitted
	14	Secondary shift selector or RSI link fault	No	Hold in last valid direction. May cause “cateye” display.
	15	Secondary shift selector mode function fault	No	Mode change not permitted
	16	Shift Selector display line fault	No	None. May cause “cateye” display.
24	12	Sump fluid temperature, cold	Yes	DNS, lock in neutral
(0011 00-64)	23	Sump fluid temperature, hot	No	No upshifts above a calibration range
25 (011 00-69)	00	Output speed sensor, detected at 0 output rpm, Low	Yes (1)	DNS, lock in current range (Low), DNA
	11	Output speed sensor, detected at 0 output rpm, 1st	Yes (1)	DNS, lock in current range (1st), DNA
	22	Output speed sensor, detected at 0 output rpm, 2nd	Yes (1)	DNS, lock in current range (2nd), DNA
	33	Output speed sensor, detected at 0 output rpm, 3rd	Yes (1)	DNS, lock in current range (3rd), DNA
	44	Output speed sensor, detected at 0 output rpm, 4th	Yes (1)	DNS, lock in current range (4th), DNA
	55	Output speed sensor, detected at 0 output rpm, 5th	Yes (1)	DNS, lock in current range (5th), DNA
	66	Output speed sensor, detected at 0 output rpm, 6th	Yes (1)	DNS, lock in current range (6th), DNA
	77	Output speed sensor, detected at 0 output rpm, Reverse range	Yes (1)	DNS, lock in current range (R), DNA
26	00	Throttle source not detected	No	Use throttle default values, DNA
(0011 00-71)	11	Engine coolant source not detected	No	Use default value of –18°C (0°F)
32	00	C3 pressure switch open, Low range	Yes	DNS, lock in current range (Low), DNA
(0011 00-73)	33	C3 pressure switch open, 3rd range	Yes	DNS, lock in current range (3rd), DNA
	55	C3 pressure switch open, 5th range	Yes	DNS, lock in current range (5th), DNA
	77	C3 pressure switch open, Reverse range	Yes	DNS, lock in current range (R), DNA
33 (0011 0-75)	12	Sump oil temperature sensor failed low	No	Use default value of 93°C (200°F)
	23	Sump oil temperature sensor failed high	No	Use default value of 93°C (200°F)

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
34 (0011 00-77)	12	Factory calibration compatibility number wrong	Yes(5)	DNS, SOL OFF (hydraulic default), DNA
	13	Factory calibration block checksum	Yes(5)	DNS, SOL OFF (hydraulic default), DNA
	14	Power off block checksum	No	Use previous location, or factory calibration and reset adaptive, DNA
	15	Diagnostic queue block checksum	No	Use previous location, or clear diagnostic queue, DNA
	16	Real time block checksum	Yes	DNS, SOL OFF (hydraulic default), DNA
	17	Customer modifiable constants checksum	Yes(5)	DNS, SOL OFF (hydraulic default), DNA
35 (0011 00-79)	00	Power interruption (code set after power restored)	No	None (hydraulic default during interruption)
	16	Real time write interruption	Yes	DNS, SOL OFF (hydraulic default), DNA
36 (0011 00-80)	00	Hardware/software not compatible	Yes (2)	DNS, SOL OFF (hydraulic default), DNA
	01	TID not compatible with hardware/software	No(2)	Use TIDCAP cal
	02	TID did not complete	No	Use TIDCAP cal, code 42 XX or 69 XX may be logged
42 (0011 00-82)	12	Short-to-battery, A solenoid circuit	Yes	DNS, SOL OFF, DNA
	13	Short-to-battery, B solenoid circuit	Yes	DNS, SOL OFF, DNA
	14	Short-to-battery, C solenoid circuit	Yes	DNS, SOL OFF, DNA
	15	Short-to-battery, D solenoid circuit	Yes	DNS, SOL OFF, DNA
	16	Short-to-battery, E solenoid circuit	Yes	DNS, SOL OFF, DNA
	21	Short-to-battery, F solenoid circuit	No	Lockup inhibited, DNA
	22	Short-to-battery, G solenoid circuit	Yes	DNS, SOL OFF, DNA
	23	Short-to-battery, H solenoid circuit	No	Differential lock inhibited (3070 only), retarder inhibited
	24	Short-to-battery, J solenoid circuit	No	Low and 1st inhibited
	26	Short-to-battery, N solenoid circuit	No	Low and 1st inhibited, allow retarder
44 (0011 00-86)	12	Short-to-ground, A solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	13	Short-to-ground, B solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	14	Short-to-ground, C solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	15	Short-to-ground, D solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	16	Short-to-ground, E solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	21	Short-to-ground, F solenoid circuit	No	Lockup inhibited, DNA
	22	Short-to-ground, G solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
44 *(cont'd)*	23	Short-to-ground, H solenoid circuit	No	Differential lock inhibited (3070 only), retarder operation inhibited
	24	Short-to-ground, J solenoid circuit	No	Low and 1st inhibited
	26	Short-to-ground, N solenoid circuit	No	Low and 1st inhibited, retarder allowed
45	12	Open circuit, A solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
(0011 00-90)	13	Open circuit, B solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	14	Open circuit, C solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	15	Open circuit, D solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	16	Open circuit, E solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	21	Open circuit, F solenoid circuit	No	Lockup inhibited, DNA
	22	Open circuit, G solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
	23	Open circuit, H solenoid circuit	No	Differential lock inhibited (3070 only), retarder inhibited
	24	Open circuit, J solenoid circuit	No	Low and 1st inhibited
	26	Open circuit, N solenoid circuit	No	Low and 1st inhibited, retarder allowed
46	21	Overcurrent, F solenoid circuit	No	Lockup inhibited, DNA
(0011 00-94)	26	Overcurrent, N and H solenoid circuit	No	Low and first inhibited or retarder inhibited, DNA
	27	Overcurrent, A-Hi solenoid circuit	Yes	DNS, SOL OFF (hydraulic default), DNA
51 (0011 00-95)	01	Offgoing ratio test (during shift), Low to 1	Yes	DNS, RPR, DNA
	10	Offgoing ratio test (during shift), 1 to Low	Yes	DNS, RPR, DNA
	12	Offgoing ratio test (during shift), 1 to 2	Yes	DNS, RPR, DNA
	21	Offgoing ratio test (during shift), 2 to 1	Yes	DNS, RPR, DNA
	23	Offgoing ratio test (during shift), 2 to 3	Yes	DNS, RPR, DNA
	24	Offgoing ratio test (during shift), 2 to 4	Yes	DNS, RPR, DNA
	35	Offgoing ratio test (during shift), 3 to 5	Yes	DNS, RPR, DNA
	42	Offgoing ratio test (during shift), 4 to 2	Yes	DNS, RPR, DNA
	43	Offgoing ratio test (during shift), 4 to 3	Yes (1)	DNS, RPR, DNA
	45	Offgoing ratio test (during shift), 4 to 5	Yes (1)	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
51 *(cont'd)*	46	Offgoing ratio test (during shift), 4 to 6	Yes	DNS, RPR, DNA
	53	Offgoing ratio test (during shift), 5 to 3	Yes	DNS, RPR, DNA
	64	Offgoing ratio test (during shift), 6 to 4	Yes	DNS, RPR, DNA
	65	Offgoing ratio test (during shift), 6 to 5	Yes	DNS, RPR, DNA
	XY	Offgoing ratio test, X to Y [3]		
52 (0011 00-97)	01	Offgoing C3PS test (during shift), Low to 1	Yes	DNS, RPR, DNA
	08	Offgoing C3PS test (during shift), Low to N1	Yes	DNS, NNC, DNA
	32	Offgoing C3PS test (during shift), 3 to 2	Yes	DNS, RPR, DNA
	34	Offgoing C3PS test (during shift), 3 to 4	Yes	DNS, RPR, DNA
	54	Offgoing C3PS test (during shift), 5 to 4	Yes	DNS, RPR, DNA
	56	Offgoing C3PS test (during shift), 5 to 6	Yes	DNS, RPR, DNA
	71	Offgoing C3PS test (during shift), R to 1	Yes	DNS, NNC, DNA
	72	Offgoing C3PS test (during shift), R to 2	Yes	DNS, NNC, DNA
	78	Offgoing C3PS test (during shift), R to N1	Yes	DNS, NNC, DNA
	99	Offgoing C3PS test (during shift), N3 to N2	Yes	DNS, RPR, DNA
	XY	Offgoing C3PS test, X to Y [3]		
53 (0011 00-99)	08	Offgoing speed test (during shift), L to N1	Yes [1]	DNS, NNC, DNA
	18	Offgoing speed test (during shift), 1 to N1	Yes [1]	DNS, NNC, DNA
	28	Offgoing speed test (during shift), 2 to N1	Yes [1]	DNS, NNC, DNA
	29	Offgoing speed test (during shift), 2 to N2	Yes [1]	DNS, RPR, DNA
	38	Offgoing speed test (during shift), 3 to N1	Yes [1]	DNS, NNC, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
53 *(cont'd)*	39	Offgoing speed test (during shift), 3 to N3	Yes (1)	DNS, RPR, DNA
	48	Offgoing speed test (during shift), 4 to N1	Yes (1)	DNS, NNC, DNA
	49	Offgoing speed test (during shift), 4 to N3	Yes (1)	DNS, RPR, DNA
	58	Offgoing speed test (during shift), 5 to N1	Yes (1)	DNS, NNC, DNA
	59	Offgoing speed test (during shift), 5 to N3	Yes (1)	DNS, RPR, DNA
	68	Offgoing speed test (during shift), 6 to N1	Yes (1)	DNS, NNC, DNA
	69	Offgoing speed test (during shift), 6 to N4	Yes (1)	DNS, RPR, DNA
	78	Offgoing speed test (during shift), R to N1	Yes	DNS, NNC, DNA
	99	Offgoing speed test (during shift), N2 to N3 or N3 to N2	Yes	DNS, RPR, DNA
	XY	Offgoing speed test (during shift), X to Y (3)		
54 (0011 00-101)	01	Oncoming ratio test (after shift), L to 1	Yes	DNS, RPR, DNA
	07	Oncoming ratio test (after shift), L to R	Yes	DNS, NNC, DNA
	10	Oncoming ratio test (after shift), 1 to L	Yes	DNS, RPR, DNA
	12	Oncoming ratio test (after shift), 1 to 2	Yes	DNS, RPR, DNA
	17	Oncoming ratio test (after shift), 1 to R	Yes	DNS, NNC, DNA
	21	Oncoming ratio test (after shift), 2 to 1	Yes	DNS, RPR, DNA
	23	Oncoming ratio test (after shift), 2 to 3	Yes	DNS, RPR, DNA
	24	Oncoming ratio test (during shift), 2 to 4	Yes	DNS, RPR, DNA
	27	Oncoming ratio test (after shift), 2 to R	Yes	DNS, RPR, DNA
	32	Oncoming ratio test (after shift), 3 to 2	Yes	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
54 *(cont'd)*	34	Oncoming ratio test (after shift), 3 to 4	Yes	DNS, RPR, DNA
	35	Oncoming ratio test (during shift), 3 to 5	Yes	DNS, RPR, DNA
	42	Oncoming ratio test (during shift), 4 to 2	Yes	DNS, RPR, DNA
	43	Oncoming ratio test (after shift), 4 to 3	Yes	DNS, RPR, DNA
	45	Oncoming ratio test (after shift), 4 to 5	Yes	DNS, RPR or SOL OFF (hydraulic default), DNA
	46	Oncoming ratio test (during shift), 4 to 6	Yes	DNS, RPR, DNA
	53	Oncoming ratio test (during shift), 5 to 3	Yes	DNS, RPR, DNA
	54	Oncoming ratio test (after shift), 5 to 4	Yes	DNS, RPR, DNA
	56	Oncoming ratio test (after shift), 5 to 6	Yes	DNS, RPR, DNA
	64	Oncoming ratio test (after shift), 6 to 4	Yes	DNS, RPR, DNA
	65	Oncoming ratio test (after shift), 6 to 5	Yes	DNS, RPR, DNA
	70	Oncoming ratio test (after shift), R to L	Yes	DNS, NNC, DNA
	71	Oncoming ratio test (after shift), R to 1	Yes	DNS, NNC, DNA
	72	Oncoming ratio test (after shift), R to 2	Yes	DNS, NNC, DNA
	80	Oncoming ratio test (after shift), N1 to L	Yes	DNS, RPR, DNA
	81	Oncoming ratio test (after shift), N1 to 1	Yes	DNS, RPR, DNA
	82	Oncoming ratio test (after shift), N1 to 2	Yes	DNS, RPR, DNA
	83	Oncoming ratio test (after shift), N1 to 3	Yes	DNS, RPR, DNA
	85	Oncoming ratio test (after shift), N1 to 5	Yes	DNS, RPR, DNA
	86	Oncoming ratio test (after shift), N1 to 6	Yes	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
54 *(cont'd)*	92	Oncoming ratio test (after shift), N2 to 2	Yes	DNS, RPR, DNA
	93	Oncoming ratio test (after shift), N3 to 3	Yes	DNS, RPR, DNA
	95	Oncoming ratio test (after shift), N3 to 5	Yes	DNS, RPR, DNA
	96	Oncoming ratio test (after shift), N4 to 6	Yes	DNS, RPR, DNA
	XY	Oncoming ratio test (after shift), X to Y (3)		
55 (0011 00-103)	07	Oncoming C3PS test (after shift), Low to R	Yes (1)	DNS, NNC, DNA
	17	Oncoming C3PS test (after shift), 1 to R	Yes (1)	DNS, NNC, DNA
	27	Oncoming C3PS test (after shift), 2 to R	Yes (1)	DNS, NNC, DNA
	87	Oncoming C3PS test (after shift), N1 to R	Yes	DNS, RPR, DNA
	97	Oncoming C3PS test (after shift), NVL to R	Yes (1)	DNS, NNC, DNA
	XY	Oncoming C3PS test (after shift), X to Y(3)		
56	00	Range verification test, L	Yes (1)	DNS, 1st, Low, or SOL OFF (Low), DNA
(0011 00-105)	11	Range verification ratio test, 1st	Yes	DNS, 6th, DNA
	22	Range verification ratio test, 2nd	Yes (1)	DNS, 6th or 5th, DNA
	33	Range verification ratio test, 3rd	Yes (1)	DNS, 5th or SOL OFF (4th), DNA
	44	Range verification ratio test, 4th	Yes	DNS, 3rd or 5th, DNA
	55	Range verification ratio test, 5th	Yes (1)	DNS, SOL OFF (5th) or 3rd, DNA
	66	Range verification ratio test, 6th	Yes	DNS, 5th, 3rd, or SOL OFF (3rd), DNA
	77	Range verification ratio test, R	Yes	DNS, N2 or N3, DNA
57	11	Range verification C3PS test, 1st	Yes	DNS, SOL OFF (3rd), DNA
(0011 00-107)	22	Range verification C3PS test, 2nd	Yes	DNS, 3rd, DNA
	44	Range verification C3PS test, 4th	Yes	DNS, 5th or SOL OFF (3rd), DNA
	66	Range verification C3PS test, 6th	Yes	DNS, SOL OFF (5th), DNA
	88	Range verification C3PS test, N1	Yes	DNS, N3, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
	99	Range verification C3PS test, N2 or N4	Yes	DNS, N3, DNA
61 (0011 00-108)	00	Retarder oil temperature, hot	No	None
62 (0011 00-110)	12	Retarder temperature sensor failed low	No	None
	23	Retarder temperature sensor failed high	No	None
	32	Engine coolant sensor failed low	No	Use default value of 0°F
	33	Engine coolant sensor failed high	No	Use default value of 0°F
63 (0011 00-113)	00	Input function fault	No	Does not prevent neutral to range shifts for Aux Function Range Inhibit-Special when two signals required are not “on” within 120 seconds of each other.
	26	Kickdown input failed on	No	Kickdown operation inhibited
	40	Service brake status input failed on	No	No auto Neutral to Drive shifts for refuse packer. (I/O package #41). No retarder if a TPS code is also active
	41	Pump/pack and a neutral general purpose input	No	No auto N–D shifts for refuse packer (I/O package #41)
64 (0011 00-114)	12	Retarder modulation request sensor failed low	No	Retarder operation inhibited
	23	Retarder modulation request sensor failed high	No	Retarder operation inhibited
		Engine rating too high	Yes	DNS, Lock-in-neutral, DNA
65 (0011 00-117)	00	Engine rating too high	Yes	DNS, Lock-in-neutral
66 (0011 00-118)	00	Serial communications interface fault	No	Use default throttle values, DNA
	11	SCI engine coolant source fault	No	Use default value of 0°F
69 (0011 00-120)	27	ECU, inoperative A-Hi switch	Yes	DNS, NNC, DNA
	28	ECU, inoperative F-Hi switch	Yes	Lockup inhibited, DNA
	29	ECU, inoperative N and H-Hi switch	No	Low and first inhibited, retarder inhibited, DNA

DIAGNOSTIC CODES

Table 5–2. WT Series Diagnostic Codes (Continued)

Main Code	Sub-code	Description	CHECK TRANS Light	Inhibited Operation Description
69 *(cont'd)*	33	ECU, Computer Operating Properly (COP) timeout	No	Reset ECU, shutdown ECU on 2nd occurrence (power loss; hydraulic defaults). May cause "cateye" display or all segments blank display, DNA(4)
	34	ECU, write timeout	Yes	DNS, SOL OFF (hydraulic default), DNA
	35	ECU, checksum test	No	Induce COP timeout (reset ECU), DNA(4)
	36	ECU, RAM self test	No	Induce COP timeout (reset ECU), DNA(4)
	39	Communication chip addressing error	No	Use defaults for J1939 data, DNA
	41	ECU, I/O ASIC addressing test	No	Induce COP timeout (reset ECU), DNA(4)
	42	SPI output failure	Yes	GPO 1–8 and reverse warning inoperable
	43	SPI input failure	Yes	DNS, lock-in-range, DNA
70	12	Software, minor loop overrun	No	Induce COP timeout (reset ECU)
	13	Illegal write to address $0000	No	Induce COP timeout (reset ECU)
	14	Software, major loop overrun	No	Induce COP timeout (reset ECU)

NOTES

(1) This code is logged to real time to protect the transmission in case a loss of power to the ECU (Power Interruption, code 35 00) occurs.

(2) The ECU hardware or software must be changed so that they are compatible.

(3) Additional codes could be logged for other shifts where X indicates range shifted from and Y indicates range shifted to.

(4) The COP reset will clear the active inhibit.

(5) The factory calibration must be rewritten to the ECU, or a different factory calibration is required to match the software in the ECU.

TRANSMISSION COMPONENT WIRING DIAGRAMS AND DIAGNOSTICS

DIAGNOSTIC CODES

5–6. DIAGNOSTIC CODE TROUBLESHOOTING

A. Beginning The Troubleshooting Process

1. Begin troubleshooting by checking the transmission fluid level and ECU input voltage. Check diagnostic codes by:
   - Using the shift selector display.
   - Using the Pro-Link® 9000 diagnostic tool.
2. When a problem exists but a diagnostic code is not indicated, refer to the Performance Complaint Section for a listing of various electrical and hydraulic problems, their causes, and remedies.
3. If a diagnostic code is found in the ECU memory, record all available code information and clear the active indicator (refer to Paragraph 5–2).
4. Test drive the vehicle to confirm a diagnostic code or performance complaint.
   - If the code reappears, refer to the Diagnostic Code section (Section 6) and the appropriate code chart. The Diagnostic Code section lists diagnostic codes and their description. Locate the appropriate troubleshooting chart and follow the instructions.
   - If the code does not reappear, it may be an intermittent problem. Use the Pro-Link® and the code display procedure described in Section 5. The code display procedure will indicate the number of times the diagnostic code has occurred. Refer to the troubleshooting chart for possible cause(s) of the problem.
   - Appendix A deals with the identification of potential circuit problems. Refer to Appendix A if a circuit problem is suspected.

NOTE: Information concerning specific items is contained in the appendices located in the back of this manual. The appendices are referred to throughout the manual.

B. Solenoid Locations

Solenoid locations in the control module are as illustrated in Figure 5–1. Refer to Figure 5–1 as necessary when using the diagnostic code schematics.

C. Diagnostic Code Schematics

The diagnostic code schematics in this section show wiring for both the optional oil level sensor and retarder, where applicable. If your transmission is not equipped with an oil level sensor or retarder, disregard the portions of the schematic pertaining to those optional pieces of equipment. Refer to the appropriate transmission Service Manual for solenoid replacement procedures.

D. Wire/Terminal Numbering Scheme

WTEC III wire identification presents the wire number followed by the ECU terminal source (i.e., 157-S30). This is done to retain the wire number/function assignments from WTEC II and indicate the ECU connector and terminal origination for WTEC III. If there is a letter suffix following the wire number, there is a splice between the ECU source and wire destination (i.e., 136A-S16).

DIAGNOSTIC CODES

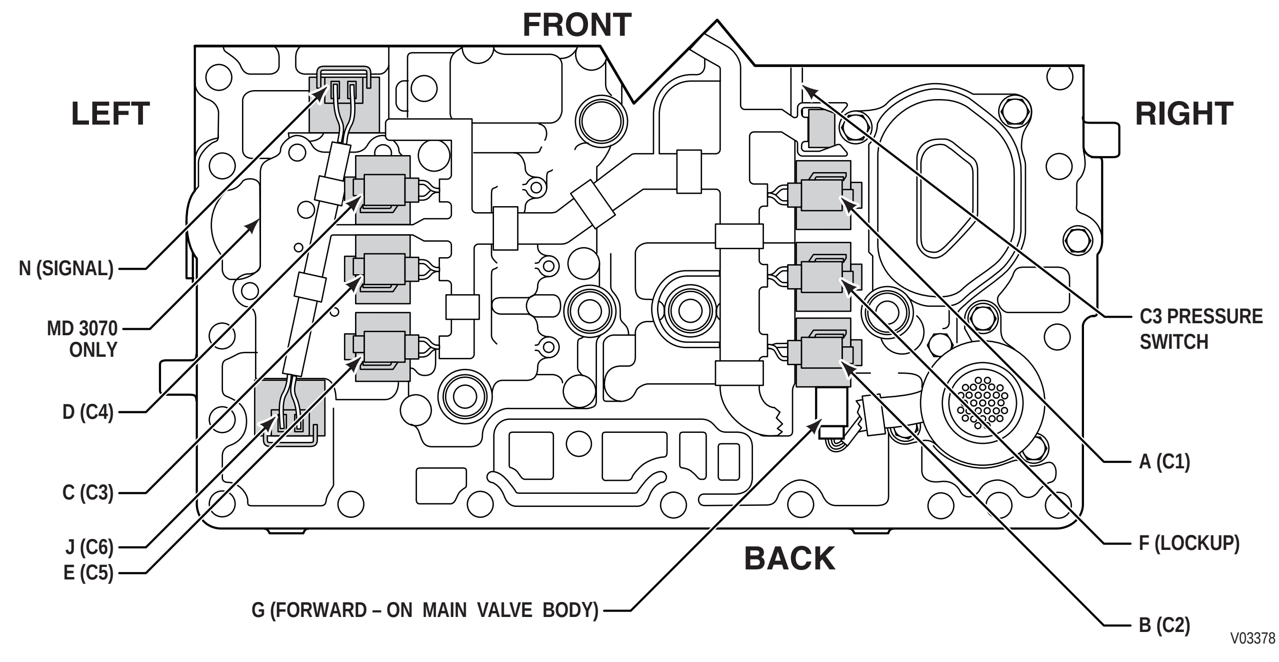


Figure 5–1. Control Module Solenoid Location

CODE 13 XX — ECU INPUT VOLTAGE

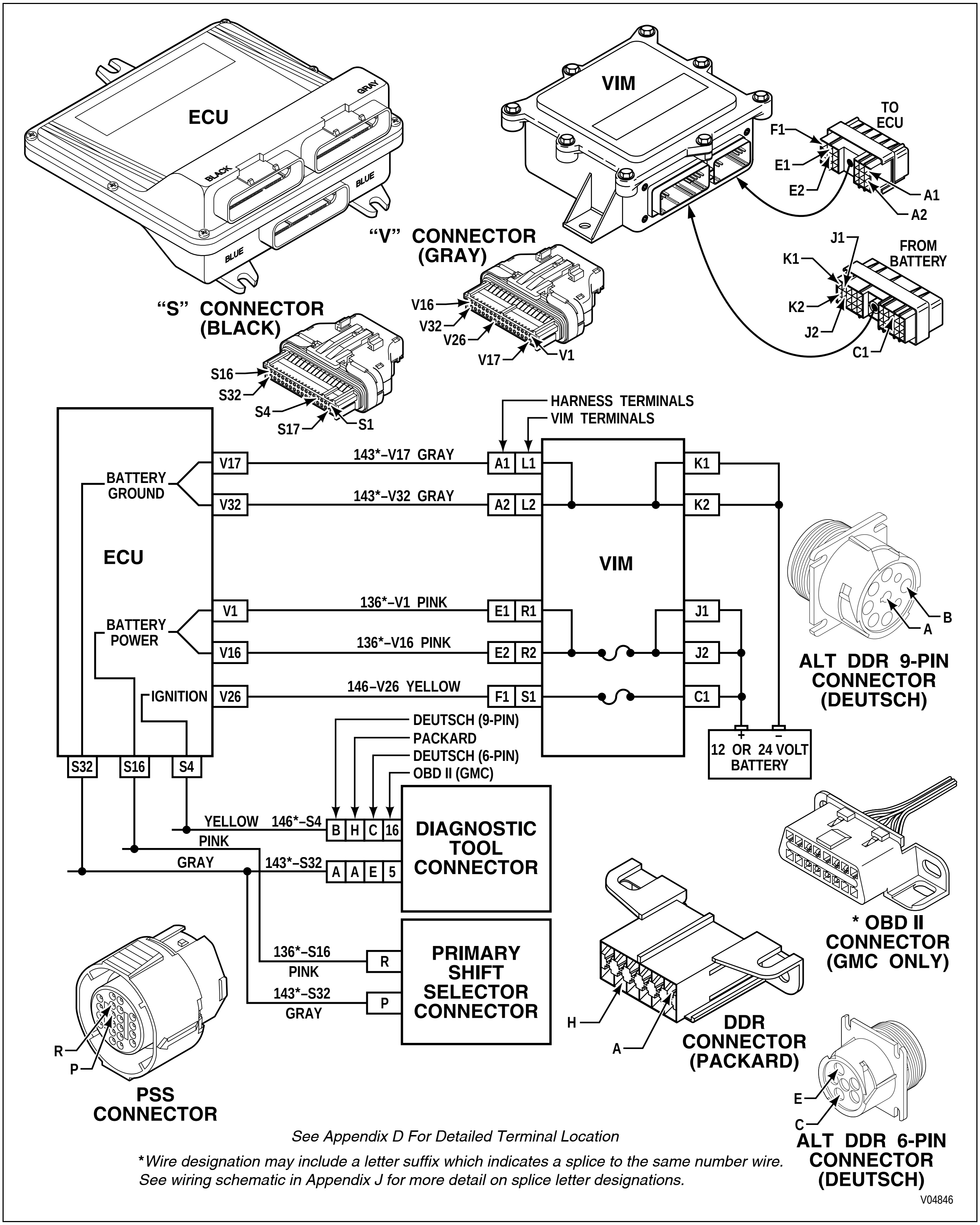


Figure 5–2. Code 13 Schematic Drawing

CODE 13 XX — ECU INPUT VOLTAGE *(Figure 5–2)*

Main code 13 indicates either a high or low input voltage. Low voltage is less than 8 volts. High voltage is over 33 volts.

Common causes for a low voltage code are:

- Bad batteries
- Faulty vehicle charging system
- No dedicated power and ground connection directly to the battery or through an electronic bus bar to the battery

Common causes for the high voltage code are:

- Faulty vehicle alternator
- Faulty vehicle voltage regulator

In the event of a power loss, the transmission fails to the ranges indicated in the following, depending upon which latch valve releases first:

Attained Range	Fail to Range
Reverse and neutral	Neutral
Low, 1	3C
2, 3, 4	4C usually, 3C sometimes
5	4C usually, 5C sometimes
6	5C

Main Code	Subcode	Meaning
13	12	Battery voltage to the ECU too low
13	13	Battery voltage to the ECU too low (medium)
13	23	Battery voltage to the ECU too high

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

B. Troubleshooting:

1. Connect the diagnostic tool and turn on vehicle ignition. Select Diagnostic Data to find input voltage. Record reading.

2. Turn off vehicle ignition and remove the connectors from the ECU.

3. Check system voltage at wire 136A and 136C, pin V1 and V16. If power is low or high at this point, and the diagnostic tool reading is also low or high, the vehicle wiring is suspect. Check for fuse problems, lack of battery-direct power and ground, faulty charging system/batteries, and loose or dirty connections (see Appendix A). Power may also be low or high at pins V1 and V16 (system power) if the batteries/charging system is faulty. Bad grounds may also cause incorrect input power readings.

CODE 13 XX — ECU INPUT VOLTAGE *(Figure 5–2)*

4. If power is correct but the diagnostic tool reading indicates incorrect voltage, closely inspect terminals V1 and V16 or S16; make sure they are not corroded or deformed. Clean or replace as necessary.

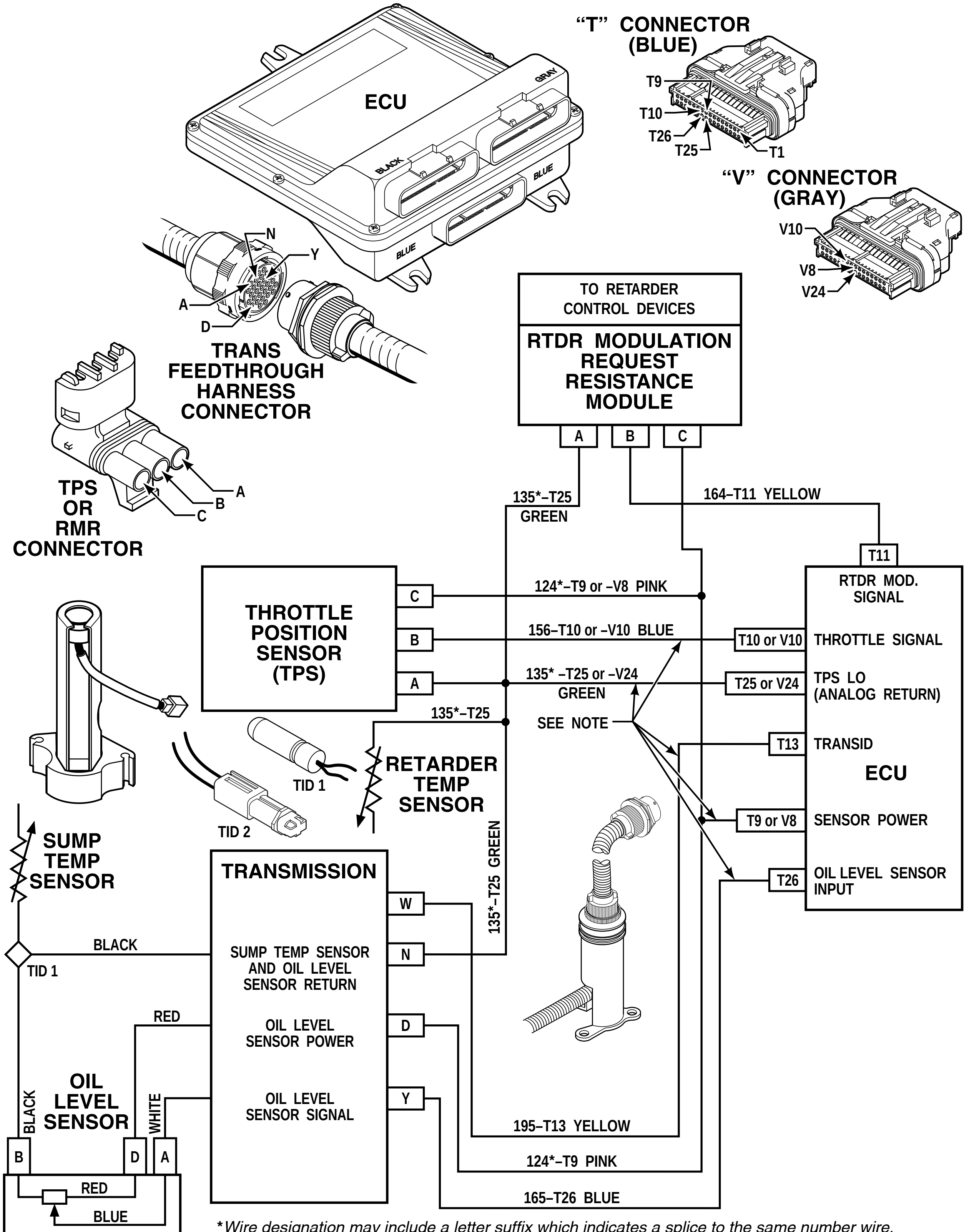
5. If the voltage condition is intermittent, closely inspect the vehicle wiring for transmission system power and grounds. Check for loose, dirty, or painted connections. Check the VIM for loose, incorrect, or overheating relays or fuses (refer to Appendix E). Check for wires that are chafed and touching other components.

6. If no other cause is found, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

Table 5–3. Voltage Chart

Voltage	Condition
33.0 (High Set Point)	High Fail Limit
32.0	Maximum Continuous ECU Voltage
10.0 (Medium Low Set Point)	Cannot Compensate With Sub-Modulation (Bad Shifts). Adaptive logic stops functioning
8.0	Low Voltage Fail Limit, Set Code, DNS
7.0 (Low Set Point)	Software Off (ECU loses power)
4.5	Neutral Start Off

CODE 14 XX — OIL LEVEL SENSOR (OLS)



Wire designation may include a letter suffix which indicates a splice to the same number wire. See wiring schematic in Appendix J for more detail on splice letter designations.

NOTE: *These wires may pass through a bulkhead connector. See Appendix D For Detailed Terminal Location.*

V04844.01

Figure 5–3. Code 14 Schematic Drawing

CODE 14 XX — OIL LEVEL SENSOR (OLS) *(Figure 5–3)*

The oil level sensor (OLS) must have been recognized by autodetect or manually selected using the Pro-Link® (see WTEC III Pro-Link® Manual) before these codes can be logged.

Code 14 12 indicates the ECU has detected a voltage signal in the low error zone.

Code 14 12 can be caused by:

- Faulty wiring to the OLS
- A faulty OLS
- A faulty ECU

CAUTION:	Never use a volt/ohmmeter to measure any parameters on the OLS. Damage to the OLS will result.

OLS ground wire 135B is common to the TPS and the RMR devices. A power wire short-to-ground for any of these devices will cause "sensor failed low" codes (21 12 and 64 12) and shutdown of the electronic pushbutton or lever selector. An OLS signal open or short-to-ground results in a code 14 12 only. Code 14 23 is programmed out of all calibrations.

A permanent maximum voltage signal generates a steady OLS sensor maximum count and a maximum fluid level overfill indication. A maximum overfill indication occurs if signal wire 165 or power wire 124 is shorted to battery or the ground wire (wire 135) is open between the OLS and the sump temperature sensor branch. An open in the ground circuit wire 135 in the portion common to the OLS, TPS and RMR devices results in code 14 12, 21 23, and 64 23.

If the ECU software supports it, Oil Level Sensor counts can be read by a DDR with Pro-Link® version 3.0 (or later). For a complete description of fluid level checking procedures using the oil level sensor, see Section 5. Normal operation of the OLS can be checked as follows: Attach the DDR and display OIL LEVEL COUNTS. Read the number of counts when the engine is not running, but the ignition is ON. The count reading should be near 255. Start the engine and observe the counts. In normal operation, the count should be 100–200 because the oil level drops when the engine starts and oil from the sump is delivered to other parts of the transmission.

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections can cause this and other electronic control codes.***

Main Code	Subcode	Meaning
14	12	Oil level sensor failed low
14	23	Oil level sensor failed high (not used)

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

CODE 14 XX — OIL LEVEL SENSOR (OLS) *(Figure 5–3)*

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check the following:***

- ***Fluid level, using dipstick***
- ***Battery voltage***
- ***ECU input voltage***
- ***Other diagnostic codes***

B. Troubleshooting:

The following procedure is to find the cause for an OLS problem. The procedure is sequential. Follow the procedure until the cause for the OLS problem is found and repaired. Once the problem is found and repaired, STOP. For example, if the problem is fixed in step 3, there is no need to continue to the other steps.

1. Disconnect the external wiring harness at the transmission feedthrough connector. With the ignition ON, verify there is 5.0 VDC between the OLS power and ground pins (see page D–10) on the external harness connector. This is to verify that power and ground are getting to the OLS. If the 5.0 VDC is not present, check the wiring for the OLS power and ground circuits (wires 124–T9 and 135–T25, respectively). If there are no wiring problems (opens, shorts-to-ground, shorts-to-battery), and if the 5.0 VDC is present, go to Step 2.
2. Observe the OIL LEVEL COUNTS on the DDR while jumpering the OLS power pin to the OLS signal pin. If the count jumps from 0 to 250+, the OLS signal line is good and the ECU function is good. Continue to Step 3. If the count remains at zero, locate and repair problems in the wiring of OLS signal (wire 165–T26). If there are no wiring problems, and the count still remains at zero, the ECU may be bad. Go to Step 5.
3. If all checks prior to this have been normal, the problem is either in the OLS itself, the internal harness wires or the transmission side of the feedthrough harness connection. Inspect the transmission feedthrough harness connector to be sure that the OLS power, ground and signal pins are not loose or out of position. Correct any connector problems found. Reconnect the external harness to the transmission feedthrough harness connector. See if Code 14 12 recurs before continuing to Step 4.
4. Consult the appropriate transmission Service Manual for proper procedure and remove the control module from the transmission. Remove the OLS from the channel plate. Reconnect the external harness to the transmission feedthrough connector, if not done in Step 3. With the ignition ON, observe OIL LEVEL COUNTS on the DDR. With the OLS in normal position, the count should be 8–35. Invert the OLS and the count should be 192–255. If the counts are abnormal, replace the sensor. Check the new sensor in both normal and inverted positions. If the counts respond correctly, the problem should be resolved. Attach the new OLS to the channel plate and reinstall the control module using the appropriate transmission Service Manual for proper procedure.
5. Replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 21 XX — THROTTLE OR PWM FAULT

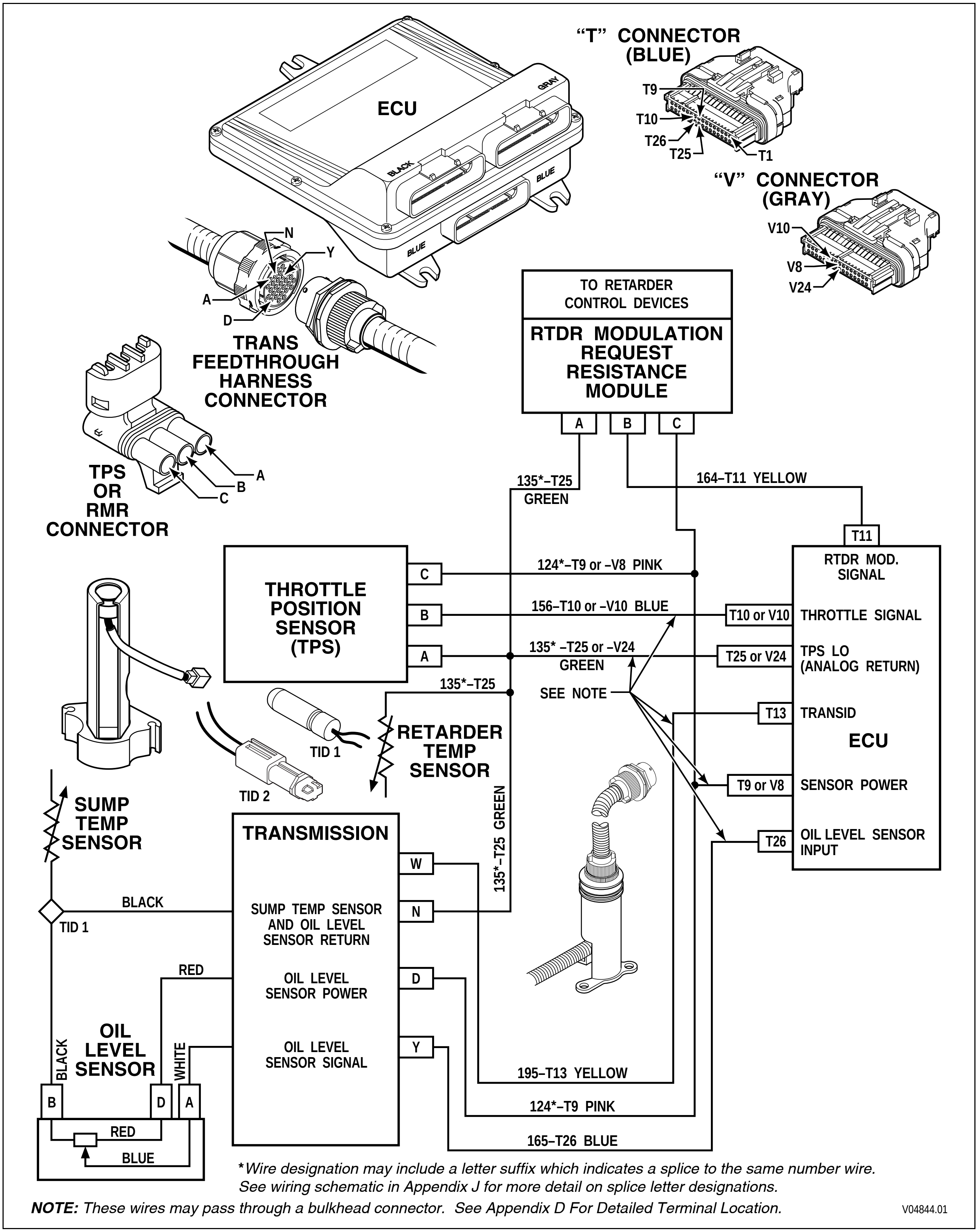


Figure 5–4. Code 21 Schematic Drawing

CODE 21 XX — THROTTLE OR PWM FAULT *(Figure 5–4)*

The throttle sensor must have been recognized by autodetect or manually selected using the Pro-Link® (see WTEC III Pro-Link® Manual) before these codes can be logged. See Paragraph 1–9 for further information.

Main code 21 indicates the throttle position sensor has been retracted or extended by its linkage into an error zone. This may be due to a fault with the sensor, or a fault in the wiring to the sensor or to the ECU. This code may also indicate a PWM signal problem. A PWM signal is proportional to throttle position and comes from some source other than an analog throttle position sensor. Code 21 12 is set when the ECU receives TPS counts of 14 or less. Code 21 23 is set when the ECU senses TPS counts of 233–255. Whenever a code 21 XX condition is detected, the system uses default throttle values and shifts will not adapt.

NOTE: Code 21 XX in conjunction with code 33 XX or code 14 XX indicates the potential loss of common ground wire 135 between the throttle, temperature sensor, and oil level sensor.

Main Code	Subcode	Meaning
21	12	Throttle position sensor failed low and ECU signals throttle default value
21	23	Throttle position sensor failed high and ECU signals a throttle default value

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check the ECU input voltage.

B. Troubleshooting:

1. Plug in the DDR, select Diagnostic Data, and read throttle counts and percent. If the TPS failed high (code 21 23), the problem may be toward the full throttle end of the TPS travel. If the TPS failed low (code 21 12), the problem may be at the closed throttle end of the TPS travel.

NOTE: Code 21 12 may occur when the throttle source is J1587 or J1939 and an analog throttle source is falsely detected. This condition may be due to a problem in an unused TPS branch of a universal external harness. To prevent this occurrence, remove wire 156 from the ECU connector and insert a cavity plug in the space vacated by the wire. Be sure that the unused TPS branch is routed away from potential induced voltage sources and the connector is protected from external contamination.

NOTE: Code 21 12 can result when the +5V line (wire 124) which powers the analog sensor is shorted to ground. Wire 124 also powers the OLS, RMR, retarder temperature sensor, sump temperature sensor, and shift selector and is present in all three ECU connectors.

2. If counts are high but the percentage never reaches 100 percent, TPS linkage may have bound up and overstroked the TPS to set a false 100 percent reading. After TPS overstroking ceases, the TPS will not automatically return to 100 percent. After the TPS is correctly installed and adjusted, use the Pro-Link® to reset throttle calibration or cycle the ignition 5 times to reset the 0 percent and 100 percent settings.

CODE 21 XX — THROTTLE OR PWM FAULT *(Figure 5–4)*

3. If the throttle counts do not change or are erratic, check the throttle sensor wiring for opens, shorts between wires, or shorts-to-ground. Also check for correct TPS voltages using test wiring harness J 41339. If wiring problems are found, isolate and repair the fault.

4. If the wiring is satisfactory, replace the throttle position sensor and adjust its linkage so the counts are not in the error zones.

5. If the throttle sensor and its linkage adjustment are correct and the wiring to the sensor is satisfactory, the condition is intermittent. Replace the sensor and properly adjust the new sensor.

6. If the condition recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the throttle sensor circuit.

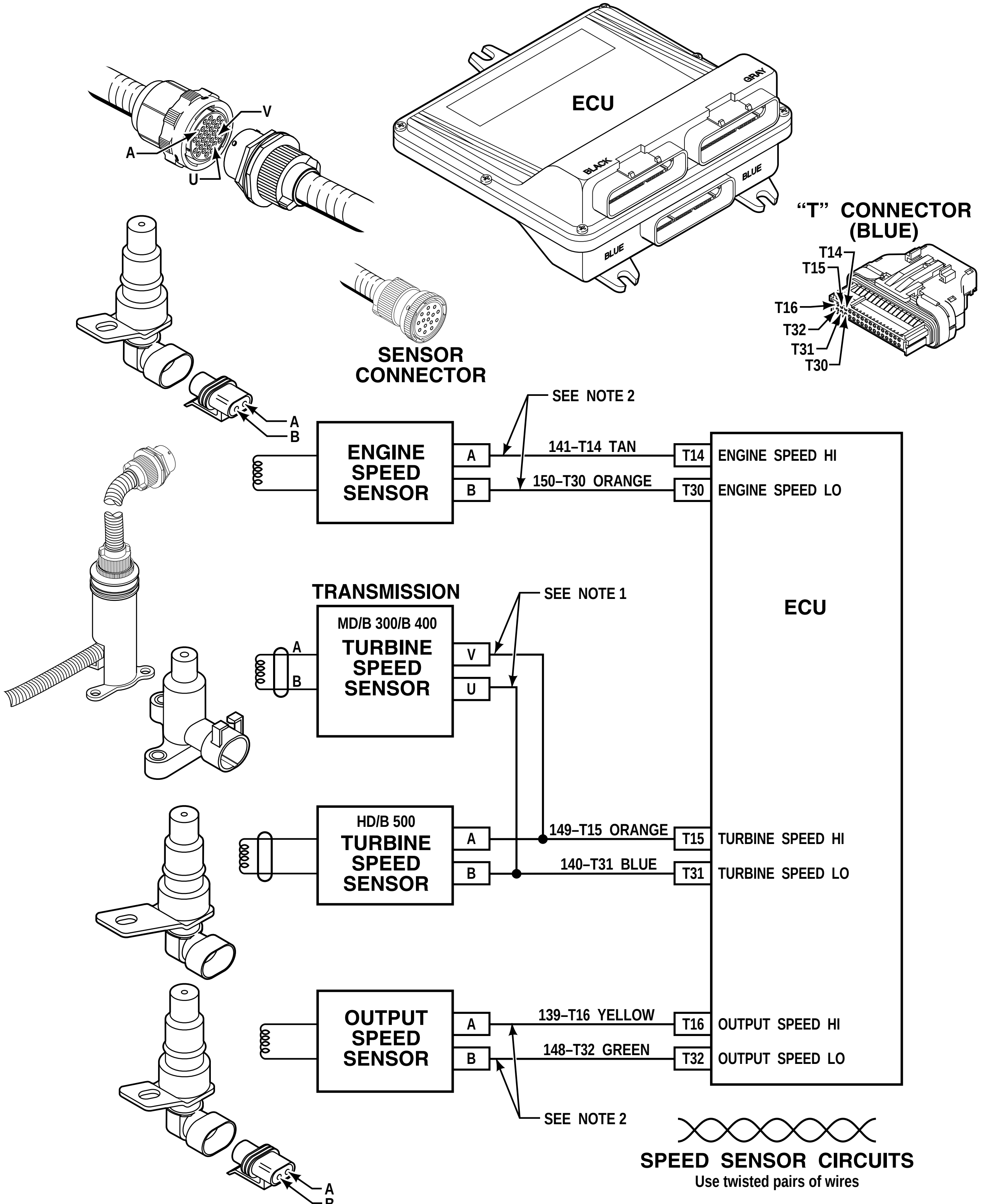
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

NOTE: A good throttle position sensor should have resistance of:

(1) 9000–15,000 Ohms across terminals A and C.

(2) 500 Ohms, moving to 9000–15,000 Ohms as TPS is stroked (measured across terminals A and B).

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT



See Appendix D For Detailed Terminal Location.

NOTE 1: *These wires may pass through a bulkhead connector or a sensor connector.*
NOTE 2: *These wires may pass through a sensor connector.*

Figure 5–5. Code 22 Schematic Drawing

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT *(Figure 5–5)*

Main code 22 indicates a fault within a speed sensor, the wiring to a speed sensor, incorrect speed sensor gap, or damaged bumps or teeth which create the speed signal. This fault is determined by the reasonableness of a speed sensor signal when compared with the other two speed sensors and the commanded range. A speed sensor will not pass the reasonableness test if there is no signal at all from that sensor when a signal should be present.

NOTE: ***If turbine speed is below 150 rpm when output speed is below 100 rpm and engine speed is above 400 rpm, Neutral Very Low (NVL) is commanded when N (Neutral) is the range selected. NVL is attained by turning D solenoid "ON" in addition to E solenoid. This causes the output to be locked (C4 and C5 clutch applied).***

NOTE: ***If the engine speed sensor code (22 14) is active and a range verification test is failed, the range verification code will not be set but a DO NOT SHIFT response is commanded.***

Main Code	Subcode	Failed Sensor
22	14	Engine Speed
22	15	Turbine Speed
22	16	Output Speed

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check the ECU input voltage.***

B. Troubleshooting:

1. Check to see if the sensor is loose, missing, or disconnected. If not, disconnect the wiring harness from the sensor and measure the resistance of the sensor (see chart below). Also check the terminals for dirt, corrosion, or damage. If resistance is not correct, replace the sensor.

Resistance	Temp °C	Temp °F
200 ¾	–40	–40
300 ¾	20	68
400 ¾	110	230

2. Remove the transmission harness connector from the ECU. Check the sensor circuit (in the external harness) for open wires, shorts between wires, or shorts-to-ground. Isolate and repair any faults.

3. If no opens or shorts are found, the condition must be intermittent. Replace the sensor indicated by the trouble code. Before replacing a speed sensor, check the sensor for physical damage or contamination. Refer to the appropriate transmission Service Manual for proper replacement procedure.

4. If the condition recurs, install new wiring (twisted-pair) for the sensor circuit between the ECU and the transmission. Use St. Clair P/N 200153 Service Harness Twisted Pair for this purpose.

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT *(Figure 5–5)*

5. If the condition again recurs, connect the diagnostic tool and select the speed signal indicated by the trouble code. Drive the vehicle and watch the speed reading on the diagnostic tool. If the signal is erratic, sensor gap, vehicle vibration, an external AC signal source, or intermittent connector contact may be inducing the erratic signal. Inspect the sensor and its surroundings for irregularities that would affect sensor gap. Isolate and correct any abnormal vehicle vibrations (particularly driveline and abnormal engine torsionals. Recheck the sensor wiring for intermittent conditions (see Appendix A).

6. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 23 XX — SHIFT SELECTOR

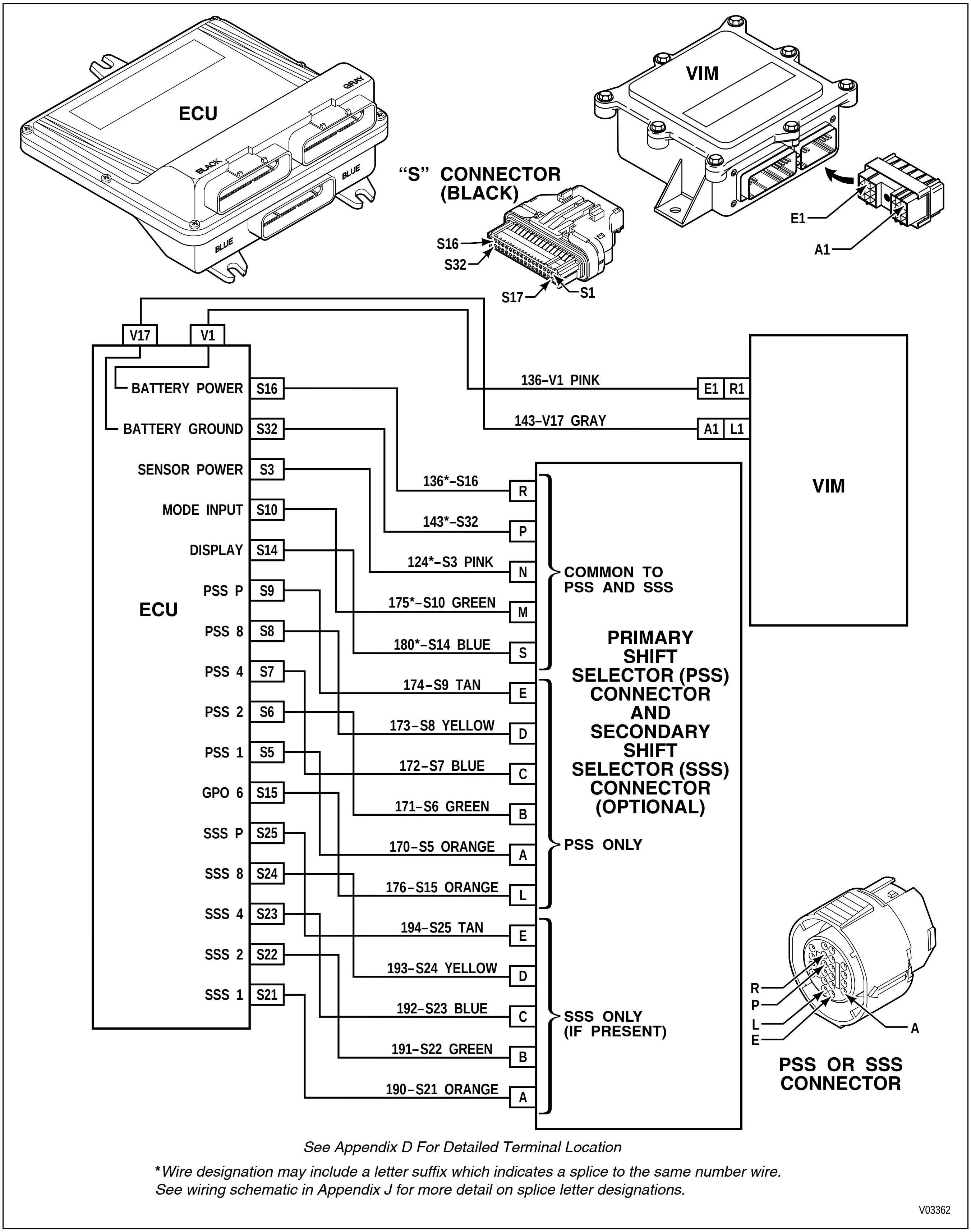


Figure 5–6. Code 23 Schematic Drawing

CODE 23 XX — SHIFT SELECTOR *(Figure 5–6)*

Main code 23 indicates a fault with a shift selector or the wiring between a shift selector and the ECU.

Main Code	Subcode	Meaning
23	12	Primary shift selector fault — a “cateye” type display may occur
23	13	Primary shift selector mode function fault. Mode change not permitted
23	14	Secondary shift selector fault — a “cateye” type display may occur
23	15	Secondary shift selector mode function fault. Mode change not permitted
23	16	Shift selector display line fault

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Paragraph 5–6.

B. Troubleshooting:

1. Clear the active indicator for code 23 XX. If code recurs, continue to Step (2).
2. Check for a poor connection at the shift selector.

NOTE: Code 23 12 can result when the +5V line (wire 124) which powers the shift selector is shorted to ground. Wire 124 also powers the TPS, OLS, RMR, retarder temperature sensor, and sump oil temperature sensor and is present in all three ECU connectors.

3. Disconnect the selector “S” harness connector from the ECU and from the shift selector and check for opens, shorts, and shorts-to-ground between the shift selector and ECU (refer to Section 4).
4. If no problem is found with the shift selector connection or wiring, replace the shift selector.
5. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 24 XX — SUMP FLUID TEMPERATURE

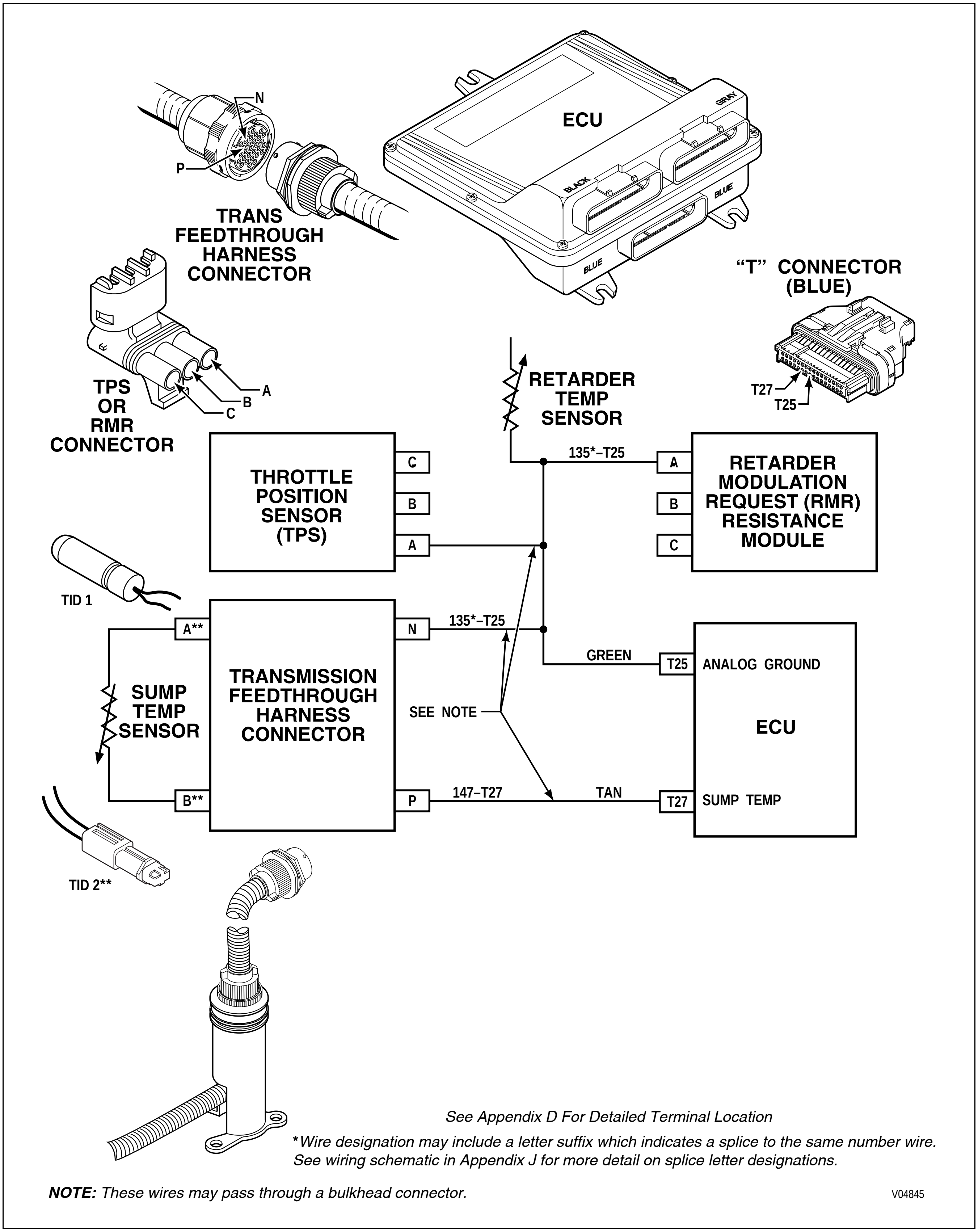


Figure 5–7. Code 24 Schematic Drawing

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figure 5–7)*

Main code 24 indicates the ECU has detected either a high or low fluid temperature in the transmission sump (via the sump temperature sensor in the internal harness). All shifts are inhibited when code 24 12 is set (only Neutral range operation is allowed). No upshifts are allowed above a calibration range when code 24 23 is set. All inhibits are cleared when the temperature conditions are normal. A related code is 33 12 which indicates a temperature reading outside the usable range of the sensor and indicates a probable sensor failure.

NOTE: When an ECU with a version 8 calibration (CIN=0A...) is used with a TransID 2 transmission, 24 XX codes are set because the ECU does not have the proper calibrations for the TID 2 thermistors. The ECU calibration must be updated to version 8A or later (CIN=0B).

Main Code	Subcode	Meaning
24	12	Sump fluid temperature cold
24	23	Sump fluid temperature hot

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check the ECU input voltage.

B. Troubleshooting:

Code 24 12:

1. If the outside temperature is between –32°C (–26°F) and –7°C (+19°F), the ECU will allow reverse, neutral, and second-range start operation. Only hold override upshifts are allowed. (See Table 6–4 on next page.) The sump must be warmed to an acceptable temperature to avoid logging codes and transmission diagnostic response.

NOTE: Code 24 12 can result when the +5V line (wire 124) which powers the sump temperature sensor is shorted to ground. Wire 124 also powers the TPS, OLS, RMR, retarder temperature sensor, and shift selectors and is present in all three ECU connectors.

2. After allowing the temperatures to normalize, if ambient temperature does not match the sump temperature reading (check using diagnostic tool), compare resistance versus sump fluid temperature. Refer to Figure 5–8 for TID 1 thermistors and Appendix Q for TID 2 thermistors. If resistance check is acceptable, then check the sensor wiring for opens, shorts, or shorts-to-ground.

3. If the sensor wiring is satisfactory, drain the fluid, remove the control module, and replace the temperature sensor.

4. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage that may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figure 5–7)*

Table 5–4. Transmission Operation as a Function of Temperature

Condition	Version 8 Software	
	°C	°F
Temperature sensor failed high (refer to code 33 23)	177	350
Hot fluid (code 24 23) adaptive turned off; maximum range limited (not limited in “emergency” calibration)	128	262
Output function “on” for sump over temp above this temperature	121	250
Output function “off” for sump over temp below this temperature	116	240
Cool/cold fluid; adaptive turned off	34	93
Turbine reasonableness and speed tie-up tests turned off	0	32
Medium cold fluid R, N, D allowed, 2nd range start (hold override upshifts only)	–7	19
All C3 Pressure Switch tests turned off	–32	–25
Temperature sensor failed low (refer to code 33 12)	–45	–49

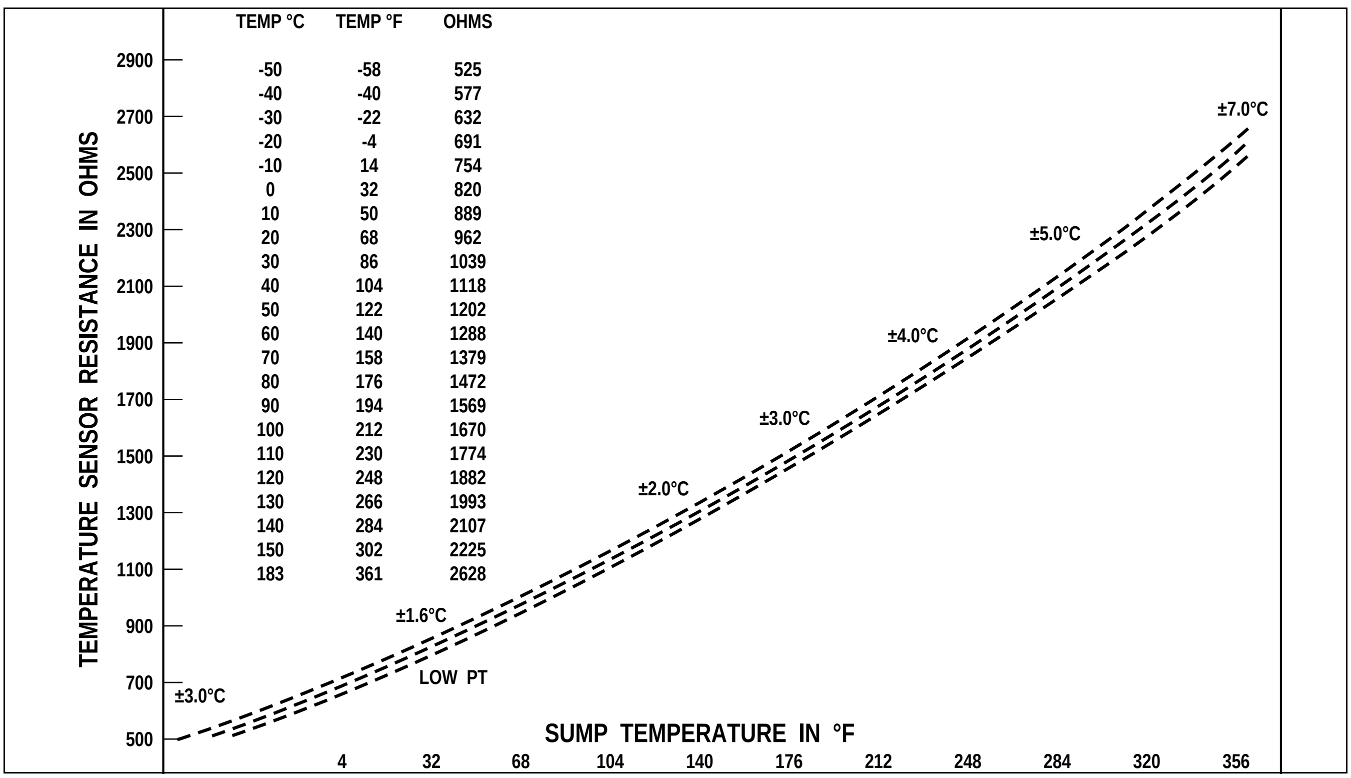


Figure 5–8. TransID 1 Temperature Sensor Chart

Code 24 23:

1. Install temperature gauges for transmission temperature and engine water temperature. Drive the vehicle. Verify that the code can be reproduced and verify the reading shown on the diagnostic tool. Observe the gauges and check for hot fluid when the code is produced.

2. If the fluid is not hot when the code is produced, remove the transmission “T” harness connector at the ECU and the transmission. Check the fluid temperature sensor wiring for opens, shorts, and shorts-to-ground. Compare the resistance readings of the sensor and the actual temperature

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figure 5–7)*

as shown on the gauge with Figure 5–8 for TID 1 thermistors and Appendix Q for TID 2 thermistors. If wiring problems or a great difference between temperature and resistance compared with the chart are found, drain the fluid, remove the control module, and replace the temperature sensor. If wiring problems are found, repair or replace as necessary.

3. If the fluid is hot when the code is produced, observe the gauges to see if the engine became hot before the transmission. If the engine cooling system is overheating and heating the transmission, the problem is with the engine or its cooling system.

4. If the transmission became hot before the engine, allow the vehicle to idle for 3–5 minutes and check the transmission fluid level. Correct the fluid level if necessary.

5. Attach pressure gauges to the cooling system (from a "to cooler" connection to a point after the cooling circuit filter) and check for pressure drop problems. If pressure drop is excessive (refer to Table 5–5), check for a plugged cooler filter, collapsed lines, obstructions, etc.

6. If the fluid level is correct and the cooling circuits satisfactory, drain the fluid, remove the control module, and inspect for damaged valve body gaskets. Replace any damaged gaskets.

7. If no problems are found in the control module area, remove the transmission and disassemble, inspecting for causes of overheating (stuck stator, plugged orifices, dragging clutches, etc.).

Table 5–5. External Hydraulic Circuit Characteristics
Basic, PTO, 93°C (200°F) Sump Temperature

HD/B 500

CONVERTER OPERATION MAXIMUM COOLER FLOW AT MINIMUM PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.22	3.4	0	0
900	0.38	6.1	0	0
1200	0.55	8.7	0	0
1500	0.80	12.7	0	0
1800	1.03	16.4	0	0
2100	1.13	18.0	0	0
2300	1.20	19.0	0	0

CONVERTER OPERATION COOLER FLOW AT MAXIMUM ALLOWABLE PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.20	3.2	31	4.5
900	0.37	5.8	63	9.1
1200	0.55	8.7	108	15.7
1500	0.77	12.2	167	24.2
1800	0.92	14.5	213	30.9
2100	0.97	15.3	238	34.5
2300	1.00	15.9	250	36.3

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figure 5–7)*

Table 5–6. External Hydraulic Circuit Characteristics
Basic, PTO, 93°C (200°F) Sump Temperature

MD/B 300/B 400

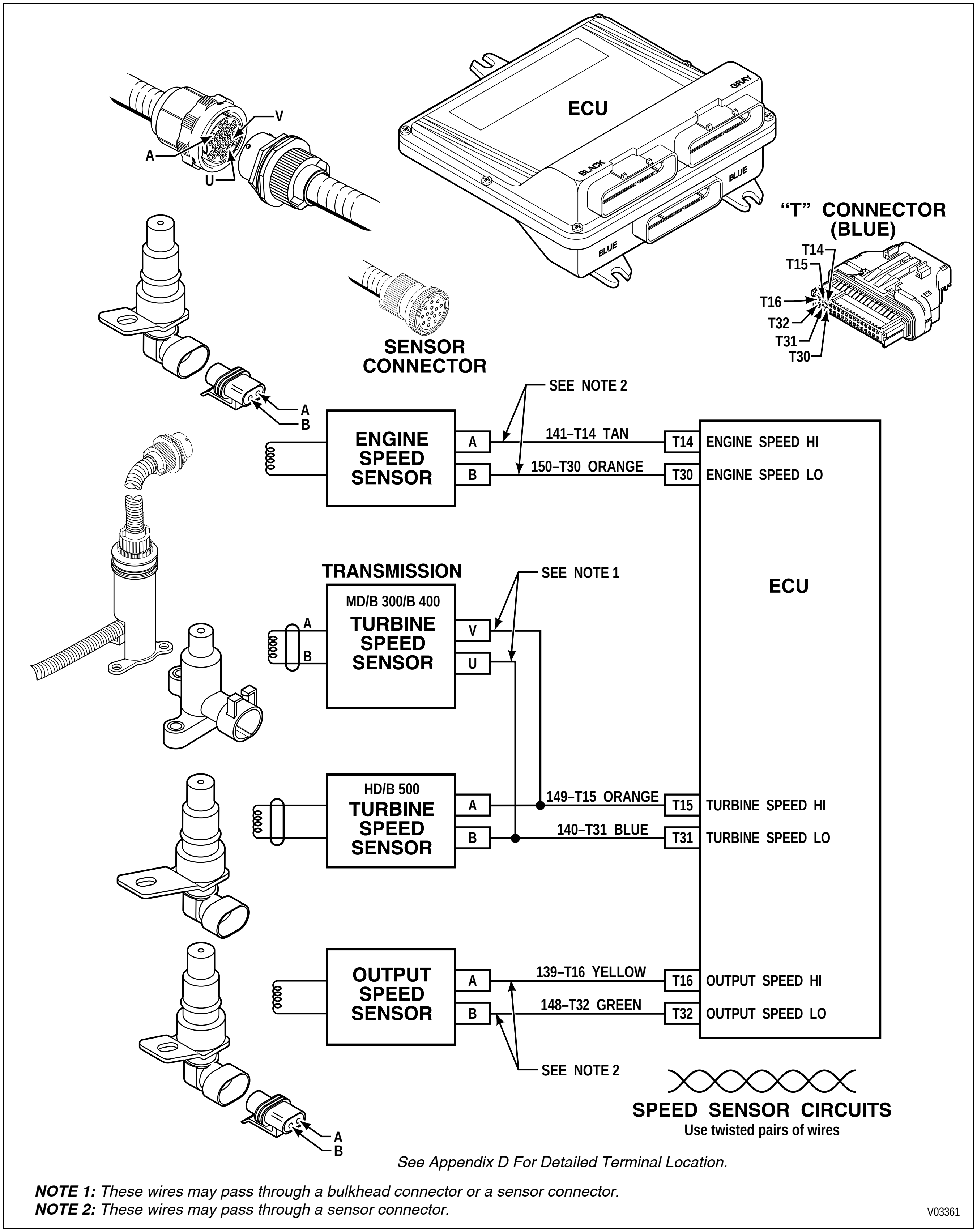
CONVERTER OPERATION MAXIMUM COOLER FLOW AT MINIMUM PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	0	0
800	0.23	3.7	0	0
1200	0.47	7.4	0	0
1400	0.61	9.7	0	0
1600	0.74	11.7	0	0
2000	0.94	14.9	0	0
2400	1.19	18.9	0	0
3200	1.28	20.3	0	0

LOCKUP OPERATION MAXIMUM COOLER FLOW AT MINIMUM PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	0	0
800	0.23	3.7	0	0
1200	0.50	7.9	0	0
1400	0.63	10.0	0	0
1600	0.77	12.2	0	0
2000	0.95	15.1	0	0
2400	1.12	17.8	0	0
2800	1.22	19.3	0	0
3200	1.28	20.3	0	0

CONVERTER OPERATION MAXIMUM ALLOWABLE PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	10	1.5
800	0.22	3.5	40	5.8
1200	0.45	7.1	159	23.1
1400	0.57	9.0	252	36.5
1600	0.67	10.6	338	49.0
2000	0.80	12.7	481	69.8
2400	0.85	13.5	549	79.6
3200	0.85	13.5	549	79.6

LOCKUP OPERATION MAXIMUM ALLOWABLE PRESSURE DROP				
Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	5	0.7
800	0.23	3.7	46	6.7
1200	0.48	7.6	148	21.5
1400	0.62	9.8	247	35.8
1600	0.73	11.6	346	50.2
2000	0.90	14.3	561	81.4
2400	1.07	17.0	737	106.9
2800	1.10	17.4	770	111.7
3200	1.10	17.4	791	114.7

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE



CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE *(Figure 5–9)*

Figure 5–9. Code 25 Schematic Drawing

Main code 25 occurs if the output speed sensor reports a zero speed reading while both engine and turbine speeds are approximately equal, turbine speed is above a calibration value, and neutral is not selected or commanded. Main code 25 indicates either the output speed sensor has failed or the required oncoming clutch or clutches did not come on. Code 25 11 can be generated by a false turbine speed reading. This may be due to crosstalk between solenoid and turbine speed sensor circuits caused by direct wire-to-wire short or by water in the electrical connectors. See Section 4 for corrective action.

NOTE: If code 25 XX is in memory at ECU initialization (ignition on), all display segments are illuminated.

Main Code	Subcode	Meaning	Applied Clutches
25	00	Output speed sensor, detected at zero speed, Low range	C3, C6
25	11	Output speed sensor, detected at zero speed, 1st range	C1, C5
25	22	Output speed sensor, detected at zero speed, 2nd range	C1, C4
25	33	Output speed sensor, detected at zero speed, 3rd range	C1, C3
25	44	Output speed sensor, detected at zero speed, 4th range	C1, C2
25	55	Output speed sensor, detected at zero speed, 5th range	C2, C3
25	66	Output speed sensor, detected at zero speed, 6th range	C2, C4
25	77	Output speed sensor, detected at zero speed, Reverse	C3, C5

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections can cause this and other codes.

B. Troubleshooting:

1. Check the transmission fluid level and ensure correct fluid level.
2. Check for the presence of code 22 16. If code 22 16 is in the code list, go to code 22 XX section and follow troubleshooting steps for code 22 16.
3. Connect the Pro-Link® 9000 with ignition on, engine off; check for indication of turbine speed. If turbine speed is indicated, refer to Paragraph 4–2 for corrective action.
4. If the output speed sensor and wiring are satisfactory, install pressure gauges into the appropriate clutch pressure taps (see Appendix B in this manual) and make the shift again. See if either of the clutches has low or no pressure. Lack of pressure in C1 in first range may be due to a G solenoid stuck closed. Lack of pressure in C5 in first range may be due to an E solenoid stuck closed.
5. If a clutch is leaking pressure, drain the fluid, remove the control module and check for damaged valve body gaskets and stuck or sticky valves. If no problems are found, replace the solenoids for the clutches used in the range indicated by the code (refer to Figure 5–1). Refer to the appropriate transmission Service Manual for replacement procedure.

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE *(Figure 5–9)*

6. If, after detecting leaking pressure and replacing solenoids, the problem persists, check for worn clutch or piston seals. Remove the transmission and repair or replace as necessary.
7. This code requires accurate output and turbine speed readings. If there were no transmission problems detected, use the diagnostic tool and watch the speed readings for noise (erratic signals) from low speed to high speed in the range indicated by the code.
8. If a noisy sensor is found, check the sensor resistance (refer to the sensor resistance chart below) and check its wiring for opens, shorts, and shorts-to-ground (see code 22 XX). Also closely check the terminals in the connectors for corrosion, contamination, or damage. Ensure the wiring to the sensors is a properly twisted wire pair. Remove sensor and check for damage at the tone wheel end. Check for looseness of the tone wheel. Replace the sensor if it is damaged or if its resistance (refer to Service Manual for proper procedure) is incorrect and isolate and repair any noted wiring problems. (Use St. Clair P/N 200153 Service Harness Twisted Pair for this procedure.)

Resistance	Temp. °C	Temp. °F
200 ¾	–40	–40
300 ¾	20	68
400 ¾	110	230

9. If no apparent cause for the code can be located, replace the turbine and output speed sensors. Refer to the appropriate transmission Service Manual for proper procedure.
10. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 26 XX — THROTTLE SOURCE/ENGINE COOLANT SOURCE NOT DETECTED

Main code 26 occurs when the ECU has not detected either a throttle source or an engine coolant source.

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Main Code	Subcode	Meaning
26	00	Throttle source not detected
26	11	Engine coolant source not detected

Code 26 00 means that the ECU has not detected the presence of engine throttle data or analog circuitry. For details about or using Pro-Link® to select a throttle source, see WTEC III Pro-Link® Manual.

Code 26 11 means that the ECU has not detected the presence of engine coolant temperature data or analog circuitry. For details about or using Pro-Link® to select an engine coolant temperature source, see WTEC III Pro-Link® Manual.

A. Active Indicator Clearing Procedure

- Power down
- Manual

B. Troubleshooting

1. When code 26 00 is logged and an analog TPS is known to be installed, refer to code 21 XX for troubleshooting steps. If a J1587 or J1939 throttle signal is used, refer to code 66 00 for troubleshooting steps.
2. When code 26 11 is logged and if an analog engine coolant temperature sensor is being used, refer to code 62 XX for troubleshooting steps. If a J1587 or J1939 engine coolant temperature signal is being used, refer to code 66 00 for troubleshooting steps.

CODE 32 XX — C3 PRESSURE SWITCH

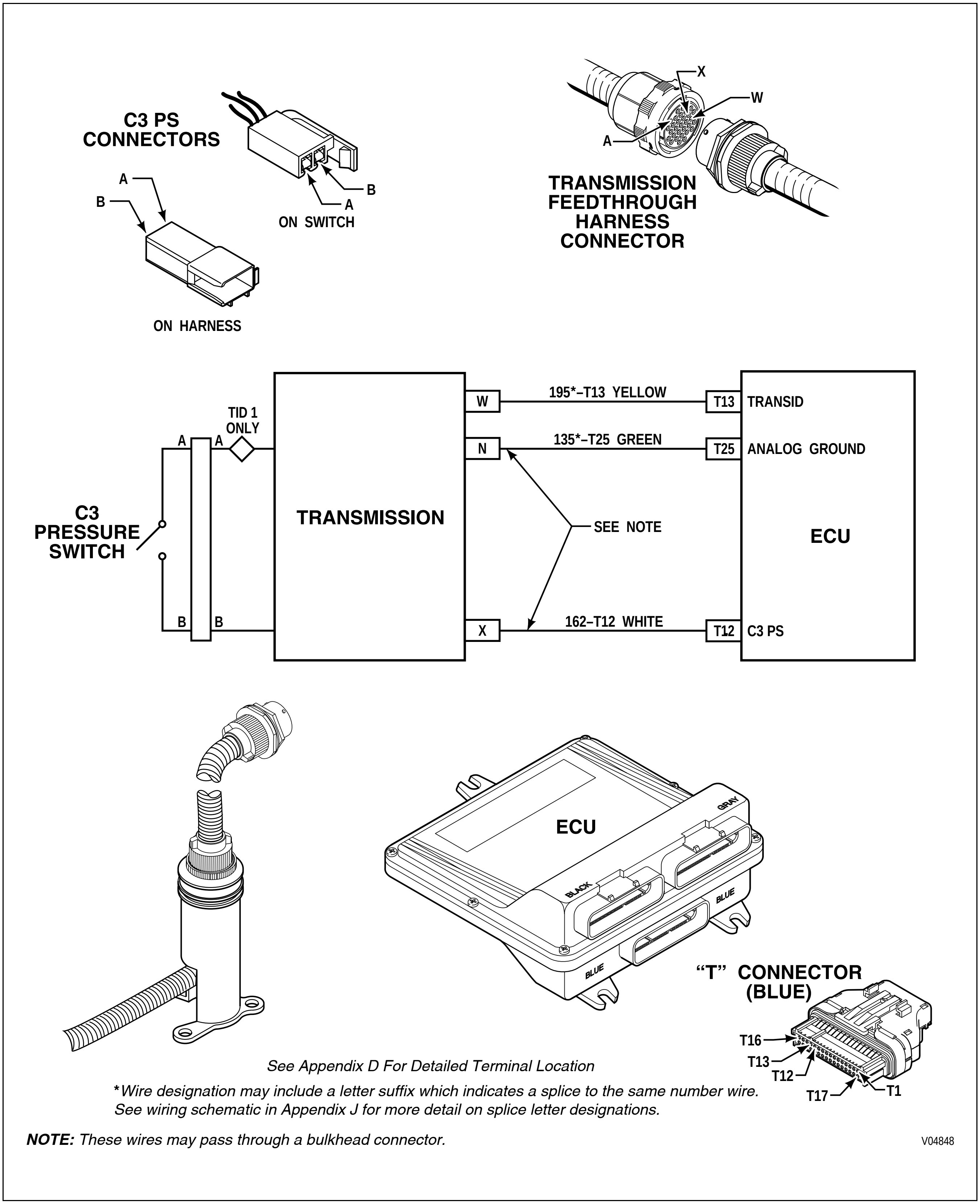


Figure 5–10. Code 32 Schematic Drawing

CODE 32 XX — C3 PRESSURE SWITCH *(Figure 5–10)*

Main code 32 indicates the transmission gear ratio is correct, but the C3 pressure switch is open when it should be closed.

NOTE: ***When an ECU with a version 8 or 8A calibration is used with a pre-TransID transmission, 32 XX codes are set because the ECU sees wire 195 is open. To correct this condition, convert to a TID 1 internal harness or install Adapter P/N 200100 available from St. Clair Technologies.***

Main Code	Subcode	Meaning
32	00	C3 switch open in low range (MD 3070 or HD 4070 only)
32	33	C3 switch open in third range
32	55	C3 switch open in fifth range
32	77	C3 switch open in reverse range

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

B. Troubleshooting:

1. Disconnect the transmission “T” harness connector at the ECU and the transmission. Check the C3 switch circuit for opens, shorts to other wires, shorts-to-ground, or short-to-battery. If wiring problems are found, isolate and repair. The C3 pressure switch closes at 206.8 ± 48 kPa (30 ± 7 psi); resistance should be 2 Ohms maximum when the switch is closed and 20,000 to infinity when the switch is open. Infinity is often indicated as OL (over limit) on a DVOM.

2. If problems are not found in the external harness, drain the fluid, remove the control module, and check the internal harness for opens, shorts between wires, or shorts-to-ground (refer to the proper transmission Service Manual). If wiring problems are found, isolate and repair.

3. If no wiring problems are found, replace the C3 pressure switch.

4. If the problem recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the C3 pressure switch circuit.

5. If the problem recurs again, replace the internal harness.

6. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR

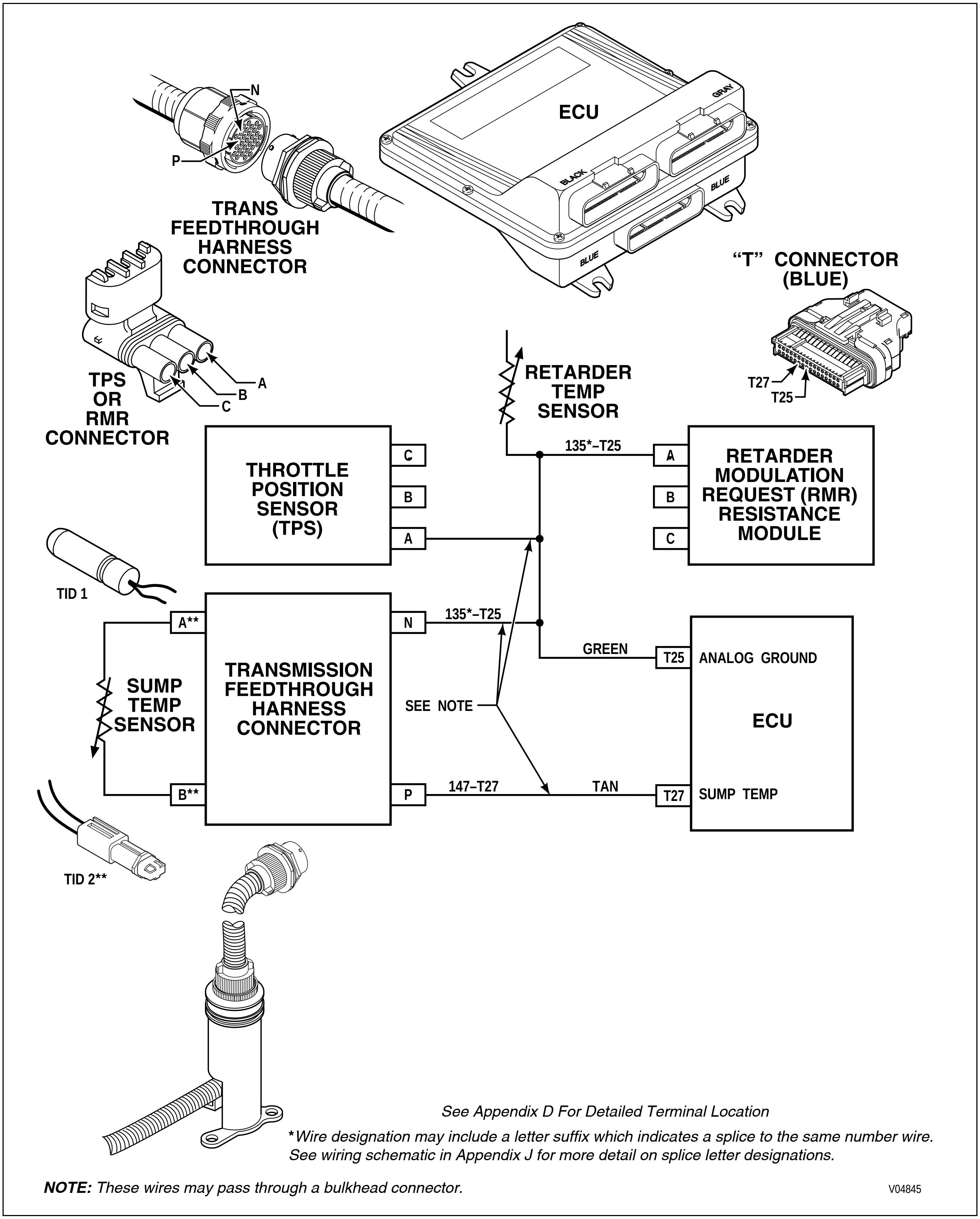


Figure 5–11. Code 33 Schematic Drawing

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR *(Figure 5–11)*

NOTE: ***When an ECU with a version 8 calibration(CIN=0A...) is used with a Trans ID 2 transmission, 33 XX codes are set because the ECU does not have the proper calibrations for the TID 2 thermistors. The ECU calibration must be updated to version 8A or later (CIN=0B...).***

Main code 33 indicates the sump temperature sensor is providing a signal outside the usable range of the ECU. This code indicates the sensor failed showing abnormally high or low temperature readings. Main code 33 can be caused by a component or circuit failure or by extremely high or low temperatures. There are no operational inhibits related to main code 33. The ECU assumes a hardware failure and that transmission temperatures are normal (93ºC; 200ºF). Temperatures above or below normal cause poor shift quality.

NOTE: ***Codeþ33 23 in conjunction with code 21þ23 indicates the loss of common ground (wire 135) between the throttle and temperature sensors.***

Main Code	Subcode	Meaning
33	12	Sump oil temperature sensor failed low
33	23	Sump oil temperature sensor failed high

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

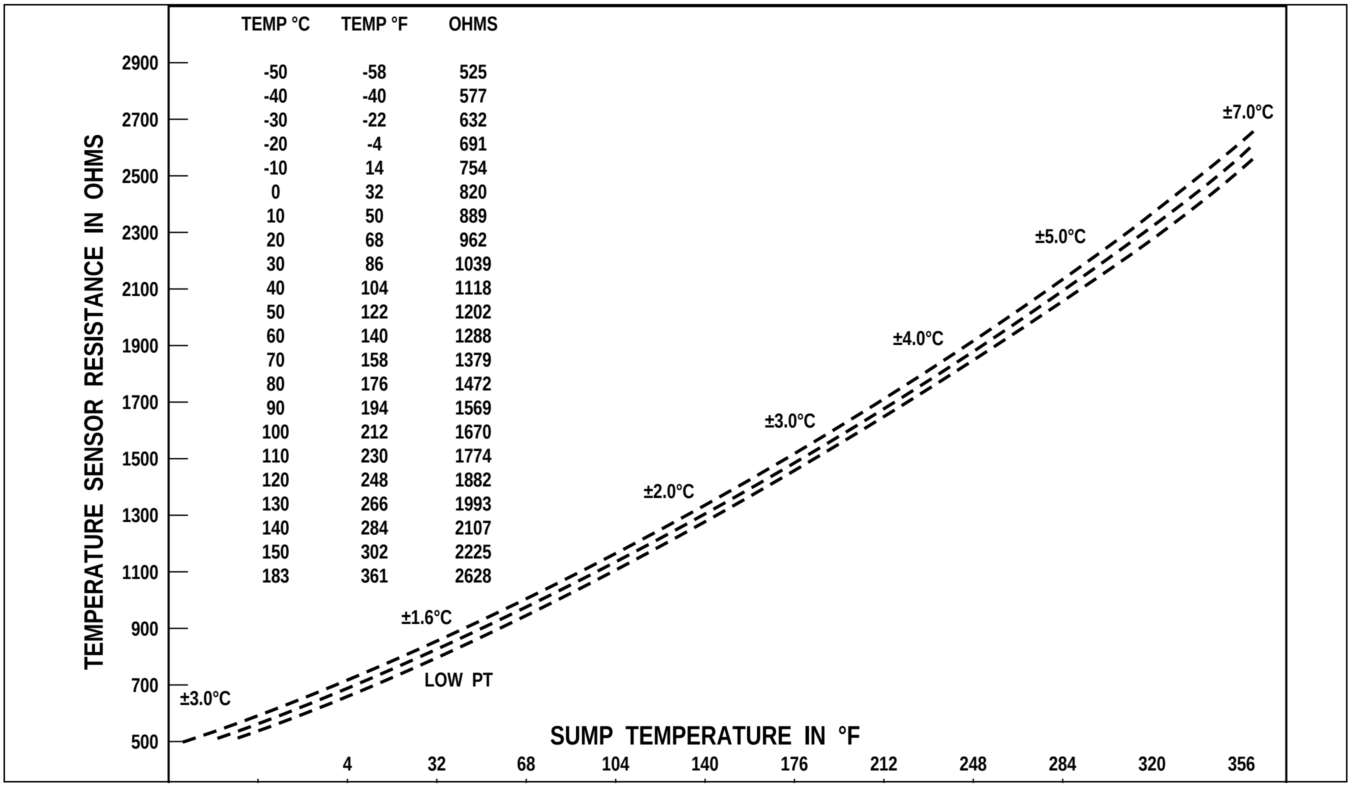
NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check the transmission fluid level.***

B. Troubleshooting:

NOTE: ***Code 33 12 can be caused when the +5V power line (wire 124) is shorted to ground or open. Wire 124 also provides power for the OLS, TPS, RMR, retarder temperature sensor, and shift selectors and is present in all three ECU connectors.***

1. If possible, check the sump temperature with a DDR. Use the fastest sample rate available on the DDR. This is necessary to catch momentary changes due to an intermittent open or short to ground. If a DDR is not available, use the shift selector display to determine if the code is active (refer to Paragraph 5–2). Disconnect the transmission “T” harness at the ECU and check resistance of the sensor and compare with Figure 6–12 for TID 1 for TID 2.
2. If Step (1) reveals that the extreme temperature indication is no longer present, the temperature limit could have been reached due to operational or ambient temperature extremes. Also, you may be experiencing an intermittent problem and the code will not be active. Proceed cautiously, it is unlikely there is a sensor hardware fault.

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR *(Figure 5–11)*



TEMP °C	TEMP °F	OHMS
-50	-58	525
-40	-40	577
-30	-22	632
-20	-4	691
-10	14	754
0	32	820
10	50	889
20	68	962
30	86	1039
40	104	1118
50	122	1202
60	140	1288
70	158	1379
80	176	1472
90	194	1569
100	212	1670
110	230	1774
120	248	1882
130	266	1993
140	284	2107
150	302	2225
183	361	2628

Figure 5–12. Temperature Sensor Chart

3. Disconnect the external harness at the transmission. Check the connectors and terminals for dirt, corrosion, or damage. Clean or replace as necessary.

4. Check the sensor wires in the external harness for opens (code 33 23), shorts between wires, or shorts-to-ground (code 33 12 — refer to Section 4). If wiring problems are found, isolate and repair.

5. If no harness problems are found, check the feedthrough harness for damage. If the feedthrough harness connector is satisfactory, drain the fluid and remove the control module. Check for chafing of the sensor wires, especially near the separator plate. Eliminate the chafe point. If no chafe point is found, replace the sensor.

6. If the problem recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the temperature sensor circuit.

7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 34 XX — CALIBRATION COMPATIBILITY OR CHECKSUM FAULT

Main code 34 indicates there is a problem with the calibration.

Main Code	Subcode	Meaning
34	12	Factory calibration compatibility number wrong
34	13	Factory calibration checksum
34	14	Power off block checksum
34	15	Diagnostic queue block checksum
34	16	Real-time block checksum
34	17	Customer modifiable constants checksum

A. Active Indicator Clearing Procedure:

- Power down

NOTE: ***Copying the current calibration from the ECU and reloading it will not correct the fault. The calibration must be downloaded directly from PCCS.***

B. Troubleshooting:

1. If the code set is 34 14 and it occurs in conjunction with code 35 00, proceed to find the cause for code 35 00 and correct it.
2. After the cause for code 35 00 has been corrected, drive the vehicle to see if code 34 14 recurs. If code 34 14 recurs, proceed to Step (3).
3. Reprogram the correct calibration. Contact your nearest Allison distributor/dealer location qualified to do recalibration. Be certain the calibration and the software level are compatible.
4. If the code recurs after reprogramming, replace the ECU.
5. If the code set is 34 17, reprogram the GPI/GPO package after re-calibration of the ECU.

CODE 35 XX — POWER INTERRUPTION

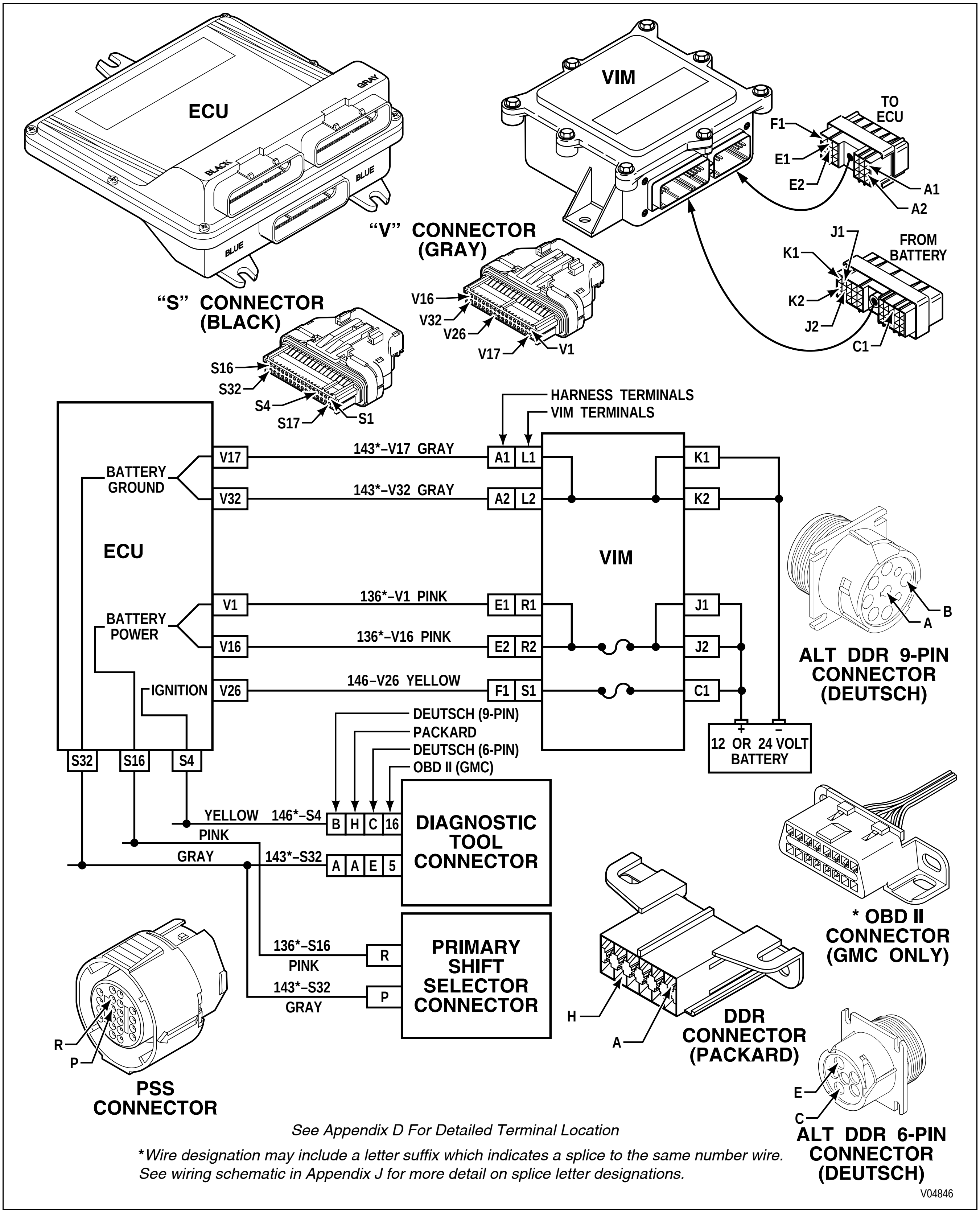


Figure 5–13. Code 35 Schematic Drawing

CODE 35 XX — POWER INTERRUPTION *(Figure 5–13)*

Main code 35 indicates the ECU has detected a complete power loss before the ignition was turned off or before ECU shutdown is completed. When this happens, the ECU is not able to save the current operating parameters in memory before turning itself off.

Main Code	Subcode	Meaning
35	00	Power interruption. (Not an active code; only appears after power is restored.) During power interruption, DNS light is not illuminated and the transmission will not shift.
35	16	Real-time write interruption. (Power interruption at the same time the ECU is recording a critical code to the real-time section.)

A. Active Indicator Clearing Procedure:

- Power down
- Manual — except code 35 16

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

B. Troubleshooting:

1. If the vehicle has a master switch controlling battery power to the ECU and an ignition switch, turning the master switch off before turning the ignition switch off can cause this code. Turning the master switch off before ECU shutdown is completed will also cause this code. No troubleshooting is necessary.

2. If improper switch sequencing is not the cause, check ECU power and ground for opens, shorts, and shorts-to-ground. Not using battery-direct power and battery ground connections can cause this code. A defective charging system, or open battery fuse or fusible link can also cause this code. The battery fuse or fusible link may be at the battery or in the VIM. Dirty, corroded, or painted power and ground connections can also cause this code.

3. If all system power and ground connections are satisfactory and the problem persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem reoccurs, reinstall the replacement ECU.

Main code 36 indicates the system has detected a mismatch between the ECU hardware and the ECU software or that there is a TransID (TID) problem.

Main Code	Subcode	Meaning
36	00	Mismatch between ECU hardware and software
36	01	TransID not compatible with hardware/software
36	02	TransID did not complete

A. Active Indicator Clearing Procedure:

- Power down

CODE 36 XX — HARDWARE AND SOFTWARE NOT COMPATIBLE

B. Troubleshooting:

1. Correction for code 36 00 requires the installation of software that is compatible with the ECU hardware involved. (If a different calibration is required, update the ECU hardware to be compatible.)
2. Correction for code 36 01 is to update the ECU calibration. Installation of the latest calibration makes the ECU compatible with the latest TransID configuration.
3. Correction for code 36 02 is to troubleshoot TransID wire 195 for short-to-battery. Codes 42 XX or 69 XX may be associated with this code.

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT

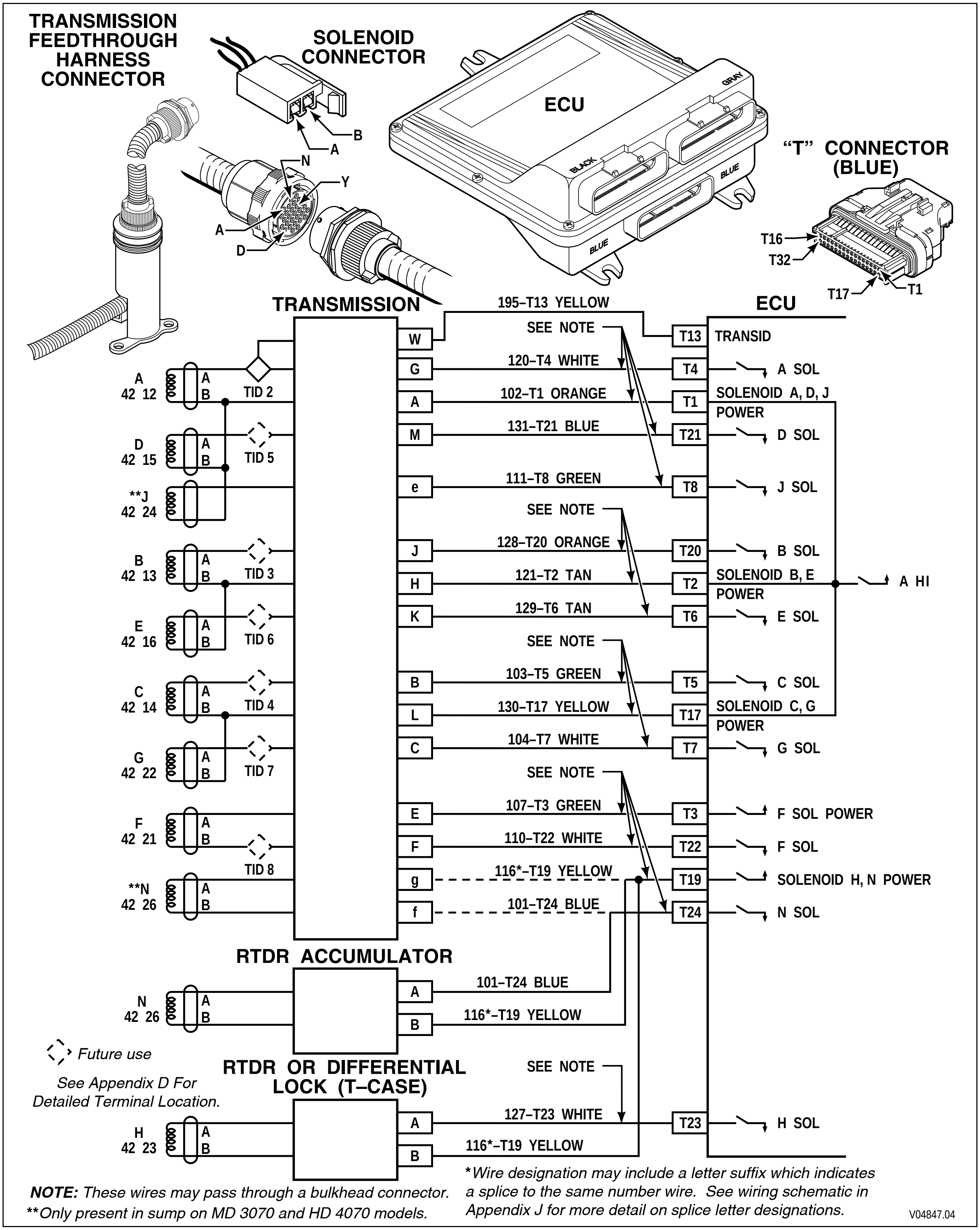


Figure 5–14. Code 42 Schematic Drawing

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT *(Figure 5–14)*

Main code 42 indicates the ECU has detected a short-to-battery condition in a solenoid wiring circuit. The **DO NOT SHIFT** response is activated when some subcodes are detected, all solenoids are turned off and the **CHECK TRANS** light is illuminated. All solenoids have a driver on the low (ground) side which can turn off the solenoid. All solenoids also have a driver on the high (power) side of the solenoid. Even though the high side driver can be turned off, a short-to-battery means the solenoid is continuously powered at an unregulated 12V or 24V instead of a regulated (pulse width modulated) voltage. The low side driver will not tolerate direct battery current and will open, causing the solenoid to be deenergized.

NOTE: ***For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable; all display segments are on if the code is logged during ECU initialization (ignition on). Subcodes 21, 23, 24, and 26 will not trigger the CHECK TRANS light.***

Main Code	Subcode	Meaning
42	12	Short-to-battery A Solenoid Circuit
42	13	Short-to-battery B Solenoid Circuit
42	14	Short-to-battery C Solenoid Circuit
42	15	Short-to-battery D Solenoid Circuit
42	16	Short-to-battery E Solenoid Circuit
42	21	Short-to-battery F Solenoid Circuit
42	22	Short-to-battery G Solenoid Circuit
42	23	Short-to-battery H Solenoid Circuit
42	24	Short-to-battery J Solenoid Circuit
42	26	Short-to-battery N Solenoid Circuit

A. Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

NOTE: ***Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.***

NOTE: ***"N" solenoid on the retarder accumulator has either a 12.5 ± 1.5 Ohm coil or a 23.5 ± 2.4 Ohm coil and is not correlated to sump temperature.***

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, the resistance of each solenoid can be measured by using a VOM. Refer to Figure 5–15 for solenoid resistance versus temperature.

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT *(Figure 5–15)*

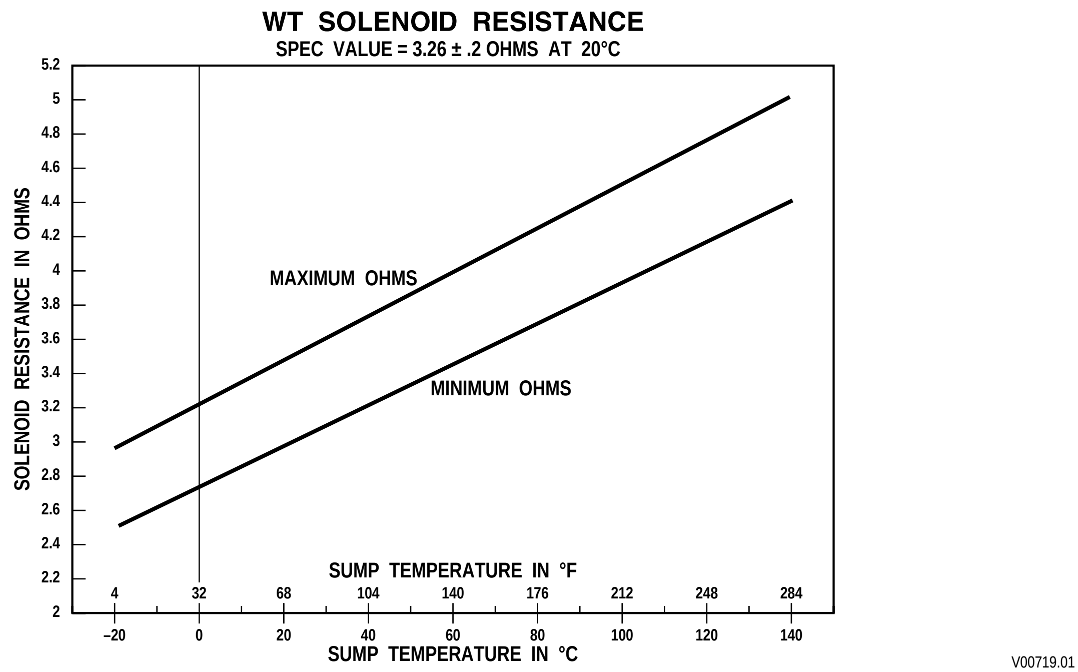


Figure 5–15. Solenoid Resistance vs. Temperature

B. Troubleshooting:

1. Make sure the transmission connector is tightly connected. If the connector is properly connected, disconnect the wiring harness at the transmission. Check the connector for corroded or damaged terminals. Clean or replace as necessary.

2. Test each solenoid circuit at the transmission connector for shorts between the solenoid circuit being diagnosed and all other terminals in the connector. This test may be simplified by using the J 41612 test tool. Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If a short is found, isolate and repair the short. The short will probably be in the internal wiring harness.

3. If multiple code 42s occur (42 12, 42 13, 42 14, 42 12, 42 16, 42 22, and 42 24), and wiring and solenoids check okay, the A-Hi driver is probably failed open.

4. Replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the problem recurs, reinstall the new ECU to complete the repair.

5. If code 42 21 occurs repeatedly and the F solenoid and wiring checks okay, the F-Hi or F-Lo driver may be failed open. Follow Step (4) above.

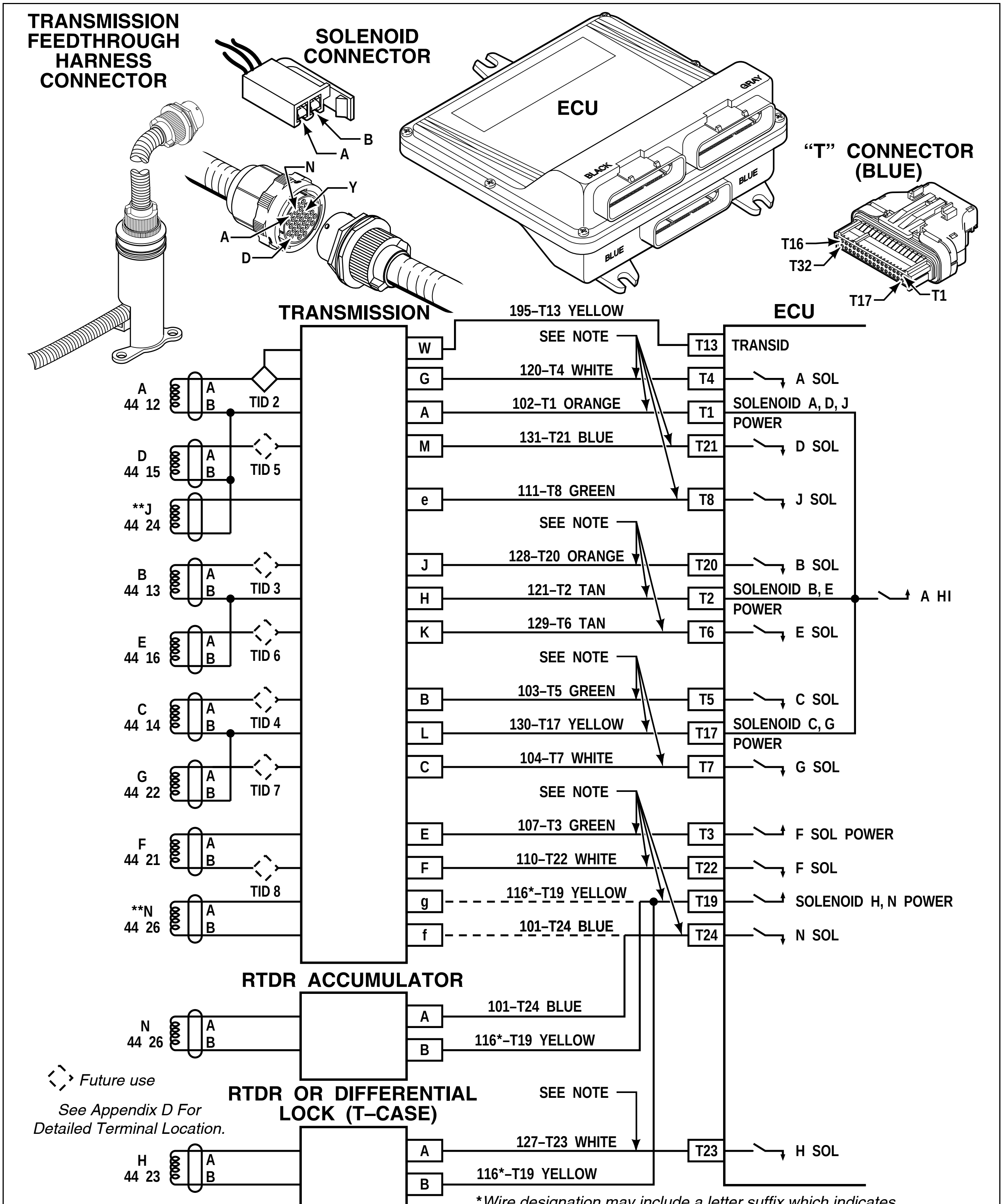
6. If codes 42 23 and 42 26 occur repeatedly and solenoids and wiring check okay, the H and N-Hi driver may be failed open. Follow Step (4) above.

7. If the short is not found at the transmission connector, disconnect the transmission “T” harness connector at the ECU and check the wires of the solenoid circuit for shorts between the solenoid wires. If the short is found in one of the wires, isolate and repair it. Use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose).

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT *(Figure 5–15)*

8. If the short is not found in either the transmission or the harness, the condition must be intermittent.
9. Drain the fluid, remove the control module and closely inspect the internal harness for damage. Repair or replace as necessary.
10. If the condition recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the solenoid circuit indicated by the trouble code.
11. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
***Only present in sump on MD 3070 and HD 4070 models.*

**Wire designation may include a letter suffix which indicates a splice to the same number wire. See wiring schematic in Appendix J for more detail on splice letter designations.*

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT *(Figure 5–16)*

Figure 5–16. Code 44 Schematic Drawing

Main code 44 indicates the ECU has detected a short-to-ground in a solenoid or its wiring. The **DO NOT SHIFT** response is activated when some subcodes are detected, all solenoids are turned off, and the **CHECK TRANS** light is illuminated.

NOTE: For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable. Subcodes 21, 23, 24, and 26 do not trigger the CHECK TRANS light.

Main Code	Subcode	Meaning
44	12	Short-to-ground A Solenoid Circuit
44	13	Short-to-ground B Solenoid Circuit
44	14	Short-to-ground C Solenoid Circuit
44	15	Short-to-ground D Solenoid Circuit
44	16	Short-to-ground E Solenoid Circuit
44	21	Short-to-ground F Solenoid Circuit
44	22	Short-to-ground G Solenoid Circuit
44	23	Short-to-ground H Solenoid Circuit
44	24	Short-to-ground J Solenoid Circuit
44	26	Short-to-ground N Solenoid Circuit

A. Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, the resistance of each solenoid can be checked using a VOM. Refer to Figure 5–17 for resistance values versus temperature.

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT *(Figure 5–17)*

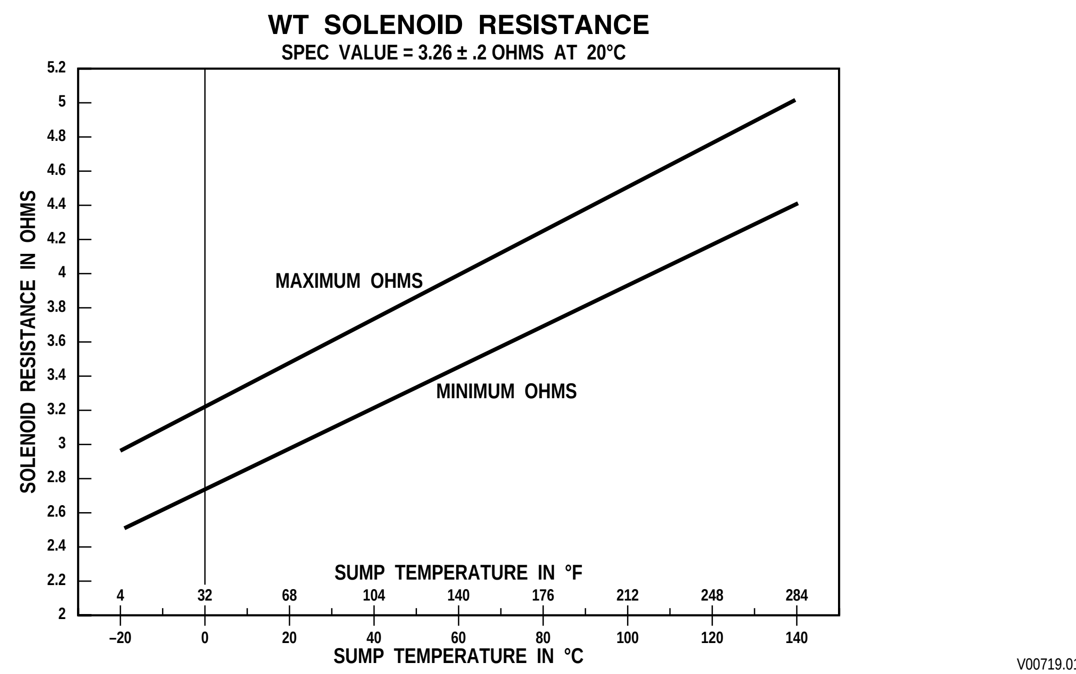


Figure 5–17. Solenoid Resistance vs. Temperature

B. Troubleshooting:

1. Check the transmission connector and make sure it is tightly connected. If the connector is properly connected, disconnect the harness at the transmission and inspect the terminals in the transmission harness and feedthrough harness connectors. Clean or replace as necessary (Appendix D).

2. If the connector is connected, clean, and not damaged, check the solenoid circuit in the transmission for shorts to other wires. (Tool J 41612 may be useful in making this test.) Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If the short circuit is found, drain the fluid, remove the control module (refer to the transmission Service Manual), and isolate the short. The short is probably in the feedthrough harness, or the solenoid itself (refer to Figure 5–1 for solenoid locations).

3. If the short is not found in the transmission, disconnect the transmission harness connector at the ECU and inspect the terminals for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, check the wires of the solenoid circuit in the transmission harness for shorts-to-ground or shorts between wires. If a short is found in one of the wires, isolate and repair it or use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) in the external harness. Refer to Appendix E for connector/terminal repair information.

4. If the short is not found in either the transmission or the harness, the condition must be intermittent.

5. Drain the fluid, remove the control module, and closely inspect the solenoid and internal harness for damage. Repair or replace as necessary.

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT *(Figure 5–17)*

6. If the condition recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the solenoid circuit indicated by the diagnostic code.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT

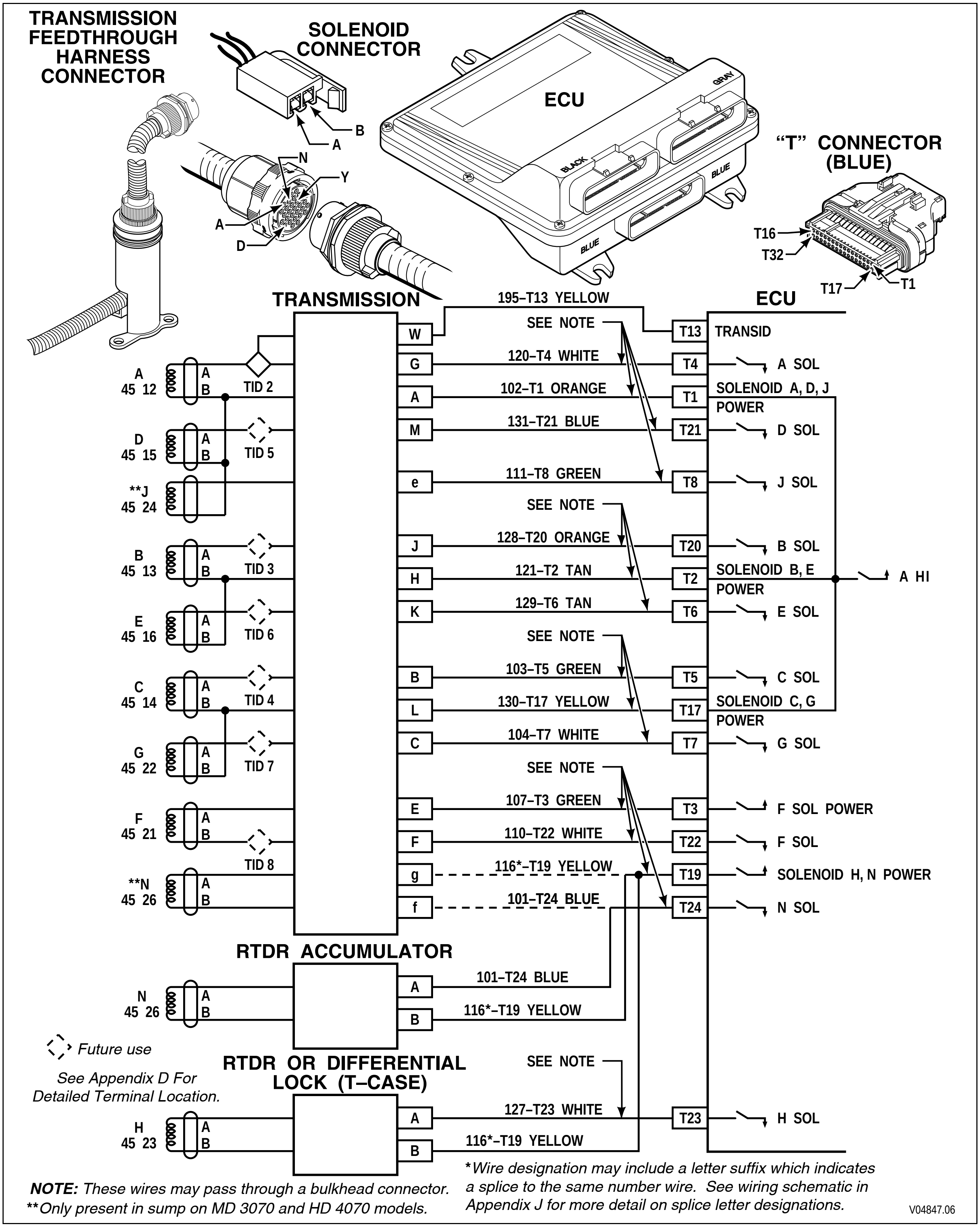


Figure 5–18. Code 45 Schematic Drawing

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT *(Figure 5–18)*

Main code 45 indicates the ECU has detected either an open circuit condition in a solenoid coil or the wiring to that solenoid. The **DO NOT SHIFT** response is activated when some subcodes are detected, all solenoids are turned off, and the **CHECK TRANS** light is illuminated.

Main Code	Subcode	Meaning
45	12	Open Circuit A Solenoid Circuit
45	13	Open Circuit B Solenoid Circuit
45	14	Open Circuit C Solenoid Circuit
45	15	Open Circuit D Solenoid Circuit
45	16	Open Circuit E Solenoid Circuit
45	21	Open Circuit F Solenoid Circuit
45	22	Open Circuit G Solenoid Circuit
45	23	Open Circuit H Solenoid Circuit
45	24	Open Circuit J Solenoid Circuit
45	26	Open Circuit N Solenoid Circuit

A. Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, the resistance of each solenoid can be checked using a VOM. Refer to Figure 5–19 for solenoid resistance values versus temperature.

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT *(Figure 5–19)*

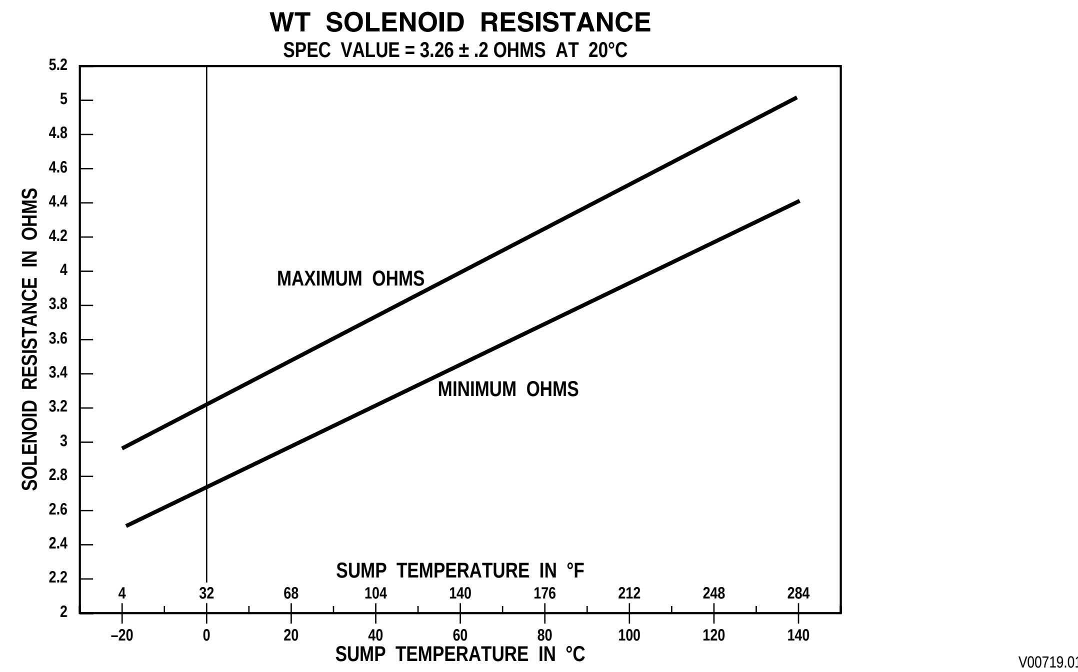


Figure 5–19. Solenoid Resistance vs. Temperature

B. Troubleshooting:

1. Check the transmission connector and make sure it is tightly connected. If the connector is properly connected, disconnect the harness at the feedthrough harness connector and check the terminals in the transmission harness and feedthrough harness connectors.

2. If the connector is connected, clean, and not damaged, check the solenoid circuit in the transmission for opens. Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If the open circuit is found, drain the fluid, remove the control module (see the transmission Service Manual), and isolate the open. The fault will be in the feedthrough harness or the solenoid itself (see Figure 5–1 for solenoid locations).

3. If the open is not found at the transmission connector, disconnect the transmission harness connector at the ECU and inspect the terminals in the connector and the ECU for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, check the wires of the solenoid circuit in the transmission harness for continuity. If the open is found in one of the wires, isolate and repair it. If this is not feasible, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose).

4. If multiple code 45s occur (45 12, 45 13, 45 14, 45 15, 45 16, 45 22, and 45 24), and wiring and solenoids check okay, the A-Hi driver is probably failed open.

5. Replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the problem recurs, reinstall the new ECU to complete the repair.

6. If code 45 21 occurs repeatedly and the F solenoid and wiring checks okay, the F-Hi or F-Lo driver may be failed open. Follow Step (5) above.

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT *(Figure 5–19)*

7. If codes 45 23 and 45 26 occur repeatedly and solenoids and wiring check okay, the H and N-Hi driver may be failed open. Follow Step (5) above.

8. If the open is not found in either the transmission or the harness or the ECU drivers, the condition must be intermittent.

9. Drain the fluid, remove the control module, and closely inspect the solenoid and internal harness for damage. Repair or replace as necessary.

10. If the condition recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the solenoid circuit indicated by the diagnostic code.

11. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 46 XX — OVERCURRENT TO SOLENOIDS

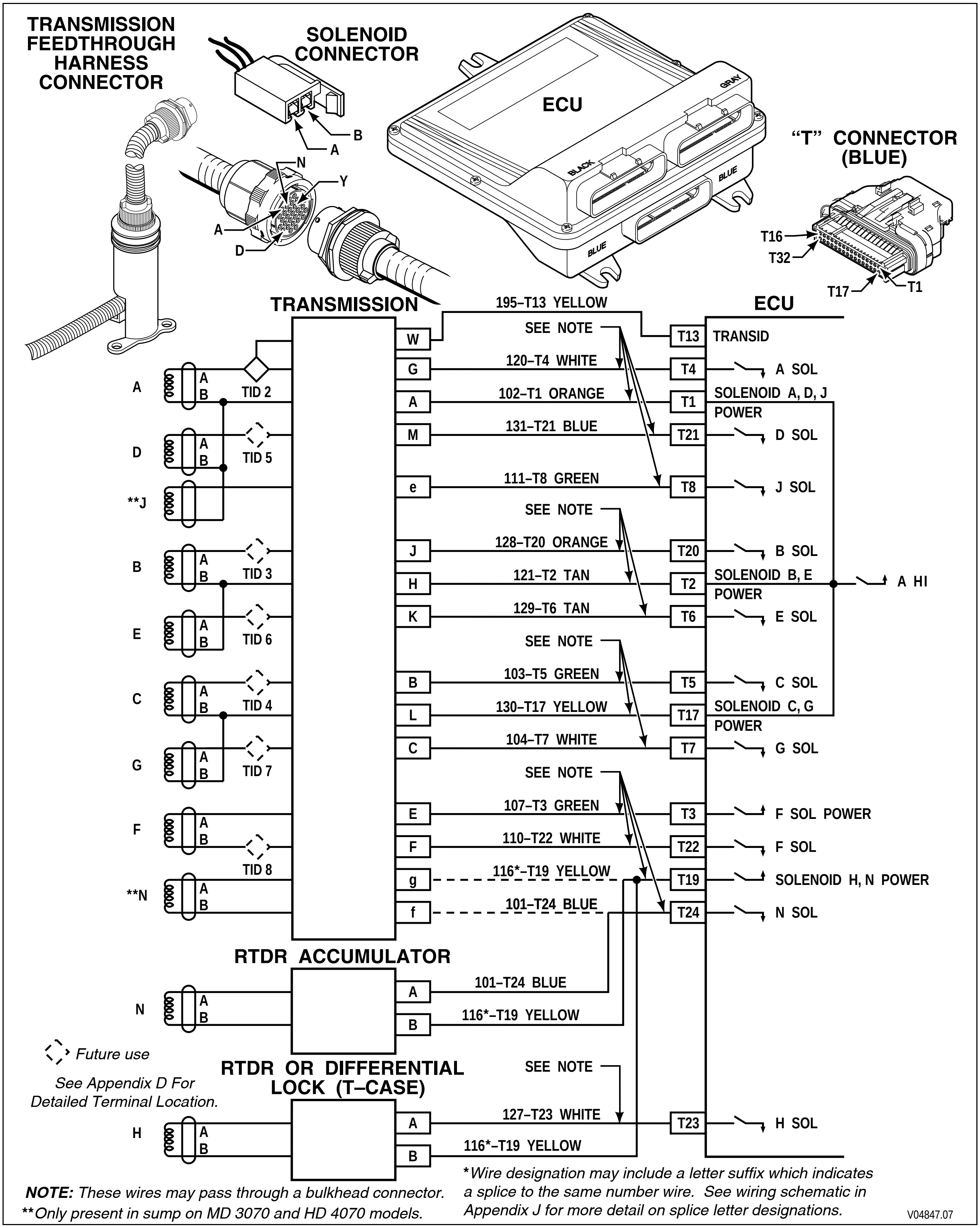


Figure 5–20. Code 46 Schematic Drawing

CODE 46 XX — OVERCURRENT TO SOLENOIDS *(Figure 5–20)*

Main code 46 indicates that an overcurrent condition exists in one of the switches sending power to the transmission control solenoids.

Main Code	Subcode	Meaning
46	21	Overcurrent, F-High solenoid circuit
46	26	Overcurrent, N and H-High solenoid circuit
46	27	Overcurrent, A-High solenoid circuit

A. Active Indicator Clearing Procedure:

- Power down
- Manual

B. Troubleshooting:

1. Probable cause is a wiring problem. A solenoid wire is probably shorted to ground or the solenoid has a shorted coil which would cause an overcurrent condition. May also be an ECU problem.
2. Follow the troubleshooting steps for code 44 XX.

CODE 51 XX — OFFGOING RATIO TEST DURING SHIFT (TIE-UP TEST)

Main code 51 indicates a failed offgoing ratio test. An offgoing ratio test occurs during a shift and uses turbine and output speed sensor readings to calculate the ratio between them. The calculated speed sensor ratio is then compared to the programmed speed sensor ratio of the commanded range. After a shift is commanded, the ECU, after a period of time, expects the old ratio to be gone. If the ratio does not change properly, the ECU assumes the offgoing clutch did not release. The shift is retried if conditions still exist to schedule the shift. If the second shift is not successfully completed, code 51 XX is set and the ECU returns the transmission to the previous range. Additional codes could be logged for other shifts where “X” indicates the range from and “Y” indicates the range to.

NOTE: This test is not performed below a calibrated transmission output speed of 200 rpm.

Main Code	Subcode	Meaning
51	01	Low–1 upshift
51	10	1–Low downshift
51	12	1–2 upshift
51	21	2–1 downshift
51	23	2–3 upshift
51	24	2–4 upshift
51	35	3–5 upshift
51	42	4–2 downshift
51	43	4–3 downshift
51	45	4–5 upshift
51	46	4–6 upshift
51	53	5–3 downshift
51	64	6–4 downshift
51	65	6–5 downshift
51	XY	X–Y upshift or downshift

A. Active Indicator Clearing Procedure:

- Power down
- Manual — except subcodes 35, 42, 43, 45, 53

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

B. Troubleshooting:

1. Incorrect fluid level can cause 51 series codes. Allow the vehicle to idle for 3–4 minutes and check the transmission fluid level. If level is not correct, add or drain fluid to correct level.

2. If the fluid level is correct, connect a pressure gauge into the pressure tap for the offgoing clutch indicated by the code (refer to solenoid and clutch chart, Appendix C). Make the shift indicated by the subcode or use the Pro-Link® diagnostic tool clutch test mode to put the transmission in the off-going and oncoming ranges (refer to Appendix B for clutch pressure check information).

CODE 51 XX — OFFGOING RATIO TEST DURING SHIFT (TIE-UP TEST)

3. If the offgoing clutch stays pressurized, drain the fluid, remove the control module, disassemble the control module and clean it, inspecting for damaged valve body gaskets and stuck or sticky valves. Inspect the transmission for signs of clutch damage indicating the need to remove and overhaul the transmission.
4. If the problem has not been isolated, replace the solenoid for the offgoing clutch.
5. If after replacing the solenoid the problem persists, install another ECU. If this corrects the problem, temporarily reinstall the old ECU to verify the repair.
6. If this does not correct the problem, reinstall the original ECU and check for mechanical problems. The clutch may be mechanically held (coned, burned and welded, etc.). It may be necessary to remove the transmission and repair or rebuild as required.

CODE 52 XX — OFFGOING C3 PRESSURE SWITCH TEST DURING SHIFT

Main code 52 indicates a failed C3 pressure switch test. When a shift is commanded and C3 is the offgoing clutch, the ECU expects the C3 pressure switch to open within a period of time after the shift is commanded. If the ECU does not see the switch open, it assumes C3 has not released. If conditions for a shift exist, the shift is retried. If the C3 pressure switch still remains closed, the code is logged and the **DO NOT SHIFT** response is commanded. If the code is set during a direction change, neutral with no clutches is commanded, otherwise the transmission is commanded to the previous range. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: C3 tests are turned off below a calibrated temperature of –32ºC (–25°F).

Main Code	Subcode	Meaning
52	01	L–1 upshift
52	08	L–N1 shift
52	32	3–2 downshift
52	34	3–4 upshift
52	54	5–4 downshift
52	56	5–6 upshift
52	71	R–1 shift
52	72	R–2 shift
52	78	R–N1 shift
52	79	R–2 shift (R to NNC to 2)
52	99	N3–N2 shift
52	XY	X–Y shift

A. Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

B. Troubleshooting:

1. Use the Pro-Link® diagnostic tool to check the state of the C3 pressure switch.
2. Check the C3 pressure switch wiring for a short-to-ground or a switch stuck closed (refer to code 32 XX). If a short is found, isolate and repair; or replace the switch if it is stuck closed.
3. If a fault is not found with the C3 pressure switch or circuitry, connect a pressure gauge to the C3 pressure tap.
4. Drive the vehicle to make the shift indicated by the subcode or use the DDR clutch test mode. Compare actual C3 pressure value with the table of specifications in Appendix B.

CODE 52 XX — OFFGOING C3 PRESSURE SWITCH TEST DURING SHIFT

5. If C3 is being held on hydraulically (C3 remains pressurized), drain the fluid, remove the control module, disassemble and clean the control module, checking for damaged valve body gaskets or stuck and sticky valves.
6. If the problem recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the C3 pressure switch in the external harness.
7. If the problem again recurs, replace the C solenoid.
8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 53 XX — OFFGOING SPEED TEST (DURING SHIFT)

Main code 53 indicates a failed offgoing speed test. The speed test during a shift is designed to ensure neutral is attained during shifts to neutral. This test compares engine speed to turbine speed. If neutral is selected and turbine speed is found to be much lower than engine speed, the ECU sees this as neutral not being attained. The transmission is commanded to Neutral with No Clutches and code 53 XX is set. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: This test is not performed if neutral output is below 200 rpm or when temperatures are below a calibrated 0°C (32°F).

Main Code	Subcode	Meaning
53	08	L–N1 shift
53	18	1–N1 shift
53	28	2–N1 shift
53	29	2–N2 shift
53	38	3–N1 shift
53	39	3–N3 shift
53	48	4–N1 shift
53	49	4–N3 shift
53	58	5–N1 shift
53	59	5–N3 shift
53	68	6–N1 shift
53	69	6–N4 shift
53	78	R–N1 shift
53	99	N3–N2 or N2–N3 shift
53	XY	X–Y shift

A. Active Indicator Clearing Procedure:

- Power down
- Manual — subcodes 78 and 99 only

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

B. Troubleshooting:

1. Be sure the transmission is warm and the fluid level is correct. Correct transmission fluid level as necessary.

2. Using the DDR, check the engine and turbine speed sensor signals under steady conditions. If a tachometer is available, compare the tachometer reading with the engine rpm reading on the diagnostic tool. Check signals in neutral, at idle, high idle, and maximum no load rpm. If a signal is erratic, check sensor wiring for opens, shorts, and shorts-to-ground (refer to code 22þXX). Check all connections for dirt and corrosion. If wiring problems are found, repair or replace as necessary.

CODE 53 XX — OFFGOING SPEED TEST (DURING SHIFT)

3. If fluid and wiring are satisfactory, install a pressure gauge in the pressure tap for the offgoing clutch. Make the shift indicated by the subcode using the clutch test mode of the Pro-Link® diagnostic tool. If the pressure gauge shows clutch pressure (above 55 kPa or 8 psi) remains in the offgoing clutch, drain the fluid and remove the control module (see the transmission Service Manual). Disassemble and clean the control module and check for damaged valve body gaskets and stuck or sticky valves, particularly latch valves and solenoid second-stage valves.
4. If excessive clutch pressure is not remaining in the offgoing clutch, replace the engine speed sensor and the turbine speed sensor.
5. If the control module is removed to replace the turbine speed sensor (MD, B 300, B 400), clean the control module and inspect for stuck or sticky valves (particularly the latch valves and solenoid G second stage valve). Check the rotating clutch drum to which the turbine speed sensor is directed for damage, contamination, or signs of contact between the drum and the sensor.
6. If the problem recurs, replace the solenoid(s) for the offgoing clutch(es).
7. If the problem again recurs, the offgoing clutch must be held on mechanically (coned, burned, etc.). Remove the transmission and repair or rebuild as necessary.
8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 54 XX — ONCOMING SPEED TEST (AFTER SHIFT)

Main code 54 indicates a failed oncoming ratio test. The ratio test after a shift is failed when the ECU has commanded the end of a shift and has not seen the transmission shift into the target range (comparing turbine and output speeds). Erratic readings from speed sensors are a likely cause of an oncoming ratio test failure. If conditions for a shift still exist, the shift will be retried one more time. If the ratio test is still not met, a code is logged and the **DO NOT SHIFT** response is commanded. If the code is set during a direction change, Neutral with No Clutches is commanded, otherwise the transmission is commanded to the previous range. **Code 54 12 can also be caused by the ECU being calibrated for a close ratio transmission and installed with a wide ratio transmission, or vice versa.** Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: This test is not performed below a calibrated transmission output speed of 200 rpm.

Main Code	Subcode	Meaning
54	01	L–1 upshift
54	07	L–R shift
54	10	1–L downshift
54	12	1–2 upshift — incorrect calibration, wide ratio vs. close ratio
54	17	1–R shift
54	21	2–1 downshift
54	23	2–3 upshift
54	24	2–4 upshift
54	27	2–R shift
54	32	3–2 downshift
54	34	3–4 upshift
54	35	3–5 upshift
54	42	4–2 downshift
54	43	4–3 downshift
54	45	4–5 upshift
54	46	4–6 downshift
54	53	5–3 downshift
54	54	5–4 downshift
54	56	5–6 upshift
54	64	6–4 downshift
54	65	6–5 downshift
54	70	R–L shift
54	71	R–1 shift
54	72	R–2 shift
54	80	N1–L shift
54	81	N1–1 shift
54	82	N1–2 shift
54	83	N1–3 shift
54	85	N1–5 shift
54	86	N1–6 shift
54	92	N2–2 shift
54	93	N3–3 shift
54	95	N3–5 shift
54	96	N4–6 shift
54	XY	X to Y shift

CODE 54 XX — ONCOMING SPEED TEST (AFTER SHIFT)

A. Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

B. Troubleshooting:

1. After the transmission is at operating temperature, allow the vehicle to idle on level ground for 3–4 minutes. Check transmission fluid level. If improper fluid level is found, correct as necessary. Improper fluid level could be the cause of the code (not enough or too much fluid may produce inadequate clutch pressure).

2. Connect a pressure gauge and check main pressure. If pressure is not adequate, the pump is possibly worn. See Appendix B for main pressure specifications.

3. If the fluid level is correct, check the turbine and output speed sensors for accurate, steady signals using the diagnostic tool (check with vehicle stopped and in range to confirm a zero speed reading from the turbine and output speed sensors). Check the wiring for opens and shorts (refer to code 22 XX) and the sensor coils for proper resistance. If problems are found, repair or replace as necessary. Remove speed sensor and check for loose tone wheel.

4. If sensor and wiring resistance are acceptable, connect a pressure gauge(s) to the pressure tap for the oncoming clutches indicated by the subcode (refer to solenoid and clutch chart in Appendix C). Make the shift indicated by the code by operating the vehicle or by using the diagnostic tool's clutch test mode.

5. If the clutch pressure does not show on the gauge(s), the control module is probably not commanding the clutch on. Drain the fluid and remove the control module. Disassemble and clean the control module, inspect for stuck or sticking valves.

6. Internal leakage is indicated by the clutch pressure gauge showing that pressure is being sent to the clutch but the clutch fails to hold. The fault may be: missing or damaged face seals, burnt clutch, leaking piston sealrings, or damaged control module gaskets. Drain the fluid, remove the control module, and inspect the face seals and control module gaskets. If the seals and gaskets are satisfactory, replace the solenoid(s) indicated by the code. If replacing the solenoid does not eliminate the code, remove the transmission and repair as necessary.

7. If clutch pressures are correct and the clutch appears to be holding, replace the output and turbine speed sensors.

8. If the problem recurs, use the diagnostic tool to check the speed sensor signals for erratic readings. Possible causes of erratic speed readings are: loose sensors, intermittent contact in the wiring, vehicle-induced vibrations, or speed sensor wiring that is not a properly twisted-pair. If necessary, use a twisted-pair for a new speed sensor circuit — Service Harness Twisted Pair P/N 200153 is available from St. Clair Technologies for this purpose.

9. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 55 XX — ONCOMING C3 PRESSURE SWITCH (AFTER SHIFT)

Main code 55 indicates the C3 clutch is the oncoming clutch in a shift and the C3 pressure switch did not close at the end of the shift. When this code is set, the **DO NOT SHIFT** response and **Neutral with No Clutches** is commanded. On the N1 to R shift the transmission is commanded to the previous range. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: ***When an ECU with a version 8 or 8A calibration is used with a pre-TransID transmission, 55 XX codes are set because the ECU sees wire 195 is open. To correct this condition, convert to a TID 1 internal harness or install Adapter P/N 200100 available from St. Clair Technologies.***

Main Code	Subcode	Meaning
55	07*	Oncoming C3PS (after shift), L–R shift
55	17*	Oncoming C3PS (after shift), 1–R shift
55	27*	Oncoming C3PS (after shift), 2–R shift
55	87	Oncoming C3PS (after shift), N1–R shift
55	97	Oncoming C3PS (after shift), N1–L to R shift
55	XY	Oncoming C3PS (after shift), X to Y shift

****NOTE:*** ***When sump temperature is below 10°C (50°F), and transmission fluid is C4 (not DEXRON®), follow this procedure when making directional change shifts:***

- ***To shift from forward to reverse; select N (Neutral) and then R (Reverse).***
- ***Failure to follow this procedure may cause illumination of the CHECK TRANS light and then transmission operation will be restricted to N (Neutral).***

A. Active Indicator Clearing Procedure:

- Power down
- Manual — subcode 87 only

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Check battery and ECU input voltages before troubleshooting.***

B. Troubleshooting:

NOTE: ***Do not bring the transmission to operating temperature if the problem occurs at sump temperatures below that level. Do troubleshooting at the temperature level where the problem occurs.***

1. After the transmission is at operating temperature, allow vehicle engine to idle on level ground for 3–4 minutes. Check transmission fluid level. If improper fluid level is found, correct as necessary. Improper fluid level could be the cause of the code (not enough or too much fluid may produce inadequate clutch pressure).

2. Connect a pressure gauge and check main pressure. If pressure is not adequate, the pump is possibly worn. See Appendix B for main pressure specifications.

CODE 55 XX — ONCOMING C3 PRESSURE SWITCH (AFTER SHIFT)

3. If fluid level and main pressure are adequate, connect a pressure gauge to the C3 pressure tap on the transmission and make the shift indicated by operating the vehicle using the Pro-Link® diagnostic tool's CLUTCH TEST MODE.

NOTE: ***When using the CLUTCH TEST MODE on the Pro-Link®, be sure to use the correct pressure specification. If testing is done with the vehicle stopped, the lockup clutch is not applied, so use the clutch pressure specification for converter operation (see Appendix B; pressure in 3C would be the same as in 2C). If testing is done with the vehicle moving, the lockup clutch may be applied depending upon the vehicle speed and throttle position. Be sure to use the clutch pressure specification for lockup operation (see Appendix B).***

4. If, when making the shift and producing the code, the C3 clutch does not show any pressure, drain the fluid and remove the control module. Disassemble, clean, and inspect the control module for stuck or sticky valves (particularly the "C" solenoid second stage valve and C-1 latch valve). If no obvious problems are found, replace the "C" solenoid and reassemble (see Figure 5–1 for location of the "C" solenoid).
5. If the gauge shows inadequate pressure being sent to the clutch, the clutch is probably worn, has leaking piston or face seals, or the control module gaskets are damaged. See Appendix B for clutch pressure specification. Drain the fluid, remove the control module and inspect the face seals and valve body gaskets. If the face seals or control module gaskets are not damaged, remove and repair the transmission (refer to the transmission Service Manual for repair procedure).
6. If the gauge shows adequate clutch apply pressure, the problem is with the C3 pressure switch or its wires. Check the C3 pressure switch wires in the transmission harness for opens, shorts, or shorts-to-ground (see code 32þXX). If found, isolate and repair the C3 pressure switch circuit.

NOTE: ***A leakage problem may be temperature related. Be sure to check pressures at the sump temperature where the problem occurred.***

7. If the problem is not in the transmission harness, drain the fluid and remove the control module. Check the feedthrough harness assembly for opens. If wiring problems are found, repair as necessary. If no wiring problems are found, replace the C3 pressure switch (see Figure 5–1 for the location).
8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 56 XX — RANGE VERIFICATION RATIO TEST (BETWEEN SHIFTS)

Main code 56 indicates a failed range verification speed sensor ratio test. The ratio test occurs after a shift and determines if a clutch has lost torque carrying capability. If output speed is above programmed output speed for a range but the correct speed sensor ratio is not present, the **DO NOT SHIFT** response is commanded and a range which can carry the torque without damage is commanded or attempted. Turbine and output speed sensor readings are used to calculate the actual ratio that is compared to the commanded ratio. **Main code 56 can also be caused by the ECU being calibrated for a close ratio transmission and installed with a wide ratio transmission, or vice versa.**

Main Code	Subcode	Meaning
56	00	Range verification ratio test (between shifts) L
56	11	Range verification ratio test (between shifts) 1
56	22	Range verification ratio test (between shifts) 2
56	33	Range verification ratio test (between shifts) 3
56	44	Range verification ratio test (between shifts) 4
56	55	Range verification ratio test (between shifts) 5
56	66	Range verification ratio test (between shifts) 6
56	77	Range verification ratio test (between shifts) R

A. Active Indicator Clearing Procedure:

- Power down
- Manual — subcodes 11, 44, 66, 77 only

*NOTE: **When a code 22 16 (output speed fault) is also present, follow the troubleshooting sequence for code 22 16 first. After completing the 22 16 sequence, drive the vehicle to see if a code 56 XX recurs.***

*NOTE: **Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

*NOTE: **Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

B. Troubleshooting:

1. After the transmission is at operating temperature, allow vehicle engine to idle on level ground for 3–4 minutes. Check the transmission fluid level. If improper fluid level is found, correct as necessary. Improper fluid level could be the cause of the code. Not enough or too much fluid may produce inadequate clutch pressure.

2. Connect a pressure gauge and check main pressure. If the pressure is not adequate, the pump is probably worn. See Appendix B for main pressure specifications.

3. If main pressure is adequate, check clutch pressure for the range indicated by following the procedure in Appendix B. The transmission range indicated by the trouble code can be found by referring to the solenoid and clutch chart in Appendix C. Drive the vehicle or use the diagnostic tool's clutch test mode and check clutch pressure.

4. If a clutch is leaking pressure, drain the fluid, remove the control module and check for damaged control module gaskets and stuck or sticking valves. Also look for damaged or missing face seals. If no problems are found, replace the solenoids for the clutches used in the range indicated by the code.

CODE 56 XX — RANGE VERIFICATION RATIO TEST (BETWEEN SHIFTS)

5. If replacing solenoids does not correct the pressure problem, a worn clutch or worn piston seals are probably the source of the pressure leak. Remove the transmission and repair or replace as necessary.

6. This code requires accurate output and turbine speed readings. If there were no transmission problems detected, use the diagnostic tool and check the speed sensor signals for noise (erratic signals) from low speed to high speed in the range indicated by the code.

7. If a noisy sensor is found, check the resistance of the sensor (300 ± 30 Ohms, refer to the code 22 XX temperature variation chart) and its wiring for opens, shorts, and shorts-to-ground (refer to code 22 XX). Carefully check the terminals in the connectors for corrosion, contamination, or damage. Ensure the wiring to the sensors is a properly twisted wire pair. Replace a speed sensor if its resistance is incorrect. Isolate and repair any wiring problems. (Use a twisted-pair if a new speed sensor circuit is needed — Service Harness Twisted Pair P/N 200153 is available from St. Clair Technologies for this purpose.)

8. If no apparent cause for the code can be found, replace the turbine and output speed sensors.

9. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 57 XX — RANGE VERIFICATION C3 PRESSURE TEST (BETWEEN SHIFTS)

Main code 57 indicates failure of the range verification C3 pressure switch test. This test determines if the C3 pressure switch is closed when it should be open. The test occurs when a range is commanded that does not use the C3 clutch (neutral, 1, 2, 4, and 6). The code is set if the C3 pressure switch is closed when it should be open. If C3 clutch comes on when not needed, three clutches are applied and a transmission tie-up occurs. The ECU will command a range which does use the C3 clutch and activate the **DO NOT SHIFT** response.

Main Code	Subcode	Meaning	Replace Solenoid
57	11	Range verification C3 pressure switch while in 1st	B
57	22	Range verification C3 pressure switch while in 2nd	C
57	44	Range verification C3 pressure switch while in 4th	C
57	66	Range verification C3 pressure switch while in 6th	A
57	88	Range verification C3 pressure switch while in N1	C
57	99	Range verification C3 pressure switch while in N2 or N4	C

A. Active Indicator Clearing Procedure:

- Power down
- Manual

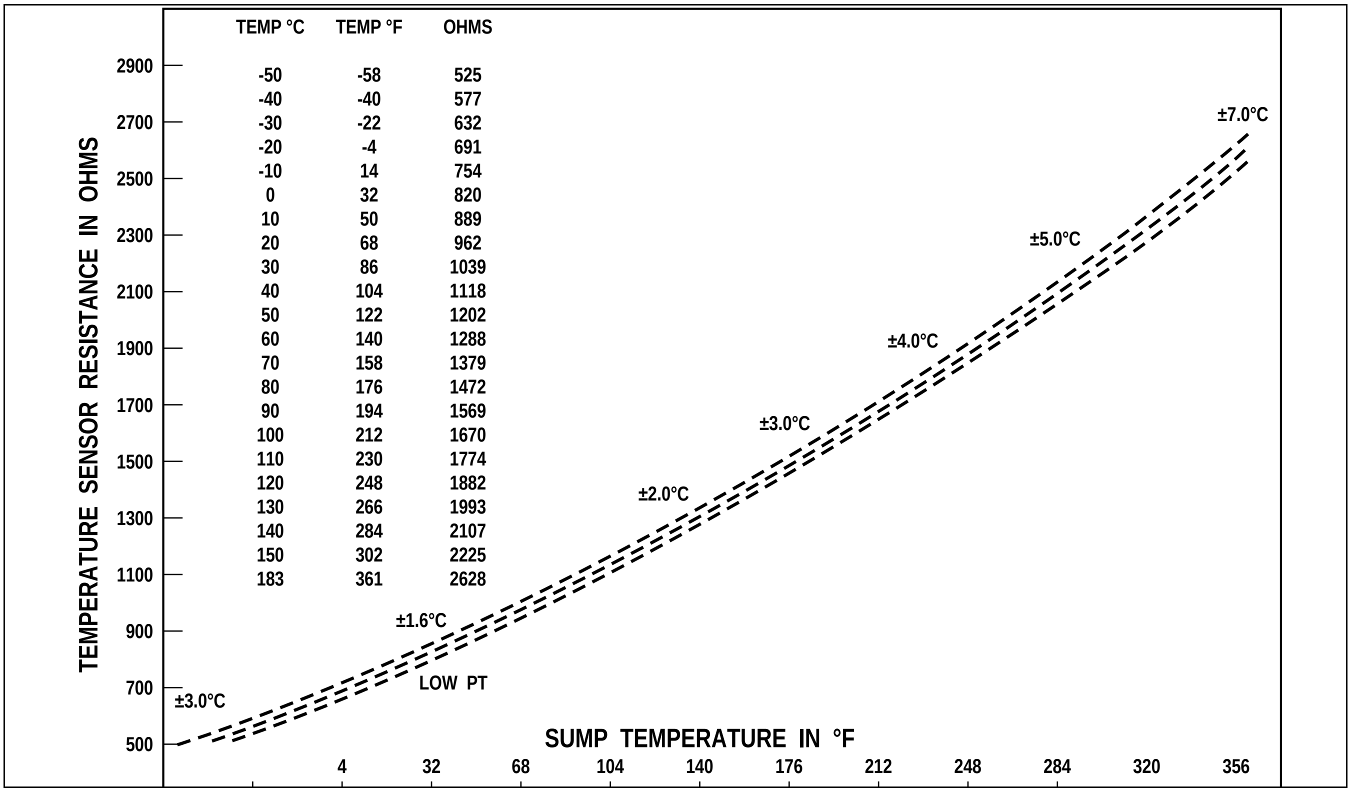
NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

B. Troubleshooting:

1. Disconnect the harness from the transmission. Check the C3 pressure switch circuit at the feedthrough harness connector for continuity (refer to code 32 XX).
2. Continuity at the feedthrough harness connector indicates the C3 pressure switch is closed or the C3 circuit is shorted together. Drain the fluid, remove the control module, and isolate the short. The fault is either a shorted feedthrough harness or stuck C3 pressure switch. Repair or replace as necessary.
3. If there is no continuity at the transmission, disconnect the transmission harness connector from the ECU and check the C3 pressure switch wires in the transmission harness for shorts. Use the system wiring diagram to identify wires which are connected. If a shorted C3 pressure switch circuit in the external harness is found, isolate and repair.
4. If the C3 pressure switch or circuit is not shorted either in the transmission or the external harness, connect a pressure gauge in the C3 pressure tap (refer to Appendix B for pressure tap location). Drive the vehicle in the range indicated by the code or use the diagnostic tool's clutch test mode to attain that range.
5. If the gauge shows C3 pressure is present in the range indicated by the subcode, drain the fluid and remove the control module. Check for damaged valve body gaskets or stuck or sticking valves. Repair or replace as necessary. If no obvious defects are found, replace the listed solenoid.
6. If the gauge shows C3 pressure is not present in the range indicated by the subcode, drain the fluid and remove the control module. Replace the C3 pressure switch.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem reoccurs, reinstall the replacement ECU.

CODE 61 XX — RETARDER OIL TEMPERATURE HOT



Main code 61 indicates the ECU has detected a hot fluid condition in the output retarder. Table 5–7 shows what actions are taken by the ECU at elevated retarder temperatures.

Possible causes (but not all causes) for hot fluid are:

1. Prolonged retarder use.
2. TID 2 transmission with ECU prior to Version 8A.
3. Low fluid level.
4. High fluid level.
5. A retarder apply system that allows the throttle and retarder to be applied simultaneously.
6. Cooler inadequately sized for retarder.

If the validity of the hot fluid diagnosis is in question, temperature can be checked by using a temperature gauge at the retarder-out port or by reading retarder temperature with the Pro-Link® diagnostic tool. Another method of checking retarder temperature is to remove the “T” connector at the ECU and measure resistance (Ohms) between terminals T28 and T25. Compare the resistance value to the value in Figure 6–21 to see if the result is within the expected operating range.

NOTE: ***Use the Pro-Link® diagnostic tool to determine the software version being used.***

The retarder temperature sensor is located externally on the HD retarder housing and under the plate on the MD retarder housing. When retarder temperature reaches a preset level, a retarder hot temperature light is illuminated.

NOTE: ***When an ECU with a version 8 calibration is used with a TransID 2 transmission, 62 XX codes are set because the ECU does not have the proper calibrations for the TID 2 thermistors. The ECU calibration must be updated to version 8A.***

CODE 61 XX — RETARDER OIL TEMPERATURE HOT

Main code 62 indicates the retarder temperature sensor or engine coolant sensor or circuitry is providing a signal outside the usable range of the ECU. Main code 62 can be the result of a hardware failure or an actual extremely high or low temperature condition.

Main Code	Subcode	Meaning
62	12	Retarder temperature sensor failed low (–45°C; –49°F)
62	23	Retarder temperature sensor failed high (178°C; 352°F)
62	32	Engine coolant sensor failed low
62	33	Engine coolant sensor failed high

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check the transmission fluid level.***

B. Troubleshooting:

NOTE: ***A combination of codes 62 23, 33 23, and 21 23 indicates a problem with one of the branches of the common ground wire (wire 135) between the throttle and temperature sensors.***

NOTE: ***Code 62 12 can be caused when the +5V power line (wire 124) is shorted to ground or open. Wire 124 also provides power for the OLS, TPS, RMR, sump temperature sensor, and shift selectors and is present in all three ECU connectors.***

1. Check the retarder temperature or engine coolant temperature with a DDR. If a DDR is not available, use the shift selector display to determine if the code is active (cycle the ignition on and off at least once since the code was logged to clear the code's active indicator). If a condition that is unreasonable for the current conditions exists, go to Step (3).
2. If Step (1) reveals that the extreme temperature indication is no longer present, the temperature limit could have been reached due to operational or ambient temperature extremes. Proceed cautiously as it is unlikely there is a sensor hardware fault.
3. Remove the connector at the ECU. Measure resistance between harness terminals T25 and T28 or between harness terminals V9 and V24. Compare resistance value to chart (see Figure 5–21) to see if reading is within expected operating range.
4. Disconnect the sensor connector and remove the connector at the ECU. Check the sensor and the ECU terminals for dirt, corrosion, and damage. Clean or replace as necessary.
5. Check the temperature sensor circuit for opens (code 62 23 or 62 33), shorts between wires, and short-to-ground (code 62 12 or 62 32). If a wiring problem is found, isolate and repair.
6. If no wiring problem is found, replace the retarder or engine coolant temperature sensor.
7. If the problem recurs, use a spare wire, if available, or provide a new wire (St. Clair P/N 200153 may be used for this purpose) for the retarder or engine coolant temperature circuit.

CODE 62 XX — RETARDER TEMPERATURE SENSOR

8. If the condition continues to recur, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

Code 63 00 is set when one of the two inputs for an input function Auxiliary Function Range Inhibit (Special) is in a different state (on or off) from the other input for longer than two minutes. When this condition is detected, code 63 00 is set. The transmission will not be inhibited in shifting from neutral to range.

Main Code	Subcode	Meaning
63	00	Auxiliary Function Range Inhibit (Special) inputs states are different
63	26	Kickdown input failed on (software version 8 only)
63	40	Service brake status failed on
63	41	Pump/pack and a neutral general purpose input

Subcode 26 is set when this function (Kickdown) is selected by calibration, the calibration designated input is active for a calibration time, and throttle position is less than the calibration value defined. The kickdown shift schedule is inhibited when subcode 26 is active. The service indicator will be turned on if it is selected by the calibration. The kickdown shift schedule is not inhibited, the code is cleared and the service indicator will be turned off if the kickdown input remains inactive for the calibration time period while throttle position is less than the calibration value. This diagnostic and code has been removed from software version 8A.

Subcode 40 is set when this function (Service Brake Status) is selected by calibration, and the specified input remains active for a calibration number of consecutive acceleration events. The service indicator will be turned on if it is selected by the calibration. A vehicle acceleration event is defined as an increase in transmission output speed from 1 rpm to a calibration value. The operation of the Automatic Neutral For Refuse Packer will be limited when this code is active. The active inhibit for this code is self-cleared and the service indicator will be turned off if the designated input for the Service Brake Status function becomes inactive.

Subcode 41 is set when the states of the calibration inputs are different for a calibration number of consecutive updates. The inputs in this case are Pump/Pack Enable and Automatic Neutral For Refuse Packer. The service display will also be turned ON if selected by calibration.

A. Active Indicator Clearing Procedure:

- Power down
- Manual — subcodes 26, 40, and 41
- Self-clearing — subcodes 26 and 40

B. Troubleshooting:

1. Code 63 00
   a. Use the DDR to identify the two input wires programmed with Auxiliary Function Range Inhibit (Special). Inspect the input wiring, connectors, and switches to determine why the input states are different. Correct any problems which are found.
   b. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

2. Code 63 26

   Inspect kickdown switch circuit.

CODE 62 XX — RETARDER TEMPERATURE SENSOR *(Figure 5–21)*

3. Code 63 40

   Inspect service brake status switch circuit.

4. Use the DDR to identify the two wires associated with the input functions for Pump/Pack Enable and Automatic Neutral For Refuse Packer. Inspect the input wiring, connectors, and switches to determine why the input states are different. Correct problems which are found. There is further information on these input functions on pages H–25, H–26, H–29, and H–30.

CODE 62 XX — RETARDER TEMPERATURE SENSOR *(Figure 5–21)*

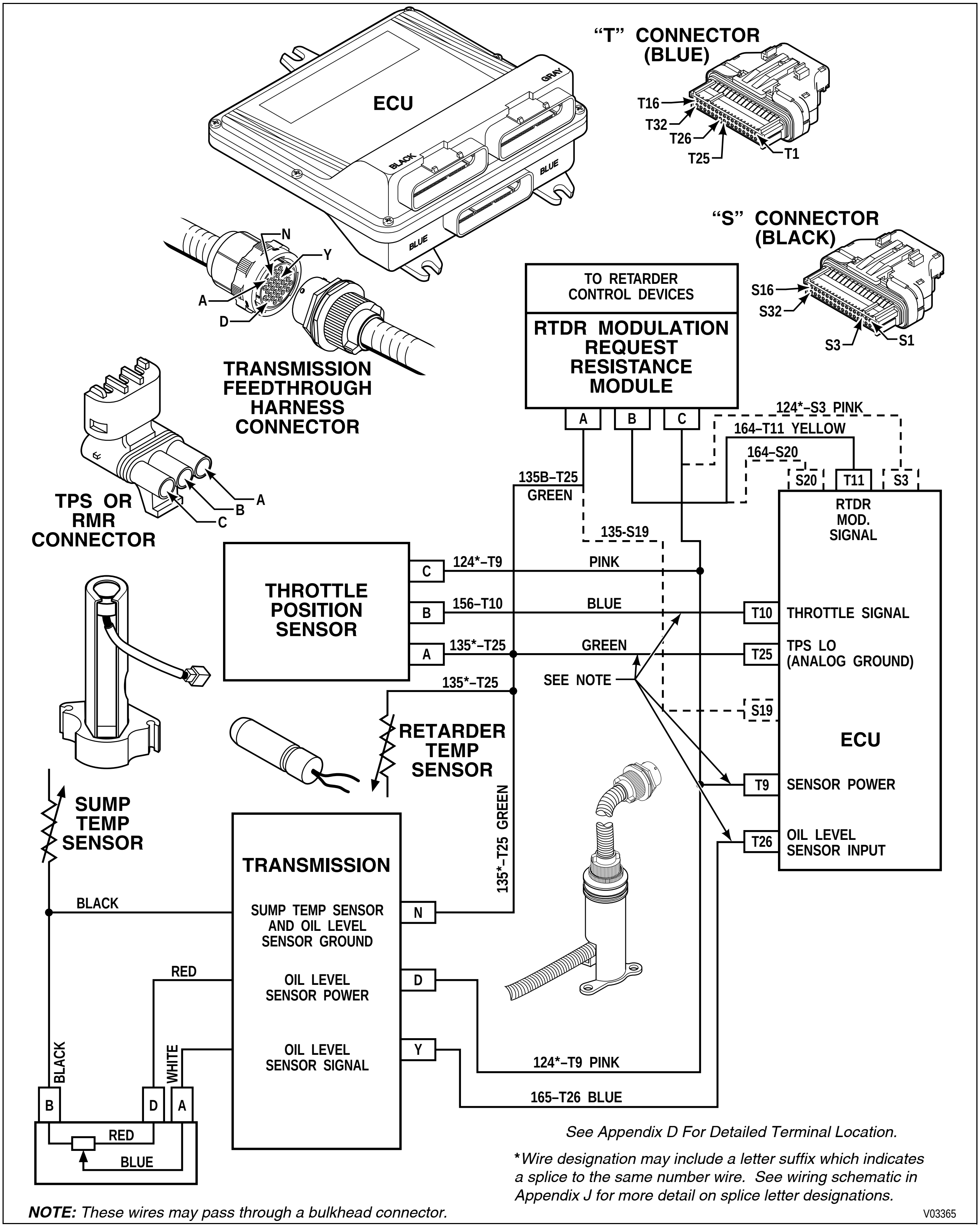


Figure 5–21. Code 64 Schematic Drawing

CODE 63 XX — INPUT FUNCTION FAULT

Main code 64 indicates the ECU has detected a voltage signal from the retarder modulation request sensor (consisting of a module and a retarder control device) in either the high or low error zone. These codes can be caused by faulty wiring, faulty connections to the resistance module or retarder control device, a faulty resistance module, a faulty retarder control device, or a faulty ECU. Power wire 124 and ground wire 135 for the retarder modulation request sensor are a common power and ground with the TPS and OLS devices. A short-to-ground on the common power wire causes a "sensor failed low" code for the other devices (codes 21 12, and 14 12). An open or a short-to-ground on retarder modulation request sensor signal wire 164 results in a code 64 12 only.

A TPS failure changes the status of the output retarder. The retarder is enabled by the Service Brake Status (wire 137) when a TPS code is active (21 XX). If a code 63 40 is also active, the Service Brake Status (wire 137) is ignored and the retarder will not work. Retarder response problems may not cause retarder modulation request sensor diagnostic codes. If response questions occur, test the retarder control devices for proper voltage signals at each of the percentage of retarder application settings. Table 5–8 contains the voltage measurements for each device's application percentage and resistances measured across terminals A and C of the retarder request sensor. **Use test wiring harness J 41339 when conducting voltage tests.**

Main Code	Subcode	Meaning
64	12	Retarder Modulation Request sensor failed Low (14 counts and below)
64	23	Retarder Modulation Request sensor failed High (232 counts and above)

A. Active Indicator Clearing Procedure:

- Power down

NOTE: ***Before troubleshooting, read Paragraph 5–6. Also, check battery and ECU input voltages.***

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections can cause this and other electronic control codes.***

B. Troubleshooting:

NOTE: ***Code 64 12 can be caused when the +5V power line (wire 124) is shorted to ground or open. Wire 124 also provides power for the OLS, TPS, sump temperature sensor, retarder temperature sensor, and shift selectors and is present in all three ECU connectors.***

1. Plug in the DDR and set to read retarder counts and percent (0 percent will be between 15 and 60 counts and 100 percent will be between 150 and 233 counts). A retarder request sensor failed high code can be caused by a short-to-battery of either signal wire 164 or power wire 124 or an open on ground wire 135. An open in the portion of the ground circuit common to the TPS and OLS devices will also result in a code 21 23 and a high fluid level reading. A retarder request sensor failed low code can be caused by an open or short-to-ground on either signal wire 164 or power wire 124.
2. Isolate and repair any wiring problems found.
3. If no wiring or connector problems are found, check the retarder request sensor voltages for each position on each of the retarder request sensors used on the vehicle. If two resistance modules are used, disconnect one of them when measuring voltage signals from the other. If problems are found, replace the resistance modules or retarder control devices.
4. If the problem persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 64 XX — RETARDER MODULATION REQUEST DEVICE FAULT

Table 5–1. RMR Device Resistance Checks

	Resistance Check in Resistance Module*		Voltage Signal **		Wiring to Control Device
Description	**Terminals**	**Resistance ± 5%**	**% Retarder Application**	**Voltage ± 0.2 v**	**Device Terminal**
Auto Full On	A to C	12K	100	3.6	No connections
Pressure Switch Full On High	 A to C	 32K	 0 100	 1.1 3.6	 A B
3-Step E-10R Bendix Pedal	A to C	32K	0 32 58 100	1.1 1.9 2.8 3.6	A B C D
6-Step Hand Lever — Off Position 1 Position 2 Position 3 Position 4 Position 5 Position 6	A to C	32K	 0 14 28 45 65 82 100	 1.1 1.5 1.9 2.3 2.8 3.2 3.6	 + 1 2 3 4 5 6
Auto ½ On	A to C	12K	50	2.4	No connections
3 Pressure Switches — Low Medium High	A to C	32K	0 32 68 100	1.1 1.9 2.8 3.6	 A B A B A B
Auto ⅓ On 2 Pressure Switches Auto Medium High	A to C	21.4K	 32 68 100	 1.9 2.8 3.6	 A B A B
Dedicated Pedal	No Checks	Interface not a resistance module	0 100	0.7 – 1.2 3.4 – 3.5	A B C

* Resistance module must be disconnected from the wiring harness and retarder control devices
** These voltages must be measured between terminals A and B.

CODE 64 XX — RETARDER MODULATION REQUEST DEVICE FAULT *(Figure 5–22)*

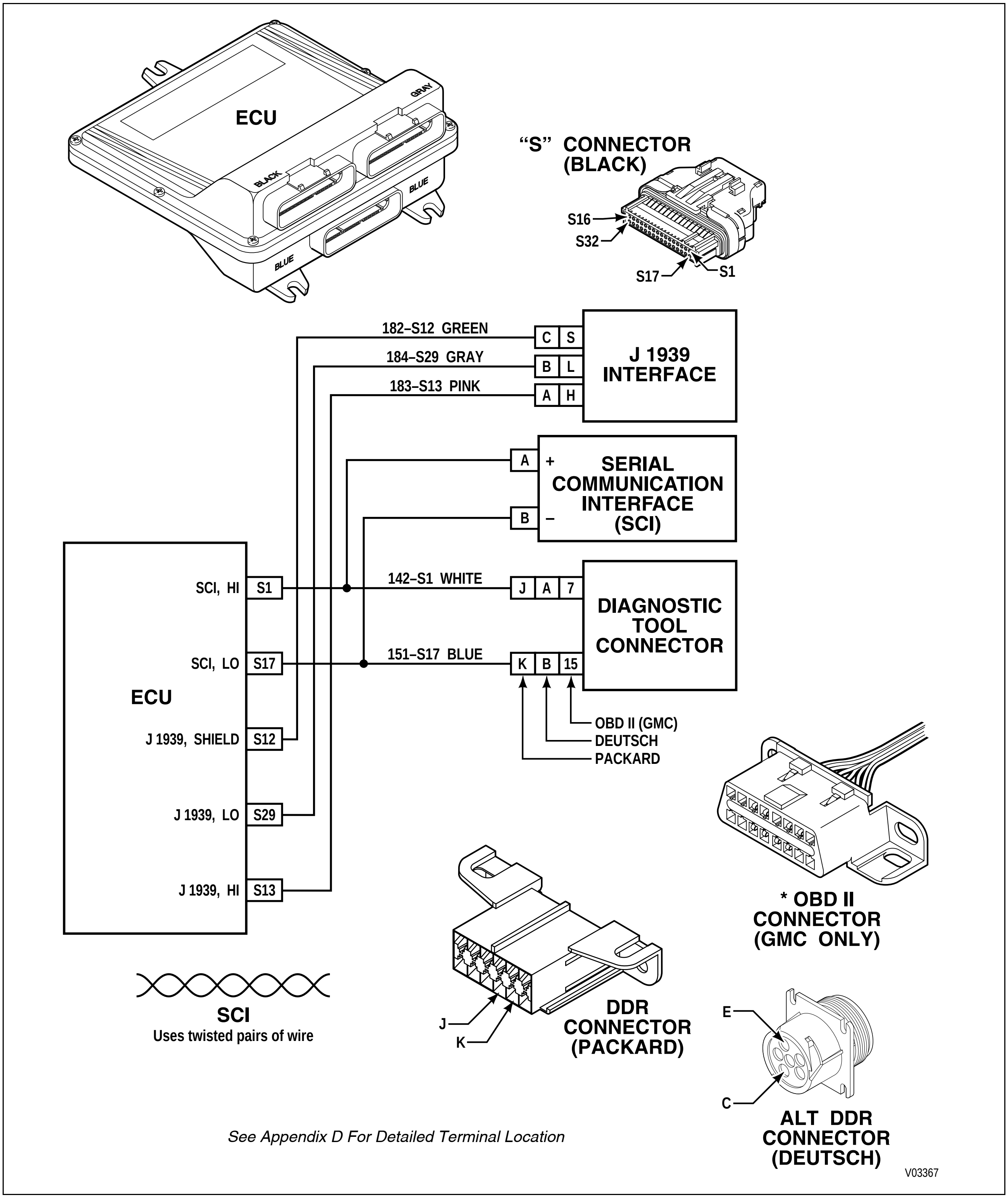


Figure 5–22. Code 66 Schematic Drawing

CODE 64 XX — RETARDER MODULATION REQUEST DEVICE FAULT

The datalink for throttle sensor or engine coolant temperature must have been recognized by auto detect or manually selected using the Pro-Link® (see WTEC III Pro-Link® Manual) before these codes can be logged.

Main code 66 indicates the ECU is expecting to get its throttle position signal or engine coolant signal across a serial communication interface from a computer-controlled engine. Either the engine computer is not sending the throttle or engine coolant information or the wiring between the engine and transmission computers has failed.

Code 66 00 can occur when the transmission ECU remains powered when the engine ECM is powered down. The transmission sees this as a communication link failure.

Main Code	Subcode	Meaning
66	00	SCI (Serial Communication Interface) fault
66	11	SCI Engine coolant source fault

A. Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

B. Troubleshooting:

1. Check for a throttle signal or engine coolant signal from the engine to the transmission, an engine computer malfunction, an engine throttle fault, or an engine coolant fault.

NOTE: ***Throttle position data sent from a computer-controlled engine may register a low number of counts on the DDR, but the counts will not change as throttle percentage is changed.***

2. Check wires 142 and 151 between the engine and transmission ECU for an open or short. Check that all connectors are clean and tightly connected.

NOTE: ***These codes can also be set if J1939 communications fail. Check wires 183-S13, 184-S29, and 182-S12 for opens or shorts.***

3. Use the Pro-Link® to see if the ECU is receiving power when it should not.

CODE 65 XX — ENGINE RATING HIGH

Main code 65 indicates the vehicle's engine horsepower/governor speed rating is too high. This code is set only when computer-controlled engines are used. Code 65 means the engine computer is able to tell the transmission, the engine horsepower and/or governor speed is beyond the transmission rating or does not match the transmission shift calibration.

When a code 65 is set, no shifts out of neutral are allowed. It is possible the transmission calibration selected for this engine is improper. Contact local Allison Transmission Division distributor for assistance in selecting a proper calibration.

If the engine is beyond transmission ratings, contact the vehicle OEM for correction. The local ATD regional representative may also be contacted for assistance.

This code cannot be cleared until the proper level engine is installed or the transmission is properly calibrated.

CODE 66 XX — SCI (SERIAL COMMUNICATION INTERFACE) FAULT

Main code 69 indicates a problem which has been identified as being from within the ECU.

A "cateye" display or a blank display may occur with subcode 33.

Main Code	Subcode	Meaning
69	27	ECU, Inoperative A-Hi switch
69	28	ECU, Inoperative F-Hi switch
69	29	ECU, Inoperative N-Hi and H-Hi switch
69	33	ECU, computer operating properly timeout
69	34	ECU, write timeout
69	35	ECU, checksum
69	36	ECU, RAM self-check failure
69	39	Communication chip addressing error
69	41	ECU, I/O ASIC addressing test
69	42	SPI output failure
69	43	SPI input failure

A. Active Indicator Clearing Procedure:

- Power down
- Manual — except subcodes 33, 35, 36, 41, 42, and 43
- Self-clearing — subcode 42 and subcodes 33, 35, 36, and 41; after an ECU reset

NOTE: Subcode 34 cannot be cleared.

B. Troubleshooting:

1. For subcodes 27, 28, and 29, check for shorts to battery before replacing the ECU. Follow the troubleshooting steps for code 42 XX for checking shorts to battery. If no shorts are found, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the problem recurs, reinstall the new ECU to complete the repair.
2. For all other subcodes, replace the ECU.

APPENDICES

APPENDIX A — IDENTIFICATION OF POTENTIAL CIRCUIT PROBLEMS

Intermittent codes are a result of faults that are detected, logged, and then disappear, only to recur later. If, when troubleshooting, a code is cleared in anticipation of it recurring and it does not, check the items in the following list for the fault's source.

A. Circuit Inspection

1. Intermittent power/ground problems — can cause voltage problems during ECU diagnostic checks which can set various codes depending upon where the ECU was in the diagnostic process.
2. Damaged terminals.
3. Dirty or corroded terminals.
4. Terminals not fully seated in the connector. Check indicated wires by uncoupling connector and gently pulling on the wire at the rear of the connector and checking for excessive terminal movement.
5. Connectors not fully mated. Check for missing or damaged locktabs.
6. Screws or other sharp pointed objects pushed into or through one of the harnesses.
7. Harnesses which have rubbed through and may be allowing intermittent electrical contact between two wires or between wires and vehicle frame members.
8. Broken wires within the braiding and insulation.

B. Finding an Intermittent Fault Condition

To find a fault, like one of those listed, examine all connectors and the external wiring harnesses. Harness routing may make it difficult to see or feel the complete harness. However, it is important to thoroughly check each harness for chafed or damaged areas. Road vibrations and bumps can damage a poorly installed harness by moving it against sharp edges and cause some of the faults. If a visual inspection does not identify a cause, move and wiggle the harness by hand until the fault is duplicated.

The next most probable cause of an intermittent code is an electronic part exposed to excessive vibration, heat, or moisture. Examples of this are:

1. Exposed harness wires subjected to moisture.
2. A defective connector seal allows moisture to enter the connector or part.
3. An electronic part (ECU, shift selector, solenoid, or throttle sensor) affected by vibration, heat, or moisture may cause abnormal electrical conditions within the part.

When troubleshooting Item 3, eliminate all other possible causes before replacing any parts.

Another cause of intermittent codes is good parts in an abnormal environment. The abnormal environment will usually include excessive heat, moisture, or voltage. For example, an ECU that receives excessive voltage will generate a diagnostic code as it senses high voltage in a circuit. The code may not be repeated consistently because different circuits may have this condition on each check. The last step in finding an intermittent code is to observe if the code is set during sudden changes in the operating environment.

Troubleshooting an intermittent code requires looking for common conditions that are present whenever the code is diagnosed.

APPENDIX A — IDENTIFICATION OF POTENTIAL CIRCUIT PROBLEMS

C. Recurring Conditions

A recurring condition might be:

- Rain
- Outside temperature above or below a certain temperature
- Only on right-hand or left-hand turns
- When the vehicle hits a bump, etc.

If such a condition can be related to the code, it is easier to find the cause. If the time between code occurrences is very short, troubleshooting is easier than if it is several weeks or more between code occurrences.

APPENDIX B — CHECKING CLUTCH AND RETARDER PRESSURES

Checking individual clutch pressures helps to determine if a transmission malfunction is due to a mechanical or an electrical problem. Properly making these pressure checks requires transmission and vehicle (or test stand) preparation, recording of data, and comparing recorded data against specifications provided. These instructions are for all WT Series transmissions.

NOTE: ***Check to see if there are diagnostic codes set which are related to the transmission difficulty you are evaluating. Proceed to make mechanical preparations for checking clutch pressures after codes have first been evaluated.***

A. Transmission and Vehicle Preparation

1. Remove the plugs from the pressure tap locations where measurement is desired (refer to Figure B–1).

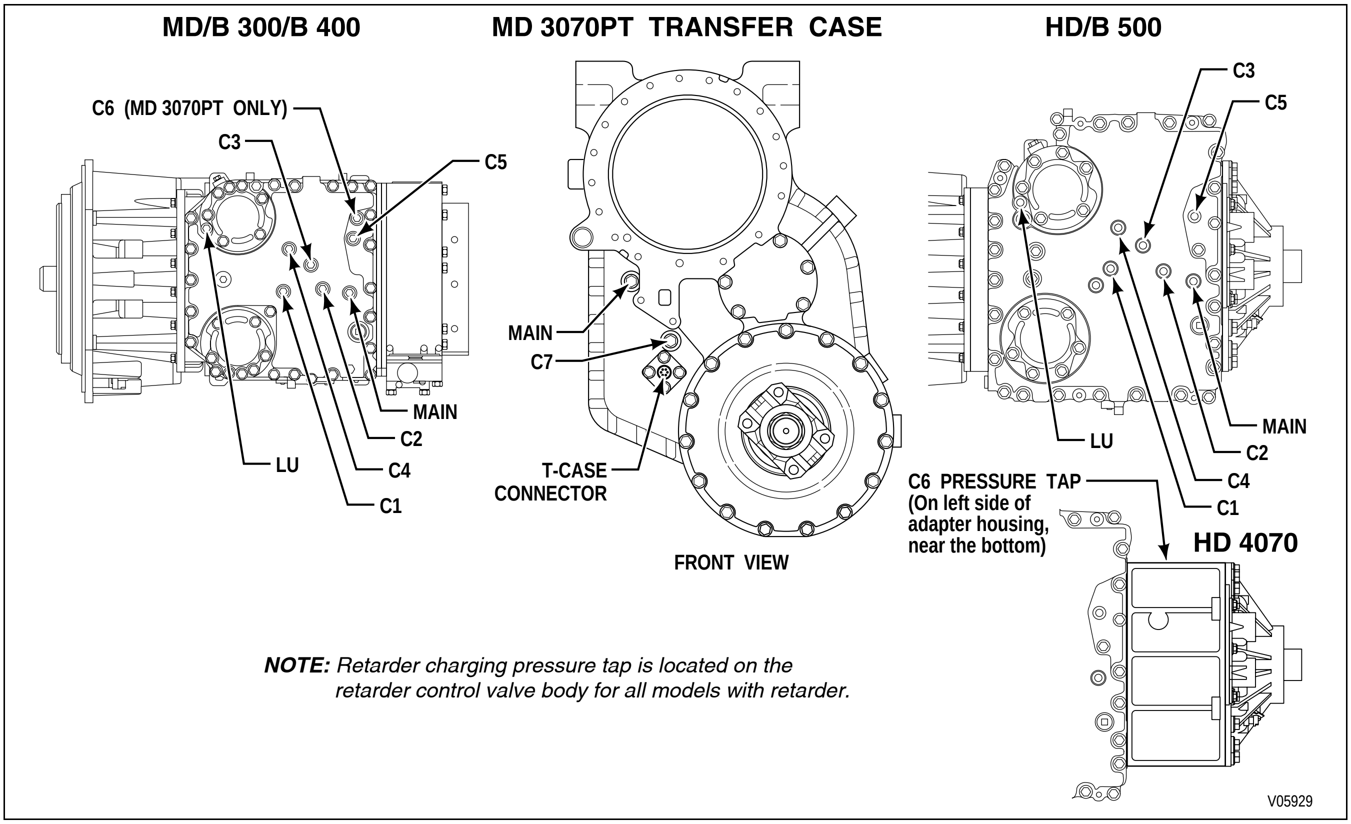


Figure B–1. Clutch Pressure Check Points

CAUTION:	Be sure that the hydraulic fittings have the same thread as the plugs removed (7/16-20 UNF-2A). Also please note that these fittings must be straight thread, O-ring style. Failure to do this will result in damage to the control module.

2. Install hydraulic fittings suitable for attaching pressure gauges or transducers.

3. Connect pressure gauges or transducers. Pressure gauge set J 26417-A is available for this purpose. See Table B–2 for pressure levels expected.

4. Check that engine speed can be monitored (Pro-Link® 9000 diagnostic tool may be used for this purpose).

APPENDIX B — CHECKING CLUTCH AND RETARDER PRESSURES

5. Be sure that transmission sump fluid temperature can be measured (Pro-Link® 9000 diagnostic tool may be used for this purpose).
6. Be sure that the transmission has enough fluid for cold operation until an operating temperature fluid level can be set.
7. Bring the transmission to normal operating temperature of 71–93ºC (160–200ºF). Check for fluid leaks in the added pressure gauge/transducer lines. Repair leaks as needed. Be sure that fluid level is correct.

B. Recording Data

1. Use the Pro-Link® 9000 diagnostic tool, which allows checking of individual range clutch pressures, with the vehicle stationary. Consult Appendix G or the Pro-Link® 9000 operating instructions for Action Request and select Clutch Test Mode. Follow instructions to check clutch pressures in individual ranges.

NOTE: Check lockup clutch pressure by driving the vehicle in a range where lockup can be obtained. Record the pressure values at the engine speed and sump fluid temperature values shown in Table B–1. The lockup clutch is functioning correctly when engine speed and turbine speed values are equal as recorded from the Pro-Link® 9000.

2. Consult Table B–1 and locate the transmission model that you are testing.
3. Operate the transmission at the conditions shown in Table B–1 and record engine speed, transmission sump fluid temperature, main hydraulic pressure, and clutch pressures in the ranges where a problem is suspected.

Table B–1. Clutch Pressure Test Conditions

Transmission Model/ Test Type	Engine rpm	Sump Fluid Temperature	Range	Clutches Pressurized
All (except MD 3070) — Idle Check	580–620	71–93ºC (160–200ºF)	Neutral Reverse 1C 2C (2nd range start)	C5 C3 C5 C1 C5 C1 C4
MD 3070 — Idle Check	580–620	71–93ºC (160–200ºF)	Neutral Reverse LowC 1C	C5 C3 C5 C3 C6 C1 C5
MD (except 3070) B 300/B 400 — High Speed	2080–2120	71–93ºC (160–200ºF)	Reverse Neutral 1C 2C 2L 3L 4L 5L 6L	C3 C5 C5 C1 C5 C1 C4 C1 C4 LU C1 C3 LU C1 C2 LU C2 C3 LU C2 C4 LU

APPENDIX B — CHECKING CLUTCH AND RETARDER PRESSURES

Table B–1. Clutch Pressure Test Conditions (Continued)

Transmission Model/ Test Type	Engine rpm	Sump Fluid Temperature	Range	Clutches Pressurized
MD 3070 — High Speed	2080–2120	71–93ºC (160–200ºF)	Reverse	C3 C5
			Neutral	C5
			LowC	C3 C6
			1C	C1 C5
			2C	C1 C4
			2L	C1 C4 LU
			3L	C1 C3 LU
			4L	C1 C2 LU
			5L	C2 C3 LU
			6L	C2 C4 LU
HD/B 500 — High Speed	1780–1820	71–93ºC (160–200ºF)	Reverse	C3 C5
			Neutral	C5
			LowC**	C1 C6
			1C	C1 C5
			2C	C1 C4
			2L	C1 C4 LU
			3L	C1 C3 LU
			4L	C1 C2 LU
			5L	C2 C3 LU
			6L	C2 C4 LU
			** Only applies to HD 4070.	

C. Comparing Recorded Data to Specifications

1. Be sure that engine speed and transmission sump fluid temperatures were within the values specified in Table B–1.
2. Compare the main pressure and clutch pressure data, recorded in Step B, with the specifications in Table B–2.
3. If clutch pressures are within specifications, return the transmission and vehicle to their original configuration and proceed with electrical troubleshooting.
4. If clutch pressures are not within specification, take corrective action to replace the internal parts of the transmission necessary to correct the problem. (Refer to the Transmission Service Manual for the model being checked.)
5. Recheck pressure values after the transmission has been repaired.
6. Return the transmission to its original configuration. (Remove instrumentation and reinstall any components removed for the pressure testing.)

Table B–2. Main Pressure and Clutch Pressure Specifications
(Sump Fluid Temperature Same as in Table B–1)

Transmission Model/Test Type	Engine rpm	Range	Clutches Applied	Main Press. Spec kPa [psi]	Range Clutch Press. Spec* kPa [psi]	Conv. Out Press. Spec kPa [psi]	Lube Press. Spec kPa [psi]	LU Clutch Press. Spec* kPa [psi]	D'BOX MAIN Press. Spec* kPa [psi]
MD — Idle (except 3070)	580–620	Neutral	C5	1400–2000 [203–290]	0–40 (C5) [0–5.8]		—		
		Reverse	C3 C5	1400–2000 [203–290]	0–40 (C3 And C5) [0–5.8]		3.5 min. [0.5 min.]		
		1C	C1 C5	1300–1970 [189–286]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]		3.5 min. [0.5 min.]		
		2C	C1 C4	1300–1970 [189–286]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]		3.5 min. [0.5 min.]		
MD 3070 — Idle		Neutral	C5	1400–2000 [203–290]	0–40 (C5) [0–5.8]		—		1400–2000 [203–290]
		Reverse	C3 C5	1400–2000 [203–290]	0–40 (C3 And C5) [0–5.8]		3.5 min. [0.5 min.]		1400–2000 [203–290]
		LowC	C3 C6	1300–1970 [189–286]	0–40 (C3 And C6) [0–5.8]		3.5 min. [0.5 min.]		1300–1970 [189–286]
		1C	C1 C5	1300–1970 [189–286]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]		3.5 min. [0.5 min.]		1300–1970 [189–286]
MD — High Speed (except 3070)	2080–2120	Neutral	C5	1825–1965 [265–285]	0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		Reverse	C3 C5	1825–1965 [265–285]	0–40 (C3 And C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		1C	C1 C5	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		

* Subtract clutch pressure from main pressure; the difference must fall within the specifications given (unless a pressure range is supplied).

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Table B–2. Main Pressure and Clutch Pressure Specifications (Sump Fluid Temperature Same as in Table B–1) (Continued)

Transmission Model/Test Type	Engine rpm	Range	Clutches Applied	Main Press. Spec kPa [psi]	Range Clutch Press. Spec* kPa [psi]	Conv. Out Press. Spec kPa [psi]	Lube Press. Spec kPa [psi]	LU Clutch Press. Spec* kPa [psi]	D'BOX MAIN Press. Spec* kPa [psi]
MD — High Speed (except 3070) *(cont'd)*	2080–2120	2C	C1 C4	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		2L	C1 C4 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		3C	C1 C3	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		3L	C1 C3 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		4C	C1 C2	1550–1690 [225–245]	0–70 (C1) [0–10] 0–70 (C2) [0–10]	310–410 [45–60]	150–190 [22–28]		
		4L	C1 C2 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–70 (C2) [0–10]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		5C	C2 C3	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		5L	C2 C3 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		6C	C2 C4	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		6L	C2 C4 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	

* Subtract clutch pressure from main pressure; the difference must fall within the specifications given (unless a pressure range is supplied).

Table B–2. Main Pressure and Clutch Pressure Specifications (Sump Fluid Temperature Same as in Table B–1) (Continued)

Transmission Model/Test Type	Engine rpm	Range	Clutches Applied	Main Press. Spec kPa [psi]	Range Clutch Press. Spec* kPa [psi]	Conv. Out Press. Spec kPa [psi]	Lube Press. Spec kPa [psi]	LU Clutch Press. Spec* kPa [psi]	D'BOX MAIN Press. Spec* kPa [psi]
MD 3070 — High Speed	2080–2120	Neutral	C5	1825–1965 [265–285]	0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		Reverse	C3 C5	1825–1965 [265–285]	0–40 (C3 And C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		LowC	C3 C6	1550–1690 [225–245]	0–40 (C3 And C6) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		1C	C1 C5	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		2C	C1 C4	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		2L	C1 C4 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	1440–1700 [209–247]
		3C	C1 C3	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		3L	C1 C3 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	1440–1700 [209–247]
		4C	C1 C2	1550–1690 [225–245]	0–70 (C1 And C2) [0–10]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		4L	C1 C2 LU	1100–1240 [160–180]	0–70 (C1 And C2) [0–10]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	1440–1700 [209–247]
		5C	C2 C3	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]

* Subtract clutch pressure from main pressure; the difference must fall within the specifications given (unless a pressure range is supplied).

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Table B–2. Main Pressure and Clutch Pressure Specifications (Sump Fluid Temperature Same as in Table B–1) (Continued)

Transmission Model/Test Type	Engine rpm	Range	Clutches Applied	Main Press. Spec kPa [psi]	Range Clutch Press. Spec* kPa [psi]	Conv. Out Press. Spec kPa [psi]	Lube Press. Spec kPa [psi]	LU Clutch Press. Spec* kPa [psi]	D'BOX MAIN Press. Spec* kPa [psi]
MD 3070 — High Speed *(cont'd)*	2080–2120	5L	C2 C3 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	1440–1700 [209–247]
		6C	C2 C4	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		1440–1700 [209–247]
		6L	C2 C4 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	1440–1700 [209–247]
HD — Idle	580–620	Neutral	C5	1400–2000 [203–290]	0–40 (C5) [0–5.8]		—		
		Reverse	C3 C5	1400–2000 [203–290]	0–40 (C3 And C5) [0–5.8]		3.5 min. [0.5 min.]		
		1C	C1 C5	1300–1970 [189–286]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]		3.5 min. [0.5 min.]		
		2C	C1 C4	1300–1970 [189–286]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]		3.5 min. [0.5 min.]		
HD — High Speed	1780–1820	Neutral	C5	1825–1965 [265–285]	0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		Reverse	C3 C5	1825–1965 [265–285]	0–40 (C3 And C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		LowC**	C3 C6	1550–1690 [225–245]	0–40 (C3 And C6) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		1C	C1 C5	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C5) [0–5.8]	310–410 [45–60]	150–190 [22–28]		

* Subtract clutch pressure from main pressure; the difference must fall within the specifications given (unless a pressure range is supplied).

** HD 4070 Only.

Table B–2. Main Pressure and Clutch Pressure Specifications (Sump Fluid Temperature Same as in Table B–1) (Continued)

Transmission Model/Test Type	Engine rpm	Range	Clutches Applied	Main Press. Spec kPa [psi]	Range Clutch Press. Spec* kPa [psi]	Conv. Out Press. Spec kPa [psi]	Lube Press. Spec kPa [psi]	LU Clutch Press. Spec* kPa [psi]	D'BOX MAIN Press. Spec* kPa [psi]
HD — High Speed	1780–1820	2C	C1 C4	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
(cont'd)		2L	C1 C4 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		3C	C1 C3	1550–1690 [225–245]	0–70 (C1) [0–10] 0–40(C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		3L	C1 C3 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		4C	C1 C2	1550–1690 [225–245]	0–70 (C1) [0–10] 0–70 (C2) [0–10]	310–410 [45–60]	150–190 [22–28]		
		4L	C1 C2 LU	1100–1240 [160–180]	0–70 (C1) [0–10] 0–70 (C2) [0–10]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		5C	C2 C3	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		5L	C2 C3 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C3) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	
		6C	C2 C4	1550–1690 [225–245]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]		
		6L	C2 C4 LU	1100–1240 [160–180]	0–70 (C2) [0–10] 0–40 (C4) [0–5.8]	310–410 [45–60]	150–190 [22–28]	0–60 [0–8.7]	

* Subtract clutch pressure from main pressure; the difference must fall within the specifications given (unless a pressure range is supplied).

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APPENDIX B — CHECKING CLUTCH AND RETARDER PRESSURES

D. Retarder Pressure Checks — MD/B 300/B 400 And HD/B 500

1. MD 3060/3066, B 300, B 400 Test Conditions:

   Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1075–1125 rpm

2. MD 3560 Test Conditions:

   Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1350–1400 rpm

Table B–3. Retarder Specifications At Above Test Conditions

Parameter To Check	High Capacity	Medium Capacity	Low Capacity
Main Pressure–kPa [psi]	1200–1260 [174–183]	1200–1260 [174–183]	1200–1260 [174–183]
Retarder Charge Pressure–kPa [psi]	250–370 [36–54]	215–280 [31–41]	140–240 [20–35]
Cooler In Pressure–kPa [psi]	250–340 [36–49]	210–300 [30–44]	140–255 [20–37]
Cooler In Temperature–°C [°F]	150 [300] Max (Ref)	150 [300] Max (Ref)	150 [300] Max (Ref)

3. HD 4060/4070/B 500 Test Conditions:

   Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 800–850 rpm

4. HD 4560 Test Conditions:

   Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 965–1015 rpm

Table B–4. Retarder Specifications At Above Test Conditions

Parameter To Check	High Capacity	Medium Capacity	Low Capacity
Main Pressure–kPa [psi]	1120–1270 [162–184]	1120–1270 [162–184]	1120–1270 [162–184]
Retarder Charge Pressure–kPa [psi]	375–480 [54–70]	345–450 [50–65]	325–420 [47–61]
Cooler In Pressure–kPa [psi]	360–530 [52–77]	310–510 [45–74]	290–480 [42–70]
Cooler In Temperature–°C [°F]	150 [300] Max (Ref)	150 [300] Max (Ref)	150 [300] Max (Ref)

APPENDIX C — SOLENOID AND CLUTCH CHART

BASIC CONFIGURATION

Range	Solenoid Non-Latching Modulating							Clutches					
	A N/O	B N/O	C N/C	D N/C	E N/C	F N/C	G N/C	C1	C2	C3	C4	C5	LU
6	X			X		0			Y		Y		0
5	X		X			0	X		Y	Y			0
4						0	X	Y	Y				0
3		X	X			0	X	Y		Y			0
2		X		X		0	X	Y			Y		0
1		X			X	0		Y				Y	0
N1	X	X		*	X	0					*	Y	0
NVL	X	X		X	X						Y	Y	
N2	X	X		X							Y		
N3	X	X	X							Y			
N4	X	X		X							Y		
R	X	X	X		X					Y		Y	

NOTE: See Page C–2 for legend.

7-SPEED CONFIGURATION (MD 3070 AND HD 4070)

Range	Solenoid Non-Latching Modulating										Clutches							
	N/O	N/O	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C								
	C1	C2	C3	C4	C5	LU	FWD	LOW	C6	DIF								
	A	B	C	D	E	F	G	N	J	H	C1	C2	C3	C4	C5	LU	C6	DIF
6	X			X		0				0		Y		Y		0		0
5	X		X			0	X			0		Y	Y			0		0
4						0	X			0	Y	Y				0		0
3		X	X			0	X			0	Y		Y			0		0
2		X		X		0	X			0	Y			Y		0		0
1		X			X	0				0	Y				Y	0		0
LO	X					0	X	X	X	0			Y			0	Y	0
N1	X	X		*	X					0					Y			0
N2	X	X		X			X			0				Y				0
N3	X	X	X				X			0			Y					0
N4	X	X		X			X			0				Y				0
R	X	X	X		X					0			Y		Y			0

NOTE: See Page C–2 for legend.

APPENDIX C — SOLENOID AND CLUTCH CHART

LEGEND

X	Indicates solenoid is electrically ON.
Y	Indicates clutch is hydraulically applied.
Blank	Indicates solenoid is electrically OFF or clutch is not hydraulically applied.
0	Optional ON or OFF.
*	See NVL explanation below.
NVL	**As a diagnostic response:** If Turbine Speed is below 150 rpm when Output Speed is below 100 rpm and Engine Speed is above 400 rpm, Neutral Very Low (**NVL**) is commanded when **N1** (Neutral) is the selected range. **NVL** is achieved by turning D solenoid "on" in addition to E solenoid being "on," which locks the output. Otherwise, D solenoid is turned off in **N1** (Neutral).

APPENDIX D — WIRE/CONNECTOR CHART

The connector information in this appendix is provided for the convenience of the servicing technician. The connector illustration and pin identifications for connection to Allison Transmission components will be accurate. Allison Transmission components are the ECU, speed sensors, retarder connectors, transmission connectors, and shift selectors. Other kinds of connectors for optional or customer-furnished components are provided based on typical past practice for an Allison-designed system.

Contact St. Clair Technologies, Inc. or your vehicle manufacturer for information on connectors not found in this appendix.

NOTE: The following abbreviation guide should be used to locate connector termination points for wires in the WTEC III wiring harness(es).

Table D–1. Appendix D Abbreviation Guide

Termination Point Abbreviation	Connector Name
AGND	Analog Ground
ASOL	Solenoid A — Transmission Control Module
BSOL	Solenoid B — Transmission Control Module
C3PS	C3 Pressure Switch — Control Module
CSOL	Solenoid C — Transmission Control Module
DDRD	Diagnostic Connector — Deutsch
DDRP	Diagnostic Connector — Packard
DSOL	Solenoid D — Transmission Control Module
ECU–S	Electronic Control Unit — Selector (S) Connector
ECU–S	Electronic Control Unit — Vehicle (V) Connector
ECU–T	Electronic Control Unit — Transmission (T) Connector
ESOL	Solenoid E — Transmission Control Module
GSOL	Solenoid F — Transmission Control Module
GSOL	Solenoid G — Transmission Control Module
HSOL	Retarder H Solenoid — Retarder Housing Or Retarder Valve Body
J1939	J1939 Datalink From ECU Selector (S) Harness
JSOL	Solenoid J — Transmission Control Module (7-Speed Only)
NE	Engine Speed Sensor
NO	Output Speed Sensor
NSOL	Retarder Accumulator Solenoid
NSOL	Solenoid N — Transmission Control Module (7-Speed Only)
NT	Turbine Speed Sensor
OBDII	Diagnostic Connector — GMC On Board Diagnostics
OLS	Oil Level Sensor
PSS	Primary Shift Selector
RMOD	Retarder Module (Units Built Prior To 1/98)
RMR	Retarder Modulation Request Device
RNGTRM	Chassis Ground Ring Terminal
RTEMP	Retarder Temperature — Retarder Housing

APPENDIX D — WIRE/CONNECTOR CHART

Table D–1. Appendix D Abbreviation Guide (Continued)

Termination Point Abbreviation	Connector Name
SCI	Serial Communication Interface
SSS	Secondary Shift Selector
TCASE	MD 3070 Transfer Case
TPS	Throttle Position Sensor
TRANS	Transmission Feedthrough Harness
VIM	Vehicle Interface Module
VIWS	Vehicle Interface Wiring — ECU Selector (S) Harness
VIWV	Vehicle Interface Wiring — ECU Vehicle (V) Harness

APPENDIX D — WIRE/CONNECTOR CHART

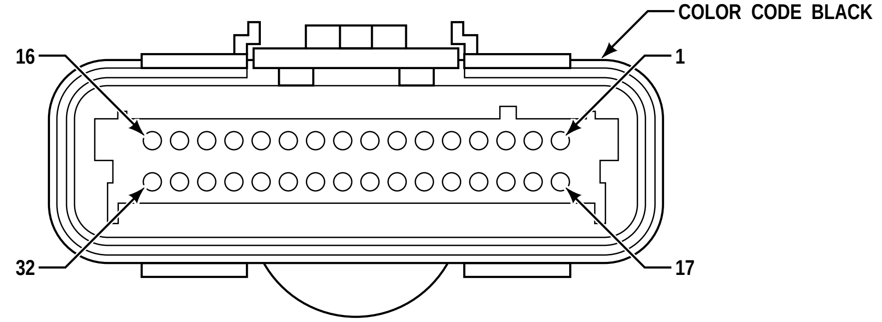


Figure D–1. ECU Connector "S"

ECU CONNECTOR "S" (BLACK)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1	White	142-S1	Serial Communication Interface, High	DDRP-J, DDRD-A, OBDII-7
2	Tan	159-S2	Diagnostic Communication Link (ISO9141)	VIWS-A
3	Pink	124-S3	Sensor Power	RMR-C, PSS-N, SSS-N
4	Yellow	146-S4	Ignition Sense	VIWS-E, DDRP-H, DDRD-C, OBDII-16
5	Orange	170-S5	Primary Shift Selector, Data Bit 1	PSS-A
6	Green	171-S6	Primary Shift Selector, Data Bit 2	PSS-B
7	Blue	172-S7	Primary Shift Selector, Data Bit 4	PSS-C
8	Yellow	173-S8	Primary Shift Selector, Data Bit 8	PSS-D
9	Tan	174-S9	Primary Shift Selector, Parity	PSS-E
10	Green	175-S10	Shift Selector Mode Input	PSS-M, SSS-M
11	Yellow	119-S11	General Purpose Input 4	VIWS-M
12	Green	182-S12	CAN Controller Shield (J1939)	J1939C
13	Pink	183-S13	CAN Controller, High (J1939)	J1939A
14	Blue	180-S14	Shift Selector Display	PSS-S, SSS-S
15	Orange	176-S15	General Purpose Output 6	PSS-L, SSS-L, VIWS-L
16	Pink	136-S16	Battery Power	PSS-R, SSS-R
17	Blue	151-S17	Serial Communication Interface, Low	DDRP-K, DDRD-B, OBDII-15
18	Tan	166-S18	General Purpose Output 7	VIWS-N
19	Green	135-S19	Analog Ground	RMR-A
20	Yellow	164-S20	Retarder Modulation Request	RMR-B
21	Orange	190-S21	Secondary Shift Selector, Data Bit 1	SSS-A
22	Green	191-S22	Secondary Shift Selector, Data Bit 2	SSS-B
23	Blue	192-S23	Secondary Shift Selector, Data Bit 4	SSS-C
24	Yellow	193-S24	Secondary Shift Selector, Data Bit 8	SSS-D
25	Tan	194-S25	Secondary Shift Selector, Parity	SSS-E
26	Blue	169-S26	General Purpose Input 12	VIWS-S
27	Blue	163-S27	General Purpose Input 6	VIWS-R
28	Yellow	126-S28	General Purpose Input 9	VIWS-C
29	Gray	184-S29	CAN Controller, Low (J1939)	J1939-B
30	Tan	157-S30	Vehicle Speed	VIWS-D
31	Green	115-S31	Check Transmission	VIWS-B
32	Gray	143-S32	Battery Ground	PSS-P, SSS-P, VIWS-P, DDRP-A, DDRD-E, OBDII-5

APPENDIX D — WIRE/CONNECTOR CHART

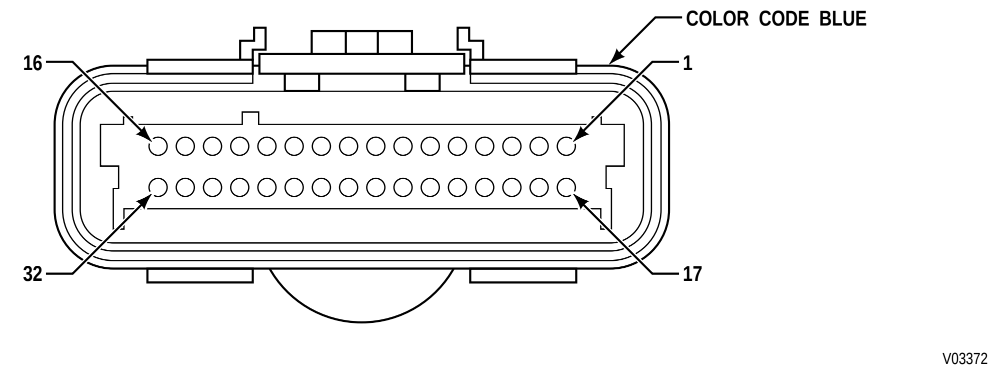


Figure D–2. ECU Connector "T"

ECU CONNECTOR "T" (BLUE)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1	Orange	102-T1	Solenoid Power, Solenoids A, D, and J (MD 3070 only)	TRANS-A
2	Tan	121-T2	Solenoid Power, Solenoids B and E	TRANS-H
3	Green	107-T3	Solenoid Power, Solenoid F	TRANS-E
4	White	120-T4	A Solenoid, Low	TRANS-G
5	Green	103-T5	C Solenoid, Low	TRANS-B
6	Tan	129-T6	E Solenoid, Low	TRANS-K
7	White	104-T7	G Solenoid, Low	TRANS-C
8	Blue	111-T8	J Solenoid, Low	TRANS-e
9	Pink	124-T9	Sensor Power	TRANS-D, TPS-C, RMR-C
10	Blue	156-T10	Throttle Position Sensor	TPS-B
11	Yellow	164-T11	Retarder Modulation Request	RMR-B
12	White	162-T12	C3 Pressure Switch Input	TRANS-X
13	Yellow	195-T13	Transmission Identification	TRANS-W
14	Tan	141-T14	Engine Speed Sensor, High	NE-A
15	Orange	149-T15	Turbine Speed Sensor, High	NT-A (HD), TRANS-V (MD)
16	Yellow	139-T16	Output Speed Sensor, High	NO-A, TCASE-C (MD 3070), RMOD-C (MDR)
17	Yellow	130-T17	Solenoid Power, Solenoids C and G	TRANS-L
18				
19	Yellow	116-T19	Solenoid Power, Solenoids H and N	HSOL-B, NSOL-B, TRANS-g, TCASE-B (MD 3070), RMOD-B (MDR)
20	Orange	128-T20	B Solenoid, Low	TRANS-J
21	Blue	131-T21	D Solenoid, Low	TRANS-M
22	White	110-T22	F Solenoid, Low	TRANS-F
23	White	127-T23	H Solenoid, Low	HSOL-A (HD), RMOD-A (MDR), TCASE-A (MD 3070)
24	Blue	101-T24	N Solenoid, Low	NSOL-A (HD and MD), TRANS-f (MD 3070)
25	Green	135-T25	Analog Ground	RMR-A, RTEMP-B (HD), RMOD-F (MD)
26	Blue	165-T26	Oil Level Sensor Input	TRANS-Y
27	Tan	147-T27	Sump Temperature Sensor Input	TRANS-P
28	Orange	138-T28	Retarder Temperature Sensor Input	RTEMP-A (HD), RMOD-E (MD)
29				
30	Orange	150-T30	Engine Speed Sensor, Low	NE-B
31	Blue	140-T31	Turbine Speed Sensor, Low	NT-B, TRANS-U (MD)
32	Green	148-T32	Output Speed Sensor, Low	NO-B, TCASE-D (MD 3070), RMOD-D (MDR)

APPENDIX D — WIRE/CONNECTOR CHART

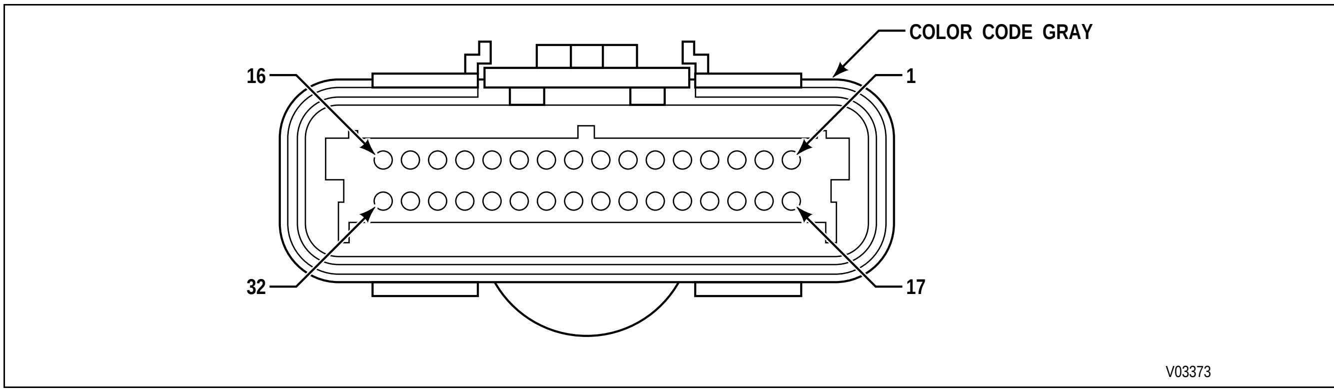


Figure D–3. ECU Connector "V"

ECU CONNECTOR "V" (GRAY)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1	Pink	136-V1	Battery Power	VIM-E1
2	White	114-V2	General Purpose Output 1	VIM-F3
3	Orange	132-V3	General Purpose Output 2	VIM-B1
4	White	113-V4	Reverse Warning	VIM-F2
5	White	167-V5	General Purpose Output 8	VIWV-V
6	Tan	123-V6	Neutral Start	VIM-D1
7				
8	Pink	124-V8	Sensor Power	TPS-C
9	Blue	179-V9	Engine Water Temperature	VIWV-M
10	Blue	156-V10	Throttle Position Sensor	TPS-B
11	Green	155-V11	General Purpose Input 1	VIWV-A
12	Yellow	153-V12	General Purpose Input 2	VIWV-B
13	Blue	118-V13	General Purpose Input 3	VIWV-C
14	Tan	177-V14	General Purpose Input 10	VIWV-S
15				
16	Pink	136-V16	Battery Power	VIM-E2
17	Gray	143-V17	Battery Ground	VIM-A1
18	White	125-V18	General Purpose Output 4	VIM-C2
19	Green	105-V19	General Purpose Output 5	VIWV-E
20	Tan	157-V20	Vehicle Speed	VIM-B2
21				
22	Tan	112-V22	General Purpose Output 3	VIM-D2
23				
24	Green	135-V24	Analog Ground	TPS-A, VIWV-N
25	Gray	144-V25	Chassis Ground	RNGTRM
26	Yellow	146-V26	Ignition Sense	VIM-F1
27	White	154-V27	General Purpose Input 5	VIWV-D
28	Orange	178-V28	General Purpose Input 11	VIWV-R
29	Orange	137-V29	General Purpose Input 7	VIWV-U
30	Green	117-V30	General Purpose Input 8	VIWV-P
31	Yellow	161-V31	Digital Ground (GPI)	VIWV-L
32	Gray	143-V32	Battery Ground	VIM-A2

APPENDIX D — WIRE/CONNECTOR CHART

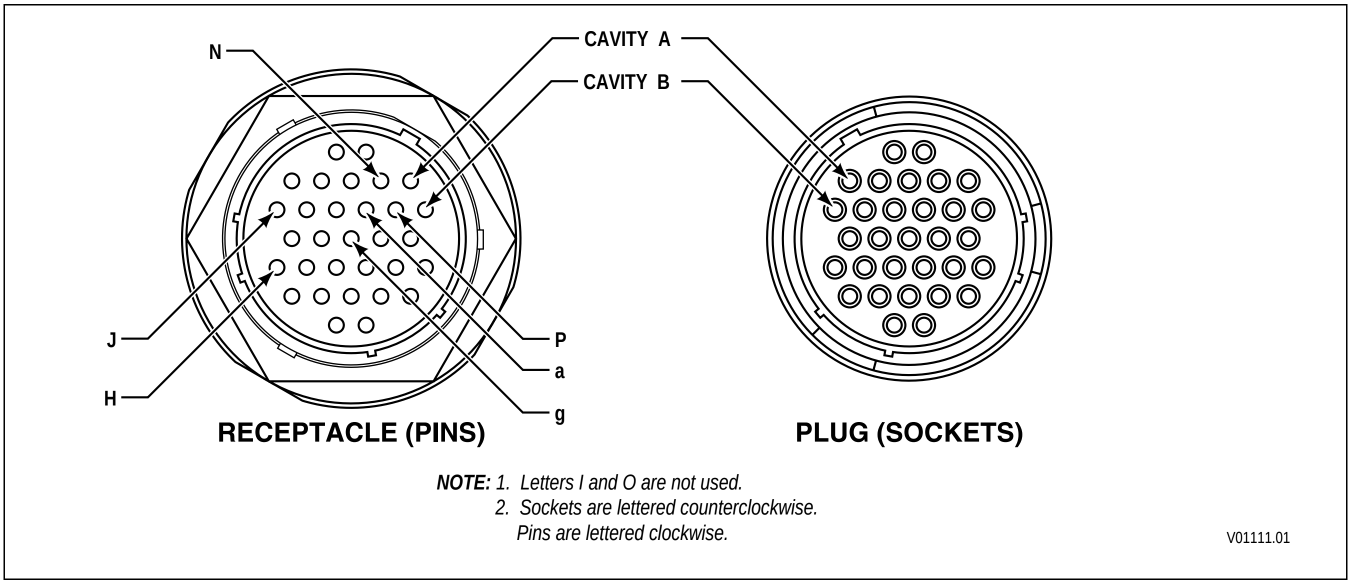


Figure D–4. Deutsch Bulkhead Connector, ECD

BULKHEAD CONNECTOR FOR "S" HARNESS (Plug With Sockets, Receptacle With Pins)

Terminal No.*	Color	Wire No.	Description	Termination Points*
A	Tan	159-S2	Diagnostic Communication Link (ISO 9141)	ECU-S2, VIWS-A
B	Green	115-S31	Check Transmission	ECU-S31, VIWS-B
C	Yellow	126-S28	General Purpose Input 9	ECU-S28, VIWS-C
D	Pink	124-S3	Sensor Power	ECU-S3, RMR-C, PSS-N, SSS-N
E	Yellow	146-S4	Ignition Sense	ECU-S4, VIWS-E, DDRP-H, DDRD-C, OBDII-16
F	Orange	170-S5	Primary Shift Selector, Data Bit 1	ECU-S5, PSS-A
G	Pink	136-S16	Battery Power	ECU-S16, PSS-R, SSS-R
H	White	142-S1	Serial Communication Interface, High	ECU-S1, DDRP-J, DDRD-A, OBDII-7, SCI-A
J	Blue	172-S7	Primary Shift Selector, Data Bit 4	ECU-S7, PSS-C
K	Blue	151-S17	Serial Communication Interface, Low	ECU-S17, DDRP-K, DDRD-B, OBDII-15, SCI-B
L	Orange	176-S15	General Purpose Output 6	ECU-S15, PSS-L, SSS-L, VIWS-L
M	Yellow	119-S11	General Purpose Input 4	ECU-S11, VIWS-M
N	Green	135-S19	Analog Ground	ECU-S19, RMR-A
P	Gray	143-S32	Battery Ground	ECU-S32, PSS-P, SSS-P, VIWS-P, DDRP-A, DDRD-E, OBDII-5
Q	Green	171-S6	Primary Shift Selector, Data Bit 2	ECU-S6, PSS-B
R	Blue	163-S27	General Purpose Input 6	ECU-S27, VIWS-R
S	Yellow	173-S8	Primary Shift Selector, Data Bit 8	ECU-S8, PSS-D
T	Tan	174-S9	Primary Shift Selector, Parity	ECU-S9, PSS-E
U	Green	175-S10	Shift Selector Mode Input	ECU-S10, PSS-M, SSS-M
V	Blue	180-S14	Shift Selector Display	ECU-S14, PSS-S, SSS-S
W	Tan	166-S18	General Purpose Output 7	ECU-S18, VIWS-N
X	Blue	169-S26	General Purpose Input 12	ECU-S26, VIWS-S
Y	Orange	190-S21	Secondary Shift Selector, Data Bit 1	ECU-S21, SSS-A

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

BULKHEAD CONNECTOR FOR "S" HARNESS (Plug With Sockets, Receptacle With Pins) (Contin-

Terminal No.*	Color	Wire No.	Description	Termination Points*
Z				
a	Yellow	164-S20	Retarder Modulation Request	ECU-S20, RMR-B
b	Green	191-S22	Secondary Shift Selector, Data Bit 2	ECU-S22, SSS-B
c	Blue	192-S23	Secondary Shift Selector, Data Bit 4	ECU-S23, SSS-C
d	Tan	157-S30	Vehicle Speed	ECU-S30, VIWS-D
e	Yellow	193-S24	Secondary Shift Selector, Data Bit 8	ECU-S24, SSS-D
f	Tan	194-S25	Secondary Shift Selector, Parity	ECU-S25, SSS-E
g				

BULKHEAD CONNECTOR FOR "T" HARNESS (Receptacle With Sockets, Plug With Pins)

Terminal No.*	Color	Wire No.	Description	Termination Points*
A	Orange	102-T1	Solenoid Power, Solenoids A, D, and J (MD 3070 only)	ECU-T1, TRANS-A
B	Green	103-T5	C Solenoid, Low	ECU-T5, TRANS-B
C	White	104-T7	G Solenoid, Low	ECU-T7, TRANS-C
D	Pink	124-T9	Sensor Power	ECU-T9, TRANS-D, TPS-C, RMR-C
E	Green	107-T3	Solenoid Power, Solenoid F	ECU-T3, TRANS-E
F	White	110-T22	F Solenoid, Low	ECU-T22, TRANS-F
G	White	120-T4	A Solenoid, Low	ECU-T4, TRANS-G
H	Tan	121-T2	Solenoid Power, Solenoids B and E	ECU-T2, TRANS-H
J	Orange	128-T20	B Solenoid, Low	ECU-T20, TRANS-J
K	Tan	129-T6	E Solenoid, Low	ECU-T6, TRANS-K
L	Yellow	130-T17	Solenoid Power, Solenoids C and G	ECU-T17, TRANS-L
M	Blue	131-T21	D Solenoid, Low	ECU-T21, TRANS-M
N	Green	135-T25	Analog Ground	ECU-T25, TRANS-N, TPS-A, RMR-A, RTEMP-B (HD), RMOD-F (MD)
P	Tan	147-T27	Sump Temperature Sensor Input	ECU-T27, TRANS-P
Q	Green	148-T32	Output Speed Sensor, Low	ECU-T32, NO-B, TCASE-D (MD 3070), RMOD-D (MDR)
R	Yellow	139-T16	Output Speed Sensor, High	ECU-T16, NO-A, TCASE-C (MD 3070), RMOD-C (MDR)
S	Orange	150-T30	Engine Speed Sensor, Low	ECU-T30, NE-B
T	Tan	141-T14	Engine Speed Sensor, High	ECU-T14, NE-A
U	Blue	140-T31	Turbine Speed Sensor, Low	ECU-T31, NT-B (HD), TRANS-U (MD)
V	Orange	149-T15	Turbine Speed Sensor, High	ECU-T15, NT-A (HD), TRANS-V (MD)
W	Yellow	195-T13	Transmission Identification	ECU-T13, TRANS-W
X	White	162-T12	C3 Pressure Switch Input	ECU-T12, TRANS-X
Y	Blue	165-T26	Oil Level Sensor Input	ECU-T26, TRANS-Y
Z				
a	Yellow	164-T11	Retarder Modulation Request	ECU-T11, RMR-B
b	Blue	156-T10	Throttle Position Sensor	ECU-T10, TPS-B
c	White	127-T23	H Solenoid, Low	ECU-T23, HSOL-A (HD), RMOD-A (MDR), TCASE-A (MD 3070)

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

BULKHEAD CONNECTOR FOR "T" HARNESS (Receptacle With Sockets, Plug With Pins) (Contin-

Terminal No.*	Color	Wire No.	Description	Termination Points*
d	Orange	138-T28	Retarder Temperature Sensor Input	ECU-T28, RTEMP-A (HD), RMOD-E (MD)
e	Blue	111-T8	J Solenoid, Low	ECU-T8, TRANS-e
f	Blue	101-T24	N Solenoid, Low	ECU-T24, NSOL-A (HD and MD), TRANS-f (MD 3070)
g	Yellow	116-T19	Solenoid Power, Solenoids H and N	ECU-T19, HSOL-B, NSOL-B, TRANS-g, TCASE-B (MD 3070), RMOD-B (MDR)

BULKHEAD CONNECTOR FOR "V" HARNESS (Receptacle With Sockets, Plug With Pins)

Terminal No.*	Color	Wire No.	Description	Termination Points*
A	Green	155-V11	General Purpose Input 1	ECU-V11, VIWV-A
B	Yellow	153-V12	General Purpose Input 2	ECU-V12, VIWV-B
C	Blue	118-V13	General Purpose Input 3	ECU-V13, VIWV-C
D	Pink	124-V8	Sensor Power	ECU-V8, TPS-C
E	Green	105-V19	General Purpose Output 5	ECU-V19, VIWV-E
F	Gray	143-V32	Battery Ground	ECU-V32, VIM-A2
G	Gray	143-V17	Battery Ground	ECU-V17, VIM-A1
H	Tan	112-V22	General Purpose Output 3	ECU-V22, VIM-D2
J	White	114-V2	General Purpose Output 1	ECU-V2, VIM-F3
K	Tan	123-V6	Neutral Start	ECU-V6, VIM-D1
L	Yellow	161-V31	Digital Ground (GPI)	ECU-V31, VIWV-L
M	Blue	179-V9	Engine Water Temperature	ECU-V9, VIWV-M
N	Green	135-V24	Analog Ground	ECU-V24, TPS-A, VIWV-N
P	Green	117-V30	General Purpose Input 8	ECU-V30, VIWV-P
Q	White	113-V4	Reverse Warning	ECU-V4, VIM-F2
R	Orange	178-V28	General Purpose Input 11	ECU-V28, VIWV-R
S	Tan	177-V14	General Purpose Input 10	ECU-V14, VIWV-S
T				
U	Orange	137-V29	General Purpose Input 7	ECU-V29, VIWV-U
V	White	167-V5	General Purpose Output 8	ECU-V5, VIWV-V
W	Pink	136-V16	Battery Power	ECU-V16, VIM-E2
X	Tan	157-V20	Vehicle Speed	ECU-V20, VIM-B2
Y	White	125-V18	General Purpose Output 4	ECU-V18, VIM-C2
Z				
a				
b	Blue	156-V10	Throttle Position Sensor	ECU-V10, TPS-B
c				
d	White	154-V27	General Purpose Input 5	ECU-V27, VIWV-D
e	Yellow	146-V26	Ignition Sense	ECU-V26, VIM-F1
f	Orange	132-V3	General Purpose Output 2	ECU-V3, VIM-B1
g	Pink	136-V1	Battery Power	ECU-V1, VIM-E1

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

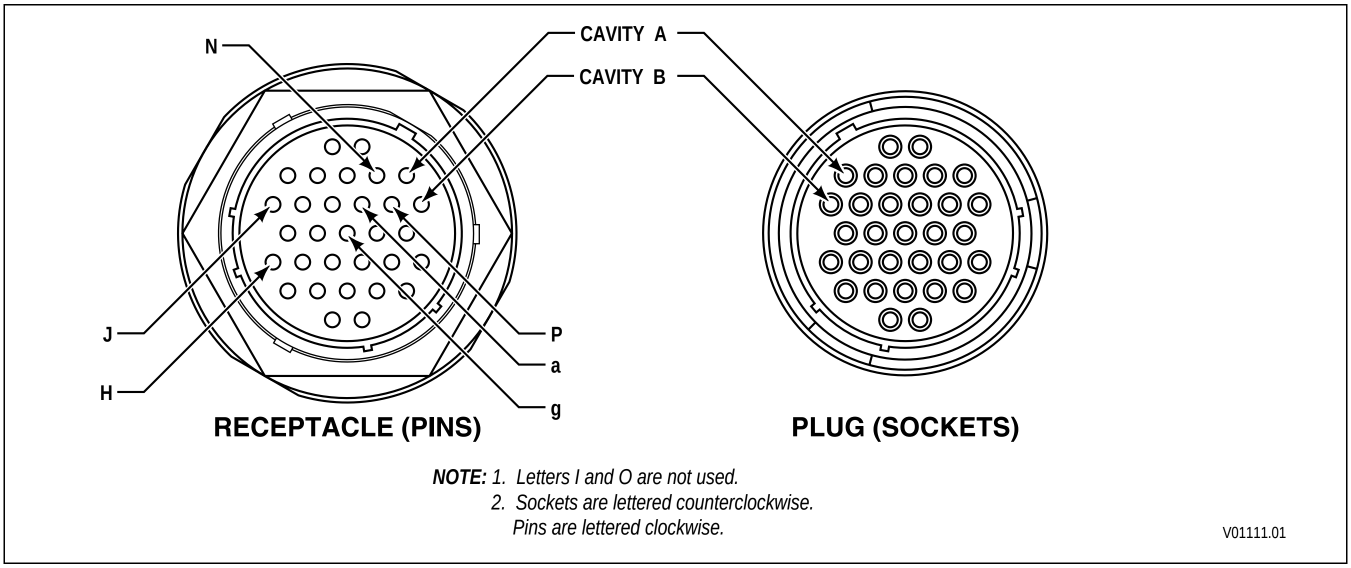


Figure D–5. Deutsch Transmission Connector, ECD

DEUTSCH TRANSMISSION CONNECTOR (Plugs With Sockets, Receptacles With Pins)

Terminal No.*	Color	Wire No.	Description	Termination Points*
A	Orange	102-T1	Solenoid Power, Solenoids A, D, and J	ECU-T1, ASOL-B, DSOL-B, JSOL-B
B	Green	103-T5	C Solenoid, Low	ECU-T5, CSOL-A
C	White	104-T7	G Solenoid, Low	ECU-T7, GSOL-A
D	Pink	124-T9	Sensor Power	ECU-T9, TPS-C, RMR-C, OLS-D
E	Green	107-T3	Solenoid Power, Solenoid F	ECU-T3, FSOL-A
F	White	110-T22	F Solenoid, Low	ECU-T22, FSOL-B
G	White	120-T4	A Solenoid, Low	ECU-T4, ASOL-A
H	Tan	121-T2	Solenoid Power, Solenoids B and E	ECU-T2, BSOL-B, ESOL-B
J	Orange	128-T20	B Solenoid, Low	ECU-T20, BSOL-A
K	Tan	129-T6	E Solenoid, Low	ECU-T6, ESOL-A
L	Yellow	130-T17	Solenoid Power, Solenoids C and G	ECU-T17, GSOL-B, CSOL-B
M	Blue	131-T21	D Solenoid, Low	ECU-T21, DSOL-A
N	Green	135-T25	Analog Ground	ECU-T25, TPS-A, RMR-A, RTEMP-B (HD), RMOD-F (MD), C3PS-B, OILT-LO, OLS-B
P	Tan	147-T27	Sump Temperature Sensor Input	ECU-T27, OILT-HI
Q				
R				
S				
T				
U	Blue	140-T31	Turbine Speed Sensor, Low (MD, MD7 only)	ECU-T31, NT-B
V	Orange	149-T15	Turbine Speed Sensor, High (MD, MD7 only)	ECU-T15, NT-A
W	Yellow	195-T13	Transmission Identification (TransID)	ECU-T13, AGND
X	White	162-T12	C3 Pressure Switch Input	ECU-T12, C3PS-A

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

DEUTSCH TRANSMISSION CONNECTOR (Plugs With Sockets, Receptacles With Pins) (Continued)

Terminal No.*	Color	Wire No.	Description	Termination Points*
Y	Blue	165-T26	Oil Level Sensor Input	ECU-T26, OLS-A
Z				
a				
b				
c				
d				
e	Blue	111-T8	J Solenoid, Low (MD7 or HD7 only)	ECU-T8, JSOL-A
f	Blue	101-T24	N Solenoid, Low (MD7 or HD7 only)	ECU-T24, NSOL-A
g	Yellow	116-T19	Solenoid Power, Solenoids H and N (MD7 only)	ECU-T19, HSOL-B, NSOL-B

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

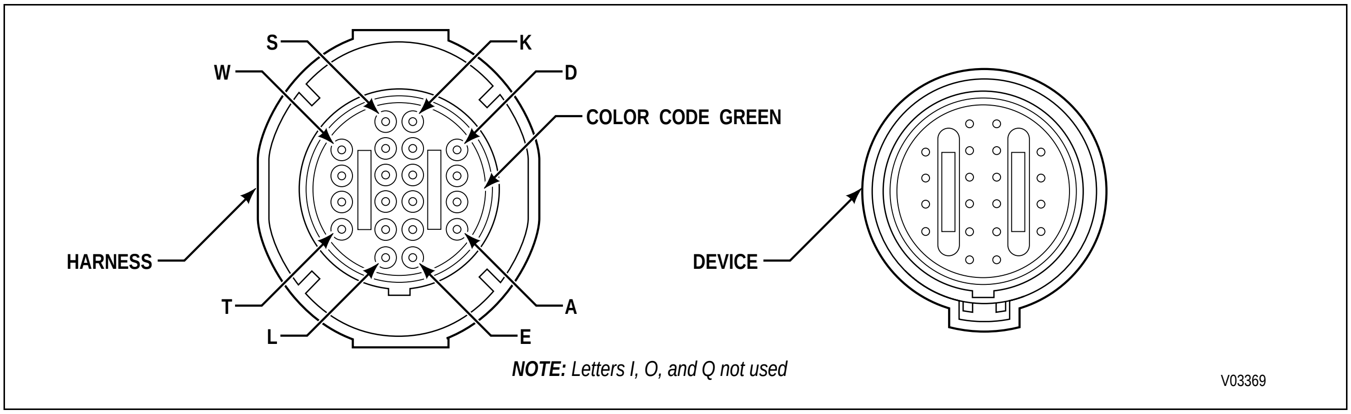


Figure D–6. Remote Selector Connector

REMOTE SHIFT SELECTOR CONNECTOR — PRIMARY SELECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
A	Orange	170-S5	Primary Shift Selector, Data Bit 1	ECU, S5
B	Green	171-S6	Primary Shift Selector, Data Bit 2	ECU, S6
C	Blue	172-S7	Primary Shift Selector, Data Bit 4	ECU, S7
D	Yellow	173-S8	Primary Shift Selector, Data Bit 8	ECU, S8
E	Tan	174-S9	Primary Shift Selector, Parity	ECU, S9
F				
G				
H				
J				
K				
L	Orange	176-S15	General Purpose Output 6	VIWS-L, SSS-L
M	Green	175-S10	Shift Selector Mode Output	SSS-M
N	Pink	124-S3	Sensor Power	RMR-C, SSS-N
P	Gray	143-S32	Battery Ground	VIWS-P, SSS-P, DDRP-A, DDRD-E, or OBDII-5
R	Pink	136-S16	Battery Power	SSS-R
S	Blue	180-S14	Shift Selector Display	SSS-S
T	White	186	Dimmer Input A	SSS-T
U	Yellow	187	Dimmer Input B	SSS-U
V	Gray	188	Dimmer Ground	SSS-V
W				

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

REMOTE SHIFT SELECTOR CONNECTOR — SECONDARY SELECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
A	Orange	190-S5	Secondary Shift Selector, Data Bit 1	ECU, S21
B	Green	191-S6	Secondary Shift Selector, Data Bit 2	ECU, S22
C	Blue	192-S7	Secondary Shift Selector, Data Bit 4	ECU, S23
D	Yellow	193-S8	Secondary Shift Selector, Data Bit 8	ECU, S24
E	Tan	194-S9	Secondary Shift Selector, Parity	ECU, S25
F				
G				
H				
J				
K				
L	Orange	176-S15	General Purpose Output 6	VIWS-L, SSS-L
M	Green	175-S10	Shift Selector Mode Output	SSS-M
N	Pink	124-S3	Sensor Power	RMR-C, SSS-N
P	Gray	143-S32	Battery Ground	VIWS-P, SSS-P, DDRP-A, DDRD-E, or OBDII-5
R	Pink	136-S16	Battery Power	SSS-R
S	Blue	180-S14	Shift Selector Display	SSS-S
T	White	186	Dimmer Input A	SSS-T
U	Yellow	187	Dimmer Input B	SSS-U
V	Gray	188	Dimmer Ground	SSS-V
W				

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

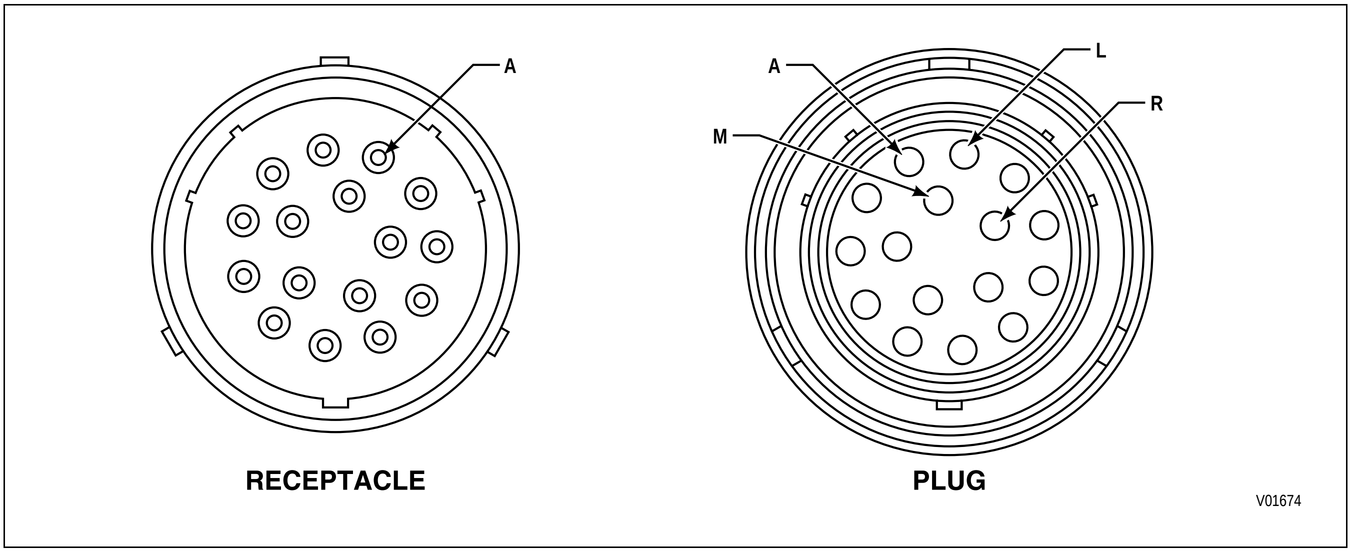


Figure D–7. Optional Deutsch Sensor Harness Connector

OPTIONAL DEUTSCH SENSOR HARNESS CONNECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
A				
B				
C	Green	135-T25	Analog Ground	ECU-T25, TRANS-N, RTEMP-B (HD), RMOD-F (MD), TPS-A, RMR-A
D	Orange	138-T28	Retarder Temperature Sensor Input	ECU-T28, RTEMP-A (HD), RMOD-E (MD)
E	Yellow	116-T19	Solenoid Power, Solenoids H and N	ECU-T19, HSOL-B, NSOL-B
F	White	127-T23	H Solenoid, Low	ECU-T23, HSOL-A
G	Yellow	116-T19	Solenoid Power, Solenoids H and N	ECU-T19, HSOL-B, NSOL-B
H	Blue	101-T24	N Solenoid, Low	ECU-T24, NSOL-B
J				
K				
L	Blue	140-T31	Turbine Speed Sensor, Low	ECU-T31, NT-B (HD)
M	Orange	149-T15	Turbine Speed Sensor, High	ECU-T15, NT-A (HD)
N	Orange	150-T30	Engine Speed Sensor, Low	ECU-T30, NE-B
P	Tan	141-T14	Engine Speed Sensor, High	ECU-T14, NE-A
R	Green	148-T32	Output Speed Sensor, Low	ECU-T32, NO-B
S	Yellow	139-T16	Output Speed Sensor, High	ECU-T16, NO-A

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

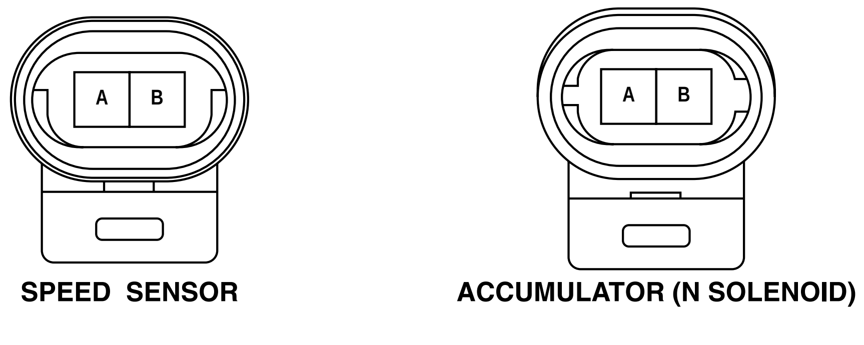


Figure D–8. Speed Sensor Connector

ENGINE SPEED SENSOR CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Tan	141-T14	Engine Speed Sensor Hi	ECU-T14
B	Orange	150-T30	Engine Speed Sensor Lo	ECU-T30

TURBINE SPEED SENSOR CONNECTOR (HD/B 500 ONLY)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Orange	149-T15	Turbine Speed Sensor Hi	ECU-T15
B	Blue	140-T31	Turbine Speed Sensor Lo	ECU-T31

OUTPUT SPEED SENSOR CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Yellow	139-T16	Output Speed Sensor Hi	ECU-T16
B	Green	148-T32	Output Speed Sensor Lo	ECU-T32

ACCUMULATOR (N) SOLENOID

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Blue	101-T24	N Solenoid Lo	ECU-T24
B	Yellow	116-T19	N Solenoid Hi	ECU-T19

MD RETARDER (H SOLENOID, TID 2)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	127-T23	H Solenoid Lo	ECU-T23
B	Yellow	116C-T19	H Solenoid Hi	ECU-T19

APPENDIX D — WIRE/CONNECTOR CHART

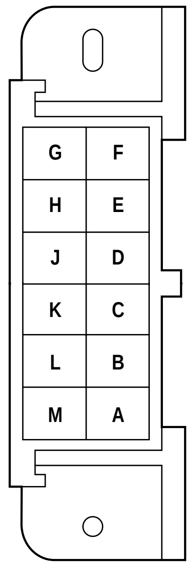


Figure D–9. Diagnostic Connector (Packard)

DIAGNOSTIC CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Gray	143-S32	Battery (–)	ECU-S32, VIWS-P, PSS-P, SSS-P
H	Yellow	146-S4	Ignition Signal (+)	ECU-S4, VIWS-E
J	White	142-S1	Serial Communication (+)	ECU-S1, SCI-A
K	Blue	151-S17	Serial Communication (–)	ECU-S17, SCI-B

APPENDIX D — WIRE/CONNECTOR CHART

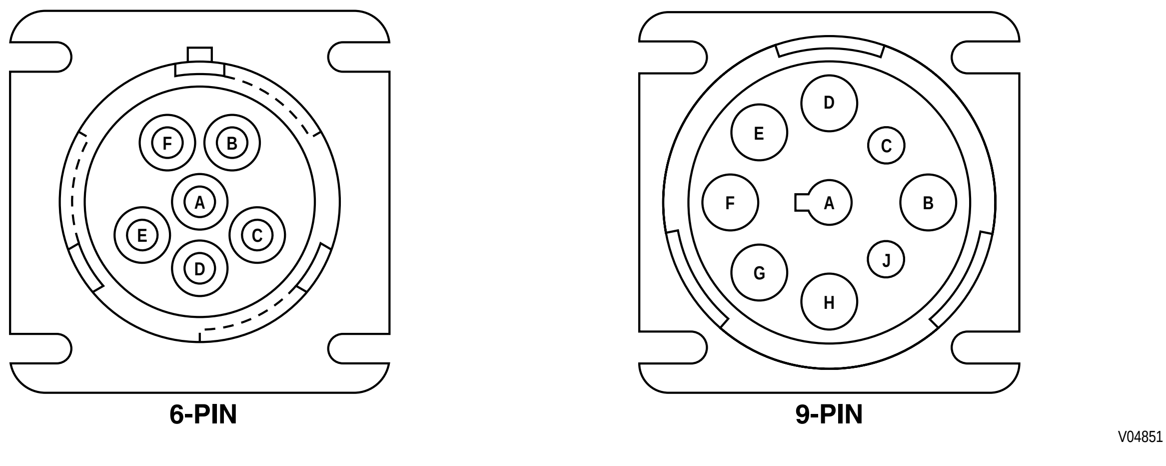


Figure D–10. Optional Deutsch DDR Connectors

OPTIONAL 6-PIN DIAGNOSTIC CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	142-S1	Serial Communication (+)	ECU-S1, SCI-A
B	Blue	151-S17	Serial Communication (–)	ECU-S17, SCI-B
C	Yellow	146-S4	Ignition Signal (+)	ECU-S4, VIWS-E
D			Open	
E	Gray	143-S32	Battery (–)	ECU-S32, VIWS-P, PSS-P, SSS-P
F			Open	

OPTIONAL 9-PIN DIAGNOSTIC CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Gray	143-S32	Battery Ground (–)	ECU-S32, VIWS-P, PSS-P, SSS-P
B	Yellow	146-S4	Ignition Power (+)	ECU-S4, VIWS-E
B (Optional)	Pink	136-S16	Battery Power (+)	ECU-S16, PSS-R, SSS-R
C	Pink	183-S13	J1939 High	ECU-S13, J1939-A/H
D	Gray	184-S29	J1939 Low	ECU-S29, J1939-B/L
E	Green	182-S12	J1939 Shield/Ground	ECU-S12, J1939-C/S
F	White	142-S1	Serial Communication (+)	ECU-S1, SCI-A
G	Blue	151-S17	Serial Communication (–)	ECU-S17, SCI-B

APPENDIX D — WIRE/CONNECTOR CHART

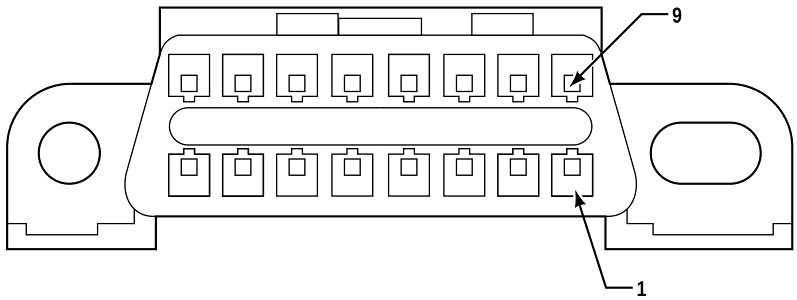


Figure D–11. GMC Connector for OBD-II DDR Adapter

OPTIONAL OBD–II DDR CONNECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
1				
2				
3				
4				
5	Gray	143-S32	Battery Ground (–)	ECU-S32, VIWS-P, PSS-P, SSS-P
6				
7	White	142-S1	Serial Communication Interface, Hi	ECU-S1, SCI-A
8				
9				
10				
11				
12				
13				
14				
15	Blue	151-S17	Serial Communication Interface, Lo	ECU-S17, SCI-B
16	Yellow	146-S4	Ignition Sense (+)	ECU-S4, VIWS-E

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

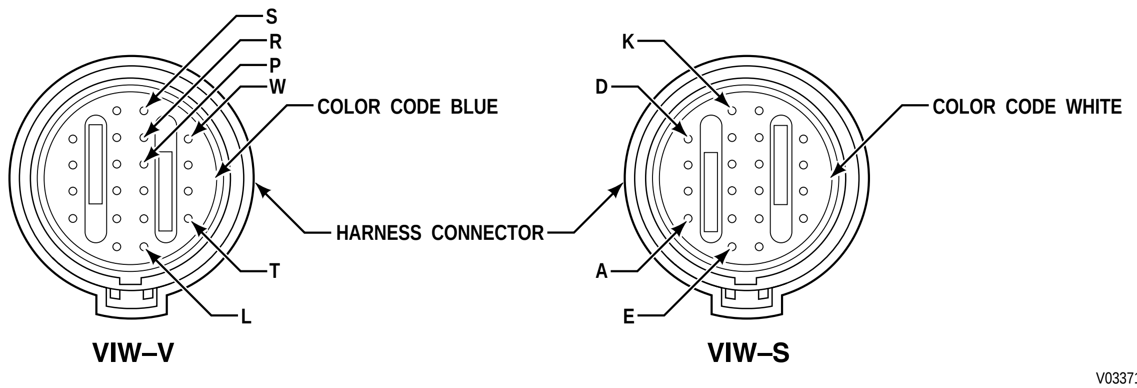


Figure D–12. VIW Connector (Packard Micro Pack)

VIW–V CONNECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
A	Green	155-V11	General Purpose Input 1	ECU-V11, VIWV-A
B	Yellow	153-V12	General Purpose Input 2	ECU-V12, VIWV-B
C	Blue	118-V13	General Purpose Input 3	ECU-V13, VIWV-C
D	White	154-V27	General Purpose Input 5	ECU-V27, VIWV-D
E	Green	105-V19	General Purpose Output 5	ECU-V19, VIWV-E
F				
G				
H				
J				
K				
L	Yellow	161-V31	Digital Ground (GPI)	ECU-V31, VIWV-L
M	Blue	179-V9	Engine Water Temperature	ECU-V9, VIWV-M
N	Green	135-V24	Analog Ground	ECU-V24, TPS-A, VIWV-N
P	Green	117-V30	General Purpose Input 8	ECU-V30, VIWV-P
R	Orange	178-V28	General Purpose Input 11	ECU-V28, VIWV-R
S	Tan	177-V14	General Purpose Input 10	ECU-V14, VIWV-S
T				
U	Orange	137-V29	General Purpose Input 7	ECU-V29, VIWV-U
V	White	167-V5	General Purpose Output 8	ECU-V5, VIWV-V
W				

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

VIW–S CONNECTOR

Terminal No.*	Color	Wire No.	Description	Termination Point(s) *
A	Tan	159-S2	Diagnostic Communication Link (ISO9141)	ECU-S2, VIWS-A
B	Green	115-S31	Check Transmission	ECU-S31, VIWS-B
C	Yellow	126-S28	General Purpose Input 9	ECU-S28, VIWS-C
D	Tan	157-S30	Vehicle Speed	ECU-S30, VIWS-D
E	Yellow	146-S4	Ignition Sense	ECU-S4, VIWS-E, DDRP-H, DDRD-C
F				
G				
H				
J				
K				
L	Orange	176-S15	General Purpose Output 6	ECU-S15, VIWS-L, PSS-L, SSS-L
M	Yellow	119-S11	General Purpose Input 4	ECU-S11, VIWS-M
N	Tan	166-S18	General Purpose Output 7	ECU-S18, VIWS-N
P	Gray	143-S32	Battery Ground	ECU-S32, VIWS-P, PSS-P, SSS-P, DDRP-A, DDRD-E
R	Blue	163-S27	General Purpose Input 6	ECU-S27, VIWS-R
S	Blue	169-S26	General Purpose Input 12	ECU-S26, VIWS-S
T	White	186	Dimmer Input A	VIWS-T, PSS-T, SSS-T
U	Yellow	187	Dimmer Input B	VIWS-U, PSS-U, SSS-U
V	Gray	188	Dimmer Ground	VIWS-V, PSS-V, SSS-V
W				

* Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulk-head connector are used.

APPENDIX D — WIRE/CONNECTOR CHART

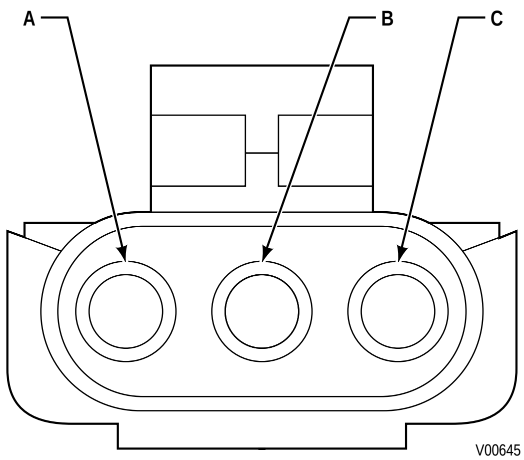


Figure D–13. TPS Connector

THROTTLE POSITION SENSOR CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Green	135-T25 or 135-V24	Analog Ground	ECU-T25 or V24; TRANS-N; RMR-A, RMOD-F or B; VIWV-N
B	Blue	156-T10 or V10	TPS Signal	ECU-T10 or V10
C	Pink	124-T9 or V8	TPS Hi	ECU-T9 or V8; RMR-C

APPENDIX D — WIRE/CONNECTOR CHART

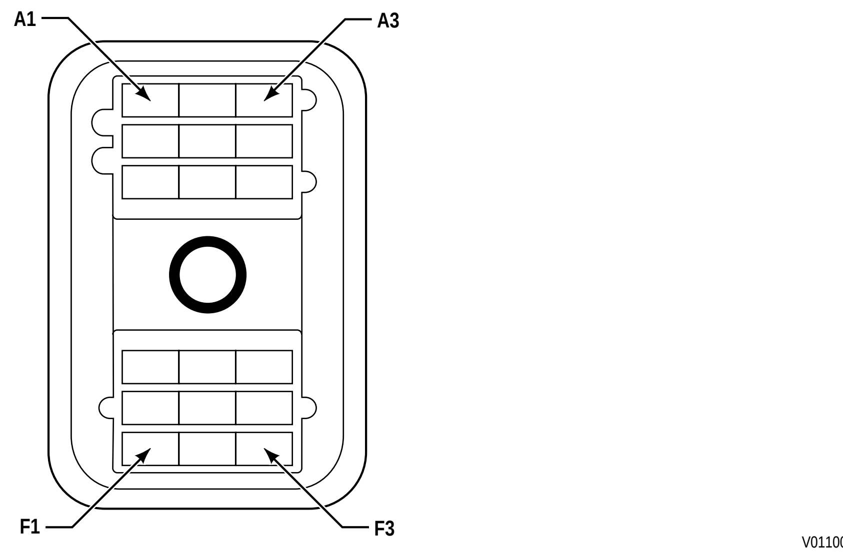


Figure D–14. VIM Connector (Harness)

VIM CONNECTOR (HARNESS)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A1	Gray	143-V17	Battery (–)	ECU-V17
A2	Gray	143-V32	Battery (–)	ECU-V32
A3			Reserved	
B1	Orange	132-V3	GPO 2	ECU-V3
B2	Tan	157-V20	Speedometer Signal	ECU-V20
B3			Reserved	
C1			Reserved	
C2	White	125-V18	GPO 4	ECU-V18
C3			Reserved	
D1	Tan	123-V6	Neutral Start	ECU-V6
D2	Tan	112-V22	GPO 3	ECU-V22
D3			Reserved	
E1	Pink	136-V1	Battery (+)	ECU-V1
E2	Pink	136-V16	Battery (+)	ECU-V16
E3			Reserved	
F1	Yellow	146-V26	Ignition Sense (+)	ECU-V26
F2	White	113-V4	Reverse Warning	ECU-V4
F3	White	114-V2	GPO 1	ECU-V2

APPENDIX D — WIRE/CONNECTOR CHART

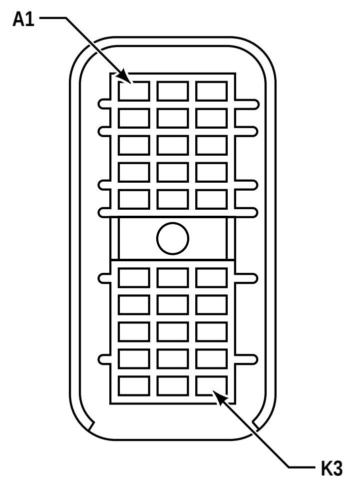


Figure D–15. VIM Connector (Harness)

VIM CONNECTOR (HARNESS 30-WAY)

Terminal No.	Color	Wire No.	Description	Termination Point(s)*
A1	Blue	313NO	Reverse Warning Relay — Normally Open	
A2	Yellow	314CM	Output Wire 114 Relay — Common	
A3	Blue	314NO	Output Wire 114 Relay — Normally Open	
B1	Yellow	313CM	Reverse Warning Relay — Common	
B2	Green	314NC	Output Wire 114 Relay — Normally Closed	
B3			Reserved	
C1	Orange	346	Ignition Power	
C2	Green	312NC	Output Wire 112 Relay — Normally Closed	
C3			Reserved	
D1	Green	325NC	Output Wire 125 Relay — Normally Closed	
D2	Green	332NC	Output Wire 132 Relay — Normally Closed	
D3			Reserved	
E1	Yellow	325CM	Output Wire 125 Relay — Common	
E2	Yellow	332CM	Output Wire 132 Relay — Common	
E3	Blue	332NO	Output Wire 132 Relay — Normally Open	
F1	Blue	323NO	Neutral Start Relay — Normally Open	
F2	Yellow	312CM	Output Wire 112 Relay — Common	
F3	Blue	312NO	Output Wire 112 Relay — Normally Open	
G1	Yellow	323CM	Neutral Start Relay — Common	
G2			Reserved	
G3			Reserved	
H1			Reserved	
H2	White	357UF	Speedometer — Unfiltered	
H3			Reserved	
J1	Pink	336A	Battery Power	
J2	Pink	336C	Battery Power	
J3			Reserved	
K1	Gray	343A	Battery Ground	
K2	Gray	343C	Battery Ground	
K3			Reserved	

* Termination Points are determined by OEM electrical system design.

APPENDIX D — WIRE/CONNECTOR CHART

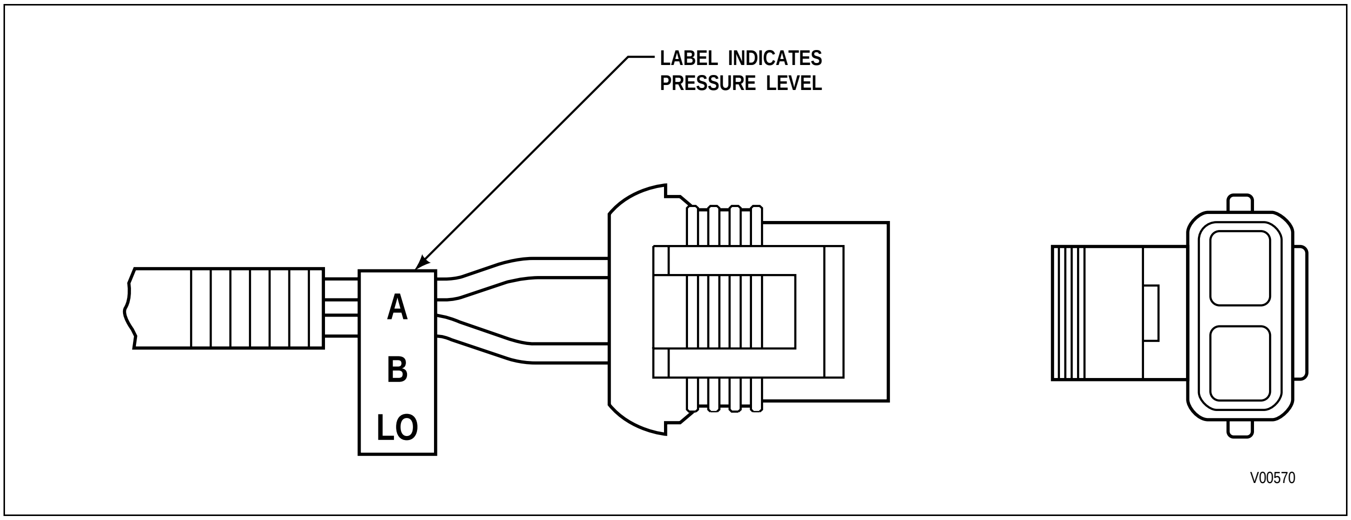


Figure D–16. Resistance Module Type 2 — Single Pressure Switch and SCI Interface

RESISTANCE MODULE TYPE 2

Terminal No.
A
B

SCI INTERFACE CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	142-S1	Serial Communication Interface, Hi	ECU-S1, DDRP-J, DDRD-A
B	Blue	151-S17	Serial Communication Interface, Lo	ECU-S17, DDRP-K, DDRD-B

APPENDIX D — WIRE/CONNECTOR CHART

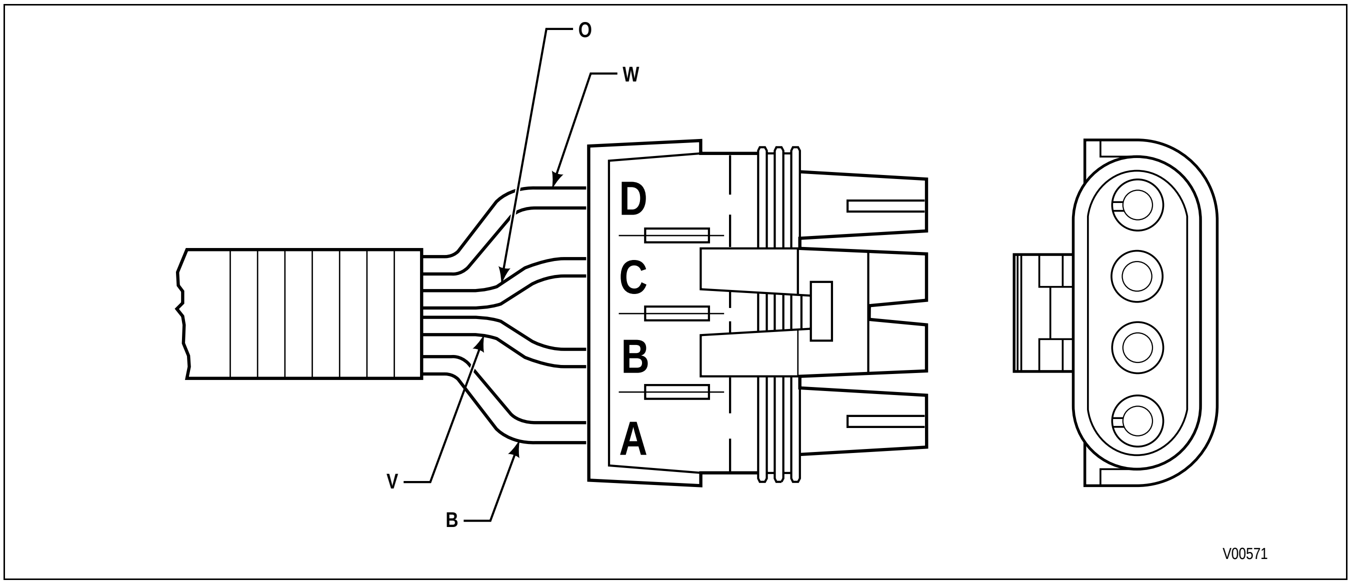


Figure D–17. Resistance Module Type 3 — Bendix E-10R Pedal

RESISTANCE MODULE TYPE 3

Terminal No.	Wire Color
A	Blue
B	Violet
C	Orange
D	White

APPENDIX D — WIRE/CONNECTOR CHART

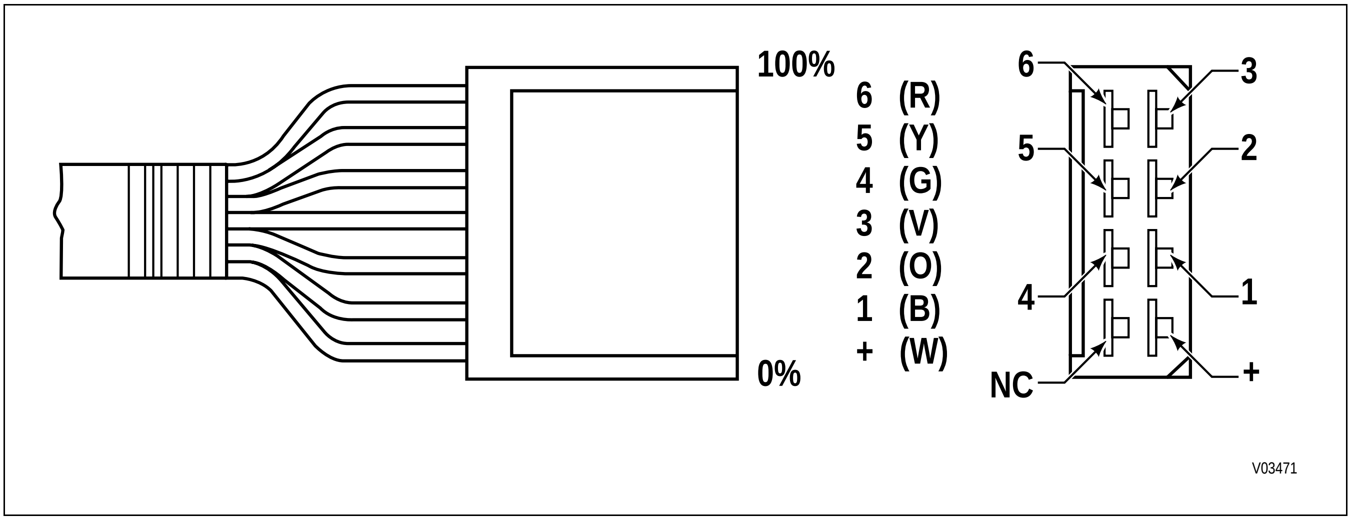


Figure D–18. Resistance Module Type 5 — Hand Lever

RESISTANCE MODULE TYPE 5

Terminal No.	Wire Color
+	White
1	Blue
2	Orange
3	Violet
4	Green
5	Yellow
6	Red

APPENDIX D — WIRE/CONNECTOR CHART

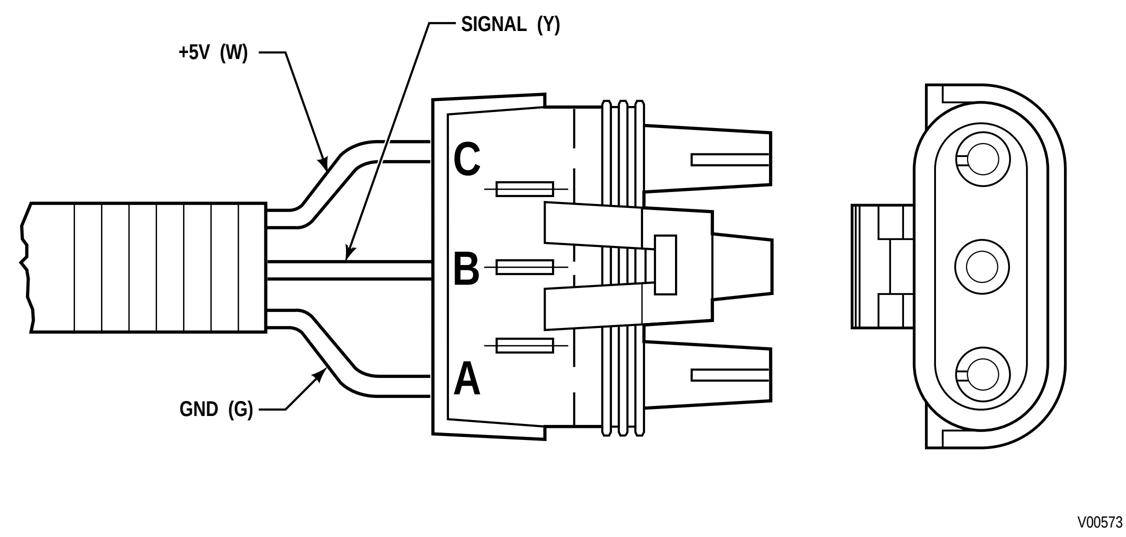


Figure D–19. Resistance Module Type 7 — Dedicated Pedal

RESISTANCE MODULE TYPE 7

Terminal No.	Wire Color
A	Green
B	Yellow
C	White

APPENDIX D — WIRE/CONNECTOR CHART

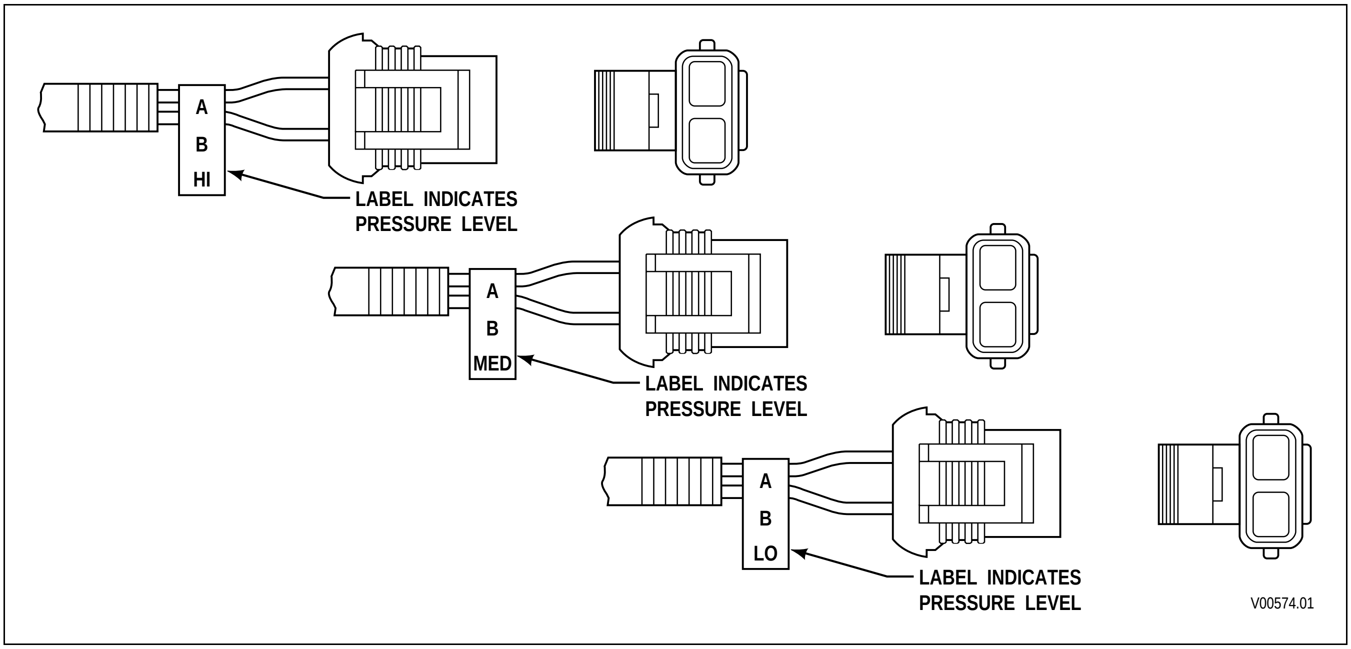


Figure D–20. Resistance Module Type 8 — Three Pressure Switch

RESISTANCE MODULE TYPE 8

LOW PRESSURE

Terminal No.	Wire Color
A	White
B	Blue

MEDIUM PRESSURE

Terminal No.	Wire Color
A	White
B	Orange

HIGH PRESSURE

Terminal No.	Wire Color
A	White
B	Violet

APPENDIX D — WIRE/CONNECTOR CHART

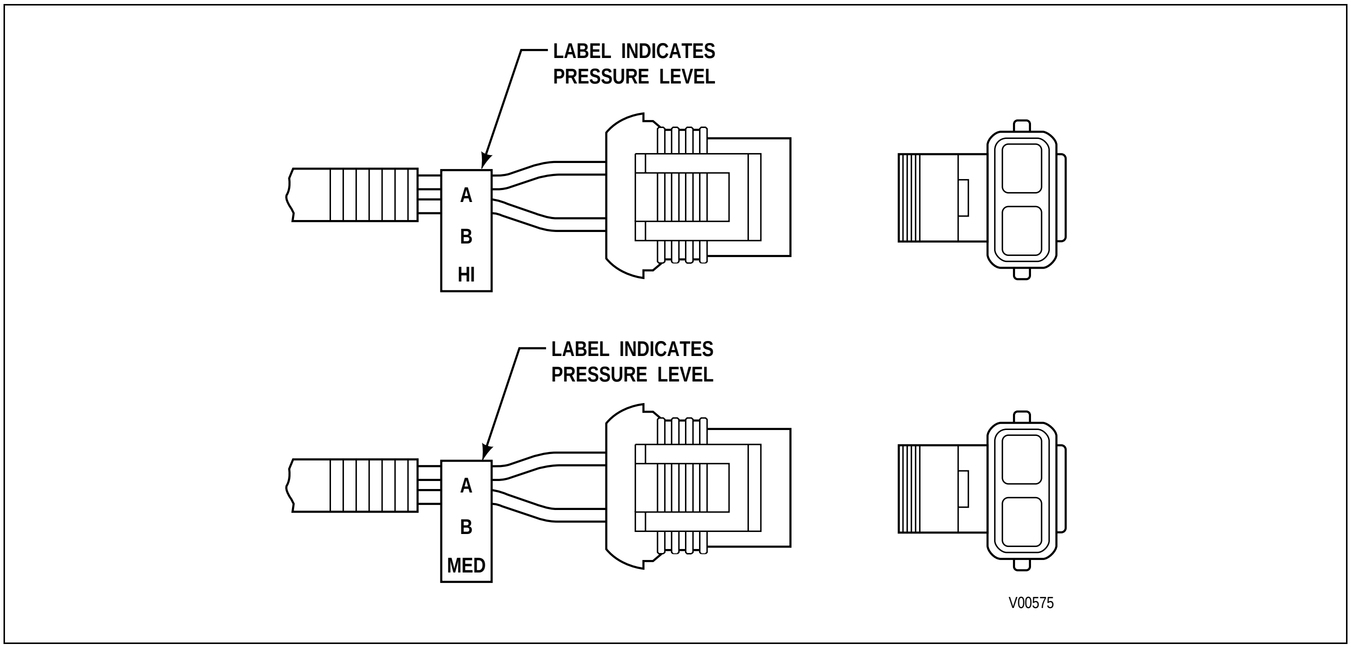


Figure D–21. Resistance Module Type 9 — Two Pressure Switch

RESISTANCE MODULE TYPE 9

MEDIUM PRESSURE

Terminal No.	Wire Color
A	White
B	Orange

HIGH PRESSURE

Terminal No.	Wire Color
A	White
B	Violet

APPENDIX D — WIRE/CONNECTOR CHART

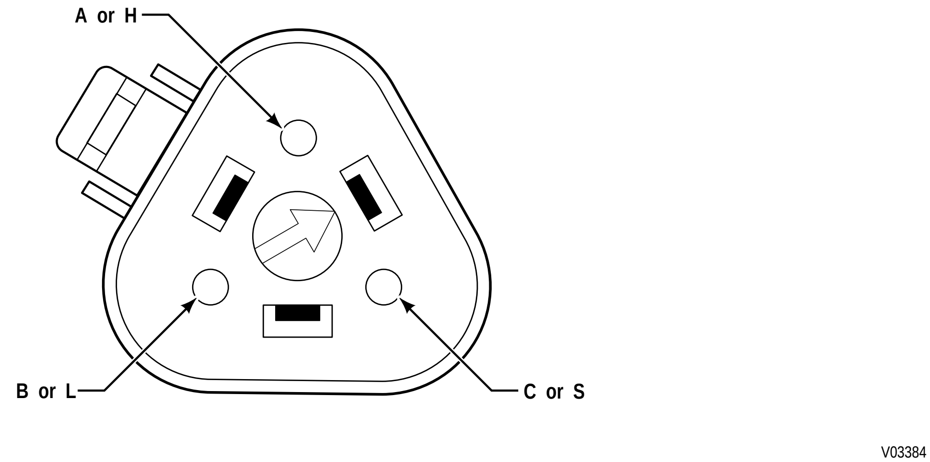


Figure D–22. J1939 Interface Connector

J1939 INTERFACE CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A or H	Pink	183-S13	J1939 Controller, Hi	ECU-S13
B or L	Gray	184-S29	J1939 Controller, Lo	ECU-S29
C or S	Green	182-S12	J1939 Shield	ECU-S12

APPENDIX E — WELDING ON VEHICLE/VEHICLE INTERFACE MODULE

1–3. WELDING ON VEHICLE

When frame or other welding is required on the vehicle, take the following precautions to protect the electronic control components:

1. Disconnect the wiring harness connectors at the transmission electronic control unit.
2. Disconnect the positive and negative battery connections, and any electronic control ground wires connected to the frame or chassis.
3. Cover electronic control components and wiring to protect them from hot sparks, etc.
4. Do not connect welding cables to electronic control components.

WARNING!	**Do not jump start a vehicle with arc welding equipment. Arc welding equipment's dangerously high currents and voltages cannot be reduced to safe levels.**

1–4. VEHICLE INTERFACE MODULE

The Allison Vehicle Interface Module (VIM) containing all Allison system relays and fuses must be used as the interface to all vehicle wiring. Refer to Figure E–2 for VIM component location and pin-out.To close an open VIM, tighten the bolts in the numerical order shown in Figure E–1 to provide a sealed, water-tight box. Torque the bolts to 5–8 Nm (4–6 lb ft).

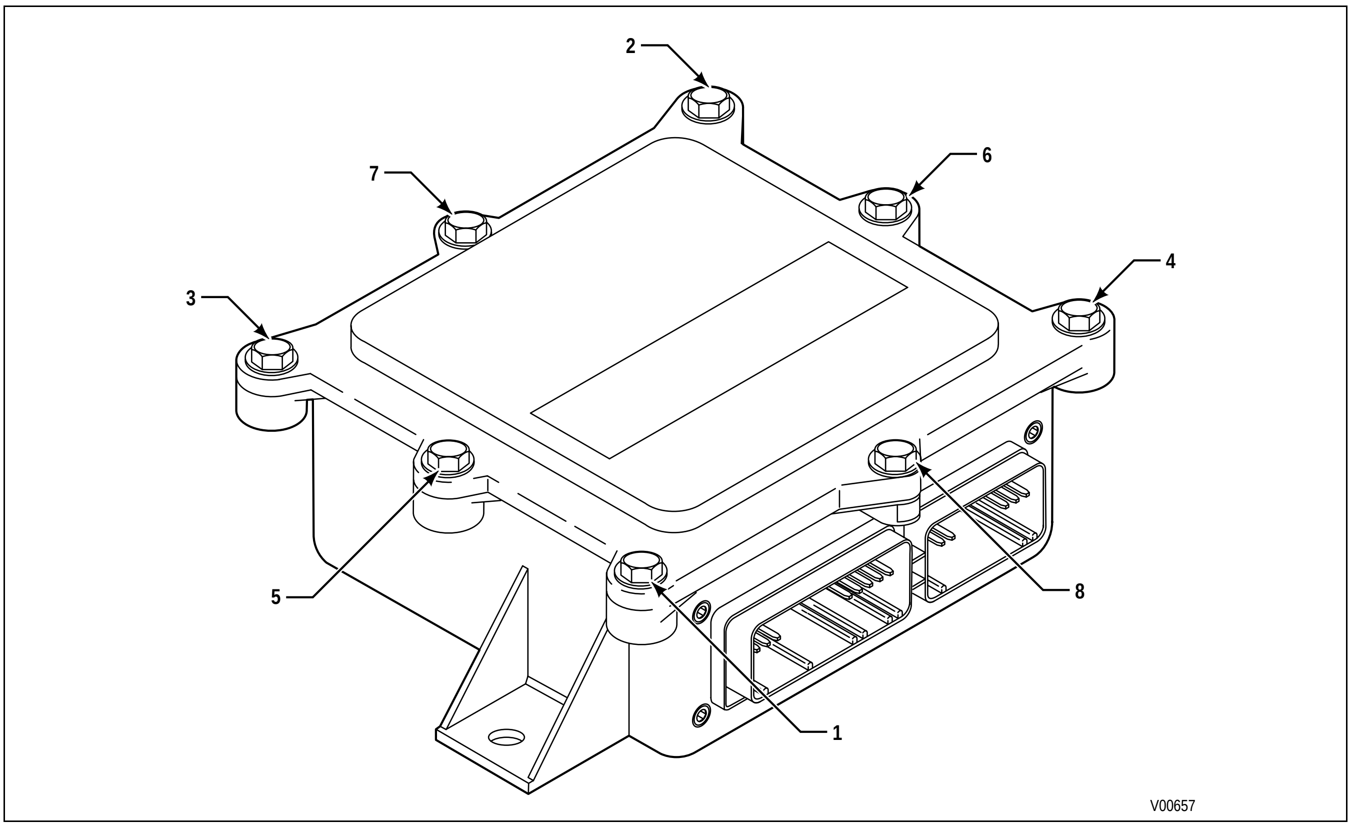


Figure E–1. Vehicle Interface Module

APPENDIX E — WELDING ON VEHICLE/VEHICLE INTERFACE MODULE

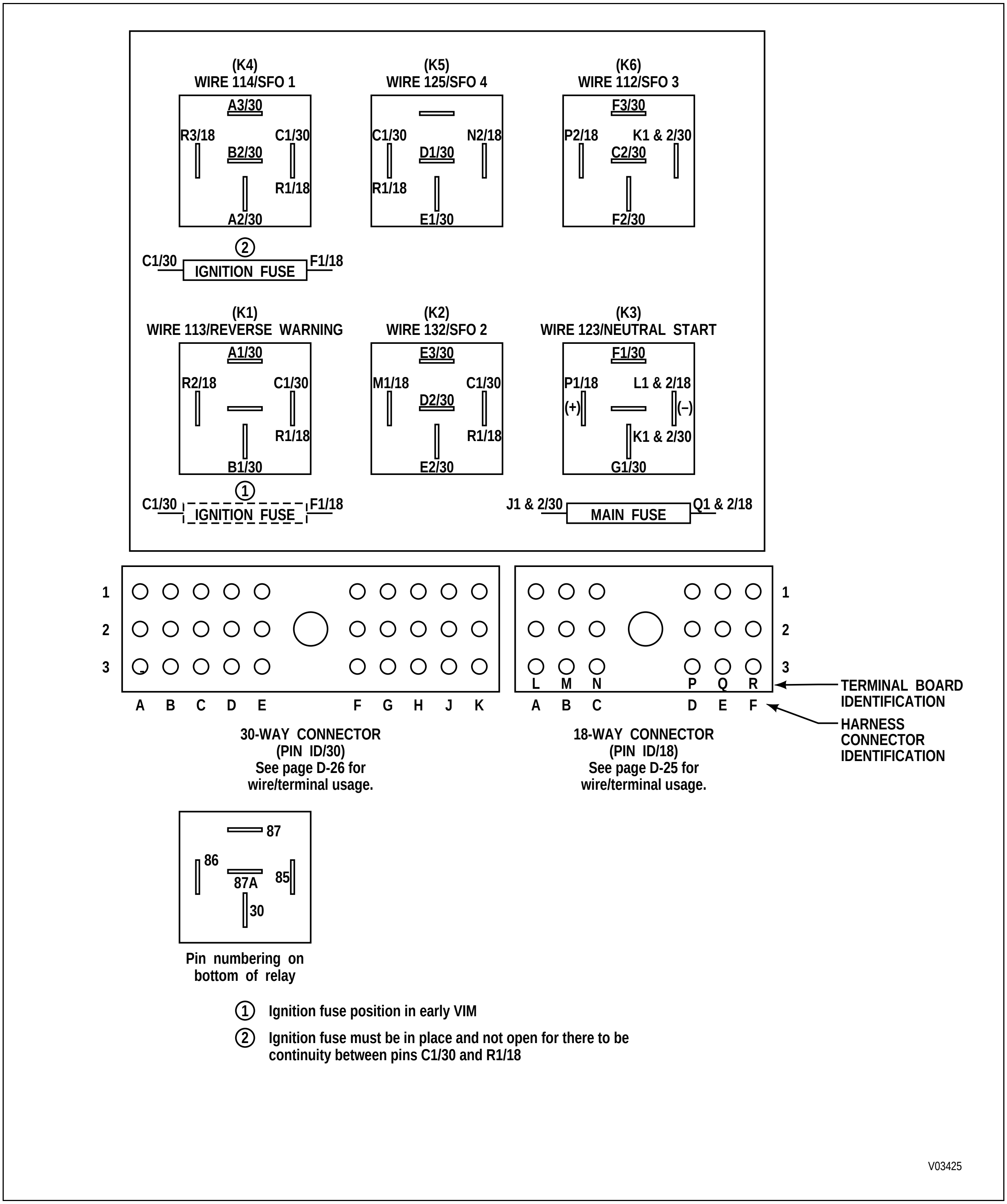


Figure E–2. VIM Components Location and Pin-Out Diagram

APPENDIX F — DIAGNOSTIC TREE — WT HYDRAULIC SYSTEM

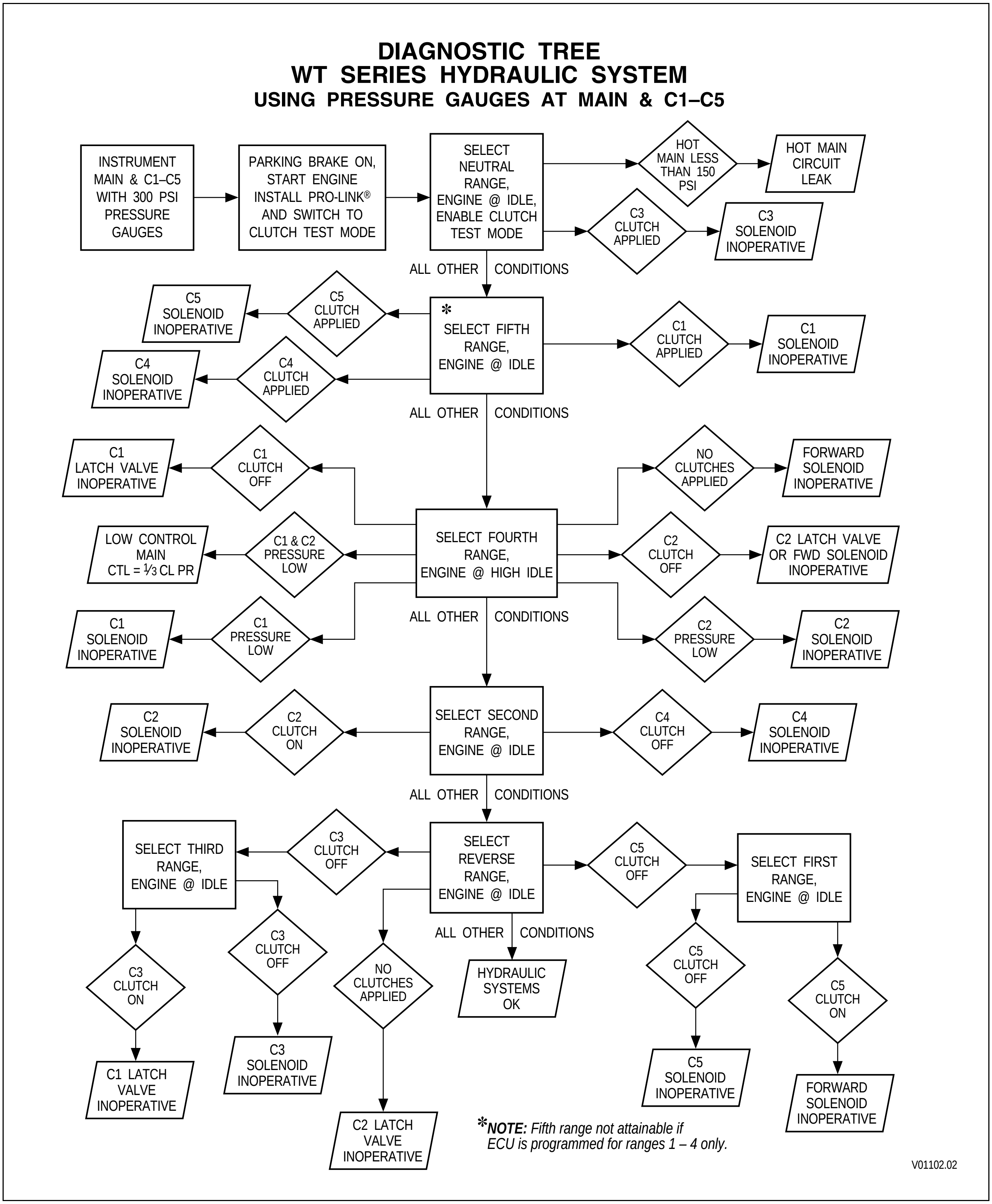


Figure F–1. Diagnostic Tree — WT Series Hydraulic System With Gauges

APPENDIX F — DIAGNOSTIC TREE — WT HYDRAULIC SYSTEM

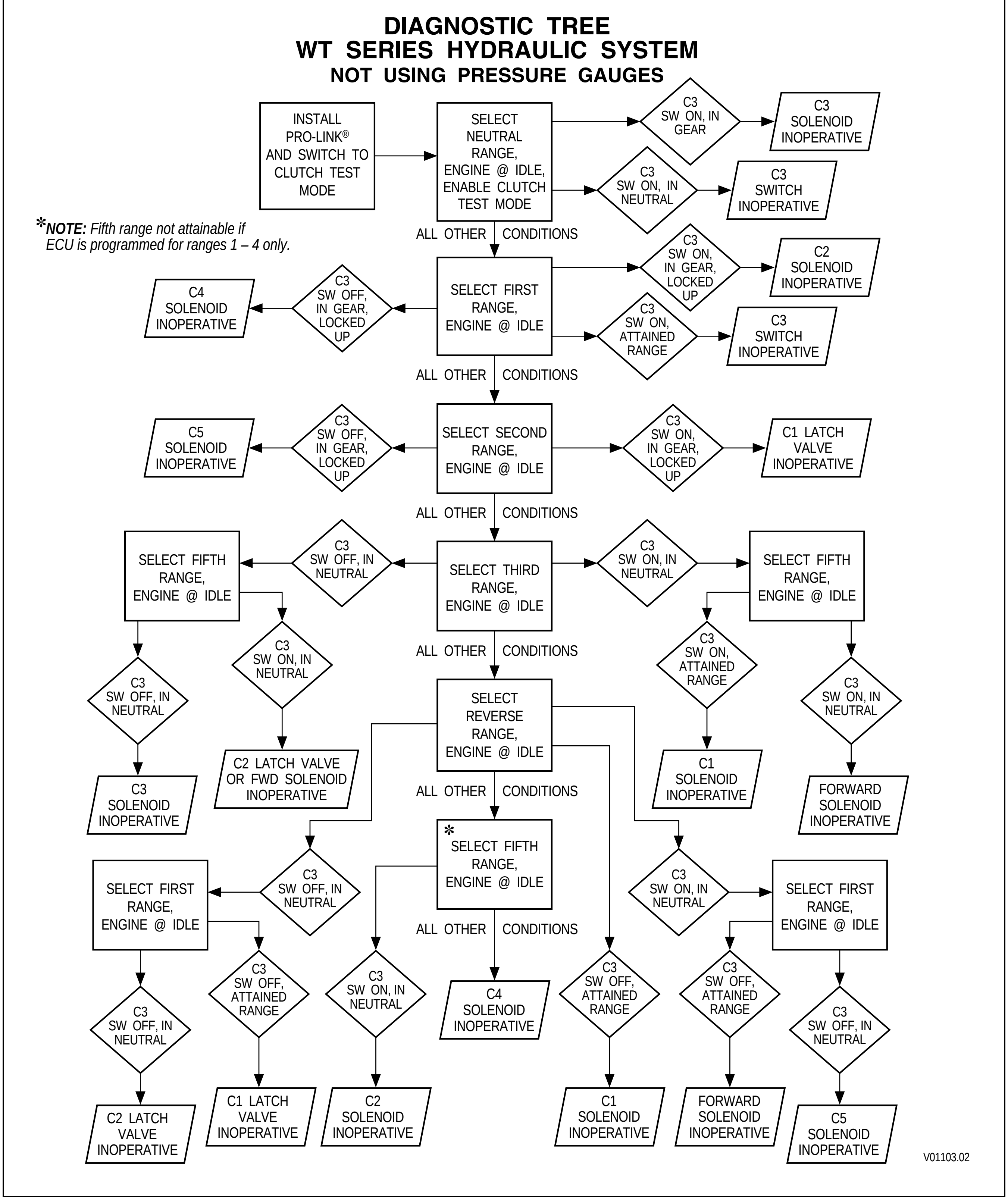


Figure F–2. Diagnostic Tree — WT Series Hydraulic System Without Gages

APPENDIX G — PRO-LINK® 9000 DIAGNOSTIC DATA READER INFORMATION

Pro-link® 9000 Diagnostic Tools

The WTEC III system will require new Pro-Link® 9000 hardware for reprogramming and diagnostics. The following is a list of required updates to the current Pro-Link® 9000 hardware:

Hardware	Tool P/N
Diagnostic Cartridge	J38500-303
PROM Update Kit	J38500-313
MultiProtocol Cartridge (MPC)	J38500-1500A
Reprogramming PCMCIA Card*	J38500-1700
Diagnostic Card*	J38500-1800

* Requires J38500-1500A to function

Limited diagnostic information for the WTEC III system can be accessed through the current WTEC II Pro-Link® 9000 hardware. This diagnostic information will however be limited to that information that is common to the WTEC II and WTEC III systems. Access to information described in this SIL can only be accessed through **either** the WTEC III Diagnostic Cartridge or by updating the current WTEC II Diagnostic Cartridge with the PROM update kit or the WTEC III Reprogramming Cartridge.

The MultiProtocol Cartridge (MPC) and the Reprogramming Card are required to modify customer constants and alter Calibration packages within the WTEC III ECU. After completing an ATD-approved training class, those ordering a reprogramming cartridge are required to submit a copy of their completion certificate with their order. This serves as proof of eligibility to purchase these items. Training is available from ATD and ATD distributors.

APPENDIX H — INPUT/OUTPUT FUNCTIONS

The schematics which follow were taken from the Sales Tech Data Book entitled “WTEC III Controls.” These schematics provide detail information needed to correctly perform input and output function connections.

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

A. SECONDARY SHIFT SCHEDULE

USES: Provides operator selection of dual shift schedules. Can be used for performance/economy, loaded/empty, or other shift schedule combinations.

VARIABLES TO SPECIFY: None

VOCATIONS: Various

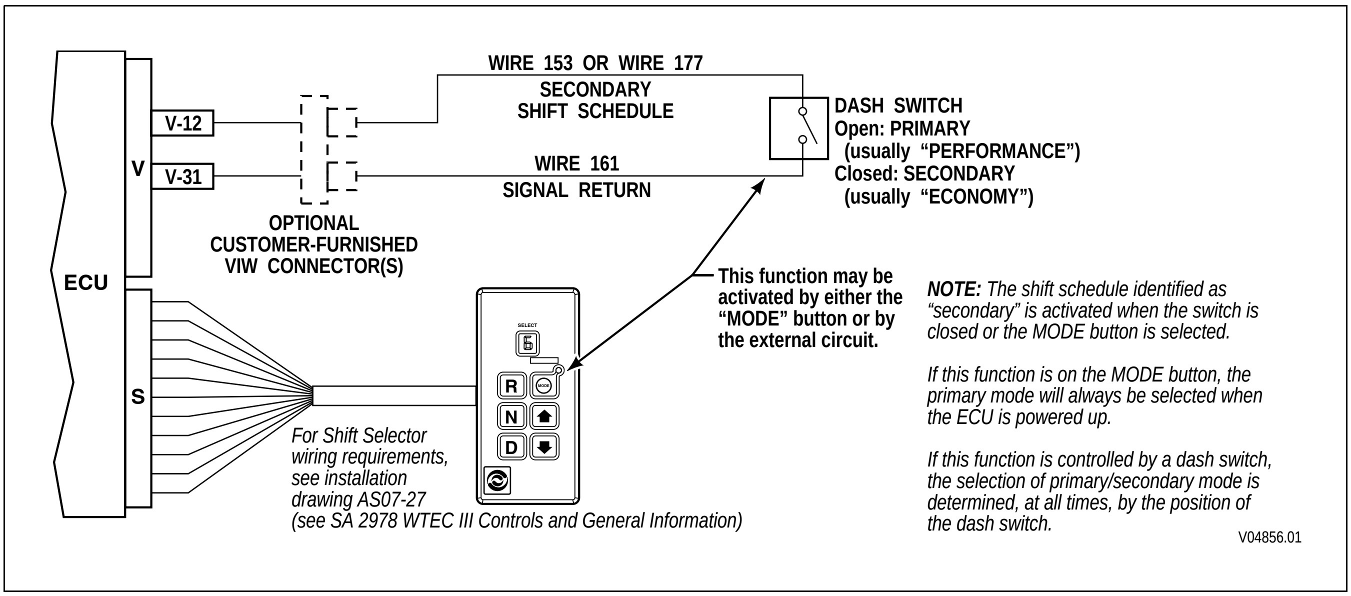


Figure H–1. Secondary Shift Schedule

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

B. D1 SELECTION

USES: Provides a convenient means of attaining 1st range hold for pushbutton shift selectors. Range to select is programmable for Primary and Secondary modes.

VARIABLES TO SPECIFY: Primary Mode selected range, Secondary Mode selected range (usually 1st range). Can be used only on the MODE button.

VOCATIONS: Various

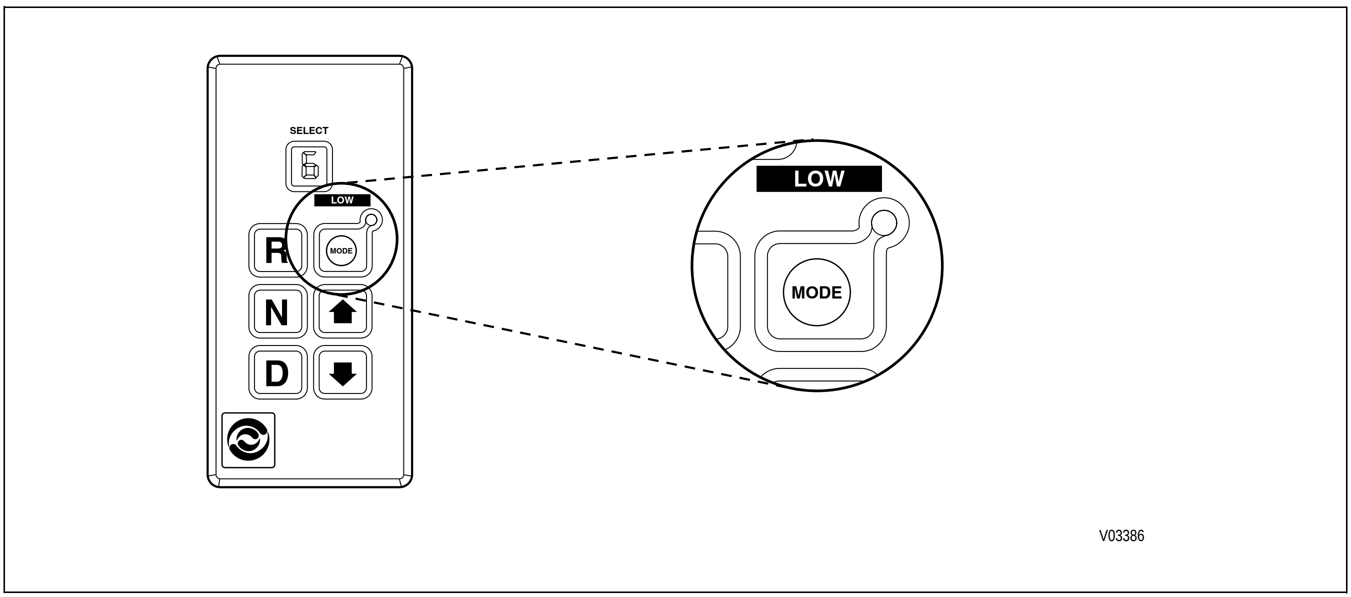


Figure H–2. D1 Selection

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

D. SHIFT SELECTOR TRANSITION

USES: When two shift selectors are used, to select which one is active.

VARIABLES TO SPECIFY: None

VOCATIONS: Various

WARNING!	**If this function is enabled in the shift calibration, the function MUST be integrated into the vehicle wiring. If the function is available in the shift calibration but will not be used in the vehicle, it MUST be disabled in the calibration.**

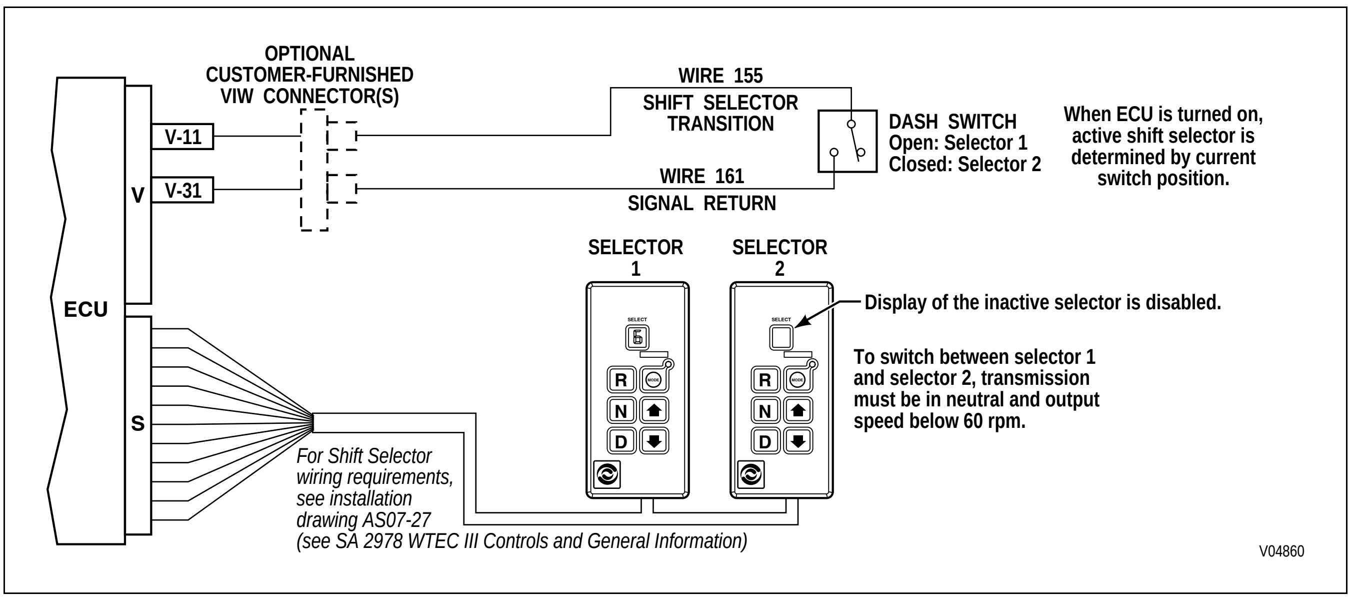


Figure H–3. Shift Selector Transition

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

H. ENGINE BRAKE/PRESELECT REQUEST AND ENGINE BRAKE ENABLE (EXHAUST BRAKE – OPTIONAL)

USES: Used with engine brakes controlled by electronic engines to signal the ECU that the brake is active and to provide increased braking by preselecting a lower range. Also prevents engagement of engine brake with throttle > 0 or lockup OFF.

VARIABLES TO SPECIFY: Preselect range. Standard value is second range.

VOCATIONS: Various

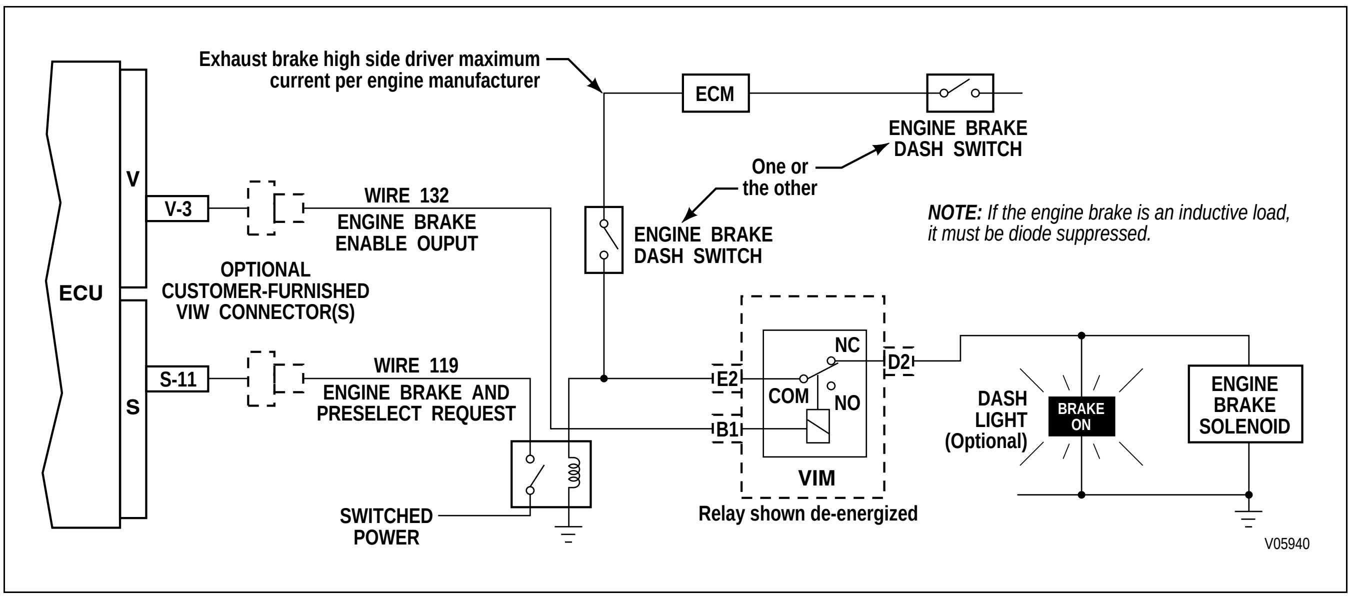


Figure H–4. Engine Brake/Preselect Request and Engine Brake Enable (Exhaust Brake — Optional)

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

H. ENGINE BRAKE/PRESELECT REQUEST AND ENGINE BRAKE ENABLE (COMPRESSION BRAKE)

USES: Used with single-level compression brakes to signal the ECU that the brake is active and to provide increased braking by preselecting a lower range. Also prevents engagement of engine brake with throttle > 0 or lockup OFF.

VARIABLES TO SPECIFY: Preselect range. Standard value is fourth range.

VOCATIONS: Various

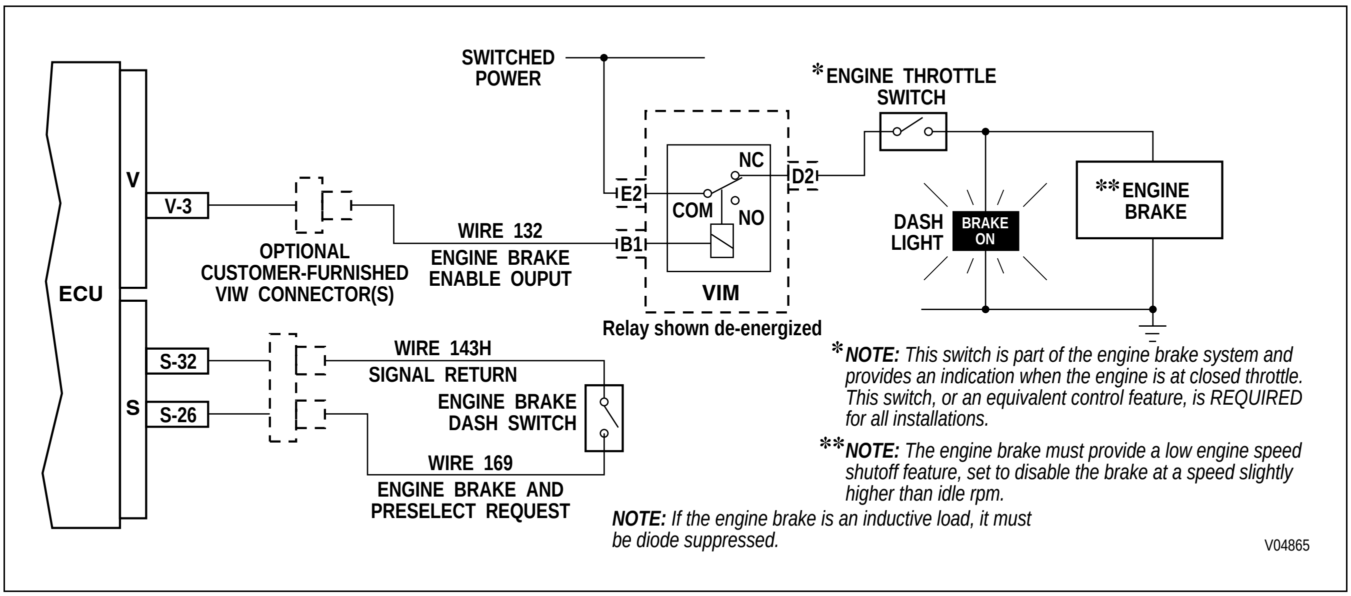


Figure H–5. Engine Brake/Preselect Request and Engine Brake Enable (Compression Brake)

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

I. ENGINE BRAKE/PRESELECT REQUEST AND ENGINE BRAKE ENABLE (EXHAUST BRAKE — SPECIAL)

USES: Used with engine brakes to provide a signal to the ECU that the brake is active and to provide increased braking by preselecting a lower range. Also prevents engagement of engine brake with throttle > 0 or lockup OFF.

VARIABLES TO SPECIFY: Preselect range. Standard value is second range.

VOCATIONS: Various

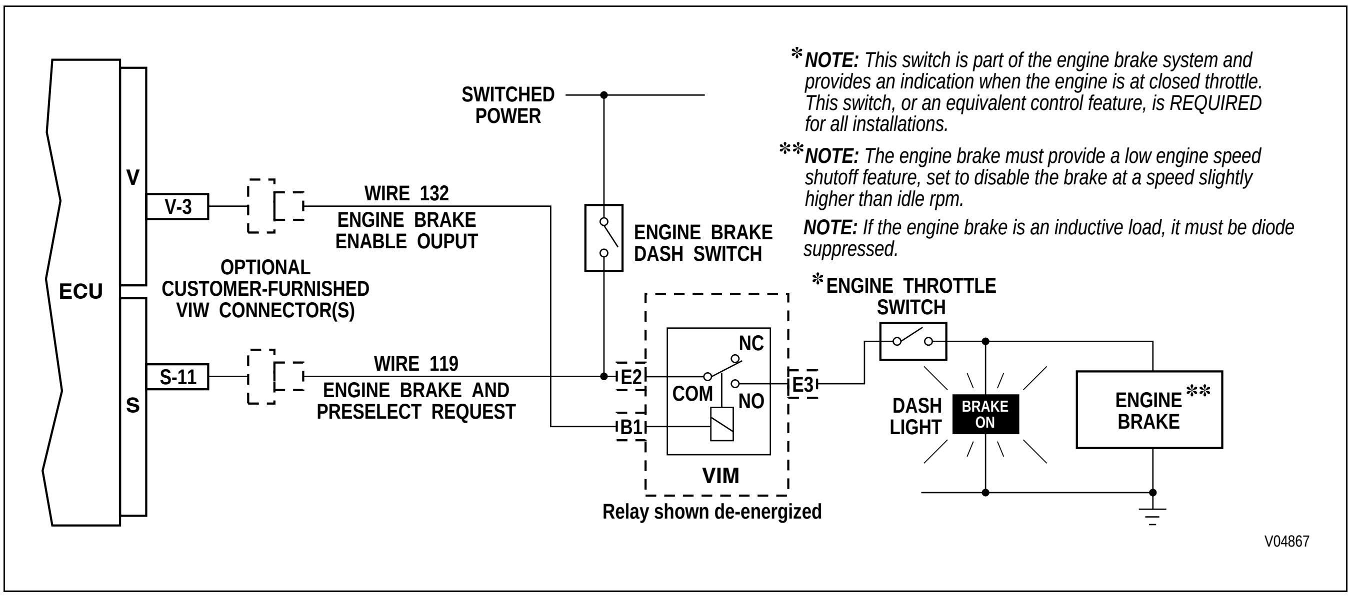


Figure H–6. Engine Brake/Preselect Request and Engine Brake Enable (Exhaust Brake — Special)

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING! **These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

Y. ANTI-LOCK BRAKE RESPONSE

USES: Signals the ECU when ABS function is active, so that lockup clutch and retarder will be disabled.

VARIABLES TO SPECIFY: None

VOCATIONS: Various

For schematics of this function, see the **ANTI-LOCK BRAKES** section located in Section C: Vehicle Electrical System Interface of SA2978, WTEC III Controls And General Information.

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

Y. ANTI-LOCK BRAKE RESPONSE (OPTIONAL)

USES: Provides for enhanced control of lockup and retarder during hard braking conditions. Can be used separately or in conjunction with ABS.

VARIABLES TO SPECIFY: None

VOCATIONS: Various

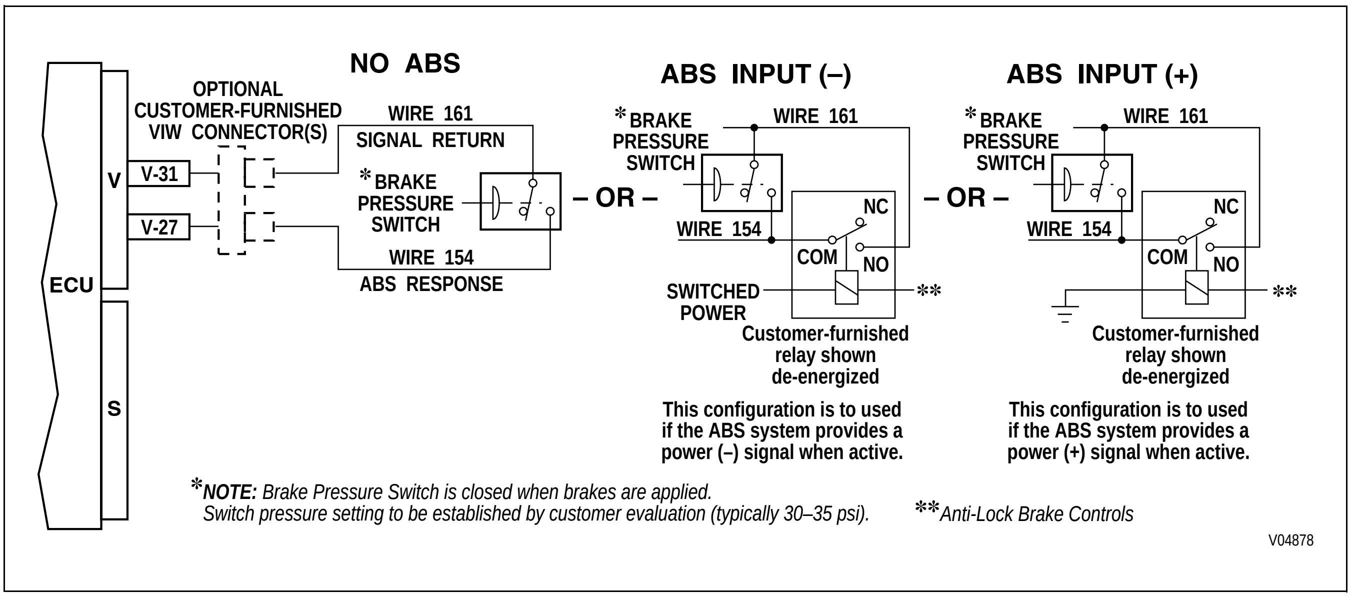


Figure H–7. Anti-Lock Brake Response (Optional)

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

AI. MILITARY AUXILIARY FUNCTION RANGE INHIBIT (STANDARD)

USES: Prevents inadvertent range selection when auxiliary equipment is operating.

VARIABLES TO SPECIFY: None

VOCATIONS: Military wheeled vehicles

WARNING!	**If this function is turned "ON" in the shift calibration, the function MUST be integrated into the vehicle wiring. If the function is available in the shift calibration but will not be used in the vehicle, it MUST be turned "OFF" in the calibration.**

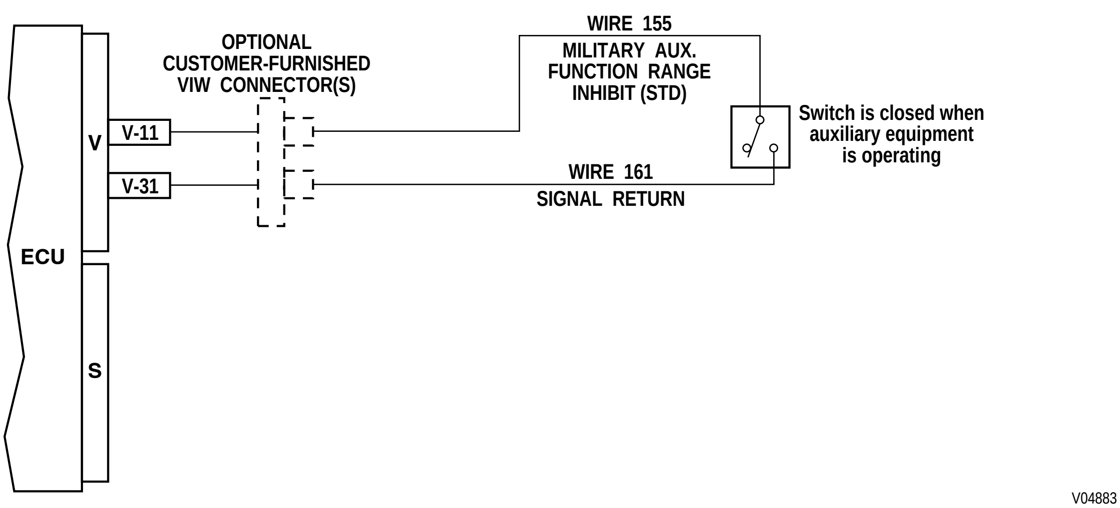


Figure H–8. Military Auxiliary Function Range Inhibit (Standard)

APPENDIX H — INPUT/OUTPUT FUNCTIONS

WARNING!	**These schematics show the intended use of the specified controls features which have been validated in the configuration shown. Any miswiring or use of these features which differs from that shown could result in damage to equipment or property, personal injury, or loss of life. ALLISON TRANSMISSION IS NOT LIABLE FOR THE CONSEQUENCES ASSOCIATED WITH MISWIRING OR UNINTENDED USE OF THESE FEATURES.**

AQ. SELECTOR DISPLAY BLANKING

USES: Blanks the digital display and mode on indicator on the lever or pushbutton shift selectors.

VARIABLES TO SPECIFY: None

VOCATIONS: Military wheeled vehicles

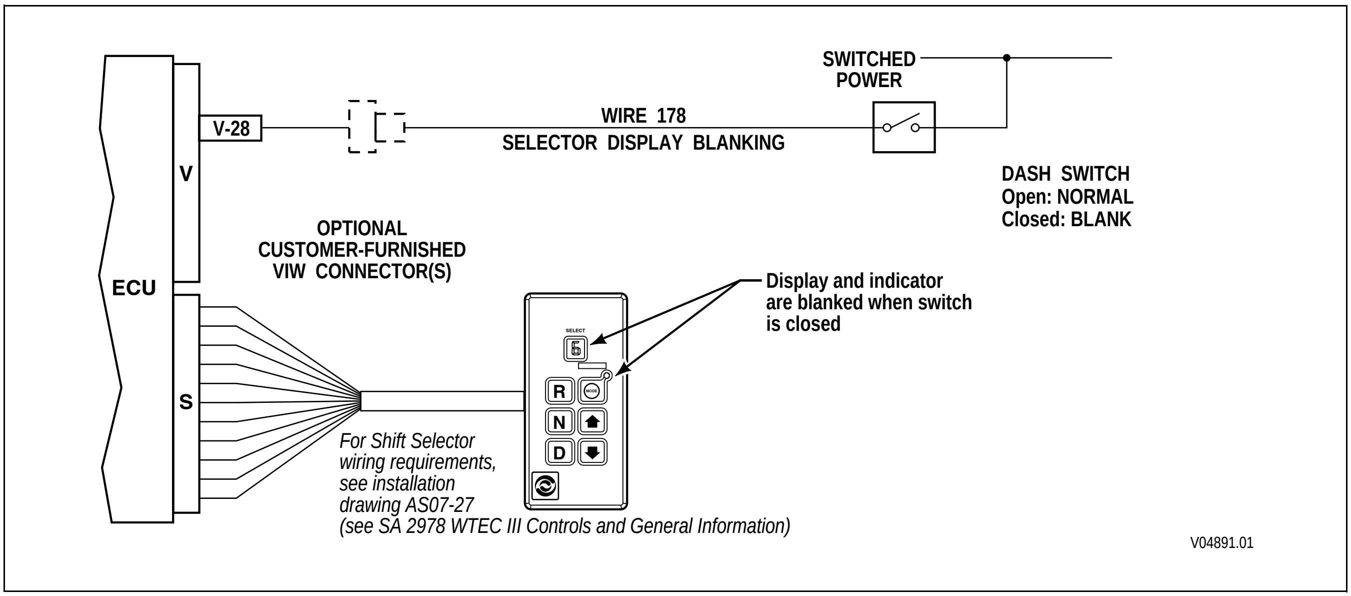


Figure H–9. Selector Display Blanking

BRAKE SYSTEM TROUBLESHOOTING 0012 00

THIS WORK PACKAGE COVERS

Brake System Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Brake System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Vehicle Does Not Slow Down Quickly Enough When Brakes Are Applied.	1. Check for proper lubrication.	Lubricate brake system (WP 0023 00).
	2. Check for heat-damaged and glazed brakeshoe linings.	Replace any damaged or glazed brakeshoes (all brakeshoes must be replaced on an axle) (WP 0173 00, WP 0174 00 or WP 0177 00).
	3. Check brake drums for excessive heat damage, cracks, scoring, and out-of-roundness.	Replace damaged brake drums (WP 0207 00, WP 0208 00 or WP 0209 00).
	4. Check for faulty air chambers.	Replace faulty air chamber(s) (WP 0181 00 or WP 0182 00).
	5. Check for air pressure leakage to air chambers.	Replace air compressor (Notify Direct Support Maintenance).
2. Brakes Do Not Release or Release Too Slowly.	1. Check for proper lubrication of brake system.	Lubricate brake system (WP 0023 00).
	2. Check that foot valve returns to fully released position.	Remove any debris interfering with pedal travel.
	3. Check exhaust ports on brake foot valve, quick release valve, and gladhand vent holes for blockage.	Clear obstructions from exhaust port(s) and vents (WP 0203 00).
	4. Check for weak and broken brakeshoe return springs.	Replace weak or broken springs (WP 0173 00, WP 0174 00 or WP 0177 00).
	5. Check for frozen brakeshoe anchor pins.	Clean and lubricate sticking pins or replace pins if damaged (WP 0173 00, WP 0174 00 or WP 0177 00).

Table 1. Brake System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Brakes Do Not Release or Release Too Slowly - Continued.	6. Check for broken spring in air chamber.	Replace air chamber (WP 0181 00 or WP 0182 00).
3. Brakes Are Uneven, Drag or Pull When Applied.	1. Check for uneven adjustment between axles.	Replace slack adjuster (WP 0180 00).
	2. Check for proper wheel bearing adjustment.	Adjust wheel bearings (WP 0207 00, WP 0208 00 or WP 0209 00).
	3. Check for grease-saturated or worn brake linings.	Replace brake linings (WP 0173 00, WP 0174 00 or WP 0177 00).
	4. Check for out-of-round brakedrum(s).	Replace brakedrum(s) (WP 0207 00, WP 0208 00 or WP 0209 00).
	5. Check for worn s-cam or roller.	Replace s-cam or roller (WP 0180 00).
	6. Check for broken spring in air chamber.	Replace air chamber (WP 0181 00 or WP 0182 00).

END OF WORK PACKAGE

ANTI-LOCK BRAKE SYSTEM (ABS) TROUBLESHOOTING AND TESTING 0013 00

THIS WORK PACKAGE COVERS

Introduction, Pretest Inspection, General Information, System Components, Diagnostics, Diagnostic and Testing Procedure, Pro-link Screens, Wiring Diagrams

INITIAL SETUP

Tools and Special Tools

Adapter, test, ABS (Item 2, WP 0306 00)

PC Card, ABS (Item 30, WP 0306 00)

Multimeter, digital (Item 28, WP 0306 00)

Tester, Pro-link, diagnostic reader (Item 46, WP 0306 00)

INTRODUCTION

This work package contains information on troubleshooting and testing the Anti-lock Brake System (ABS) using blink code diagnostics and Prolink. The ABS is an electronic system that monitors and controls braking only during emergency situations. The ABS controls the braking of each wheel separately, which prevents wheel locking, maintains steerability, and reduces stopping distance. The ABS has two diagonal circuits. Each circuit connects the front wheel of one side of the vehicle to the rear wheels of the opposite side. In case of a system fault, only half of the ABS stops working. Control of that half is returned to the standard braking system. The ABS uses a tone ring and sensor on the hub of each monitored wheel. The sensor sends wheel speed information to the Electronic Control Unit (ECU). The ECU signals the modulator valve for that wheel to increase, reduce or maintain pressure in the brake chamber (Figure 1).

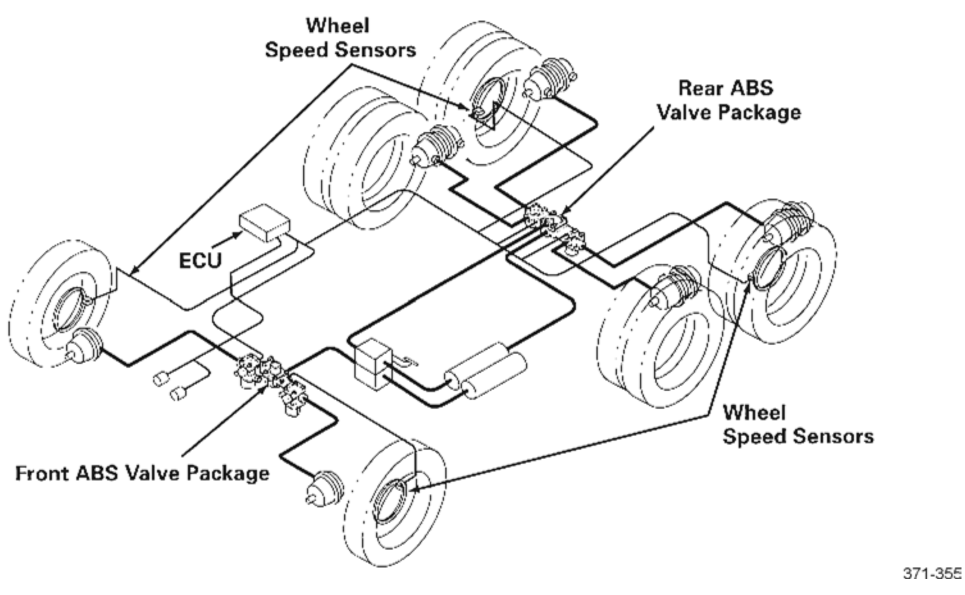


Figure 1. Location of ABS Components.

PRETEST INSPECTION

Prior to performing vehicle test, ensure that daily Preventive Maintenance Checks and Inspections (PMCS) has been performed.

GENERAL INFORMATION

1. Rockwell WABCO ABS D and E Versions are electronic systems that monitor and control wheel speed during braking. The system works with standard air brake systems. ABS monitors wheel speeds at all times and controls braking during wheel lock situations. The system improves vehicle stability and control by reducing wheel lock during braking.

2. The ECU receives and processes signals from the wheel speed sensors. When the ECU detects a wheel lockup, the unit activates the appropriate modulator valve, and air pressure is controlled. In the event of a malfunction in the system, the ABS in the affected wheel(s) is disabled; that wheel still has normal brakes. The other wheels keep the ABS function.

3. An ABS warning lamp lets the driver know the status of the system. If the ECU senses a fault during normal vehicle operation, the ABS warning lamp will come on. This lamp is also used to display blink code diagnostics.

ABS WARNING LAMP

The ABS warning lamp works as shown in Table 1. If the ECU senses a fault during normal vehicle operation, the ABS warning lamp will come on and stay on.

Table 1. Warning Lamp Operation.

WHAT YOU DO	WHAT HAPPENS	WHAT IT MEANS
Turn the ignition on.	The ABS lamp comes on momentarily for a bulb check, then goes out.	The system is okay.
	The ABS lamp does not go out at ignition.	If the lamp goes out after 5-10 second self-test, the system is okay. If the lamp does not go out after 10 seconds, the ECU senses a fault in the ABS system.

ABS MODULATOR VALVES

1. Modulator valves control the air pressure to each affected brake during an ABS function.

2. To make sure the ABS valves are working, listen to them as follows:

    a. Turn on the ignition.

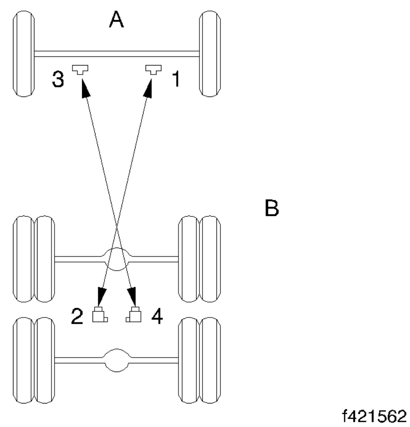
    b. Wait for the ABS light.

NOTE

The valves will cycle in 1-2-3-4 order, then diagonally in 1-2 and 3-4 order.

    c. Listen for the valves to cycle, one by one, then together diagonally (Figure 2).

ABS MODULATOR VALVES - CONTINUED



NOTE: The valves will cycle in 1-2-3-4 order, then diagonally in 1-2 and 3-4 order

A. Cab
B. Curbside

Figure 2. Modulator Valve Checking.

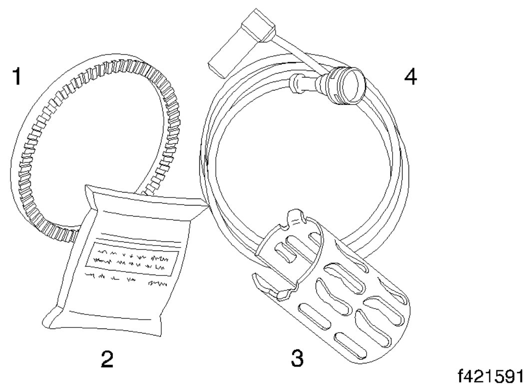
ABS SENSORS

1. ABS sensor systems consist of a tooth wheel mounted on the hub of each monitored wheel and a sensor installed so that its end is against the tooth wheel. The sensor continuously sends wheel speed information to the ECU. A sensor clip holds the sensor in place at the tooth wheel.
2. The type of axle determines the sensor mounting location:
   a. Steering axle sensors are installed in the steering knuckle or in a bolted-on bracket.
   b. Drive axle sensors are mounted in a block attached to the axle housing or in a bolted-on bracket.

SYSTEM COMPONENTS

1. The ECU is the brain of the ABS system. It receives information from the sensors and sends signals to the ABS valves (Figure 1).
2. A tooth wheel (Figure 3) is mounted at the hub of each sensed wheel, with a sensor installed so that its end is against the tooth wheel. A sensor clip holds the sensor in place at the tooth wheel. The sensor and clip must be greased with Rockwell WABCO-recommended lubricant.

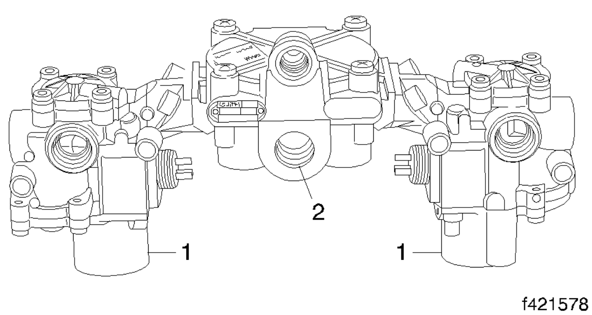
SYSTEM COMPONENTS - CONTINUED



1. Tooth Wheel
2. Lubricant
3. Sensor Clip
4. Sensor

Figure 3. Sensor Components.

3. The ABS valve package is an alternative to individual valves on the rear axles. It combines two ABS modulator valves and one service relay valve (Figure 4).

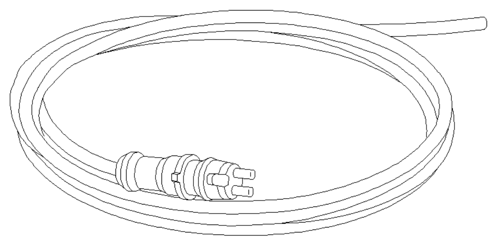


1. Modulator
2. Relay Valve

Figure 4. ABS Valve Package.

SYSTEM COMPONENTS - CONTINUED

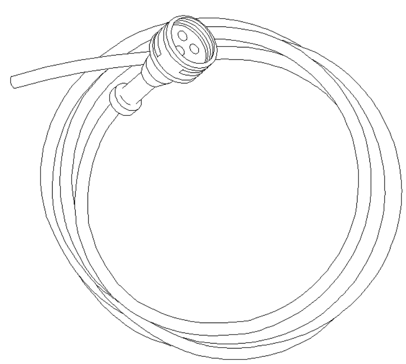
4. Sensor cables connect the sensor to the ECU (Figure 5).



f421583

Figure 5. ABS Sensor Cable.

5. ABS modulator valve cables connect the modulator valve to the ECU (Figure 6).



f421584

Figure 6. ABS Modulator Valve Cable.

LAMP BULB CHECK

To make sure the ABS lamp is operating, check the lamp every time the vehicle is started. When the vehicle is started, the ABS lamp should come on momentarily. If it does not come on, it could mean a burned-out bulb.

DIAGNOSTICS

1. **Diagnostic Methods.** You can troubleshoot the system in the following ways:
   a. Blink Code Diagnostics
   b. Pro-link 9000
2. **Blink Code Diagnostics.** Before using blink code diagnostics, you should be familiar with a few basic terms. If you used previous versions of Rockwell WABCO blink code diagnostics, review these definitions to identify major changes.
   a. **ABS Warning Lamp.** This lamp serves two purposes: it alerts drivers to an ABS fault and it is used during diagnostics to display the blink code.
   b. **Blink Code.** A series of blinks or flashes that describe a particular ABS system fault or condition.

DIAGNOSTICS - CONTINUED

c. **Blink Code Cycle.** A set of two flashes with each flash separated by a one-and-one-half second pause. Blink codes are defined in Table 2.

d. **Blink Code Switch.** A switch that activates blink code diagnostic capabilities. Switch types and locations vary, depending on the vehicle.

e. **Clear**. The process of erasing faults from the ECU.

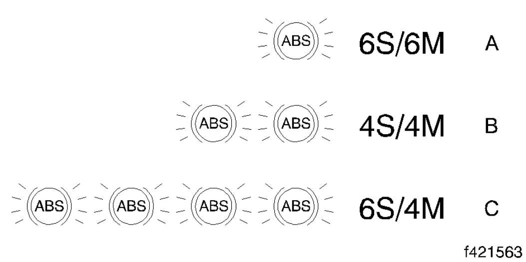
f. **Diagnostics.** The process of using blink codes to determine ABS system faults.

g. **Fault.** An ABS malfunction detected and stored in memory by the Rockwell WABCO ECU. System faults may be Active or Stored.

h. **Active Fault.** A condition that currently exists in the ABS system; for example, a sensor circuit malfunction on the left front steering axle. An active fault must be repaired before it can be cleared from memory and before you can display additional codes.

i. **Stored Fault.** There are two types of stored faults: One type is a repaired fault that has not been cleared from the ECU. The other type is a fault that occurred, but no longer exists, for example a loose wire that makes intermittent contact. Because stored faults are not currently active, they do not have to be repaired before they can be cleared from memory.

j. **System Configuration Code.** A one digit code (Blink Code: 2) is displayed during the clear mode. Blink codes for common ABS system configurations are shown in Figure 7.



A. Blink Code: 1
B. Blink Code: 2
C. Blink Code: 4

Figure 7. System Configuration Codes.

DIAGNOSTICS - CONTINUED

Table 2. Blink Code Identification.

FIRST DIGIT (TYPE OF FAULT)	SECOND DIGIT (SPECIFIC LOCATION OF FAULT)
1. No Faults	1. No Faults
2. ABS modulator valve 3. Too much sensor gap 4. Sensor short or open 5. Sensor signal erratic 6. Tooth wheel	1. Right front steer axle (curb side) 2. Left front steer axle (driver side) 3. Right forward/rear tandem drive axle (curb side) 4. Left forward/rear tandem drive axle (driver side) 5. Right rearmost tandem drive axle (curb side) 6. Left rearmost tandem drive axle (driver side)
7. System function	1. J1922 or J1939 datalink 2. ATC valve (not used on M915A3) 3. Retarder relay (third brake) 4. ABS warning lamp 5. ATC configuration (not used on M915A3) 6. Reserved for future use
8. ECU	1. Low power supply 2. High power supply 3. Internal fault 4. System configuration error 5. Ground

NOTE

Blink code switch is located on ABS Electronic Control Unit (ECU) behind passenger's seat.

3. **Diagnostic Mode.** To enter the diagnostic mode, press and hold the blink code switch for one second, then release.
4. **Clear Mode.**
   a. To erase faults from the ECU, you must be in the clear mode. To enter the clear mode, press and hold the blink code switch for at least three seconds, then release.
   b. If the system displays eight quick flashes followed by a system configuration code, the clear was successful. The ABS fault has been cleared from memory.
   c. If you do not receive eight flashes, there are still active faults that must be repaired before they can be cleared.

DIAGNOSTICS - CONTINUED

5. **Blink Code Diagnostic Procedures**.

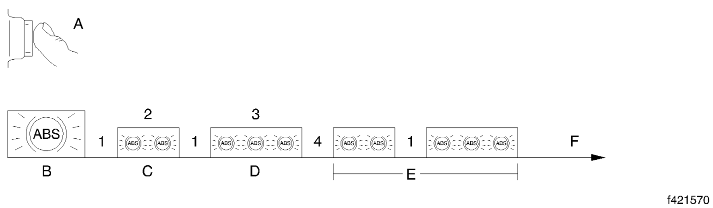
For the step-by-step blink code diagnostic procedure, see Table 3.

Table 3. Blink Code Diagnostic Procedure.

MODE	PROCEDURE	SYSTEM RESPONSE	ACTION
Diagnostic	**Step 1.** Turn the ignition on.	The ABS warning lamp comes on for 5-10 seconds then goes out, indicating System Okay.	No recognizable faults in the ABS. No action required.
		The ABS warning lamp does not light, indicating possible wiring fault or burned-out bulb.	Inspect the wiring. Inspect the bulb. Make necessary repairs.
		The ABS warning lamp stays on, indicating there is a fault, or faults, in the system.	Continue with the blink code diagnostics. Go to the next step.
	Step 2. Press and hold the Blink Code Switch for one second, then release.	The ABS warning lamp begins flashing two-digit blink codes(s).	Determine if the fault is active or stored: **Active Fault:** The lamp will repeatedly display one code. **Stored Fault:** The lamp will display the code for each stored fault then stop blinking. Faults will be displayed *one at a time*.
	Step 3. Count the flashes to determine the blink code.	First Digit: 1 to 8 flashes; Pause (1-1/2 seconds). Second Digit: 1 to 6 flashes; pause (4 seconds).	Turn the ignition off. Find the definition for the blink code in Table 2.
	Step 4. Repair and record the faults.	Active Fault.	Make the necessary repairs. Repeat the first three steps of this procedure until System Okay Code (1-1) is received.
		Stored Faults.	Record for future reference. **NOTE:** The last fault code stored is the first fault code displayed.
Clear	**Step 5.** Clear faults from the memory: Press and hold the blink code switch for at least three seconds, then release.	The ABS warning lamp flashes eight times.	All faults are successfully cleared. Turn the ignition off.
		Eight flashes are not received.	Active faults still exist. Repeat the first four steps of this procedure.

DIAGNOSTICS - CONTINUED

6. **Blink Codes Illustrated.** Refer to the following figures for examples of typical blink codes.
   a. For a typical Active Fault code, refer to Figure 8.
   b. For typical Stored Fault codes, refer to Figure 9.
   c. For the System Okay code, refer to Figure 10.
   d. For the Stored Fault Cleared code, refer to Figure 11.
   e. For the Faults Not Cleared (active faults exist) code, refer to Figure 12.

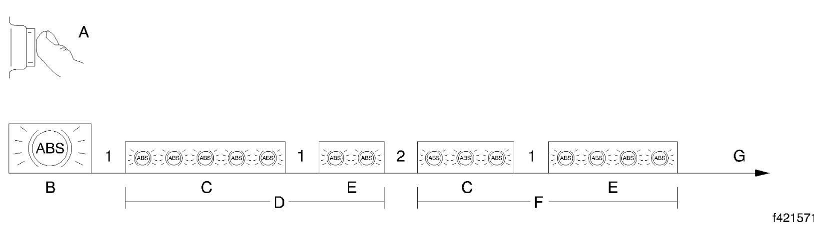


NOTE: Blink Code 2-3 is shown here: Fault in the ABS modulator valve, right side of forward-rear axle.

A.	Hold 1 second	C.	First digit (2)	E.	Repeat of blink code
B.	Light on	D.	Second digit (3)	F.	Continues until the ignition is turned off

1. Pause of 1.5 seconds
2. 1 to 8 flashes
3. 1 to 6 flashes
4. Pause of 4 seconds

Figure 8. Typical Active Fault Code.



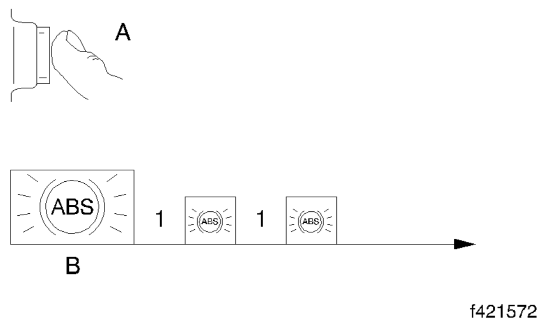
NOTE: Blink Codes 5-2 and 3-4 are shown here. Code 5-2: Sensor signal erratic, left-front steer axle. Code 3-4: Too much sensor gap, left side of forward-rear axle.

A.	Hold 1 second	C.	First digit (5)	E.	Second digit (2)	G.	Displays all stored faults at once-last fault stored is the first displayed
B.	Light on	D.	First stored fault	F.	Second stored fault		

1. Pause of 1.5 seconds
2. Pause of 4 seconds

Figure 9. Stored Fault Codes.

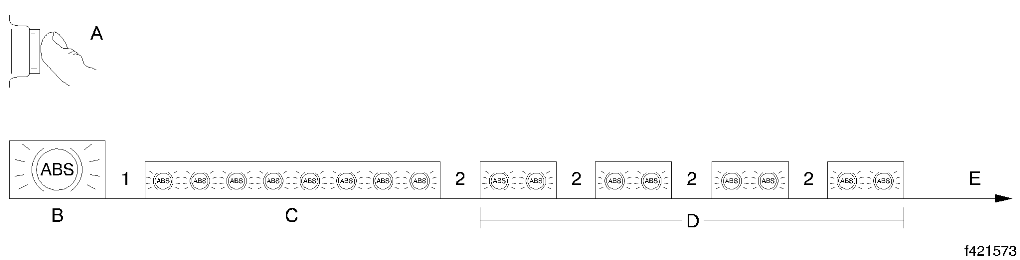
DIAGNOSTICS - CONTINUED



NOTE: Blink Code 1-1 is shown here: System okay.

A. Hold 1 second
B. Light on
1. Pause of 1.5 seconds

Figure 10. System Okay Code.



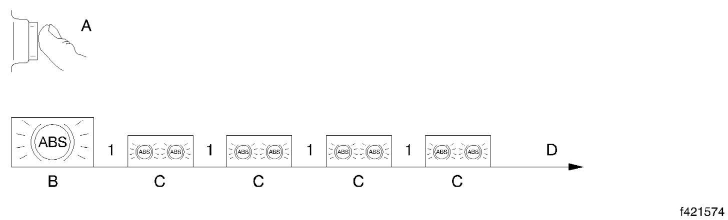
NOTE: System configuration code 2 shown: 4S/4M. After the faults are cleared and the vehicle is started, the ABS lamp will stay on until the vehicle is driven over 4 mph (6 km/h).

A. Hold 3 seconds
B. Light on
C. 8 quick blinks - fault cleared
D. System identification
E. Continues until the ignition is turned off

1. Pause of 1.5 seconds
2. Pause of 4 seconds

Figure 11. Stored Fault Cleared Codes.

DIAGNOSTICS - CONTINUED



A. Hold 3 seconds
B. Light on
C. System identification
D. Continues until the ignition is turned off

1. Pause of 4 seconds

Figure 12. Faults Not Cleared Code.

7. **Working with Blink Codes.** If problems occur while working with blink codes, see Table 4.

Table 4. Blink Code Conditions.

CONDITION	REASON	ACTION
ABS lamp does not come on at ignition.	Loose or burned-out bulb.	Check the bulb. Check the connections. Make necessary repairs.
	Voltage not within acceptable range (11 to 15 volts).	Make necessary repairs.
Can't use blink code diagnostics; ABS lamp will not go off when blink code is activated.	Switch not held for the proper length of time. 1 second - Diagnostics Mode 3 seconds - Clear All Mode	Repeat procedure, hold the switch for the proper length of time.
	Improper or faulty wiring.	Inspect and repair the wiring.
Eight flashes not received after blink code switch is pressed for at least three seconds, then released.	Active faults still exist.	Identify the active faults, then make necessary repairs. Turn the ignition off, then repeat the blink code diagnostics (Table 3).

8. **Repairs Required by Blink Codes.** For the specific tests or repairs required by each blink code, see Table 5.

DIAGNOSTICS - CONTINUED

Table 5. Troubleshooting and Repair.

BLINK CODE	ACTION REQUIRED	REFERENCE
2-1 2-2 2-3 2-4 2-5 2-6	Check the ABS modulator valve, valve cable, and connections.	Perform resistance check.
3-1 3-2 3-3 3-4 3-5 3-6	Adjust the wheel sensor to touch the tooth wheel. Check the sensor gap. Check for loose wheel bearings or excessive hub runout.	Perform sensor adjustment, sensor voltage test, or Pro-link component test.
4-1 4-2 4-3 4-4 4-5 4-6	Check sensor, sensor cable, and connectors.	Perform resistance check.
5-1 5-2 5-3 5-4 5-5 5-6	Check for tire size mismatch or tooth wheel difference.	Review tire size range.
6-1 6-2 6-3 6-4 6-5 6-6	Check for damaged tooth wheel.	
7-1	Check for proper data link connection (J1922 and J1939)	Refer to wiring diagrams.
7-2	Check the ATC valve, valve cables, and connectors. (Not used on M915A3)	Perform resistance check.
7-3	Check the brake relay connections.	Refer to wiring diagrams.
7-4	Check the ABS warning light connections.	
7-5	Verify proper ATC set-up. (Not used on M915A3)	
7-6	Verify the accuracy of the blink code and clear it from the ECU memory.	Review blink code diagnostics.
8-1	Check vehicle voltage and supply to the ECU (11 to 14 volts).	Refer to wiring diagrams. Perform voltage check.

DIAGNOSTICS - CONTINUED

Table 5. Troubleshooting and Repair - Continued.

BLINK CODE	ACTION REQUIRED	REFERENCE
8-2	Check the vehicle voltage (11 to 14 volts). Verify accuracy of blink code and clear from ECU memory.	Perform voltage check. Review blink code diagnostics.
8-3 8-4	Verify accuracy of blink code and clear from ECU memory.	Review Blink Code Diagnostics.
8-4	Verify accuracy of blink code and clear from ECU memory. *If code does not clear, it may be necessary to replace ECU.*	Contact Rockwell Customer Service at 1-800-535-5560.
8-5	Check ABS ground connections.	Refer to wiring diagrams.

MPSI PRO-LINK 9000

NOTE

You must use the D version cartridge with D version ECUs (M915A3 Old Model) and E version cartridge with E version ECUs (M915A3 New Model, M916A3, M917A2).

1. The Pro-link 9000 may be used in place of blink code diagnostic procedures.
2. Use the Pro-link 900 to:
   a. Diagnose system faults on ABS or ABS/ATC systems.
   b. Perform component measurement and function tests.

COMPONENT TESTS

Components that may be tested with the Pro-link 9000 are:

a. Vehicle voltages

b. ABS modulator valves

c. ABS lamps

d. Sensors

e. ABS switches

DIAGNOSTIC AND TESTING PROCEDURE

1. Slide ABS PC Card into the Pro-link keypad until connection is tight (Figure 13).

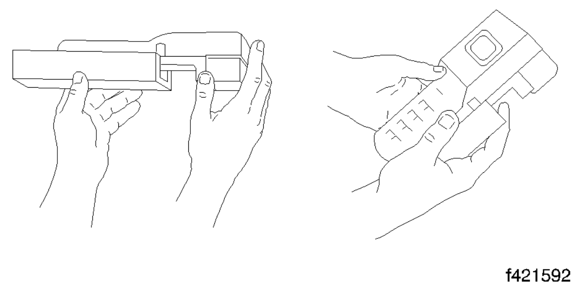


Figure 13. Pro-link Cartridge Replacement.

2. Chock the wheels, apply the parking brake, and make sure the ignition power is off.
3. Locate the 9-pin diagnostic receptacle in the vehicle cab. Insert the 9-pin connector from the Pro-link into the receptacle (Figure 14).

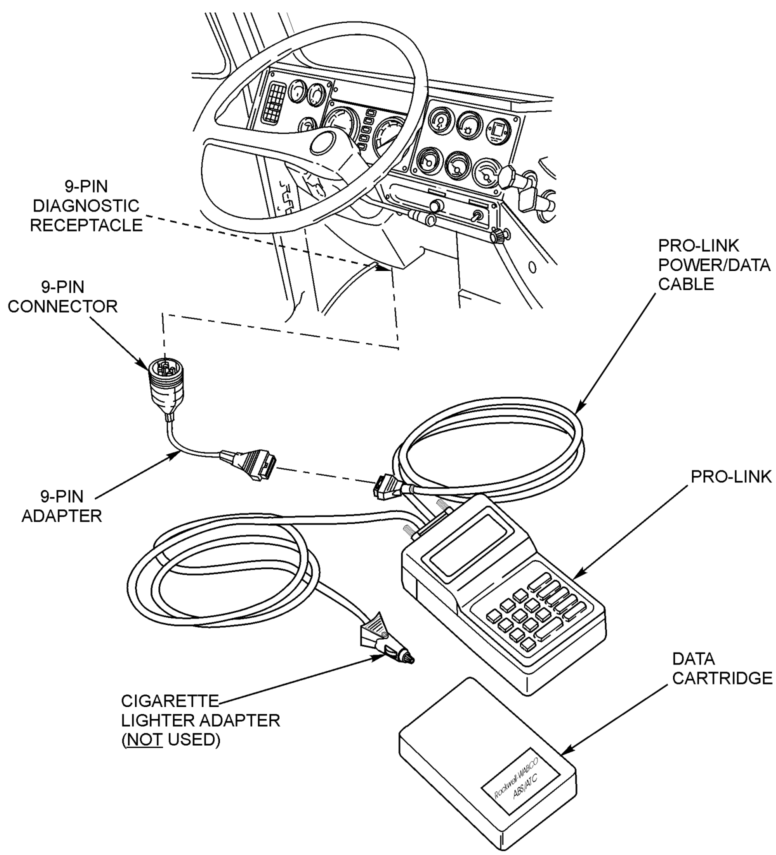


Figure 14. Pro-link Hook-up to Vehicle.

DIAGNOSTIC AND TESTING PROCEDURES - CONTINUED

4. Turn ignition to ON/RUN position. Pro-link screen should power up. If Pro-link does not power up or if the screen indicates NO DATA RECEIVED:

   a. Check connections.

   b. Make sure the cartridge is properly connected to the Pro-link keypad.

   c. Verify 12 volts DC power and ground at the connector and ABS ECU.

   d. Check the fuse panel for a blown fuse.

   e. Check for proper wiring in the diagnostic connector.

PRO-LINK SCREENS

1. **General.** This paragraph provides basic screen explanations for the Pro-link 9000 with a Rockwell WABCO D or E version cartridge. For complete operating instructions and test information, refer to the Pro-link manual. The most commonly used types of screens are the Fault Information screens and the Component Test screens.

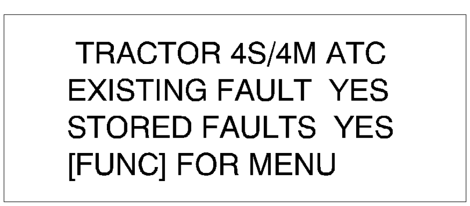
2. **Fault Information Screens.**

   a. **Existing Faults.** Use these screens to identify existing faults. The Pro-link screen displays a written description of the fault, including location on the vehicle where each exists. As long as there is an active (existing) fault in the system, Pro-link will not let you clear faults.

   b. **Stored Faults.** Use these screens to identify faults stored in the ECU memory. Stored faults may be existing faults that have been repaired, or faults that existed for a short time, then corrected themselves. After displaying stored faults, Pro-link lets you erase them from memory. All stored faults are cleared at one time.

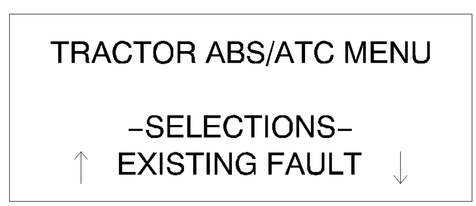
3. **Using Pro-Link.** The following illustrates a typical fault screen sequence for a 4S/4M ABS system with an existing fault.

   a. Figure 15 indicates existing and stored faults in the system. Press FUNC to display the menu shown in Figure 16.



f040373

Figure 15. Pro-link Screen One.



f040363

Figure 16. Pro-link Screen Two.

   b. Select Existing Fault to display active fault. Press ENTER to select. Screen shown in Figure 17 should appear. The first line displays the number of existing faults (1 of 1), blink code (2-3), and number of times fault occurred (1 time). Lines two and three provide a written description of the fault.

PRO-LINK SCREENS - CONTINUED

```
1 of 1      (2, 3)        1X
R REAR ABS VALVE
OPEN OR CABLE DAMAGE
↑                          ↓
```

f040364

Figure 17. Pro-link Screen Three.

c. Press FUNC to exit. The screen shown in Figure 18 should appear. Remove power from the ECU, make necessary repairs, and recycle ECU.

```
TURN IGNITION OFF
REPAIR EXISTING
FAULT
[FUNC] TO EXIT
```

f040365

Figure 18. Pro-link Screen Four.

d. Press FUNC to return to vehicle ABS/ATC menu shown in Figure 19.

```
TRACTOR ABS/ATC MENU

    –SELECTIONS–
↑   STORED FAULTS   ↓
```

f040366

Figure 19. Pro-link Screen Five.

PRO-LINK SCREENS - CONTINUED

e. Press ENTER to display stored faults as shown in Figure 20. A description of the stored fault appears. In this example, only one fault is stored in memory, as indicated on line one. The blink code and number of times the fault occurred also appear on line one. Lines two and three provide a written description of the fault. Press FUNC to exit. The screen shown in Figure 21 appears if you try to clear a stored code with an existing fault present.

```
1 of 1      (2, 3)      1X
R REAR ABS VALVE
OPEN OR CABLE DAMAGE
 ↑                      ↓
```

f040364

Figure 20. Pro-link Screen Six.

```
CANNOT ERASE STORED
FAULTS. REPAIR
EXISTING FAULT(S)
[ENTER] TO CONTINUE
```

f040367

Figure 21. Pro-link Screen Seven.

f. Remove the power from the ECU, make necessary repairs, and recycle the ECU.

4. **Clearing Stored Faults.** The screens you will see when clearing stored faults are illustrated in Figures 22 and 23.

a. Figure 22 shows there are no existing faults. Select stored faults to view and clear memory. Press FUNC to display the menu shown in Figure 23.

```
 TRACTOR 4S/4M ATC
EXISTING FAULT  NO
STORED FAULTS  YES
[FUNC] FOR MENU
```

f040368

Figure 22. Pro-link Screen Eight.

```
TRACTOR ABS/ATC MENU

   -SELECTIONS-
↑  STORED FAULTS  ↓
```

f040366

Figure 23. Pro-link Screen Nine.

PRO-LINK SCREENS - CONTINUED

b. Select Stored Faults, then press ENTER to display the stored faults shown in Figure 24. Pro-link displays number, blink code, number of occurrences, and written description of the stored faults.

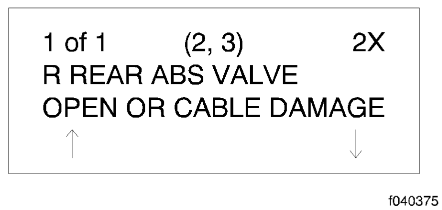


Figure 24. Pro-link Screen Ten.

c. Press FUNC, and the screen shown in Figure 25 will appear.

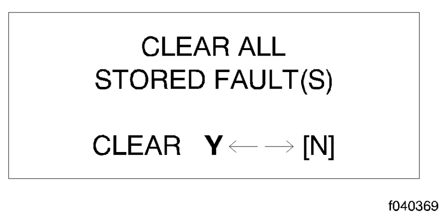


Figure 25. Pro-link Screen Eleven.

d. When the faults are cleared, Pro-link will prompt you to continue. See Figures 26 and 27.

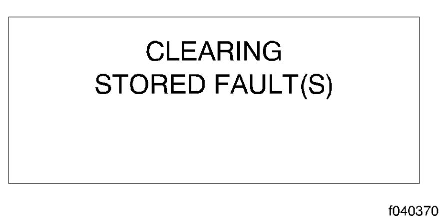


Figure 26. Pro-link Screen Twelve.

PRO-LINK SCREENS - CONTINUED

STORED FAULT(S)
CLEARED

[ENTER] TO CONTINUE

f040371

Figure 27. Pro-link Screen Thirteen.

e. Press ENTER to return to the ABS menu.

5. **<u>Component Test Screens</u>.**

a. These screens help you test ABS components. Select this function from the vehicle ABS/ATC menu (Figure 28). Select appropriate function. Each screen has instructions to guide you through test. Refer to Pro-link service information for complete instructions.

TRACTOR COMP TESTS

–SELECTIONS–
↑ VEHICLE VOLTAGES ↓

f040372

Figure 28. Typical Component Test Screen.

b. You can test the following components:

(1) ABS valves

(2) ABS lamp

(3) ABS switches

(4) Sensors

c. See Table 6 for definitions that explain the function of each test.

PRO-LINK SCREENS - CONTINUED

Table 6. Component Test Functions.

COMPONENT TEST	FUNCTION
Vehicle voltages	Monitors two voltage signals powering the ECU.
ABS valves	Cycles valves, one at a time. You hear each valve cycle. A menu selection lets you choose from four or six valves. This test may also be used to verify valve locations. NOTE: The treadle may be applied to put air in chambers.
ABS lamp	Monitors commanded (on/off) states of the ATC lamp. Follow screen prompts (1 On, 2 Off) to change the status of lamp on instrument panel.
Sensors	Monitors input to ECU from wheel. Wheels must be rotated during this test.

COMPONENT TESTING

WARNING

When troubleshooting and testing the ABS system, do not damage the connector terminals. Damaged terminals can result in the system not functioning correctly and subsequent vehicle accidents resulting in personal injury to personnel and damage to equipment.

1. **Voltage Check.** Voltage must be between 11 and 14 volts. Ignition must be turned on for this test. Measure voltage between pins 7 and 10, pins 8 and 11, and pins 9 and 12 on cab-mounted systems.

2. **Sensor Adjustment.**

   a. Push sensor in until it contacts tooth wheel.

   b. DO NOT pry or push sensors with sharp objects. Sensor will self-adjust after wheel rotation.

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

   d. On drive axles, drum assembly may have to be pulled to gain access to sensor.

3. **Sensor Output Voltage Test.** Voltage must be at least 0.200 volts AC at 30 rpm. Check sensor voltage as follows:

   a. Turn off ignition.

   b. Rotate wheel by hand at 30 rpm (2 revolutions per second).

   c. Measure voltage at the points shown in Table 7.

Table 7. Voltage Test Points.

ECU	SENSOR	CONNECTOR	PINS
Cab-mounted	LF RF LR RR	6-pin 9-pin 15-pin 15-pin	4 and 5 4 and 5 5 and 6 8 and 9

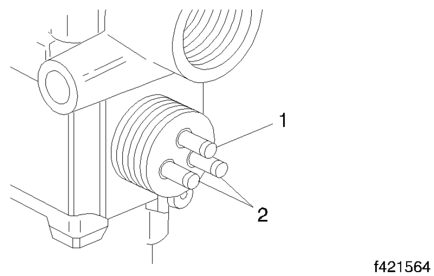
TIRE SIZE RANGE

1. For proper ABS operation with the standard ECU, front and rear tire sizes must be within ±14% of each other. When tire size range is exceeded without electronically modifying ECU, system performance can be affected and warning lamp can illuminate.
2. Call Rockwell WABCO at 1-800-535-5560 if you plan a tire size difference greater than 14%. Calculate tire size with the following equation:

   % Difference = {RPM Steer divided by RPM Drive minus 1} x 100 (in this equation RPM means tire revolutions per mile)

ABS MODULATOR VALVE TEST

1. Measure the resistance across each valve solenoid coil terminal and ground on the ABS valve to ensure 4.0 to 8.0 ohms (Figure 29).



1. Ground Terminal
2. Solenoid

Figure 29. ABS Modulator Valve.

2. If resistance is greater than 8.0 ohms, clean electrical contacts in solenoid. Check resistance again.
3. To check cable and ABS valve as one unit, measure resistance across the pins on ECU connector of harness. Check wiring diagrams of system being tested (Figures 30 through 33).

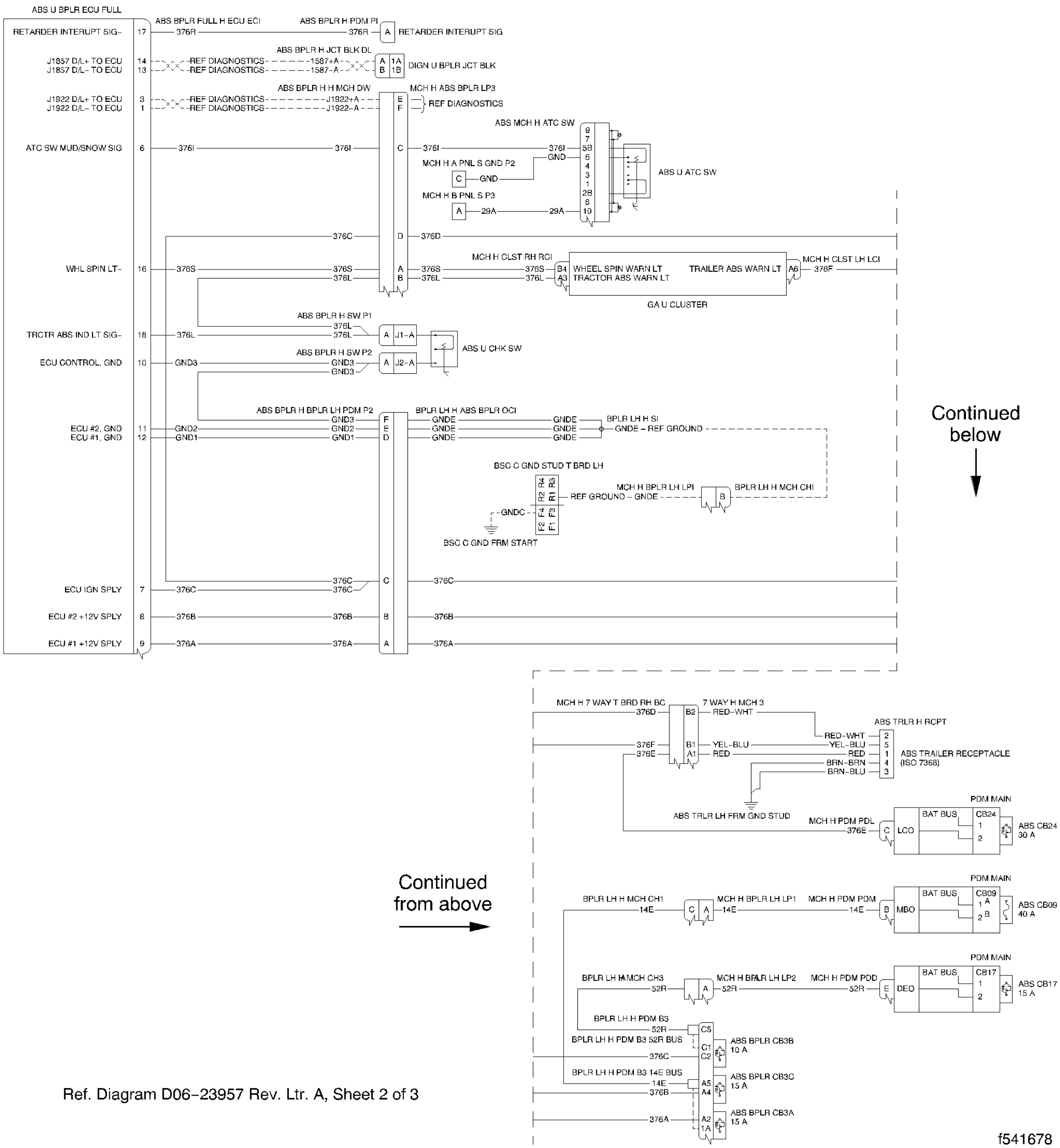


Figure 30. Wiring Diagram, Power and Control Wiring.

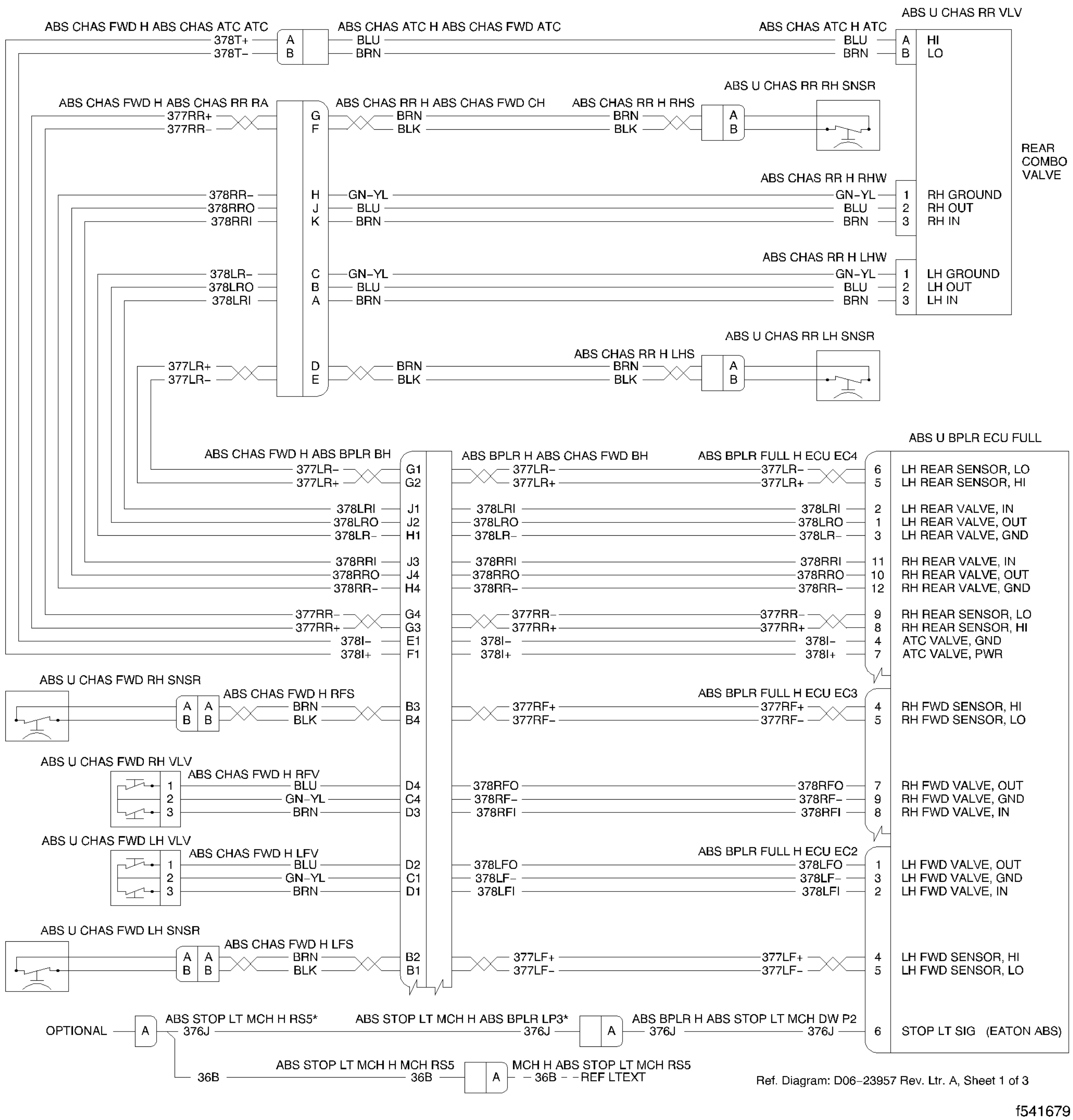


Figure 31. Wiring Diagram, Sensor and Valve Wiring.

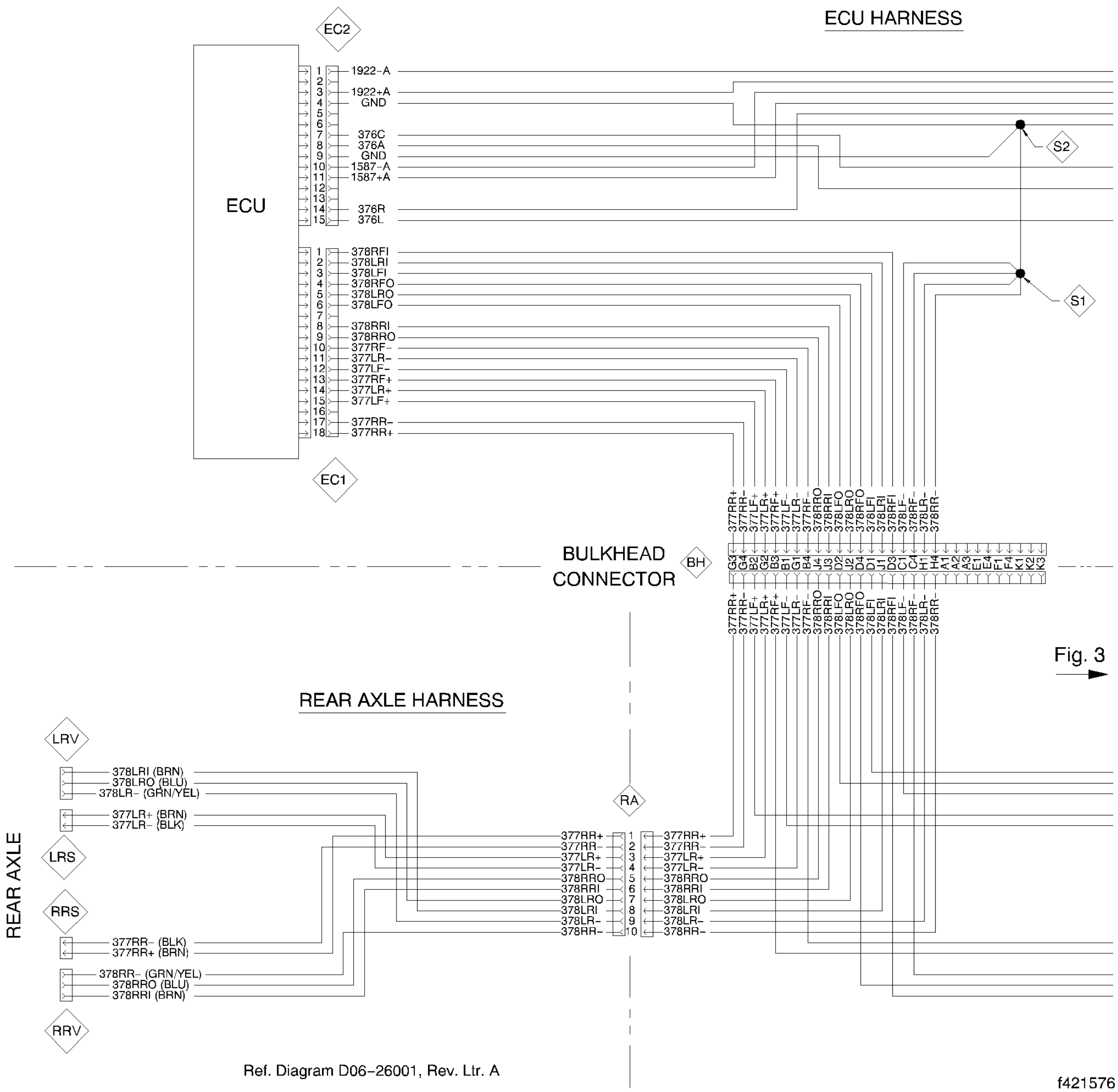


Figure 32. Wiring Diagram, Basic WABCO Wiring (Partial View).

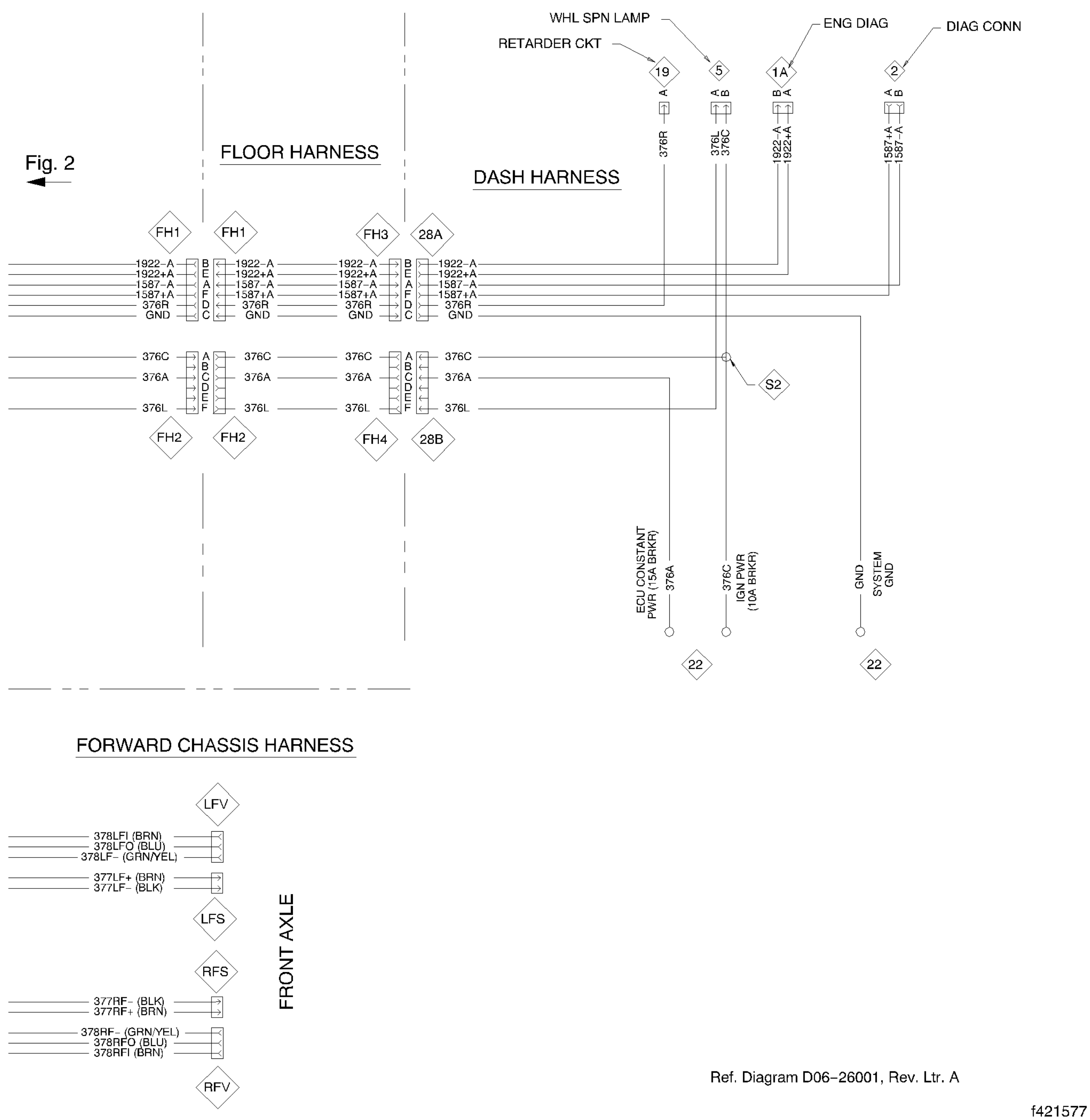


Figure 33. Wiring Diagram, Basic WABCO Wiring (Partial View).

END OF WORK PACKAGE

AIR SYSTEM TROUBLESHOOTING 0014 00

THIS WORK PACKAGE COVERS

Air System Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Air System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Loss of Air Pressure.	1. Check for leaks in air lines and fittings.	Replace air lines and fittings as necessary (WP 0188 00 or WP 0189 00).
	2. Check damaged supply tanks and components for damage.	Replace damaged components (WP 0183 00 through WP 0187 00).
2. Loss of Air Supply Function.	1. Check for blocked or kinked air lines.	Replace damaged or blocked air lines (WP 0188 00 or WP 0189 00).
	2. Check all valves for damage.	Replace faulty valves (WP 0192 00 through WP 0197 00).
3. Air Dryer Leaks.	Check for faulty filter seal.	Replace filter seal (WP 0200 00).
4. Air Dryer Fails to Absorb Moisture.	1. Check for dirty air dryer filter(s).	Service air dryer (WP 0200 00).
	2. Check for contaminated desiccant beads (drying beads).	Service air dryer (WP 0200 00).
	3. Check purge valve for damage.	Service air dryer (WP 0200 00).

END OF WORK PACKAGE

STEERING SYSTEM TROUBLESHOOTING 0015 00

THIS WORK PACKAGE COVERS

Steering System Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Steering System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Loss of Steering Control.	1. Check for failed mounting of steering wheel to steering column shaft.	Replace steering wheel or column shaft if defective (WP 0218 00 or WP 0219 00).
	2. Check for defective steering wheel.	Replace steering wheel if defective (WP 0218 00).
	3. Check for defective universal shaft.	Replace universal shaft if defective (WP 0219 00).
	4. Check tie rod, pitman arm, and drag link for damage.	Replace tie rod (Notify Direct Support Maintenance). Replace pitman arm or drag link if damaged (WP 0220 00).
2. Difficult Steering.	1. Check universal shaft for damage.	Replace universal shaft if damaged (WP 0219 00).
	2. Check for defective yoke assembly.	Replace universal shaft if defective (WP 0219 00).
	3. Check for defective attaching hardware.	Tighten or replace attaching hardware if defective (WP 0219 00).
3. Tie Rod, Drag Link or Pitman Arm Fails.	1. Check for proper lubrication.	Lubricate tie rod assembly (WP 0023 00).
	2. Check tie rod, drag link or pitman arm for damage.	Replace tie rod assembly if damaged (Notify Direct Support Maintenance). Replace drag link or pitman arm if corroded (WP 0220 00).
4. Hose Assembly Fails (Leaks).	1. Check hose assembly for loose and damaged fittings.	Tighten or replace fittings as necessary (WP 0221 00).
	2. Check hose for cracks and brittleness.	Replace hose assembly if cracked or brittle (WP 0221 00).

Table 1. Steering System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
5. Power Steering Reservoir Leaks.	1. Check for dirty filter and contamination.	Replace filter (WP 0221 00).
	2. Check for loose or damaged fitting connection(s).	Replace power steering fitting(s) (WP 0221 00).
	3. Check for damaged cover assembly and loose or damaged wing screw.	Tighten or replace cover assembly and wing screw as necessary (WP 0221 00).
	4. Check power steering reservoir for damage and cracks.	Replace power steering reservoir if damaged or cracked (WP 0221 00).

END OF WORK PACKAGE

CHASSIS AND FIFTH WHEEL TROUBLESHOOTING 0016 00

THIS WORK PACKAGE COVERS

Chassis and Fifth Wheel Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 50, WP 0306 00)

Table 1. Chassis and Fifth Wheel Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Pintle Hook Will Not Lock or Swivel.	1. Check pintle for proper lubrication.	Lubricate pintle (WP 0023 00).
	2. Check pintle hook for damage.	Replace or repair pintle hook (WP 0233 00).
2. Trailer Will Not Couple or Becomes Uncoupled.	1. Check for proper coupling by visually inspecting fifth wheel and trailer king pin.	
	2. Check fifth wheel for worn or damaged parts.	Notify Direct Support Maintenance to replace worn or damaged parts.
	3. Check operation of fifth wheel locking device.	Adjust locking mechanism (WP 0231 00 or WP 0232 00).
3. Restricted Motion Between Tractor and Trailer (M915A3, M916A3).	Check adjustment of slide bracket.	Adjust slide bracket (WP 0231 00 or WP 0232 00).
4. Roller Binds or Seizes (M916A3).	1. Check for lack of lubrication.	Lubricate roller (WP 0023 00).
	2. Check for faulty bearings.	Replace roller (WP 0238 00).

END OF WORK PACKAGE

AIR CONDITIONING SYSTEM TROUBLESHOOTING AND TESTING 0017 00

THIS WORK PACKAGE COVERS

Preliminary Checks, Safety Precautions, Performance Checks, Air Conditioning Troubleshooting

INITIAL SETUP

Tools and Special Tools	References
Tool kit, general mechanic's (Item 50, WP 0306 00)	WP 0052 00
Gloves (Item 13, WP 0306 00)	WP 0288 00
Goggles (Item 14, WP 0306 00)	TM 9-2320-302-10
Leak detector (Item 25, WP 0306 00)	

PRELIMINARY CHECKS

Before testing operation of air conditioning system, make the following checks:

1. Ensure the refrigerant compressor drive belt is not damaged and is under proper tension (WP 0053 00 or WP 0063 00). Check compressor mountings for tightness.
2. Check for broken, burst, and cut hoses. Check for loose fittings on all parts.
3. Check for road debris buildup on condenser coil fins. Using a fin comb, carefully clean condenser, using care not to bend fins.
4. Check color in moisture indicator sight glass. If color is a deep cobalt blue, refrigerant charge is dry. If moisture indicator is *not* blue, system is contaminated with moisture. Notify your supervisor.
5. If there is not enough airflow, ensure that leaves and other debris has not entered fresh air ports under windshield. If debris is present, it could clog fins of evaporator core and block airflow. Ensure that all ducts are connected to dash louvers and air-control flaps in heater housing are moving properly (WP 0288 00).

SAFETY PRECAUTIONS

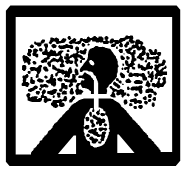
1. Whenever repairs are made to any air conditioner parts that hold refrigerant, it is necessary to discharge, purge or flush (if contaminated), evacuate, charge, and leak test system. In a good system, refrigerant lines are always under pressure and should be disconnected only after air conditioning system has been discharged to a refrigerant recovery unit through service valves on compressor.
2. Refrigerants are safe when used under proper conditions. Always wear safety goggles and non-leather gloves while discharging, purging, flushing, evacuating, charging, and leak testing system. DO NOT wear leather gloves. When refrigerant gas or liquid contacts leather, leather will stick to skin.

WARNING

Liquid refrigerant, when exposed to the air, quickly evaporates and will freeze skin or eye tissue. Use care to prevent refrigerant from touching your skin or eyes. Serious injury or blindness result if you come in contact with liquid refrigerant.

SAFETY PRECAUTIONS - CONTINUED

3. Refrigerant splashed in eyes should first be treated with a few drops of sterile mineral oil in eyes, and rinsed with a weak boric acid solution. DO NOT rub eyes. Seek medical attention immediately.
4. Refrigerant splashed on skin should be treated the same as frostbite. Gently pour cool water on area, but do not rub skin. Keep skin warm with layers of soft, sterile cloth. Seek medical attention immediately.
5. Even though refrigerant does not burn, when it contacts extreme heat or flame, poisonous phosgene gas is created. This gas is also produced when an open flame leak detector is used. Phosgene fumes have an acrid (bitter) smell.



WARNING

DO NOT work in an area where refrigerant may contact an open flame or any burning material such as a cigarette. When refrigerant contacts extreme heat, refrigerant breaks down into poisonous phosgene gas which, if breathed, causes severe respiratory irritation. DO NOT breathe fumes from an open flame leak detector.

6. You must work in an area where there is a constant flow of fresh air when system is discharged, flushed, charged, and leak tested using an open flame leak detector.
7. Under current federal laws, refrigerant must be recovered and recycled by all users to protect environment, and not released into atmosphere.
8. Because of its very low boiling point, refrigerant must be stored under pressure. To prevent refrigerant cans from exploding, never expose to temperatures higher than 125°F (52°C). Never leave refrigerant cans in the sun, and DO NOT store them in sun-exposed areas where heat can build up.

PERFORMANCE TESTS

Following is a brief description of symptoms or conditions that could exist if something goes wrong with a refrigerant part.

1. **Receiver-drier.**
   a. The receiver-drier is normally at outside temperature. To the touch, entire length of unit should be same temperature. If noticeable cool spots exist, notify DS maintenance.
   b. A blockage at receiver-drier inlet will cause high head pressures. Blockages at receiver-drier outlet will cause low head pressures and little or no cooling.
   c. If moisture indicator color is pink or white (showing system is wet), receiver-drier is saturated with moisture and must be replaced. Notify your supervisor.
2. **Cooling System.**
   a. Although not physically connected, a close tie exists between vehicle air conditioner and cooling system. Poor air conditioner cooling can be the result of a problem in the cooling system.
   b. If cooling system does not work correctly, heat of engine will rise to abnormal levels. The added heat will transfer to the air conditioner, other underhood parts, and may make its way into the cab. The added heat makes it necessary for air conditioner to work harder and, at the same time, reduces air conditioner ability to cool down air in cab. Also, if water regulating valve is not closing fully, heat will enter cab, giving the impression that the air conditioning system is not working.
3. **Expansion Valve.**
   a. Problems that start in expansion valve show up as follows:
      (1) When expansion valve is stuck closed, evaporator coil and expansion valve will be at outside temperature.

PERFORMANCE TESTS - CONTINUED

(2) When expansion valve is stuck open, both coil and valve will be extremely cold with frost or ice buildup.

b. Because expansion valve channels are very small, blockages in system tend to be found here (valve is very sensitive to contamination). Usually, contaminant is water. Less than a drop of water is all it takes to make valve inoperative. When water reaches valve, extreme cold that results from pressure drop freezes water, forming a block of ice in valve. After system shuts down and valve warms up, the ice melts and valve operates again, only to freeze up when moisture returns.

c. On-and-off operation of expansion valve means that receiver-drier is not removing moisture from system. These contaminants should cause moisture indicator element to turn white and then pink.

4. **Refrigerant Compressor.**

a. Compressor problems usually show in one of four ways: abnormal noise; seizure; leakage; or low suction and discharge pressures.

b. Resonant compressor noises are not causes for alarm. Irregular noise or rattles are likely to be caused by broken parts.

5. **Evaporator.**

a. Evaporator coils are basically trouble-free when air flow over fins is not blocked. External or, less often, internal blockages will cause low suction pressure as well as little or no cooling.

b. If a leak exists in system and cannot be traced to other parts or fittings, suspect damage to one of evaporator coils. Notify your supervisor.

6. **Condenser.**

a. The condenser is usually trouble-free. Normally, temperature of condenser outlet line is noticeably cooler than inlet line. However, when road debris (such as leaves or dirt buildup) builds up, air flow over condenser fins is blocked and air is not able to absorb enough heat to turn hot refrigerant gas into a liquid. High head pressures will result. In this case, carefully clean outer surfaces of the condenser with compressed air or soap and water solution using care not to bend fins.

b. High head pressures also occur if the condenser tubing is abnormally bent, blocking flow of refrigerant. Frost will appear at point where flow is restricted.

c. Less common internal blockages (bits of foreign material or metallic grit buildup) will stop the flow of refrigerant.

d. A quick test to check if poor system performance is caused by condenser is to direct a spray of water onto condenser while system is running. If the air conditioner cools better because of the assist provided by water, the condenser is not working.

e. When troubleshooting a suspected condenser problem, remember that the problem may be caused by radiator transferring high levels of heat to condenser.

7. **Thermostatic Switch.**

NOTE

- Before troubleshooting thermostatic switch, notify your supervisor to check for a full charge of refrigerant in system. Compressor will not operate or will cycle too often if there is not enough refrigerant in the system.
- Quick or delayed cycling of compressor may be caused by a thermostatic switch that is working, but is out of adjustment. If, after performing tests below, switch seems to be out of adjustment, replace switch (the thermostatic switch cannot be recalibrated).

a. Ensure that compressor clutch is operating properly.

b. Expose evaporator coil.

PERFORMANCE TESTS - CONTINUED

c. Start engine (TM 9-2320-302-10). Place air conditioner control at coldest setting and turn on air conditioner and fan.

d. Place an accurate thermometer in contact with a tube on evaporator coil. Ensure that thermometer is in good contact with tube or incorrect reading will result. When temperature drops below 31°F - 36°F (-1°C - 2°C), compressor clutch should disengage and remain this way until temperature rises to 39°F - 44°F (4°C - 7°C).

e. If the compressor did not engage when temperature was above accepted high range, perform the following test:

(1) Connect voltmeter or test light from one terminal on thermostatic switch to ground. Repeat this test with other terminal on switch.

(2) With engine running and air conditioner and blower on, both terminals will show voltage when compressor should be engaged. One terminal will show voltage when compressor should be disengaged. If voltage is not present, there is a problem in electrical system from batteries to thermostatic switch. Check all circuits for cause, and repair or replace necessary wiring or parts. In all other cases where compressor is not engaging and disengaging properly, thermostatic switch is cause. Replace thermostatic switch (WP 0292 00).

(3) Shut down engine (TM 9-2320-302-10) and, to prevent accidental electric shock or shorting during dash assembling, place master battery switch in OFF position (TM 9-2320-302-10).

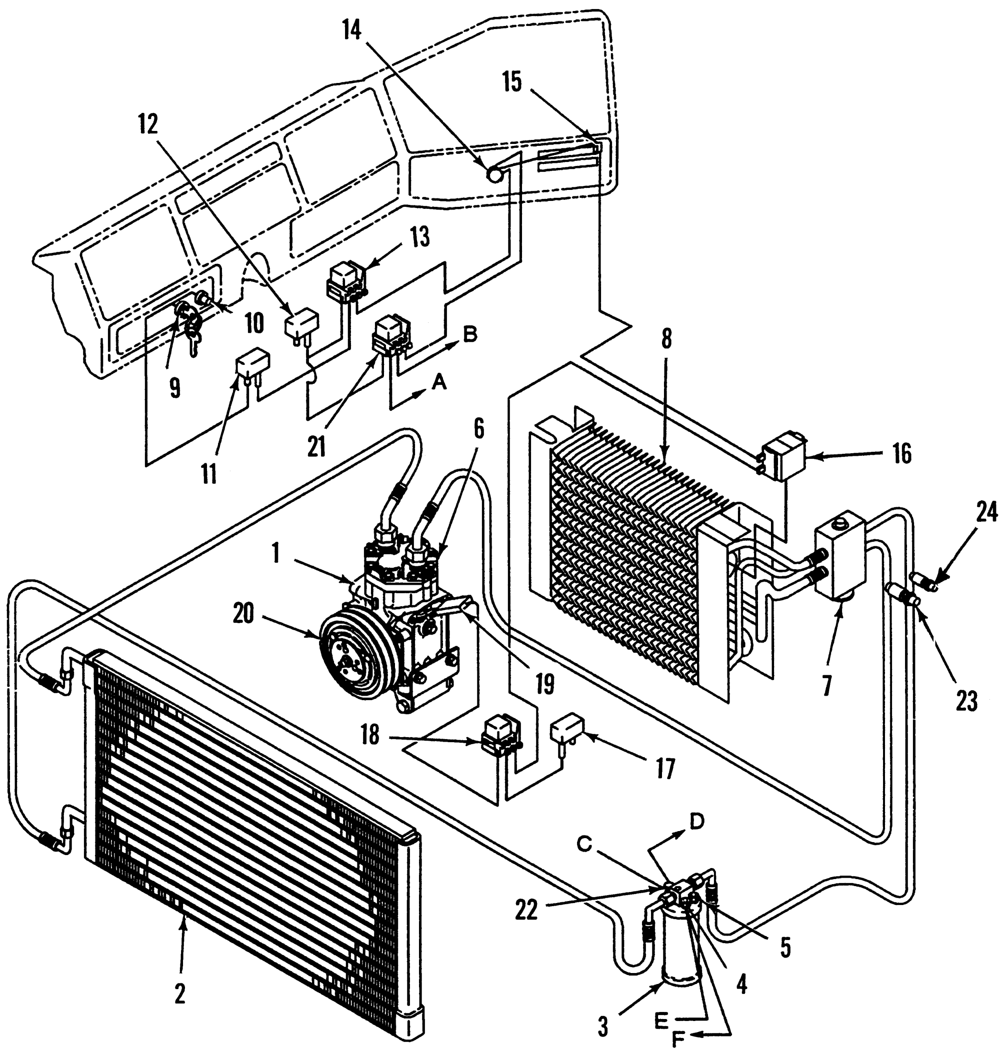
(4) Assemble dash.

8. **Line Restrictions.**

a. A restricted suction line causes low suction pressure at compressor and little or no cooling. A restriction in a line between compressor and expansion valve can cause high discharge and low suction pressure and insufficient cooling.

b. Usually, areas of ice or frost buildup mean a blockage. Parts that often freeze up are probably corroded or inoperative and should be replaced. Parts (such as expansion valve) that freeze up once in a while may do so because of moisture in system, which will cause the moisture indicator element to turn white or pink. If this happens, notify your supervisor.

PERFORMANCE TESTS - CONTINUED



A	**To resistor block**	**D**	**To engine fan thermal switch**
B	**To blower motor**	**E**	**From a/c clutch relay**
C	**From engine fan thermal switch**	**F**	**To compressor clutch**

1	Compressor	9	Ignition Switch	17	Circuit Breaker (15A)
2	Condenser	10	Start Button	18	A/C clutch Relay
3	Receiver-drier	11	Circuit Breaker (10A)	19	Diode
4	Binary Switch	12	Circuit Breaker (30A)	20	Compressor Clutch
5	Moisture Indicator	13	Power Relay	21	High-speed Relay
6	High Pressure Relief Valve	14	Blower Switch	22	Fan Cycling Switch
7	Expansion Valve	15	“On-Off” Microswitch	23	Discharger Service Valve
8	Evaporator	16	Thermostatic Switch	24	Suction Service Valve

Figure 1. Air Conditioning System Components.

PERFORMANCE TESTS - CONTINUED

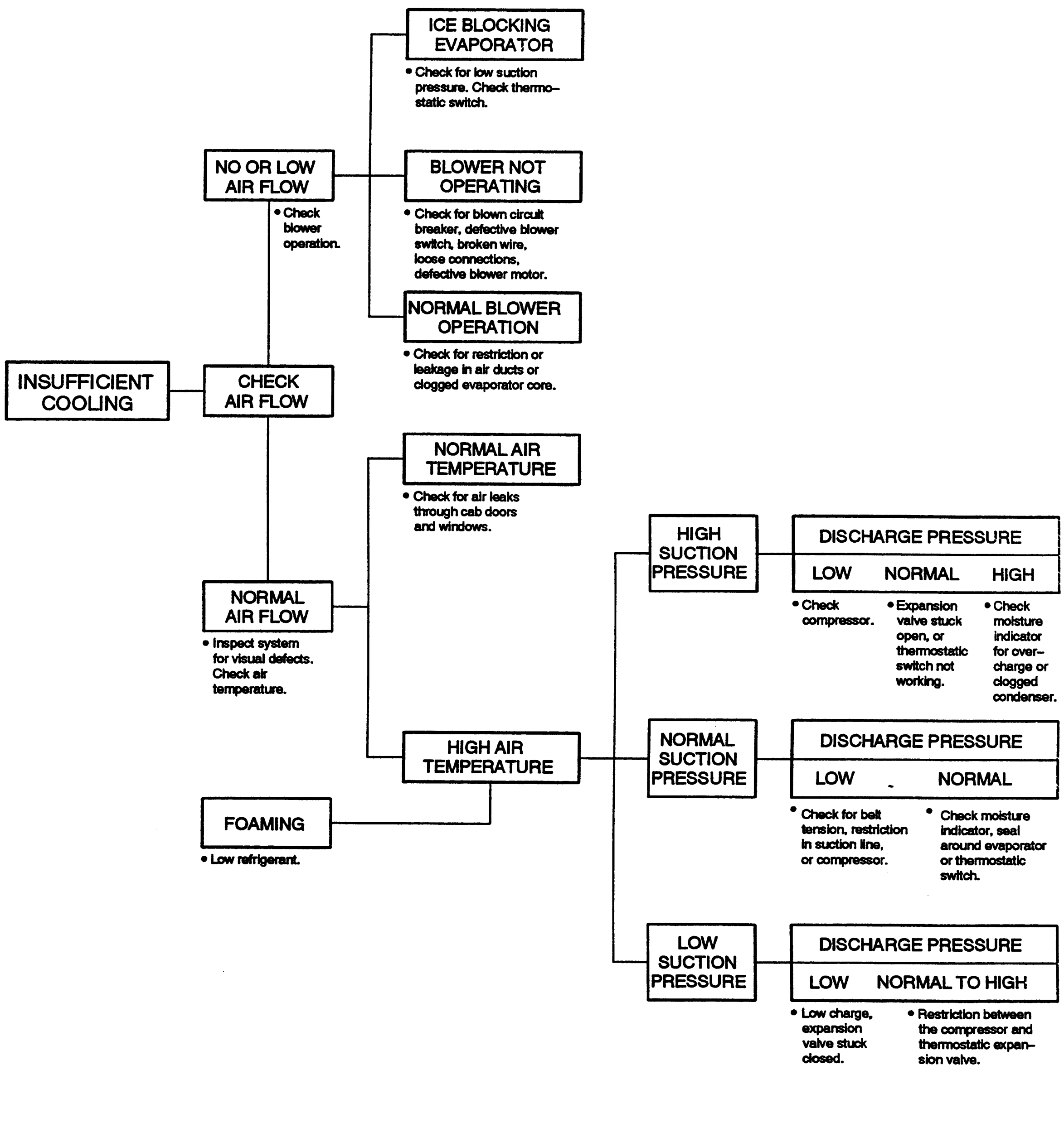


Figure 2. Air Conditioning System Troubleshooting.

AIR CONDITIONING SYSTEM TROUBLESHOOTING

Table 1. Problem - Little or No Air Flow.

POSSIBLE CAUSE	REMEDY
Blower is not operating.	Check for open circuit breaker. Open circuit indicates a short in electrical system, which must be located and repaired. Check air conditioner relays for operation. Replace as necessary (WP 0084 00). Blower motor switch is working. Replace if necessary. Check wiring to blower motor. Tighten any loose connections. Check blower motor for operation. Replace blower motor if sticking or otherwise inoperative (WP 0289 00). Check resistor block. Replace if necessary (WP 0291 00). **CAUTION** Never attempt to bypass fuse in resistor block. To do so could cause blower motor to overheat, resulting in serious damage to heater/air conditioning system.
Restrictions or leaks in the ducts.	Examine air ducts and remove blockages. Stop any leaks or replace portion if leaks cannot be stopped.
Ice has formed on evaporator coil.	Defrost evaporator coil before resuming operation of air conditioner.

Table 2. Problem - Warm Air Flow When Air Conditioner Is On.

POSSIBLE CAUSE	REMEDY
No refrigerant charge in system.	Perform air conditioner leak test (WP 0295 00).
Refrigerant compressor is not operating.	Perform air conditioner leak test (WP 0295 00). Replace drive belt (WP 0062 00).
Air conditioner microswitch is not working.	Replace microswitch.
Ice has formed on evaporator coil.	Defrost evaporator coil before resuming operation of air conditioner.

Table 3. Problem - Compressor Operates Too Often or Continuously.

POSSIBLE CAUSE	REMEDY
Too little refrigerant in system.	Perform air conditioner leak test (WP 0295 00).
Ice has formed on evaporator coil.	Defrost evaporator coil before resuming operation of air conditioner. Check operation of thermostatic switch and replace as necessary.
Dirt and debris are clogging condenser fins.	Remove dirt and debris from condenser fins.
Thermostatic switch is not working.	Replace thermostatic switch (WP 0292 00).

AIR CONDITIONING SYSTEM TROUBLESHOOTING - CONTINUED

Table 4. Problem - Quick or Delayed Cycling of Compressor.

POSSIBLE CAUSE	REMEDY
Thermostatic switch operates, but is out of adjustment.	Replace thermostatic switch (WP 0292 00). Do not attempt to adjust it.
Loss of refrigerant is causing a delayed cycling of compressor.	Perform air conditioner leak test (WP 0295 00).

Table 5. Problem - Temperature in Cab Too Low or No Heat.

POSSIBLE CAUSE	REMEDY
Water regulating valve is not open.	Slide temperature lever slide control toward “warm”.
Water regulating valve is not opening fully.	Adjust water regulating valve cable.
Water regulating valve is not working.	Replace water regulating valve.
Heater hose is pinched or twisted.	Repair or replace heater hose.
Coolant is leaking from system.	Check for leakage at heater core and at all hose connections from heater core to engine. Check radiator coolant level and add coolant if necessary (TM 9-2320-302-10). Check and repair any leaks at the radiator.
Dust or dirt is clogging heater core fins.	Remove and clean heater core (WP 0290 00).

Table 6. Problem - Condensed Water Is Leaking from Air Conditioner.

POSSIBLE CAUSE	REMEDY
Drain tubes are plugged.	Clean drain holes and drain tubes.

END OF WORK PACKAGE

COLLISION WARNING SYSTEM (CWS) TROUBLESHOOTING (M915A3, M916A3) 0018 00

THIS WORK PACKAGE COVERS

Initial System Troubleshooting, Driver's Display Unit Diagnostics Features, Activating/Clearing Failure Display Mode, Prolink Diagnostic Features, CWS Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

PC card, CTIS/CWS (Item 31, WP 0306 00)

Multimeter, digital (Item 28, WP 0306 00)

Tester, Pro-link, diagnostic reader (Item 46, WP 0306 00)

References

WP 0151 00

INITIAL SYSTEM TROUBLESHOOTING

1. Check CWS components and wiring harness for obvious damage.
2. Check all connectors for corrosion, damage, and missing pins. Repair connectors as necessary (WP 0151 00).
3. Check that all electrical connections and ground wires are secure.
4. Check that other vehicle components are not causing interference.

DRIVER'S DISPLAY UNIT (DDU) DIAGNOSTIC FEATURES

1. Red failure light on DDU illuminates until cause of failure is corrected.
2. Fault codes are indicated by a pattern of flashes blinked out on Driver Display Unit (DDU) red "FAIL" light indicator. Each fault code consists of a two digit number.
3. A pause of 3/4 of one second separates blinking of first and second digit of fault code. Example: Fault code 32 is indicated by 3 blinks, a 3/4 second pause, and 2 more blinks.
4. A pause of 3 seconds exists between each flash code fault.
5. Code 41 is flashed if there are no faults OR after all faults have been displayed.

ACTIVATING/CLEARING FAILURE DISPLAY MODE

1. Press in and hold DDU "VOLUME" knob for a minimum of five seconds. If knob is released before five seconds has elapsed, system will turn off.
2. After five seconds, DDU red "FAIL" indicator will begin to blink out fault codes.
3. Code 41 is flashed if there are no faults OR after all faults have been displayed.
4. To read active fault codes, position DDU "RANGE" knob to left of center; only active fault codes will flash.
5. To read inactive fault codes, position "RANGE" knob to right of center; only inactive fault codes will flash.
6. To clear fault codes, push and hold DDU "RANGE" knob while system is in self-test (when ignition key is turned on).

ACTIVATING/CLEARING FAILURE DISPLAY MODE - CONTINUED

Table 1. Fault Codes.

FAULT CODE	SUSPECT FAILURE
11	Central Processing Unit (CPU)
13	Driver Display Unit (DDU)
14	Antenna assembly
15	Right side sensor
21	Right turn signal
23	Brake
24	Speed
31	J1587
32	J1939
33	VBUS
34	DDU communications
35	Antenna assembly communications
41	End of Codes/No Codes

PROLINK DIAGNOSTIC FEATURES

1. Connect Pro-link tester with CTIS/CWS PC Card to vehicle.
2. Follow instructions on Pro-link tester display.

CWS TROUBLESHOOTING PROCEDURES

NOTE

- Perform Initial System Troubleshooting prior to replacing any component.
- Asterisk (*) indicates step requiring Pro-link tester w/CTIS/CWS PC Card.

Table 2. CWS Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Red Fail Light on Driver's Display Unit or Side Sensor Display Illuminates Continuously.	1. While performing side sensor test, wave hand in front of side sensor and verify that correct signal is received.*	If OK, proceed to next step. If NOT OK, replace side sensor (WP 0138 00).
	2. Verify a 5-volt output at side sensor signal wire at side sensor connector, with a target present.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace side sensor (WP 0138 00).
2. Warning Tones Not Audible.	1. Verify volume control knob is turned fully clockwise.	Turn volume control knob fully clockwise.
	2. Turn system off and back on. Turn volume control knob and listen for tone.	If tone is not heard, proceed to next step.
	3. Perform speaker test and verify audible tone is heard from DDU speaker.*	If tone is not heard, proceed to next step.
	4. Verify speed input.	If OK, proceed to next step. If NOT OK, replace DDU (WP 0137 00).
	5. Perform brake test and verify correct signal is received when brake pedal is depressed.*	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace DDU (WP 0137 00).
3. Warning Tones Audible When Brakes Are Applied.	1. Perform brake test and confirm receipt of correct signal when brake pedal is depressed.*	If OK, proceed to next step. If NOT OK, replace DDU (WP 0137 00).
	2. Verify brake mode setting is correctly configured in CPU.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	3. Verify brake logic is correctly configured.*	If OK, replace DDU (WP 0137 00). If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
4. Side Sensor Warning Tone Audible When Brakes Are Applied.	1. Verify tone is not audible when hand is waved in front of side sensor with only brake pedal depressed (turn signal not activated).	If tone is heard, replace side sensor (WP 0138 00). If tone is not heard, proceed to next step.
	2. Verify turn signal setting is correctly configured in CPU.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).

Table 2. CWS Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
4. Side Sensor Warning Tone Audible When Brakes Are Applied - Continued.	3. Perform turn signal test and confirm receipt of correct signal when turn signal is applied.*	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace DDU (WP 0137 00).
5. Volume Knob Does Not Reduce Volume.	1. Verify MIN VOL setting is zero.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	2. Perform DDU test and confirm proper operation of volume knob.*	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace DDU (WP 0137 00).
6. Range Knob Does Not Change Alert Levels.	1. Verify RANGE ENABLE configuration is ON.*	If OK, proceed to next step. If NOT OK, notify supervisor.
	2. Perform DDU test and confirm proper operation of range knob.*	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace DDU (WP 0137 00).
7. Front Antenna Detects Vehicles in an Adjacent Lane With No Vehicle in Front of Host Vehicle.	1. Confirm radar beam path is unobstructed.	Clear radar beam path if obstructed. If radar beam path is not obstructed, proceed to next step.
	2. Confirm antenna is secure and check alignment (WP 0134 00).	If antenna is secure and proper alignment is confirmed and fault still exists, replace CPU (WP 0135 00 or WP 0136 00).
8. Front Antenna Detects Vehicle in Both Left and Right Adjacent Lanes, With No Vehicle in Front of Host Vehicle.	1. Confirm radar beam path is unobstructed.	Clear radar beam path is unobstructed. If radar beam path is not obstructed, proceed to next step.
	2. Confirm antenna is secure and check alignment (WP 0134 00).	If antenna is secure and proper alignment is confirmed and fault still exists, replace CPU (WP 0135 00 or WP 0136 00).
9. Front Antenna Loses or Ignores Detected Vehicles Within 100 Feet in Front of Host Vehicle.	1. Confirm radar beam path if unobstructed.	Clear radar beam path if obstructed. If radar beam path is not obstructed, proceed to next step.
	2. Confirm antenna is secure and check alignment (WP 0134 00).	If antenna is secure and proper alignment is confirmed and fault still exists, replace CPU (WP 0135 00) or WP 0136 00).
10. Side Sensor Display Does Not Indicate Power, or a Detected Object.	1. Verify side sensor display operation.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).

Table 2. CWS Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
10. Side Sensor Display Does Not Indicate Power, or a Detected Object - Continued.	2. Check for correct continuity and supplied voltage readings at connector.	1. If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace side sensor (WP 0138 00). 2. If fault still exists, replace CPU (WP 0135 00 or WP 0136 00).
11. DDU Blinks Out Fault Code 11 (Central Processing Unit).		Replace CPU (WP 0135 00 or WP 0136 00)
12. DDU Blinks Out Fault Code 13 (Driver's Display Unit).		Replace DDU (WP 0137 00).
13. DDU Blinks Out Fault Code 14 (Antenna Assembly).		1. Replace antenna (WP 0134 00). 2. If fault still exists, replace CPU (WP 0135 00 or WP 0136 00).
14. DDU Blinks Out Fault Code 15 (Right Side Sensor).	1. While performing side sensor test, wave hand in front of side sensor and verify that correct signal is received.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	2. Verify a 5-volt output at side sensor signal wire at side sensor connector, with a target present.	If OK, proceed to next step. If NOT OK, replace side sensor (WP 0138 00).
15. DDU Blinks Out Fault Code 21 (Right Turn Signal).	1. Confirm operation of exterior turn signals.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	2. Confirm operation of turn signal switch.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	3. Check that right turn signal input is connected to right turn signal lead.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	4. Perform turn signal test to confirm correct input is received when right turn signal is activated.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	5. Verify pin number 15, on top row of main harness connector, receives 12 volts when right signal is activated.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).
16. DDU Blinks Out Fault Code 23 (Brake).	1. Confirm brake source is correctly configured in CPU.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	2. Confirm operation of exterior brake lights.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).

Table 2. CWS Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. DDU Blinks Out Fault Code 23 (Brake) - Continued.	3. Confirm operation of brake switch.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	4. Perform brake test and confirm correct signal is received when brake pedal is depressed.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	5. Confirm brake logic is correctly configured.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	6. Confirm brake input wire is connected to proper source.	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	7. Verify pin number 9, on top row of main harness connector, receives 12 volts when brake is applied.	Replace CPU (WP 0135 00 or WP 0136 00).
17. DDU Blinks Out Fault Code 24 (Speed).	1. Confirm that SPEEDO BIT setting is correcting configured in CPU.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	2. Confirm speed mode is correctly configured.*	If OK, proceed to next step. If NOT OK, replace CPU (WP 0135 00 or WP 0136 00).
	3. Perform speedometer test to confirm speedometer accuracy against vehicle speed.*	Replace CPU (WP 0135 00 or WP 0136 00).
18. DDU Blinks Out Fault Code 31 (J1587).	Confirm proper connection of J1587 wires at pin #7 positive and pin #8 negative on top row of CPU connector.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).
19. DDU Blinks Out Fault Code 32 (J1939).	Confirm proper connection of J1939 wires at pin #7 positive and pin #8 negative on bottom row of CPU connector.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).
20. DDU Blinks Out Fault Code 33 (VBUS).	Check connection of J1587 wires to vehicle harness.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).
21. DDU Blinks Out Fault Code 34 (DDU Communications).	Check connection of J1587 wires to vehicle harness.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).
22. DDU Blinks Out Fault Code 35 (Antenna Assembly Communications).	Check connection of J1587 wires to vehicle harness.	If OK, replace CPU (WP 0135 00 or WP 0136 00). If NOT OK, replace connector (WP 0151 00).

END OF WORK PACKAGE

HYDRAULIC SYSTEM TROUBLESHOOTING (M916A3, M917A2) 0019 00

THIS WORK PACKAGE COVERS

Power Take-Off (PTO) Circuits (M916A3, M917A2) Troubleshooting Procedures, Hydraulic System (M916A3) Troubleshooting Procedures

INITIAL SETUP

Tools and Special Tools

Multimeter, digital (Item 28, WP 0306 00)

Table 1. Power Take-Off (PTO) Circuits (M916A3, M917A2) Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Power Take-Off (PTO) Does Not Engage.	1. Check reservoir heater/power take-off 15A fuse.	If defective, replace 15A fuse (WP 0084 00).
	2. Remove reservoir heater/ power take-off 15A fuse. Check for +12 VDC at fuse connector from lead 18.	If +12 VDC is present, go to step 3. If no voltage is present, repair lead 18 (WP 0151 00).
	3. Disconnect lead 200D from power take-off switch on dash. Check for +12 VDC at lead 200D.	If +12 VDC is present, go to step 4. If no voltage is present repair lead 200D (WP 0151 00).
	4. Disconnect lead 200D and lead 200E from power take-off switch on dash. Check for continuity between contacts at power take-off switch and with switch closed.	If continuity is indicated, go to step 5. If no continuity is indicated, replace power take-off switch on dash (WP 0076 00).
	5. Disconnect lead 200E from power take-off solenoid valve. Check for +12 VDC at lead with power take-off switch on dash closed.	If +12 VDC is present, go to step 6. If no voltage is present, repair lead 200E (WP 0151 00).
	6. Disconnect lead 200E from power take-off solenoid valve. Disconnect power take-off solenoid ground lead from ground. Check for continuity between power take-off 200E connector and ground lead.	If continuity is indicated, repair ground lead to ground. If no continuity is indicated, replace power take-off solenoid valve (WP 0273 00). If power take-off still will not engage, notify Direct Support Maintenance.

Table 1. Power Take-Off (PTO) Circuits (M916A3, M917A2) Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Power Take-Off (PTO) RPM Control Does Not Operate.	1. Disconnect power take-off neutral lockout relay from connector. Check for +12 VDC at connector 85.	If+12 VDC is present, go to step 2. If no voltage is present, repair lead 15D (WP 0151 00).
	2. Disconnect power take-off neutral lockout relay from connector. Check for +12 VDC at connector 30.	1. If +12 VDC is present, go to step 3. If not voltage is present go to next corrective action.
		2. Disconnect lead D510 from pin R of DDEC engine harness connector. Check for continuity between connector 30 and lead D510. If continuity is not indicated, repair lead D510 (WP 0151 00). If continuity is indicated, refer to DDEC IV troubleshooting (WP 0007 00).
	3. Disconnect power take-off neutral lockout relay from connector. Check for continuity between connector 86 and ground.	If continuity is indicated, go to step 4. If no continuity is indicated, repair ground lead (WP 0151 00).
	4. Disconnect power take-off neutral lockout relay from connector. Install jumper leads between connectors 30, 85, and 86 to their respective connections at power take-off lockout relay. Check for +12 VDC at connection 87 on power take-off relay.	If +12 VDC is present, go to step 5. If no voltage is present, replace power take-off lockout relay (WP 0084 00).
	5. Disconnect lead D510C from winch speed control switch on winch. Check for +12 VDC at lead D510C.	If +12 VDC is present, go to step 6. If no voltage is present, repair lead D510C (WP 0151 00).
	6. Disconnect lead D510C and D510D from winch speed control switch on winch. Check for continuity between contacts of power take-off rpm switch with switch closed.	If continuity is indicated, go to step 7. If no continuity is indicated, replace winch speed control switch on winch (WP 0274 00).

Table 1. Power Take-Off (PTO) Circuits (M916A3, M917A2) Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Power Take-Off (PTO) RPM Control Does Not Operate - Continued.	7. Disconnect lead D510D from rpm control module potentiometer located just above vehicle fuse/relay panel. Check for +12 VDC at lead D510D.	If +12 VDC is present, go to step 8. If no voltage is present, repair lead D510D (WP 0151 00).
	8. Disconnect power take-off relay rpm control module potentiometer from connector. Check for 9 to 11 kohms between yellow and black wire.	If 9 to 11 kohms is not present, replace potentiometer.

Table 2. Hydraulic System (M916A3) Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Slow Pay Out or Return of Winch Cable	Check for low oil level in reservoir.	Service reservoir with oil (WP 0023 00).
2. Oil Flow Block.	Check for contaminated or damaged filter.	Replace filter element (WP 0272 00).
3. Oil Filter Leaks.	1. Check for leaking hoses.	Replace leaking hoses (WP 0269 00).
	2. Check oil filter for leaks and damage.	Replace oil filter assembly (WP 0272 00)
4. Hydraulic Oil Tank Leaks.	1. Check for faulty seals.	Repair hydraulic oil tank (WP 0271 00)
	2. Check for cracked or fractured tank material.	Replace hydraulic oil tank (WP 0271 00).
5. No Hydraulic Pressure at Trailer Quick-Disconnect.	1. Ensure PTO operates.	Refer to PTO troubleshooting (Table 1, this work package).
	2. Inspect hydraulic lines and fittings for leaks and damage.	Repair or replace as necessary (WP 0269 00).
	3. Check lever on speed/auxiliary circuit control valve for free movement.	If lever does not operate properly, notify Direct Support Maintenance.

END OF WORK PACKAGE

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) 0020 00

THIS WORK PACKAGE COVERS

Operator Controls, Warning Signals, Troubleshooting Tips, Test Equipment, Fault Display Codes, Electrical Schematic

INITIAL SETUP

Tools and Special Tools

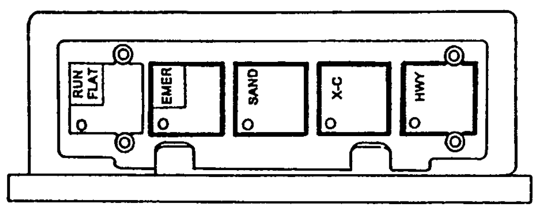
CTIS/CWS, PC card (Item 31, WP 0306 00)

Multimeter, digital (Item 28, WP 0306 00)

Pro-link tester (Item 46, WP 0306 00)

OPERATOR CONTROLS

The integrated push button/display is the primary interface for display of system information and for push button entry of system instructions. The following sections explain the purpose and operation of the ECU controls and display.



371-371

Mode Keys

These keys select pressures appropriate for different surface conditions. Any mode may be selected at any time (within built in speed limitations). Depressing the button for the current mode will result in a pressure check.

1. **HWY** (Highway) - For operation on improved paved surfaces.
2. **XC** (Cross Country) - For operation on non-paved secondary roads.
3. **SAND** (Sand) - For operation on trails and other unimproved surfaces.
4. **EMER** (Emergency) - For selection of extremely low tire pressures to help free a stuck vehicle, or to traverse a short distance over a terrain known to require very low tire pressures. Since this is an extremely low pressure, the warning lamp will flash whenever this pressure is utilized.

CAUTION

The EMER key is for extreme conditions only and should not be used for normal driving.

OPERATOR CONTROLS - CONTINUED

Mode Annunciator Lights

The associated annunciator lights indicate the selected mode and signal one of two states:

- If the light is flashing - the system is in the process of checking or changing pressures to attain the pressure(s) associated with that mode light.

Some clicking may be heard from the PCU as the system cycles to achieve the new pressure(s). A deflate will be periodically interrupted as the system checks tire pressures to determine how much further deflation is necessary.

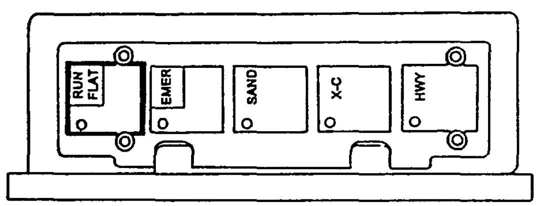
NOTE

Adequate supply system pressure is required to begin, or continue any pressure changing sequence.

- If the light is on steady - the selected pressure has been achieved, the tires have been isolated and the system is depressurized. The system will cycle periodically to assure that tire pressure is maintained.

NOTE

The system is designed to allow tire pressure increase due to heat buildup during vehicle use. This system will not automatically deflate these pressure buildups - a lower pressure mode selection by the operator must be selected to initiate a deflate.



371-372

Run Flat Key and Annunciator Light

This key instructs the system to check tire pressures at more frequent intervals. This key also allows the operator to over-ride the 4 flashing lights (tire leak imbalance) codes and re-attempt 2 lights and some 5 lights codes. (See Warning Signals in next section). While the system is in RUN FLAT mode, the RUN FLAT light will flash on and off. The “RUN FLAT” feature will automatically deselect after 10 minutes, or may be shut off by pressing the button a second time.

CAUTION

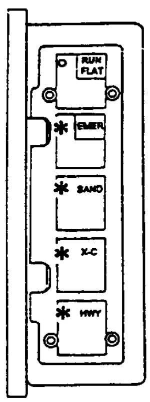
Selecting RUN FLAT to enable the system to inflate a significantly low tire may cause other tires on that channel to temporarily lose pressure. This condition will be corrected once the low tire is inflated to the pressure of the other tires.

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED 0020 00

WARNING SIGNALS

Several warning signals report operating problems.

The Central Tire Inflation System uses five general sequences displayed on the Electronic Control Unit lights and an instrument panel mounted warning lamp to identify the type and area of fault.



371-373

4 “Mode Lights” Flashing (Check Tire Conditions) - This signal reports that one tire may be at a significantly lower pressure than the others and could indicate that a tire is not holding air. The system has closed the wheel valves so the non-damaged tires will not lose pressure. The operator should immediately stop the vehicle and identify the extent of possible tire damage. The system may be used to re-inflate the low tire if damage is determined to be minimal (e.g., a minor puncture to slow leak) by selecting “RUN FLAT”. Repeated use of RUN FLAT to override reoccurring “4 mode lights” warnings may result in tires inflating to higher than preprogrammed set-points.

NOTE

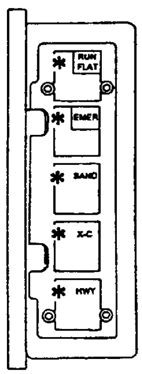
Excessive air seal leakage on cold weather start up may result in a “4 mode lights” or “5 mode lights” warning. If, upon inspection, no tire damage exists, the operator may proceed to operate the vehicle. This condition should correct itself (without the driver selecting RUN FLAT) as the seals warm-up with use.

WARNING

RUN FLAT should NOT be used to attempt inflating tires with substantial damage such as large cuts, chunkouts, or structural defects. Use of RUN FLAT in these circumstances can result in other tires on that channel losing pressure.

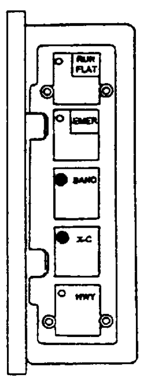
CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED 0020 00

WARNING SIGNALS - CONTINUED



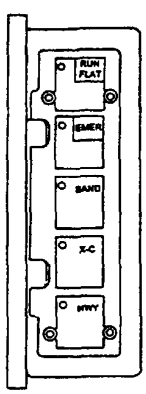
371-374

5 Lights Flashing - This signal reports that the built-in diagnostics of CTIS have detected a defect in a CTIS critical component and shut off the system, closing the wheel valves. Since the CTI system cannot properly function until the fault is corrected, there is no ability to override.



371-375

2 "Mode Lights" on Solid - This signal reports that the CTI system has shut off (closing the wheel valves) with the tire pressure between the two indicated modes. This occurs when the system is taking too long to either inflate or deflate the tires. Pressing any mode key will reattempt a change of pressures.



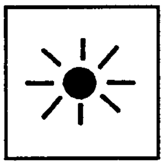
371-376

No Mode Lights - This signal reports that the CTI system has sensed either a low system voltage or an electrical fault with a Pneumatic Control Unit solenoid, and has shut off the system, closing the wheel valves until the problem is corrected.

Lights Sequentially Flashing (One after another) - This signal reports that there is a configuration error and the CTI memory has been "re-loaded" from the system defaults. Pressing the HWY and RUN-FLAT buttons at the same time will clear this display. Note, however, that any configured items (new pressure target, etc.) which in the past were updated in the ECU have now returned to their original values, and will need to be reprogrammed at the next convenient time.

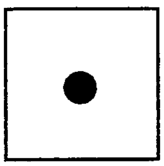
CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED

WARNING SIGNALS - CONTINUED



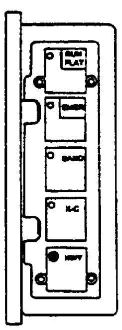
371-377

Flashing Warning Lamp and/or Buzzer (On instrument panel) - This signal reports that the vehicle speed is too fast for the pressure selected. The operator must either reduce speed or select a higher pressure by pressing the appropriate key. Continued operation in this mode will result in the system automatically selecting a more appropriate pressure setting. In addition, the warning lamp may flash while the system is in EMERGENCY mode to caution the driver.



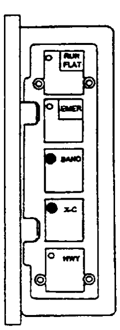
371-378

Solid Warning Lamp and/or Buzzer (On instrument panel) - This signal reports that the ECU has seen 25-50 ignition cycles without seeing any speed signal. If no problem exists with speed circuit wiring or sensor, the lamp will go off when the vehicle is moved. In addition, on vehicles equipped with a buzzer, the buzzer may be turned off by pressing any mode button on the ECU.



371-379

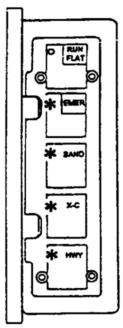
Single "Mode Light"
- **Flashing** - System working to achieve new pressures associated with that mode light
- **Solid** - Pressure achieved, system not active, wheel valves closed



371-375

2 "Mode Lights" on Solid
- System has shut off with tire pressure between two mode settings
- CTIS is still operational
- Select any mode button to re-attempt pressure change
- Frequent occurrences may indicate a need for service

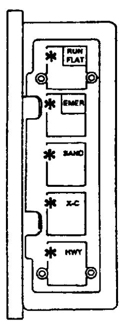
WARNING SIGNALS - CONTINUED



371-373

4 "Mode Lights" Flashing

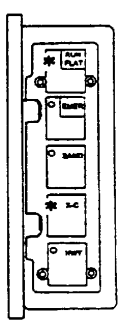
- System shut off, waiting for operator instruction
- Possible tire damage
- CTIS may be operated by selecting RUN FLAT if tire damage is minimal
- CTIS should not be operated if major tire damage is found
- Tire should be repaired before continuing to operate vehicle



371-374

5 LIGHTS Flashing

- System has shut off at least one channel due to fault detection of a CTI component
- System may periodically cycle PCU to determine if fault still exists
- Get service at next opportunity



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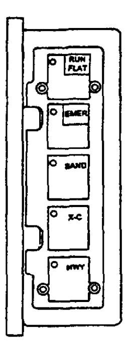
RUN FLAT Flashing (with a "Mode Light")

- RUN FLAT is selected. Tire pressures are checked at more frequent intervals
- If RUN FLAT is pushed to clear a "4 mode lights" flashing display, imbalance and confirmation fault detection is overridden for the duration of RUN FLAT
- May be turned off by depressing RUN FLAT again (or will "time-out" after 10 minutes)



371-376

No "Mode Lights"

- Inadequate vehicle power
- Electrical solenoid fault

Lights Sequentially Flashing (One after another)

- System has re-loaded default configuration values
- Pressing HWY & RUN FLAT buttons together will clear display
- Any past changes of target pressures, etc. should be updated

TROUBLESHOOTING TIPS

This checklist outlines some general hints and guidelines that will be helpful in tracking down and correcting operating problems.

The ECU only displays one active code

Only the most recent service code displays on the ECU lights. In troubleshooting, be alert for related codes. Use of a diagnostic tool offers the advantage of spotting multiple active codes as well as retrieving historical codes.

A cleared code alone does not indicate a corrected problem

A code is set by a specific fault condition and may be cleared by switching the ignition off, and then on. It's possible to clear a code (i.e., clear the flashing lights) only to have it display again when the fault condition reoccurs. To insure that a problem is fixed, you must run the system through the same operating modes that caused the problem and verify that the service code does not reappear.

Electrical faults are often connection problems

The most likely cause of electrical faults will be damaged wires or connections. As a first step in troubleshooting all electrical codes, switch off vehicle ignition, then disconnect applicable connectors and inspect for damage. (Switching off the ignition is required before disconnecting the harness at the Electronic Control Unit, but is also a recommended practice before all other electrical system disconnections.) Clean or repair all bad connections before proceeding.

Disconnect the Electronic Control Unit connector with ignition off

To avoid setting electrical fault codes, make sure that the ignition is off before unplugging the wire harness connection at the Electronic Control Unit module. Reconnect the connector before switching on the ignition.

System is not continually pressurized

When troubleshooting pneumatic faults, keep in mind that the air system is only pressurized as needed (for example, in the inflate mode). This means that such procedures as checking for leaks require the system to be in an active, pressurized state. This can be accomplished most easily by using a diagnostic tool.

Basic vehicle air and power systems are not covered in this guide

The Central Tire Inflation System requires air pressure and electrical power supply from the base vehicle systems. Diagnosis and service of these systems is located elsewhere in this manual.

Some faults will halt inflate or deflate sequence

Upon sensing some faults, the Central Tire Inflation System will immediately go to the “maintain” mode. This may cause the mode light to stop flashing before the system has actually attained the pressures for the indicated mode.

This section covers the equipment and procedures used to find and correct Central Tire Inflation System problems.

TEST EQUIPMENT

Central Tire Inflation System troubleshooting can be performed at three levels:

- Electronic Control Unit light codes
- Hand-held tester
- Personal computer based diagnostics

Regardless of the testing equipment used, the troubleshooting procedures will be based upon the diagnostic service codes. The hand-held tester and the personal computer system offer the advantages of computer-aided testing without interpreting service codes.

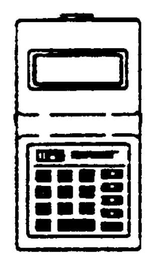
Each light sequence may represent more than one fault. Use of a hand-held or PC based diagnostic tool will give a brief description of the specific fault, narrowing the area of troubleshooting.

ECU Light Codes

The onboard system diagnostics are an important feature of Eaton’s Central Tire Inflation System. For a description of light fault displays see Operator Instructions section of this manual.

Hand-Held Testers

An MPSI hand-held tester may be used to read and clear service codes and to obtain a short description of failures. The tester can initiate test sequences for controller outputs and can also read system parameters.



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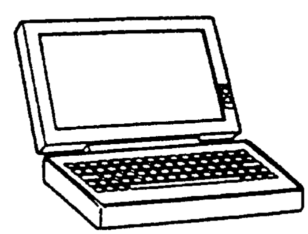
Personal Computer-Based Diagnostics

Personal computer based software provides the capability of hand-held testers with enhanced display and data logging capability. A personal computer can display multiple parameters and provide more comprehensive descriptions of fault conditions.

Use of a personal computer requires a serial link assembly (industry standard SAE J1587/1708) such as Kent-Moore’s part number J38351 and Eaton’s Central Tire Inflation System diagnostic software.



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Diagnostic Connector

Connection of a Hand-Held or PC based diagnostic tool is at the standard SAE J1587 connector.

TEST EQUIPMENT - CONTINUED

Test Modes

Hand-held or PC based diagnostic tools allow the system to be placed in several diagnostic modes:

- **Monitor (normal)** - ECU controls tire pressure, while tool only monitors status.
- **Inflate** - System “manually” inflates (test for large leaks).
- **Hold** - Pressure is held in control lines (test for small leaks).
- **Deflate** - System “manually” deflates (test relief valve pressure).
- **Pressure Check and Hold** - System checks and displays tire pressures, then holds pressure in air lines (Quick test of control line and seal integrity).

Historical Service Codes

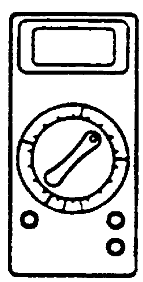
Anytime a fault occurs in the system, an active service code will be displayed on the ECU lights. Historical codes are stored in memory. Historical codes can only be accessed by a hand-held tester or personal computer. Historical codes are automatically cleared after 25-50 vehicle starts with no active faults.

Refer to the service code chart (beginning on page 0020 00-10) for more detailed information on service codes.

Multimeter

Based upon system schematics and aided by component-specific service codes, a Multimeter can be used to check sensor and solenoid resistances and to find wiring harness faults. The multimeter can be used to check the Central Tire Inflation System wiring and components for:

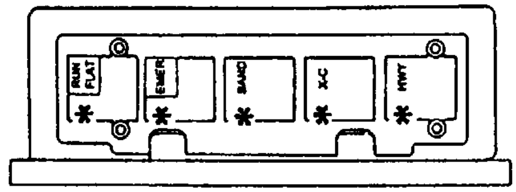
- continuity
- ground
- broken wires
- open circuits
- shorted circuits
- incorrect battery voltage



371-383

Display: **5 Flashing Lights**

Type: ***Pressure Read Low***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
System waits to check pressures	Faulty pneumatic system, or extremely low pressure reading	• Open line between Pneumatic Control Unit and wheel valve • Significant hub air seal leakage • Open solenoid (PCU electrically or pneumatically disconnected) • Crimped or plugged line between wet tank and Pneumatic Control Unit • Faulty pressure transducer (ex. frozen water) • Pneumatic Control Unit failure, supply or control off • Pressure switch failure, shorted closed • Faulty Electronic Control Unit

*Possible causes are listed in order of likely occurrence.

Air Pressure Check

Note that the Central Tire Inflation System is not continuously pressurized; pressure checks occur on a periodic basis. During tire pressure checks, the system delivers compressed air to each channel for approximately two seconds while monitoring the pressure in that channel.

Code Description

A "Pressure Read Low" code indicates an extremely low pressure reading. The most likely cause is an open line which would have a clearly audible leak during a pressure check. A secondary cause could be a faulty air delivery system (i.e., PCU electrically or pneumatically disconnected).

Other components that can cause a Pressure Read Low code are:

- Electrically or pneumatically disconnected PCU
- Faulty Pneumatic Control Unit (PCU)
- Restricted line between the wet tank and Pneumatic Control Unit
- Faulty pressure transducer
- Open line from Pneumatic Control Unit to Quick Release Valve
- Open line from Quick Release Valve to Wheel Valve

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Pressure Read Low troubleshooting tree.

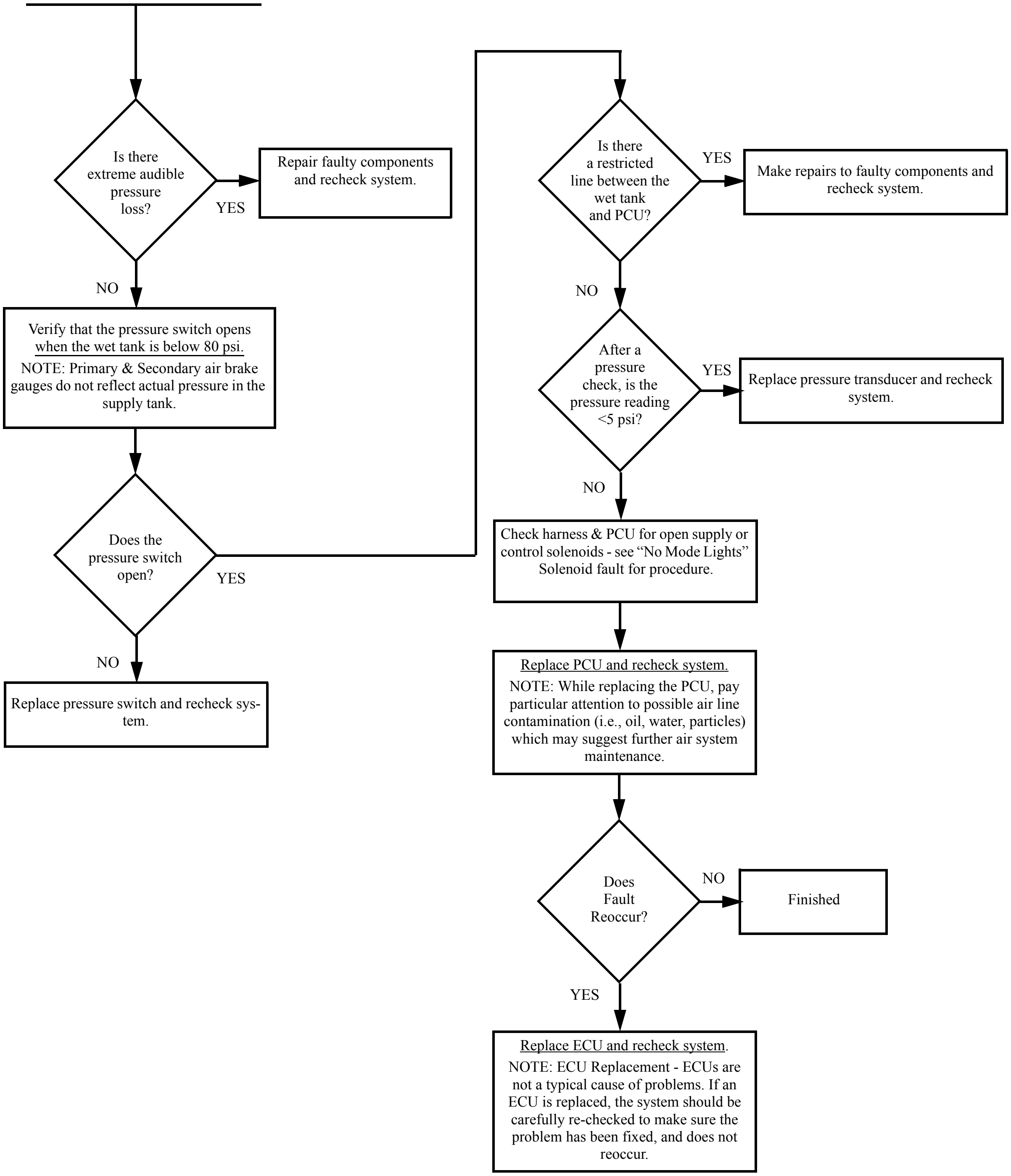
See "Troubleshooting Tips" on page 0020 00-7 for general guidelines on system diagnostics.

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED

0020 00

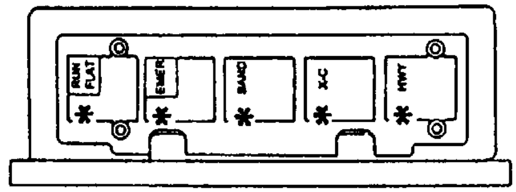
Display: **5 Flashing Lights**

Type: ***Pressure Read Low***



Display: **5 Flashing Lights**

Type: ***Inadequate Air Pressure***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
System waits to check pressures	Pressure switch won't close	• Compressor governor cut-out set too low • Air dryer needs service • Pressure switch unplugged • Faulty pressure switch • Faulty compressor • Open or broken line from wet tank to Pneumatic Control Unit • Crimped or plugged line from wet tank to Pneumatic Control Unit

*Possible causes are listed in order of likely occurrence.

Air Pressure Check

Note that the Central Tire Inflation System is not continuously pressurized; pressure checks occur on a periodic basis. During tire pressure checks, the system delivers compressed air to the tires for approximately two seconds while monitoring the pressure.

Code Description

An "Inadequate Air Pressure" code displays if system air pressure is inadequate to perform a tire pressure check.

This occurs when the pressure switch will not close. The components that can cause the pressure switch to remain open include:

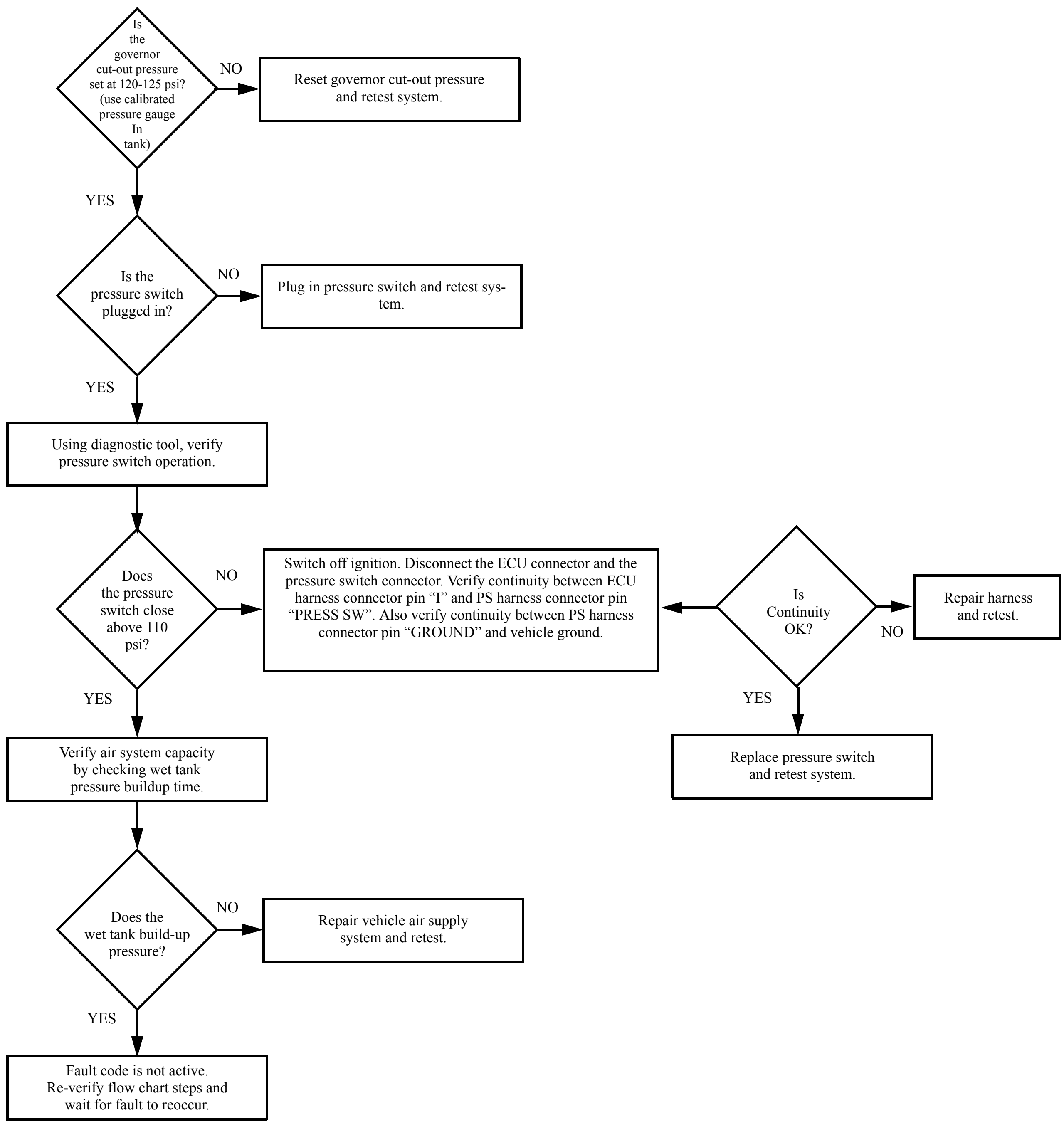
- Compressor governor cut-out set too low
- Pressure switch unplugged
- Faulty pressure switch
- Faulty compressor
- Open or broken line from wet tank to Pneumatic Control Unit
- Crimped or plugged line from wet tank to Pneumatic Control Unit

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Inadequate Air Pressure troubleshooting tree.

See "Troubleshooting Tips" on page 0020 00-7 for general guidelines on system diagnostics.

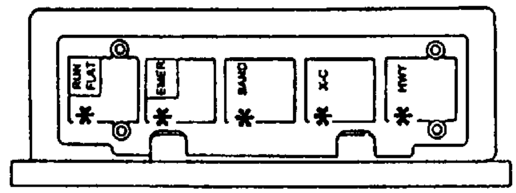
Display: **5 Flashing Lights**

Type: ***Inadequate Air Pressure***



Display: **5 Flashing Lights**

Type: ***Atmospheric***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
System waits to check pressure	Pneumatic Control Unit pressure out of range when PCU is “vented”	• Frozen water or other contaminant in transducer • Plugged PCU vent line • Poor ground connection to transducer • Faulty pressure transducer • Faulty Pneumatic Control Unit

*Possible causes are listed in order of likely occurrence.

Air Pressure Check

Note that the Central Tire Inflation System is not continuously pressurized; pressure checks occur on a periodic basis. During tire pressure checks, the system delivers compressed air to the tires for approximately two seconds while monitoring the pressure.

Code Description

An “Atmospheric” code is logged if the atmospheric pressure reading is out of range. The atmospheric pressure reading can be out of range as a result of a blocked or restricted PCU or vent line, contaminated pressure transducer (i.e., frozen water), air bleeding back into the Pneumatic Control Unit (PCU) or because of a faulty pressure transducer.

The components that can cause this code to be set include:

- Faulty or contaminated pressure transducer
- Faulty or contaminated Pneumatic Control Unit
- Faulty Electronic Control Unit (ECU)

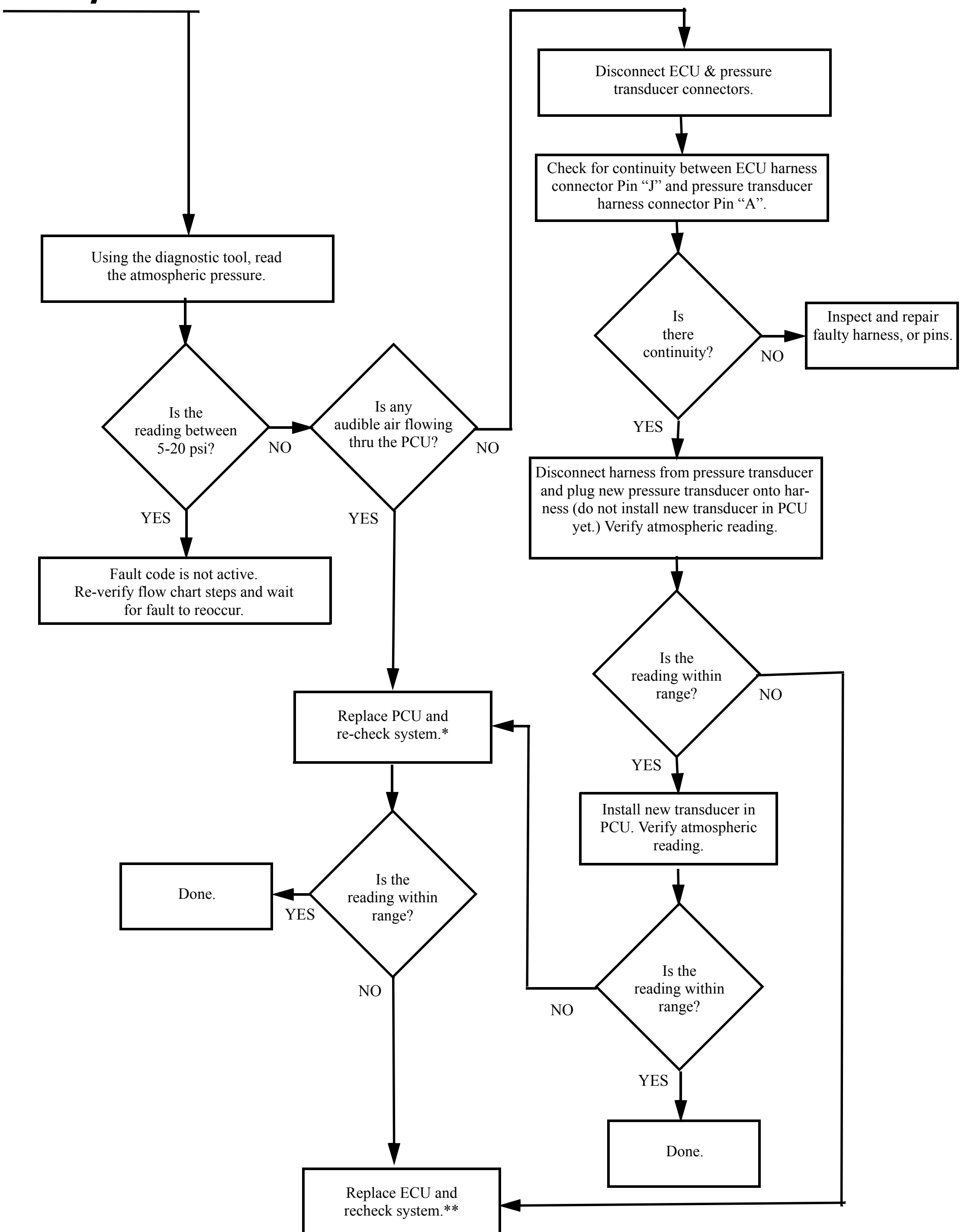
To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Atmospheric troubleshooting tree.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED

Display: **5 Flashing Lights**

Type: ***Atmospheric***

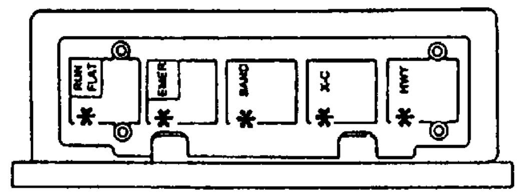


* NOTE: While replacing PCU, pay particular attention to possible air tire contamination (i.e., oil, water, particles) which may suggest further air system

** NOTE: ECU replacement - ECUs are NOT a typical cause of problems. If an ECU is replaced, the system should be carefully re-checked to make sure the problem has been fixed, and does not re-occur.

Display: **5 Flashing Lights**

Type: ***Inflate Trend***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Channel inoperative	Loss of channel pressure in inflate mode	• Damaged or leaking tire • Leaking lines • Leaking seals • Leaking QRV • Leaking wheel valve • Faulty Pneumatic Control Unit

*Possible causes are listed in order of likely occurrence.

Code Description

An “Inflate Trend” code displays when tire pressure readings are dropping while in inflate mode. Tire damage, which the compressor can not keep up with, may have occurred after starting an inflate sequence.

The air leak can be located either before or after the wheel valve location. The components located before the wheel valve that may cause this include:

- Leaking control lines
- Leaking Quick Release Valve exhaust port
- Leaking wheel air seals

Components located after the wheel valve that may cause this include:

- Tire damage
- Rim leaks
- Leaking air lines
- Faulty wheel valve

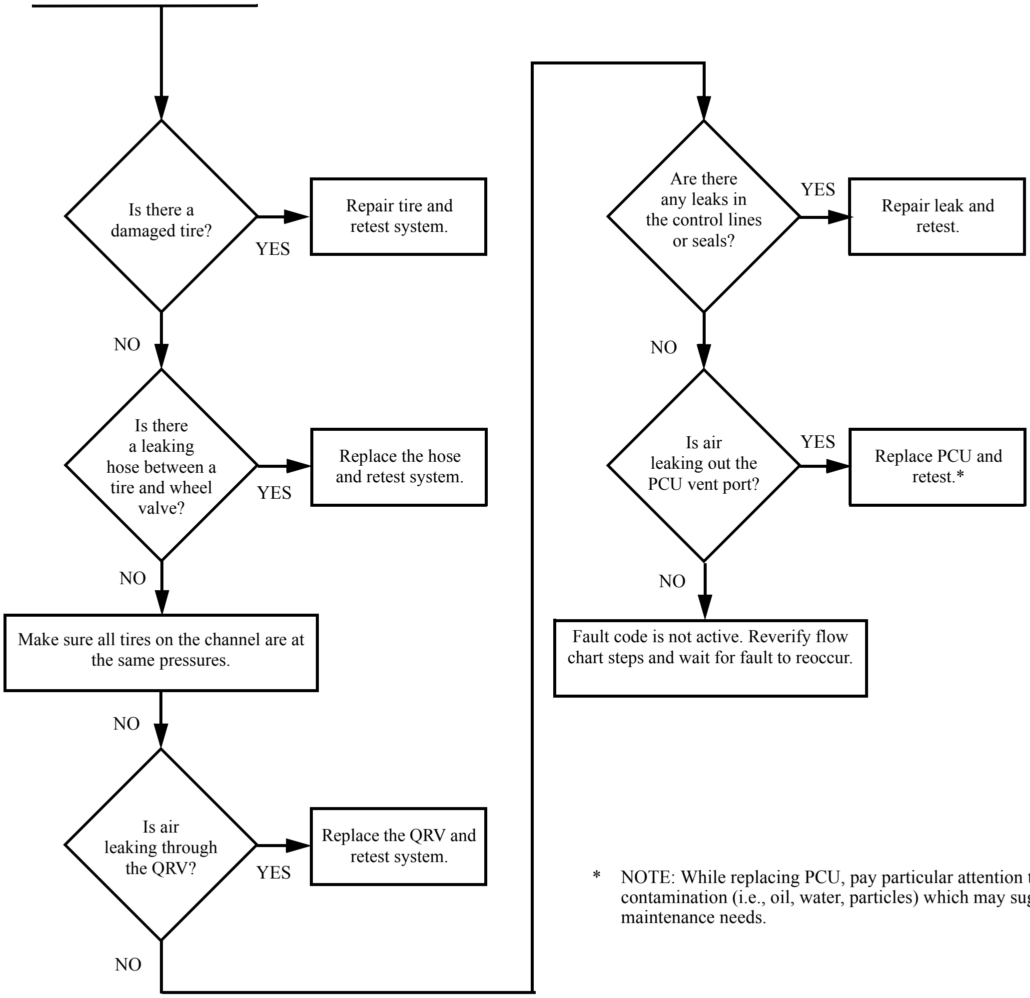
To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Inflate Trend troubleshooting tree.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED 0020 00

Display: **5 Flashing Lights**

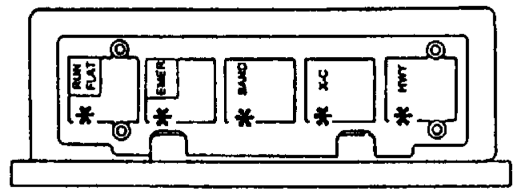
Type: ***Inflate Trend***



* NOTE: While replacing PCU, pay particular attention to possible air line contamination (i.e., oil, water, particles) which may suggest further air system maintenance needs.

Display: **5 Flashing Lights**

Type: ***Deflate Trend***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Inflate only	Improper deflate sequence	• Plugged or restricted Pneumatic Control Unit (PCU) vent line • Faulty PCU relief valve • Poor ground connection to pressure transducer • Contaminated PCU • Faulty PCU

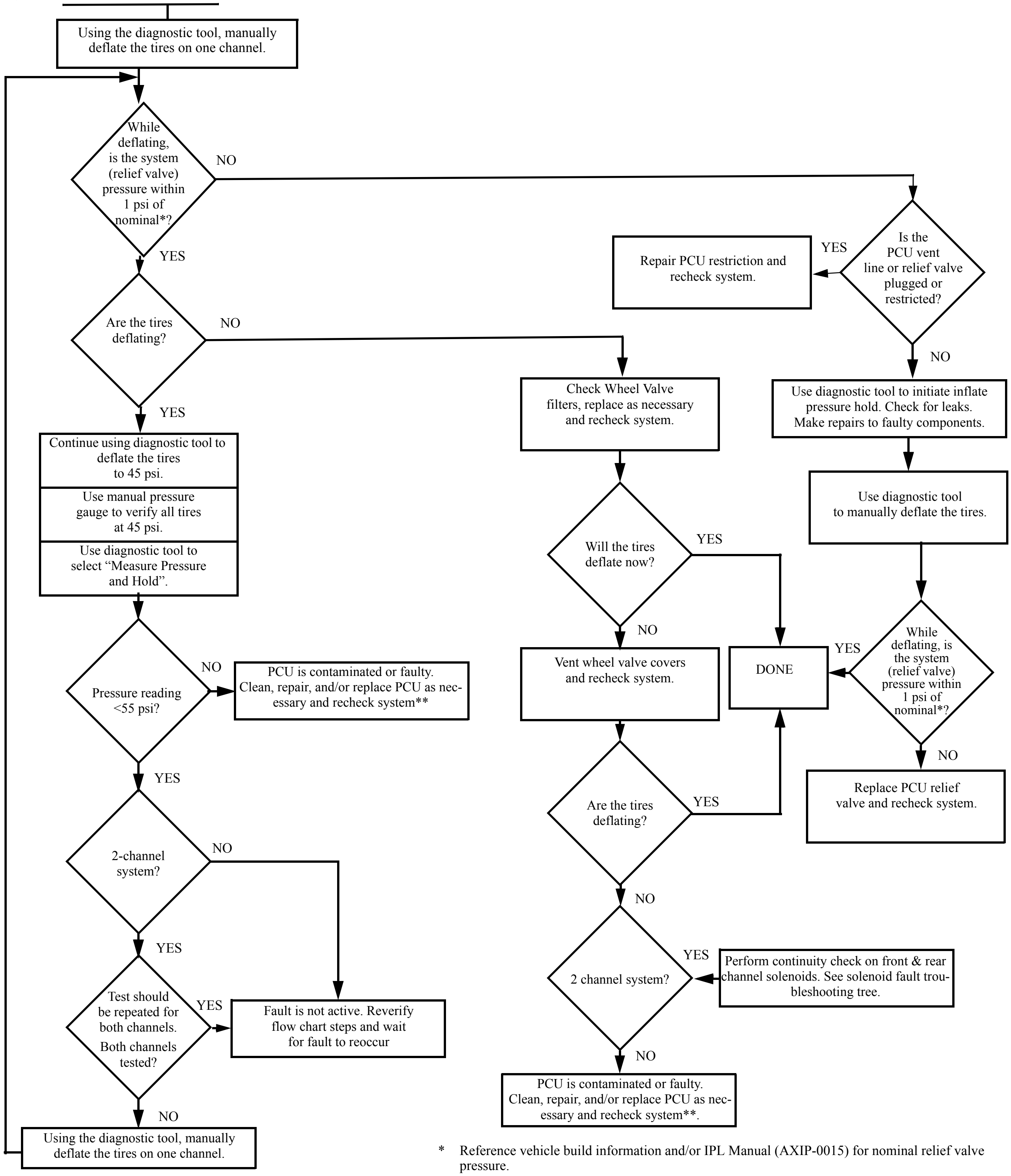
*Possible causes are listed in order of likely occurrence.

Code Description

A "Deflate Trend" code displays when the system has determined that a deflate sequence is not functioning correctly. This is the result of either a pressure increase during a deflation, or the system failing to lower the tires even a small amount of the desired pressure drop.

Display: **5 Flashing Lights**

Type: ***Deflate Trend***

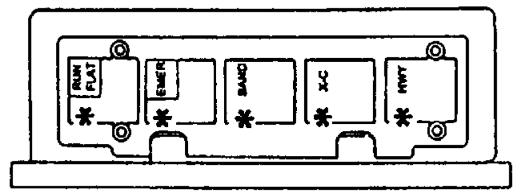


* Reference vehicle build information and/or IPL Manual (AXIP-0015) for nominal relief valve pressure.

** NOTE: While removing PCU, pay particular attention to possible air line contamination (i.e., oil, water, particles) which may suggest further air system maintenance needs.

Display: **5 Flashing Lights**

Type: ***Pressure Transducer***



371-397

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
No operation	No pressure transducer reading	• Transducer electrically disconnected • Pressure signal wire open • Pressure signal wire shorted to ground • Pressure transducer Vref wire open • Pressure transducer Vref wire shorted to ground • Pressure transducer ground wire open • Faulty transducer • Faulty Electronic Control Unit
No operation	High pressure transducer reading	• Pressure signal wire shorted to Vbat or Vref • Faulty transducer • Faulty Electronic Control Unit

*Possible causes are listed in order of likely occurrence.

Code Description

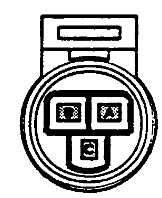
A “Pressure Transducer” code occurs when the Electronic Control Unit (ECU) receives an unusually high or low reading from the pressure transducer. A diagnostic tool will specify which of the two conditions is responsible for setting the code.

Initial troubleshooting steps involve checking for shorted-to-ground or an open pressure transducer circuit.

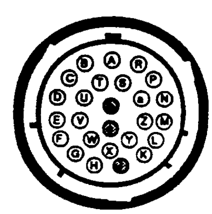
If the circuits check out OK, secondary causes could involve a faulty transducer or a faulty Electronic Control Unit.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

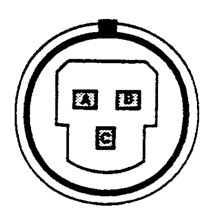
PRESSURE TRANSDUCER HARNESS CONNECTOR



ECU HARNESS CONNECTOR

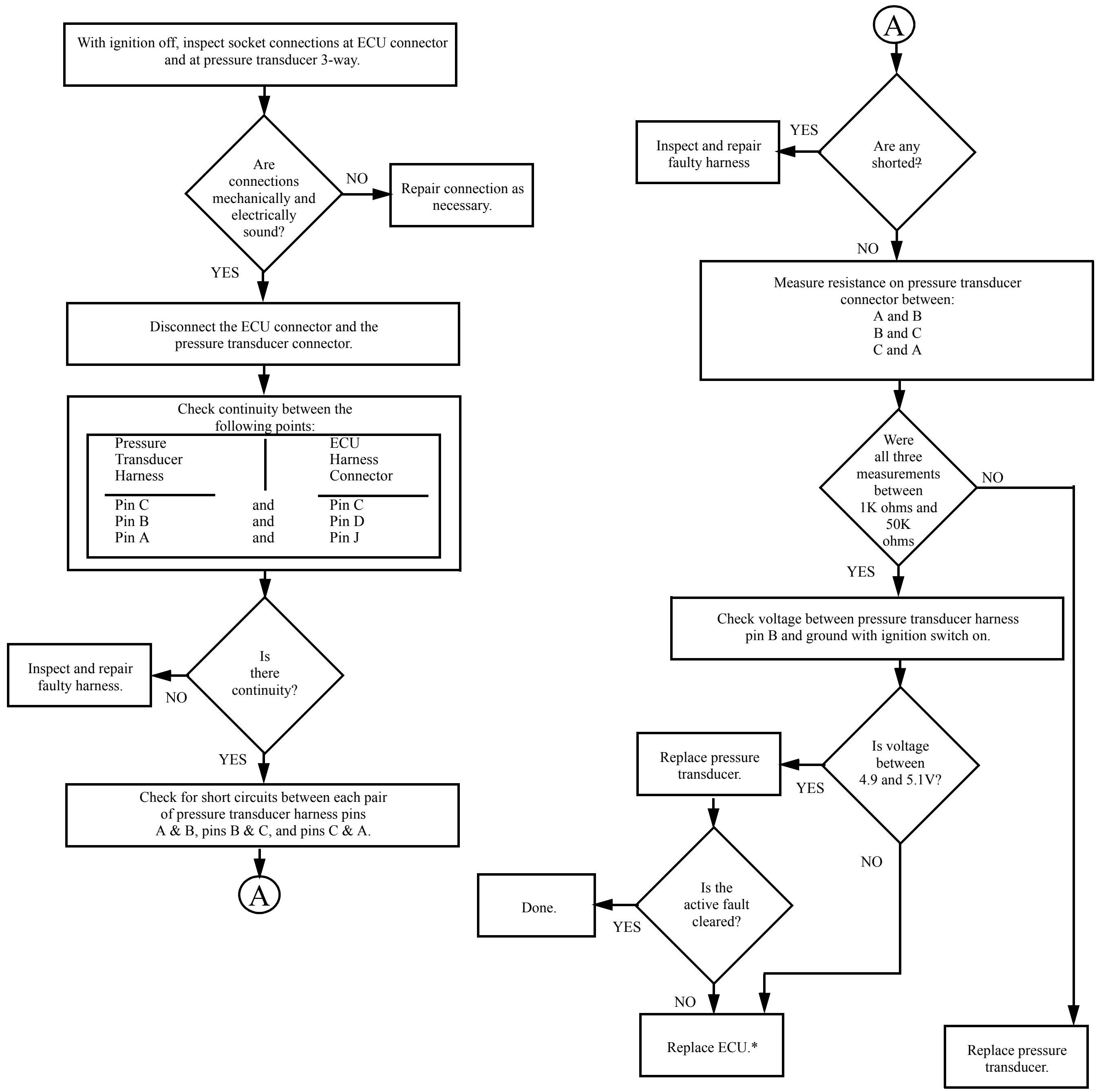


PRESSURE TRANSDUCER CONNECTOR



371-388

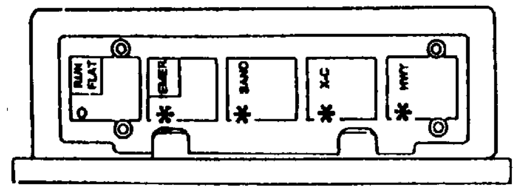
Display: **5 Flashing Lights**
Type: ***Pressure Transducer***



* NOTE: ECU replacement - ECUs are NOT a typical cause of problems. If an ECU is replaced, the system should be carefully rechecked to make sure the problem has been found, and does not reoccur.

Display: **4 Flashing Lights**

Type: ***Tire Leak (Imbalance)***



371-398

NOTE: RUN FLAT overrides this fault

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Channel only checks pressures	Tire pressure lower on one tire than others	• Minor tire leakage at start up (leaked overnight) • Severe tire damage or leaks • Contaminated wheel valve filters • Restricted tire valve stem • Leaking lines • Leaking seals • Leaking wheel valve • Crimped or restricted control lines

*Possible causes are listed in order of likely occurrence.

Air Pressure Check

Note that the Central Tire Inflation System is not continuously pressurized; pressure checks occur on a periodic basis. During tire pressure checks, the system delivers compressed air to the each channel for approximately two seconds while monitoring the pressure in that channel.

Code Description

A "Tire Leak (Imbalance)" code indicates that either the tire pressure on one tire or wheel end was read lower than the other tires, or there is an air leak someplace in the system.

Low tire pressure can be caused by a damaged tire, plugged wheel valve filter or leaking air lines. An air leak can be located either before or after the wheel valve.

NOTE

When using a diagnostic tool to inflate or inflate-hold a channel with one low tire, air may be heard leaking out of the QRV(s) by the higher pressure tires. This is normal and should stop once the low tire is inflated to the pressure of the other tires.

The components located before the wheel valve that may cause a "Tire Leak (Imbalance)" code include:

- Leaking wheel air seals
- Leaking control lines
- Restricted QRV exhaust port

Components located after the wheel valve that may cause an imbalance include:

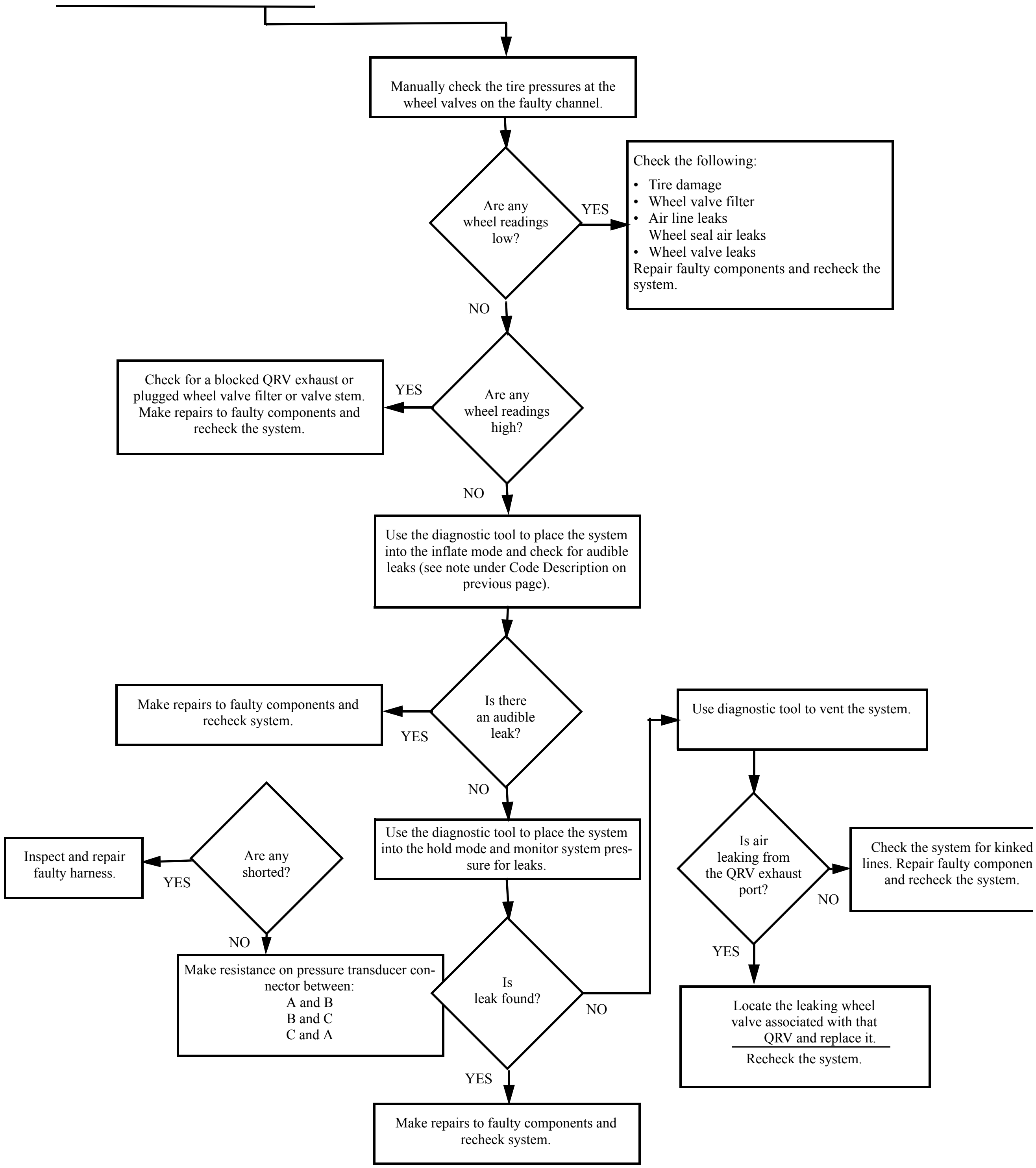
- Damaged tire
- Rim leaks
- Clogged or restricted wheel valve filter or valve stem
- Leaking air lines
- Wheel valve damage

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Tire Leak (Imbalance) troubleshooting tree.

See "Troubleshooting Tips" on page 0020 00-7 for general guidelines on system diagnostics.

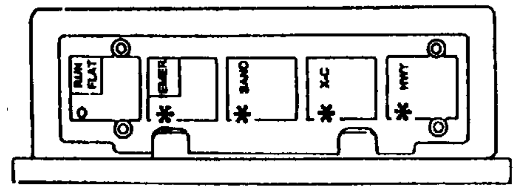
Display: **4 Flashing Lights**

Type: ***Tire Leak (Imbalance)***



Display: **4 Flashing Lights**

Type: ***Tire Leak (Confirm)***



371-398

NOTE: RUN FLAT overrides this fault

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Channel inoperative	Channel confirmation failure	• Damaged or leaking tire • Leaking line between wheel valve and tire • Plugged or restricted Quick Release Valve • Leaking Wheel Valve • Plugged or restricted PCU vent line

*Possible causes are listed in order of likely occurrence.

Air Pressure Check

Note that the Central Tire Inflation System is not continuously pressurized; pressure checks occur on a periodic basis. During tire pressure checks, the system delivers compressed air to each channel for approximately two seconds while monitoring the pressure in that channel.

Code Description

A “Tire Leak (Confirm)” code occurs if a channel fails to confirm tire pressure. Following an inflate or deflate sequence, the Central Tire Inflation System will return to confirm, or “double-check” the new pressure. If the pressure has dropped, the system will re-inflate, and then reconfirm the tires. After multiple failed confirmation attempts, the system will log a Tire Leak (Confirm) code and the system will become inoperative.

A confirmation failure can be caused by:

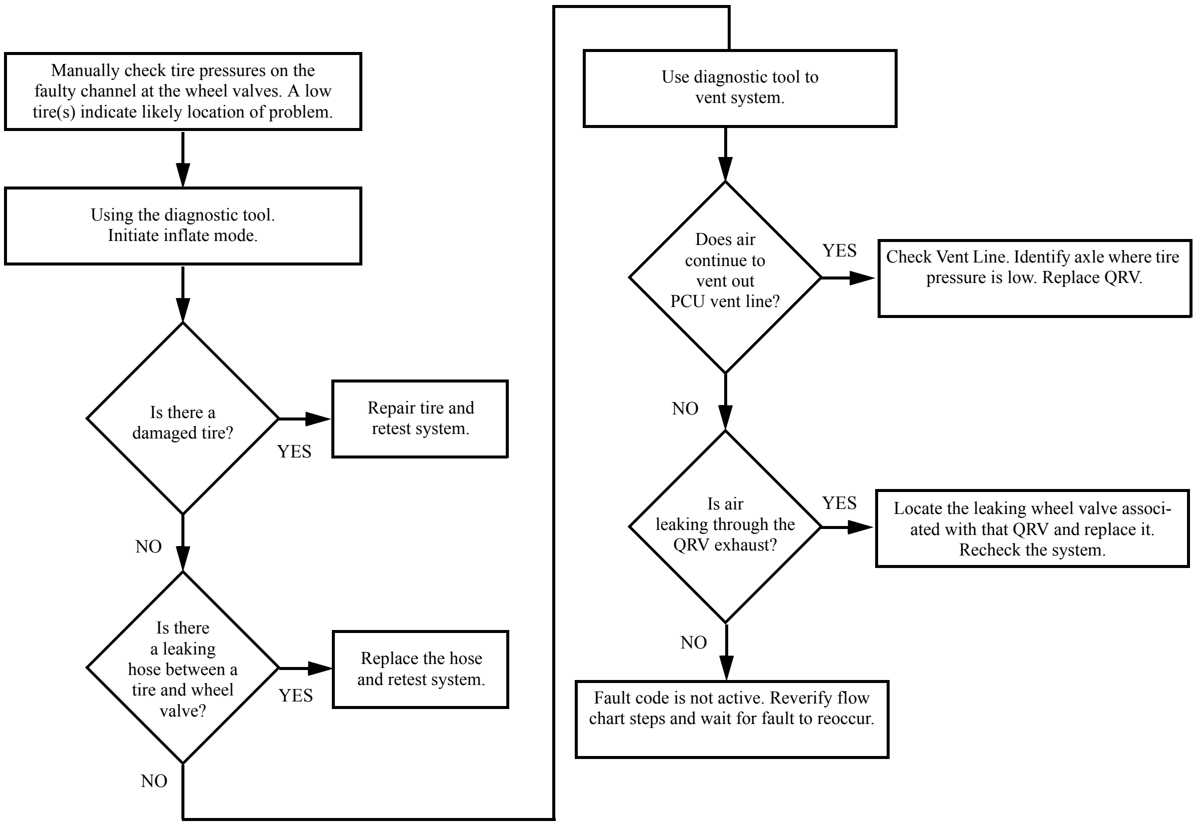
- Damaged or leaking tire
- Leaking air line between the wheel valve and tire
- Plugged or restricted Quick Release Valve
- Leaking wheel valve
- Plugged or restricted PCU vent line

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Tire Leak (confirm) troubleshooting tree.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

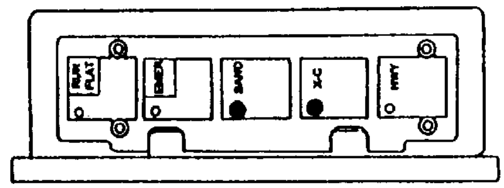
Display: **4 Flashing Lights**

Type: ***Tire Leak (Confirm)***



Display: **2 Solid Lights**

Type: ***Between Modes***



371-399

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Pressure check only	Slow inflate	• Faulty compressor • Restricted flow at wheel valve air filters • Crimped or plugged lines
	Slow deflate	• Restricted flow at wheel valve air filters or valve stem • Leaking upper control lines • Plugged or restricted Pneumatic Control Unit vent port • Restricted tire valve stem • Faulty PCU relief valve • Restricted QRV exhaust port

*Possible causes are listed in order of likely occurrence.

Code Description

A “Between Modes” code occurs if a channel inflates or deflates too slowly. The maximum allotted time for an inflate is 40 minutes, or 20 minutes for a deflate. The most likely cause is a faulty compressor or similar problem resulting in inadequate air supply to the Central Tire Inflation System.

If the system is able to generate a sufficient air supply, a “Between Modes” code means that a leak or restriction exists in an air passage. The components that may contain a restricted or leaking air passage include:

- Wheel valve air filters
- Quick Release Valve (QRV)
- Pneumatic Control Unit (PCU) vent port restriction
- Air supply lines
- Restricted tire valve stem
- Faulty PCU relief valve
- Restricted QRV exhaust

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Between Modes troubleshooting tree.

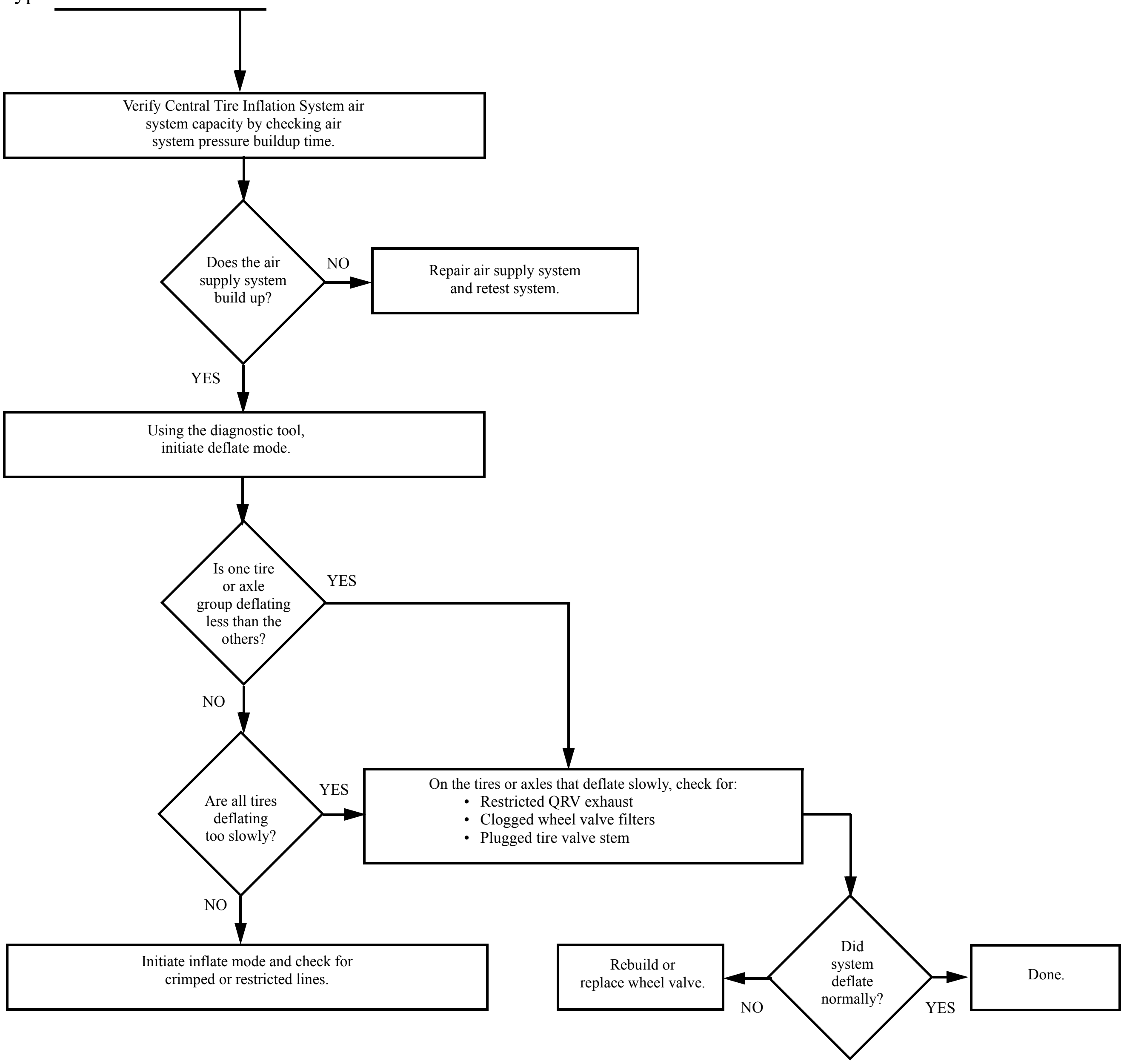
See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED

0020 00

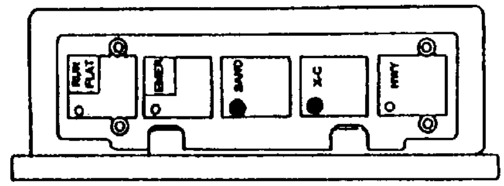
Display: **2 Solid Lights**

Type: ***Between Modes***



Display: **2 Solid Lights**

Type: ***Loss of Deflate Signal or Channel Deflate Loss***



371-399

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Inflate only	Inadequate deflate signal in the Pneumatic Control Unit and Control lines	• Plugged or restricted Pneumatic Control Unit vent line • Faulty PCU relief valve • Faulty Pneumatic Control Unit • Poor ground connector to transducer • Faulty pressure transducer

*Possible causes are listed in order of likely occurrence.

Code Description

A “Channel Deflate Loss or Loss of Deflate Signal” code indicates inadequate deflate signal in the Pneumatic Control Unit (PCU) or failure to sustain the signal in the control lines of a given channel.

When a deflate is requested, the system drops the control line pressure to a preset level which is established by the PCUs relief valve.

If the pressure (typically 10-18 psi depending on the PCU being used) cannot be maintained by the PCU, either a Channel Deflate Loss or Loss of Deflate Signal code is logged.

This can be caused by:

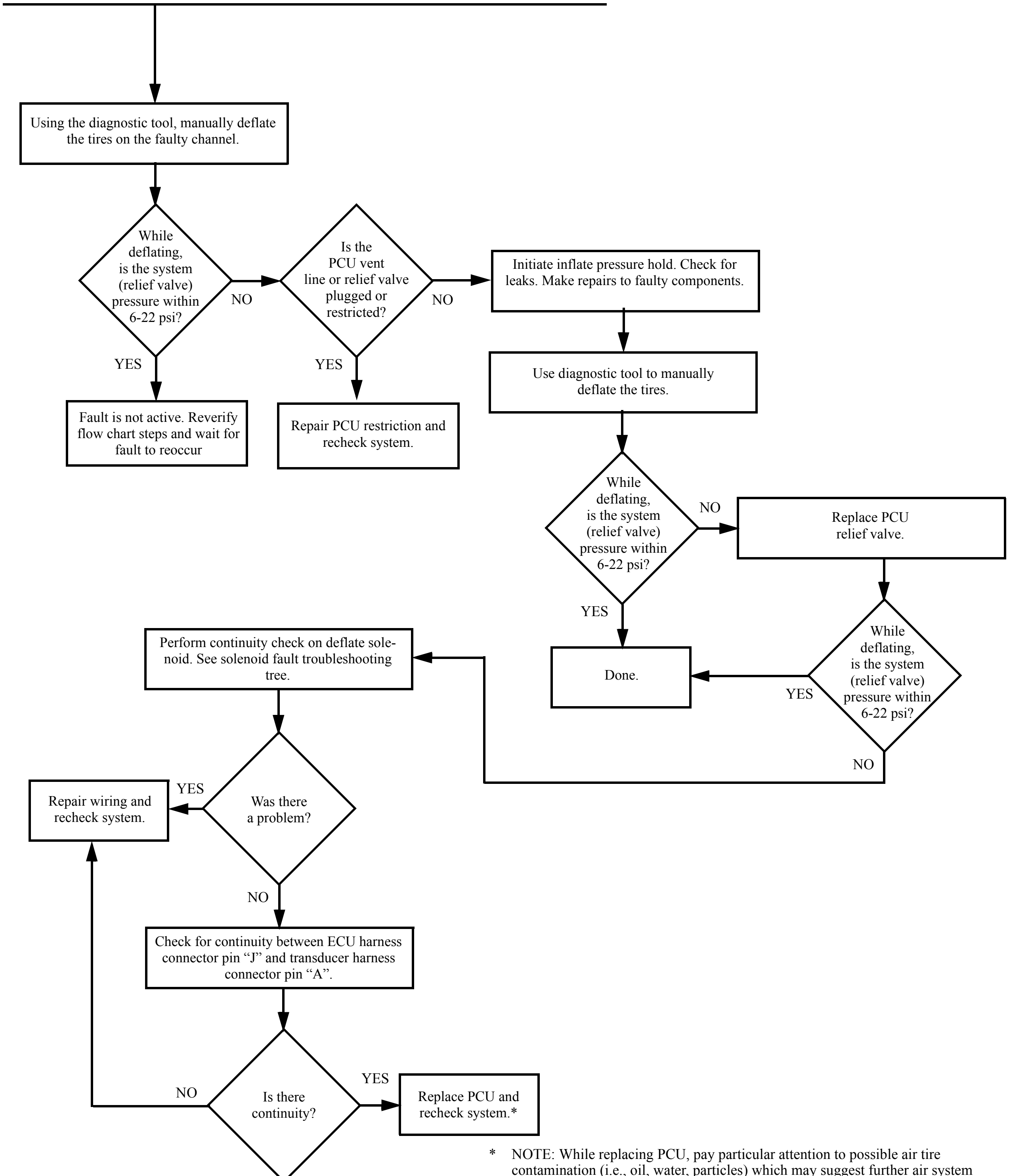
- Faulty Pneumatic Control Unit (relief valve)
- Plugged or restricted Pneumatic Control Unit vent line
- Line leak

To correctly diagnose the faulty component, connect the Diagnostic Tool (see Page 0020 00-8 for test equipment and descriptions) and follow the procedure in the Channel Deflate Loss or Loss of Deflate Signal troubleshooting tree.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

Display: **2 Solid Lights**

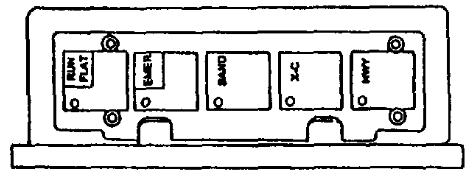
Type: ***Channel Deflate Loss or Loss of Deflate Signal***



* NOTE: While replacing PCU, pay particular attention to possible air tire contamination (i.e., oil, water, particles) which may suggest further air system maintenance needs.

Display: **No Mode Lights**

Type: ***Power***



371-400

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
No operation	Power out of range	• Low battery voltage • Poor ground connection to Electronic Control Unit • Poor switched ignition connection to Electronic Control Unit • High vehicle electrical system voltage • Faulty Electronic Control Unit

*Possible causes are listed in order of likely occurrence.

Code Description

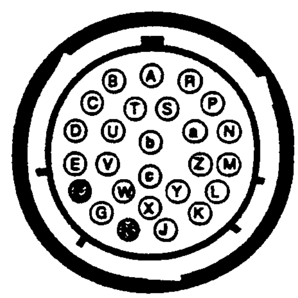
A “Power” code indicates a power fault and sets when the system power is outside a 24 Volt system’s acceptable range of 18 to 32 Volts. The fault could be caused by low battery power or some other problem with the basic vehicle electrical system.

If the vehicle power system checks out satisfactorily, other possible causes include bad Electronic Control Unit (ECU) connections, or a faulty ECU.

In inspecting circuits and connections for a Power Code, pay particular attention to a bad ground connection, which could be causing the fault.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

ECU HARNESS CONNECTOR

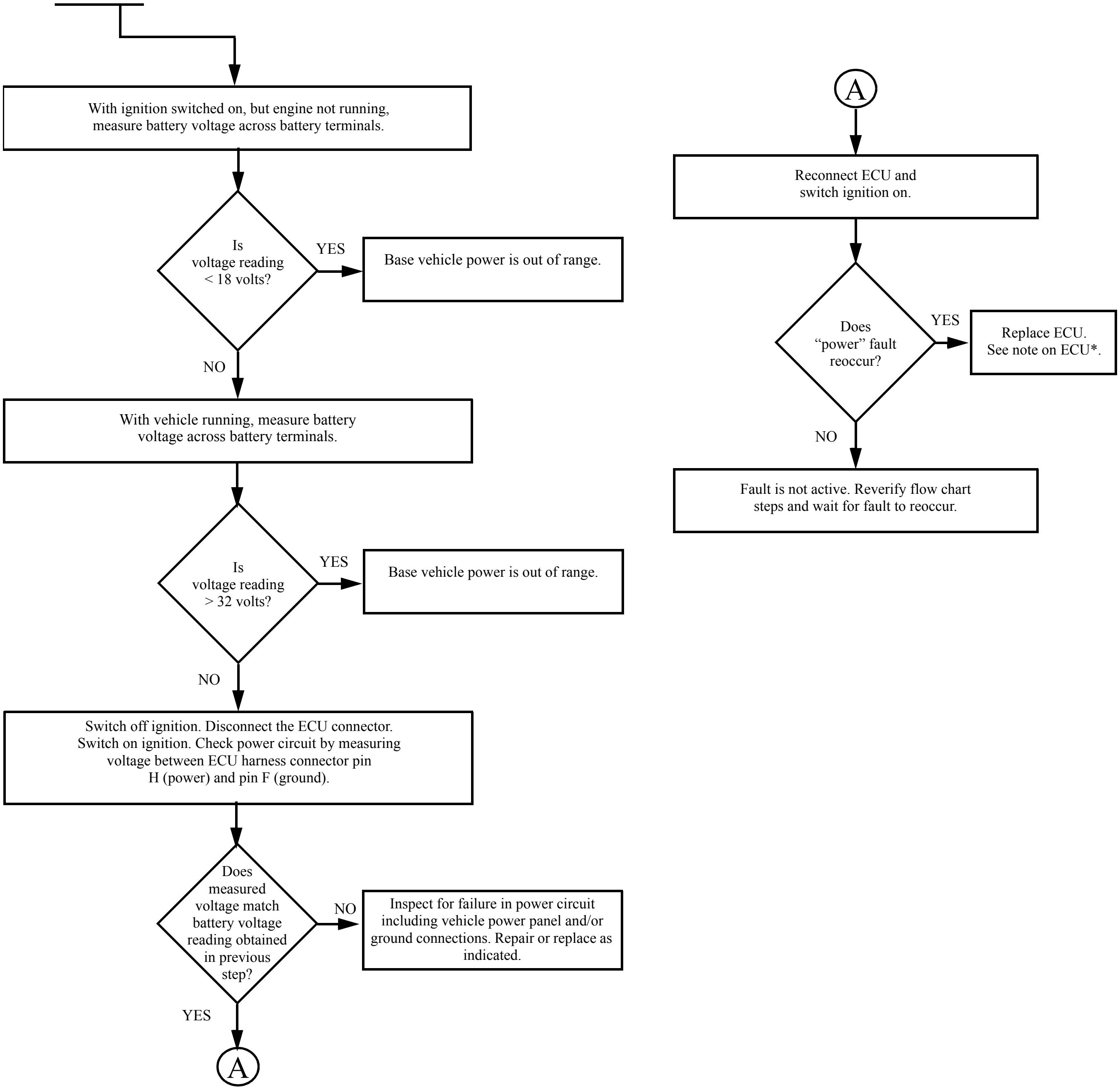


371-389

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED

Display: **No Mode Lights**

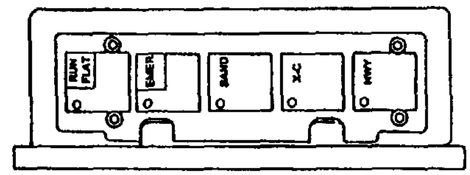
Type: ***Power***



* NOTE: ECU replacement - ECUs are NOT a typical cause of problems. If an ECU is replaced, the system should be carefully rechecked to make sure the problem has been found, and does not reoccur.

Display: **No Mode Lights**

Type: ***Solenoid Fault (Supply, Deflate, Control, Front, or Rear)***



371-400

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
No operation	Pneumatic Control Unit solenoid failed electrical diagnostic test	• Solenoid wire shorted to ground • Solenoid wire shorted to power • Faulty solenoid • Faulty Electronic Control Unit

*Possible causes are listed in order of likely occurrence.

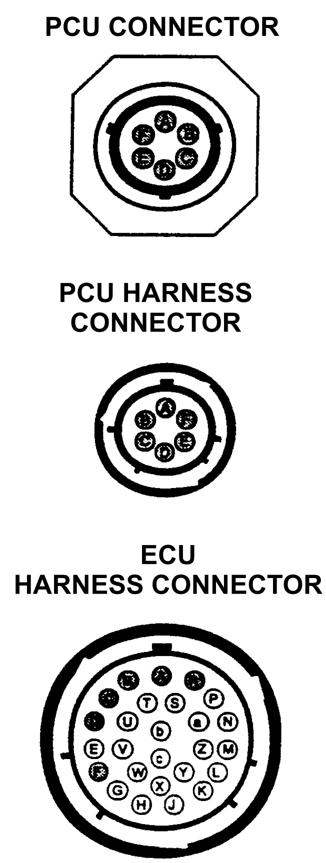
Code Description

A “Solenoid Fault” code indicates an electrical fault in the Pneumatic Control Unit (PCU). System operation is disabled when these faults are detected.

The system shuts down in a fail-safe mode and turns off the power to the solenoids.

The troubleshooting tree first tests internal solenoid circuitry. Resistance outside the specified range of 30 to 80 ohms indicates a defective solenoid. Succeeding steps check continuity of the wire harness circuits between the Pneumatic Control Unit and Electronic Control Unit (ECU). If the problem can be traced to a faulty circuit or connector, make the necessary repairs. If the troubleshooting routine leads to a problem with the solenoid itself, the Pneumatic Control Unit must be repaired or replaced. If both the solenoid and the circuitry check out OK, the Electronic Control Unit is faulty.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.



371-384

Display: **No Mode Lights**

Type: ***Solenoid Fault (Supply, Deflate, Control, Front, or Rear)***

Each code matches on specific solenoid. When the troubleshooting instructions refer to connector test points, use Chart A to select the pin test point for use with the particular fault code you are diagnosing.

CHART "A" Solenoid Wire Test Points

Fault Code	Supply	Deflate	Control	Front	Rear
PCU Harness Connector	F	E	D	C	B
ECU Harness Connector	B	C	R	D	A

Use diagnostic tool to identify which solenoid to troubleshoot.

Switch off ignition. Disconnect harness at PCU connector.

Measure solenoid coil resistance on PCU connector for identified coil. Resistance should be 30-80 ohms.

On 1-channel system

Control: B-D
Deflate: A-E
Supply: A-F

On 2-channel system

Control: A-D
Deflate: A-E
Supply: A-F
Front: A-C
Rear: A-B

Are resistance measurements OK?

NO: Repair or replace connection coils or PCU.

YES: Check for shorts between PCU connector pins D, E, F, and vehicle ground

On 2-channel systems, check for shorts between PCU connector pins, C, B, and vehicle ground.

Are any pins shorted to ground?

YES: Replace pressure transducer.

NO: Disconnect ECU harness connector.

Check for continuity between PCU harness connector Pin A and ECU harness connector Pin F.

On single channel systems, also check for continuity between PCU harness connector Pin B and ECU harness connector Pin F.

Check continuity of harness pin(s) shown in chart "A" for given fault code. (PCU harness connector to ECU harness connector)

Are circuits continuous?

NO: Repair or replace harness.

YES: Measure at PCU harness connector.

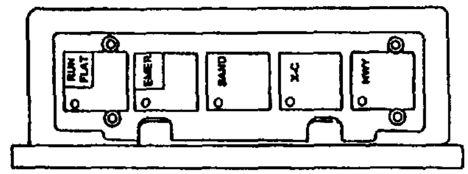
- On single channel systems, verify continuity between A & B.
- Verify no continuity between any combination of pins D, E, F on PCU harness connector and A on PCU harness connector.
- On2-channel systems, verify no continuity between any combination of pins C or B on PCU harness and Pin A on PCU harness.

Are connections OK?

NO: Repair or replace harness.

YES: Replace ECU. See note on ECU replacement.*

* NOTE: ECU replacement - ECUs are NOT a typical cause of problems. If an ECU is replaced, the system should be carefully re-checked to make sure the problem has been found, and does not reoccur.



371-400

Display: **Lights Sequentially Flashing**

Type: ***Configuration Error***

NOTE: Pressing HWY and RUN FLAT together clears this display

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Limp home/ Normal operation	System using default values	• Both Configuration Wires shorted to ground • Loss of Programmed Values • Faulty Electronic Control Unit (ECU)

*Possible causes are listed in order of likely occurrence.

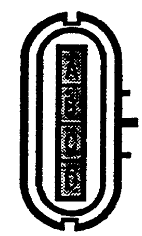
Code Description

A "Configuration Error" code displays when the system has re-loaded the system defaults into ECU memory, eliminating any changes (target pressures, etc.) previously programmed via a diagnostic tool. This code will also display on systems which have harness selected the download configuration and not programmed any values into the ECU yet.

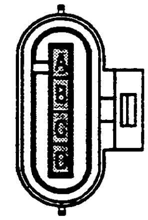
The ECU will re-load its memory anytime the harness configuration selection changes. This allows the ECU to be moved from vehicle to vehicle and change its interaction with those vehicles as needed. On all systems (except harness selected download config), pressing the HWY and RUN FLAT buttons at the same time will clear the display.

The troubleshooting procedure involves verifying that the harness configuration selection wires are making a good connection. If the configuration wires are good, and the problem repeatedly occurs, the ECU may need to be replaced.

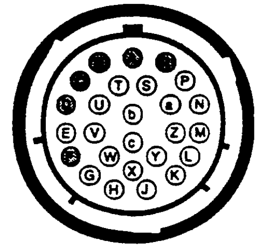
CONFIGURATION CONNECTOR



CONFIGURATION HARNESS CONNECTOR



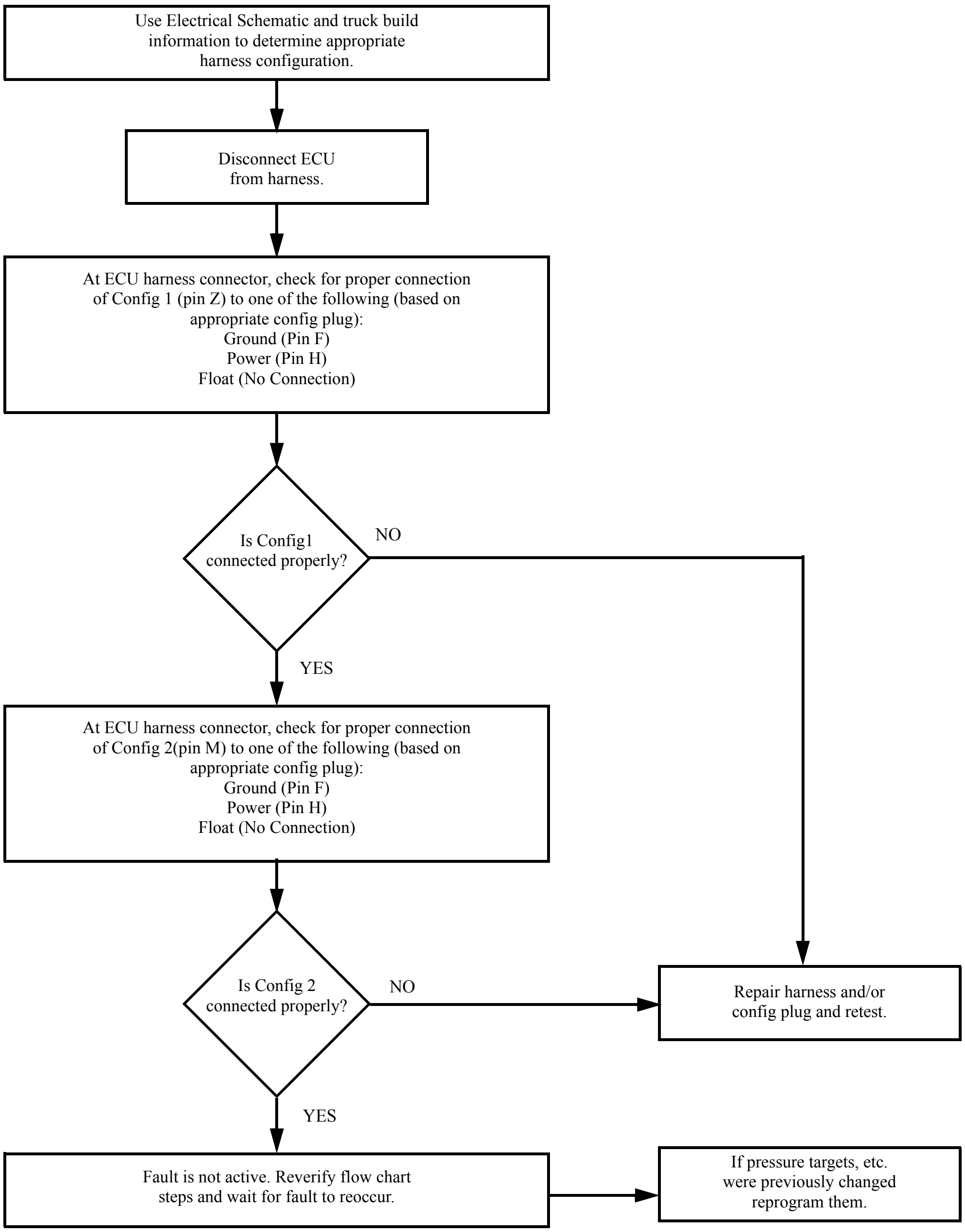
ECU HARNESS CONNECTOR



371-385

Display: **Lights Sequentially Flashing**

Type: ***Configuration Error***

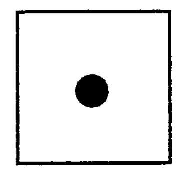


*NOTE: ECU's are NOT a typical cause of problems, however, if this fault reoccurs multiple times, and wiring harness has been confirmed to be good, ECU replacement may be necessary.

ON INSTRUMENT PANEL

Display: **Solid Warning Lamp**

Type: ***Speed Signal***



371-378

SYSTEM MODE	CONDITION	POSSIBLE CAUSES*
Normal operation	No speed signal	• Vehicle started 25 to 50 times without being moved • Sensor disconnected or loose plug • Either speed sensor wire is open (broken wire) • Either speed sensor wire is shorted to ground (bare wire is touching the frame) • Faulty speed sensor • Tang drive broken/disconnected on mechanical sensor • Gap not adjusted correctly on pole sensor • Sensor wires shorted together • Faulty Electronic Control Unit

*Possible causes are listed in order of likely occurrence.

Code Description

A “Speed Signal” code indicates a faulty speed sensor signal which can be set by one of two conditions:

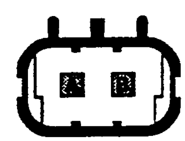
- A wiring or sensor connection may cause the signal to fail to get to the ECU.
- A misadjusted or faulty sensor may result in no speed signal being generated.

NOTE

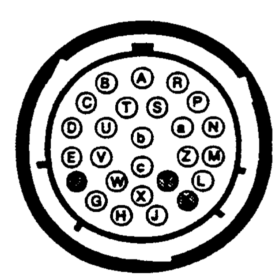
This fault may occur if ignition has been cycled 25 to 50 times without moving the vehicle.

See “Troubleshooting Tips” on page 0020 00-7 for general guidelines on system diagnostics.

SPEED SENSOR
HARNESS CONNECTOR



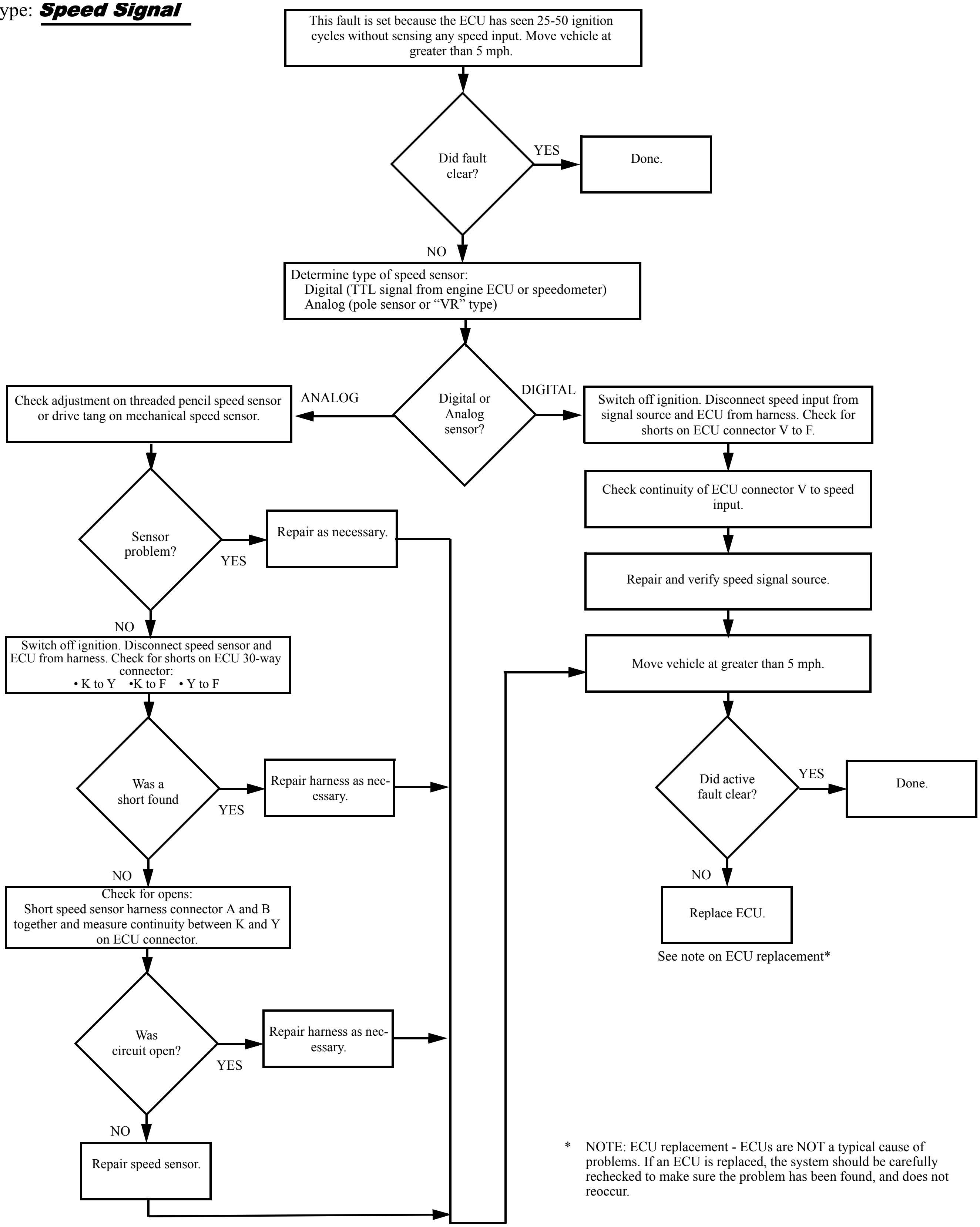
ECU
HARNESS CONNECTOR



371-386

Display: **Solid Warning Lamp**

Type: ***Speed Signal***



* NOTE: ECU replacement - ECUs are NOT a typical cause of problems. If an ECU is replaced, the system should be carefully rechecked to make sure the problem has been found, and does not reoccur.

Type: ***Miscellaneous***

Display: **No Code**

Although the Central Tire Inflation System is self-diagnosing, there are some operating problems that do not trigger a fault code. The following chart lists these conditions along with possible causes and solutions:

CONDITION Operating problems that do not trigger a fault code.	**POSSIBLE CAUSES*** Since a fault code was not set, these conditions may be universal and not call for a troubleshooting routine.	**SOLUTION** Where fault codes appear, refer to the troubleshooting procedures listed under that code.
ECU DISPLAY Blank Electronic Control Unit (ECU) display	• Power fuse blown • Bad ground to ECU • Bad switched ignition line to ECU • Faulty ECU	• Check Fuses • See “Power” code
System loses programmed tire pressure settings	• Improperly followed programming procedure • Faulty Electronic Control Unit	• Reference programming procedure • Replace Electronic Control Unit
TIRE PRESSURE Diagnostic tool display shows tires at higher pressure than target, yet system does not attempt to deflate	Tire pressure rises due to temperature, are not bled off by the Central Tire Inflation System. This is normal operation.	System will only initiate a deflate if a mode with a lower target pressure than current target is selected.
No apparent inflate or deflate	• Pressure switch not closed	See “Inadequate Air Pressure” code
Pressure Imbalance (tires on same channel at different pressures)	• Defective hose • Clogged filters	See “Tire Leak (Imbalance)” code
No inflate or deflate of particular tire	• Valve stem core not removed on tire • Clogged wheel valve filter or valve stem	Remove hose from tire valve stem and remove core. Replace hose. Change filter.
Inaccurate tire pressures (From targets PC tool shows)	• Leaking control lines • Faulty pressure transducer • Faulty Electronic Control Unit	See “Atmospheric” and “Tire Leak (Imbalance)” codes
Incorrect tire pressure targets	• System defaults to original targets	See “Configuration Error” code

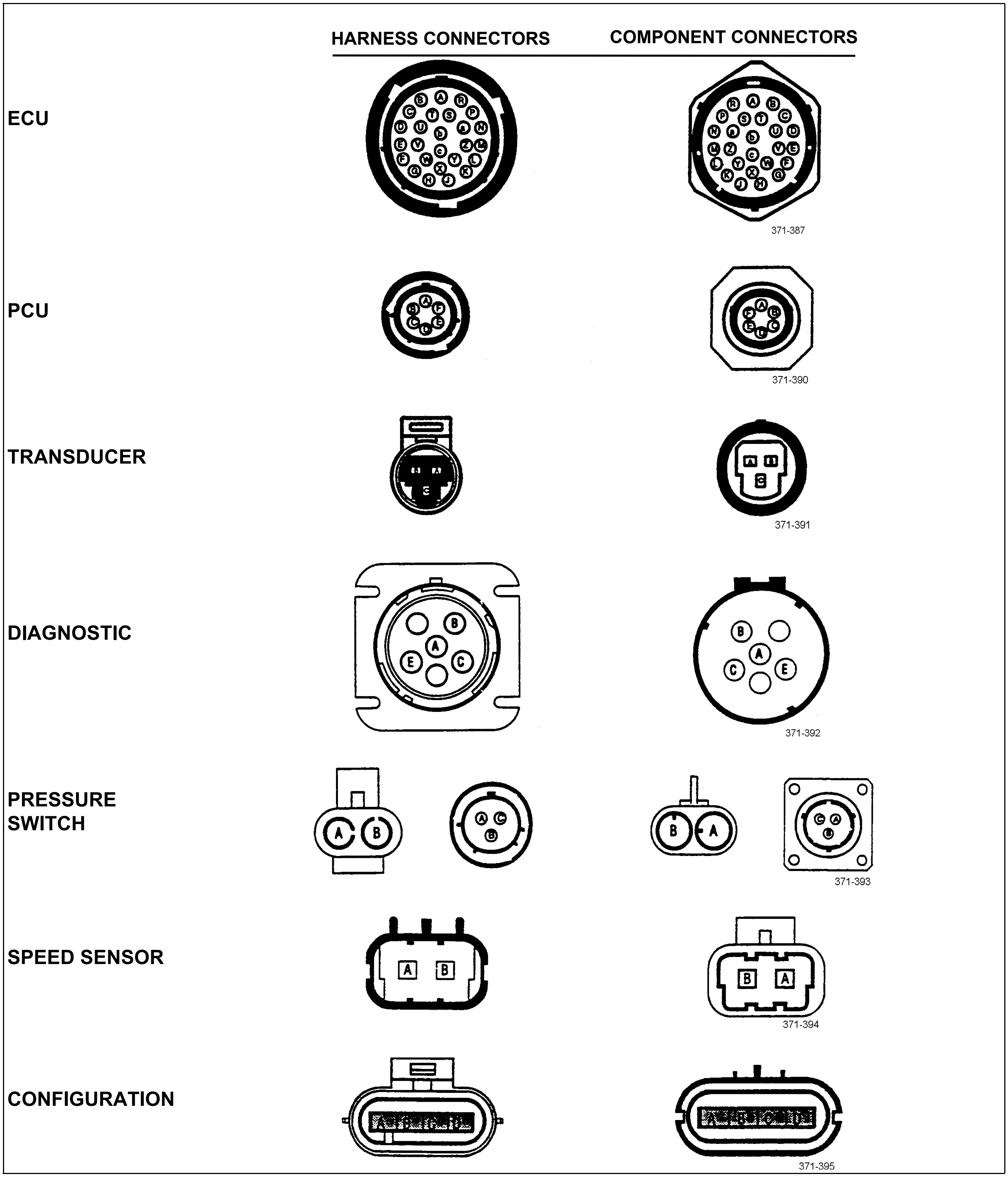
*Possible causes are listed in order of likely occurrence.

Display: **No Code**

Type: ***Miscellaneous***

CONDITION Operating problems that do not trigger a fault code.	**POSSIBLE CAUSES*** Since a fault code was not set, these conditions may be universal and not call for a troubleshooting routine.	**SOLUTION** Where fault codes appear, refer to the troubleshooting procedures listed under that code.
AIR LEAKS Air bleeding from drive axle vents	Air Seal leaks (Extreme cold temperatures)	Drive vehicle to “warm up” seals.
Tires fail to deflate when lower pressures are requested	• Pneumatic system problem	See “No Deflate Signal” code
Leaking tires	• Damaged tire • Loose connection between wheel valve and tire • Faulty wheel valve	Replace tire Tighten connection Replace wheel valve
Air bleeding (audible) through QRV when ignition is turned off	• Wheel valve is leaking back through control lines • QRV vent plugged	Identify tire with low pressure and replace faulty wheel valve.
OTHER Apparent continuous operation, or slow inflates or deflates	• Too long changing pressures • Loss of pressure during inflate	See “Between Modes”, “Trend Fault”, “Tire Leak (Confirm)” codes
System stopped in middle of inflate or deflate (display shows steady mode light before reaching targeted pressures)	• Intermittent transducer short or open	See “Pressure Transducer” code
Wheel end oil leak	• Faulty air or oil seal	
Optional “load” switch seems to have no effect	• Broken, shorted, or open wire to load switch • Faulty load switch	Use diagnostic tool in monitor mode to verify load status changes when switch position changes. Use wiring diagram to test harness for shorts or opens. Replace load switch.

*Possible causes are listed in order of likely occurrence.


HARNESS CONNECTORS
COMPONENT CONNECTORS
ECU
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PCU
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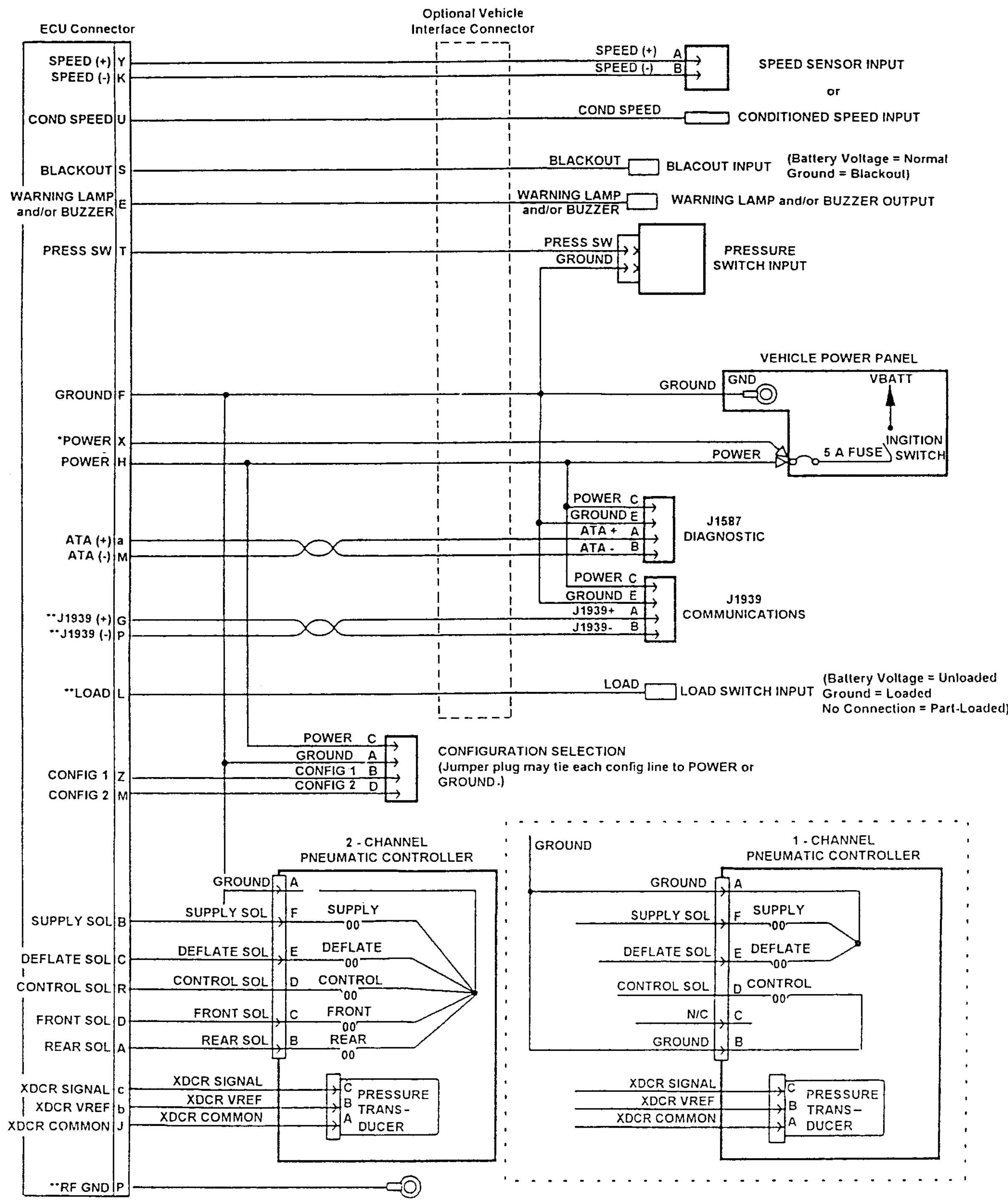
TRANSDUCER
371-391
DIAGNOSTIC
371-392
PRESSURE
SWITCH
371-393
SPEED SENSOR
371-394
CONFIGURATION
371-395

CENTRAL TIRE INFLATION SYSTEM (CTIS) TROUBLESHOOTING (M916A3, M917A2) - CONTINUED 0020 00



END OF WORK PACKAGE

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W

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

Sandra R. Riley

SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army
0409206

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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA	Use Part II *(reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE **1 July 2005**

TO: *(Forward to proponent of publication or form) (Include ZIP Code)*	**FROM:** *(Activity and location) (Include ZIP Code)*
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PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9-2320-302-20-1	24 February 2006	Unit Maintenance Manual for the M915 Family of Vehicles

ITEM	PAGE	PARA-	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON
	0035 00-1	Initial Setup				Item number for Oil, Lubricating is not correct.

SAMPLE

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

TO: *(Forward direct to addressee listed in publication)*	FROM: *(Activity and location) (Include ZIP Code)*	DATE

PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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THE METRIC SYSTEM AND EQUIVALENTS

Linear Measure

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

Weights

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Pounds
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

Liquid Measure

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

Square Measure

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.0386 Sq Miles

Cubic Measure

1 Cu Centimeter = 1,000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

Temperature

5/9 (°F - 32) = °C
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5 C° +32 = F°

APPROXIMATE CONVERSION FACTORS

To Change	To	Multiply By
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Sq Inches	Sq Centimeters	6.451
Sq Feet	Sq Meters	0.093
Sq Yards	Sq Meters	0.836
Sq Miles	Sq Kilometers	2.590
Acres	Sq Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Sq Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

To Change	To	Multiply By
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Sq Centimeters	Sq Inches	0.155
Sq Meters	Sq Feet	10.764
Sq Meters	Sq Yards	1.196
Sq Kilometers	Sq Miles	0.386
Sq Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Sq Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621

PIN: 081365-000