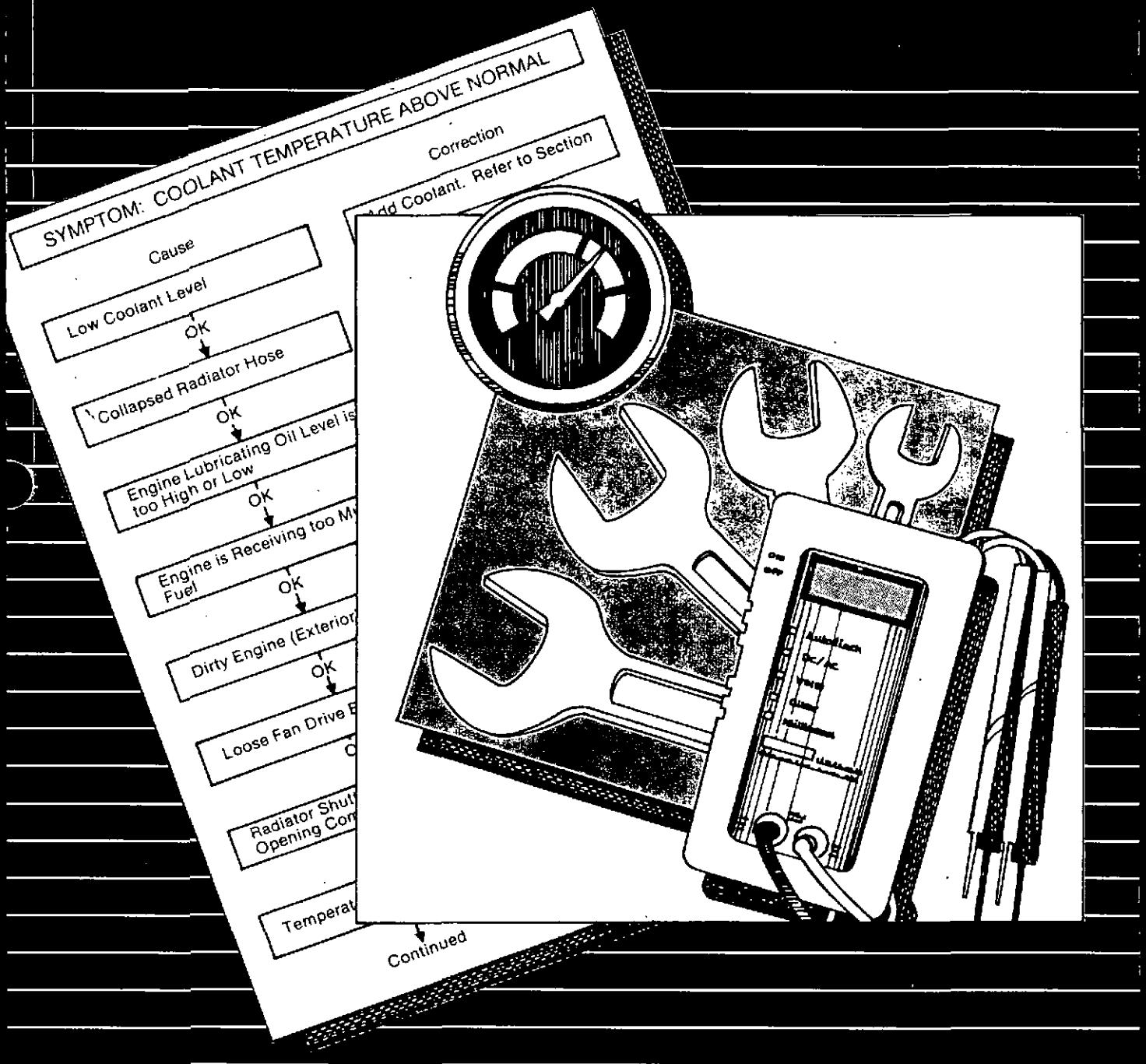
Troubleshooting and Repair Manual
QST Fuel System
QST30 G-Drive Engine Series



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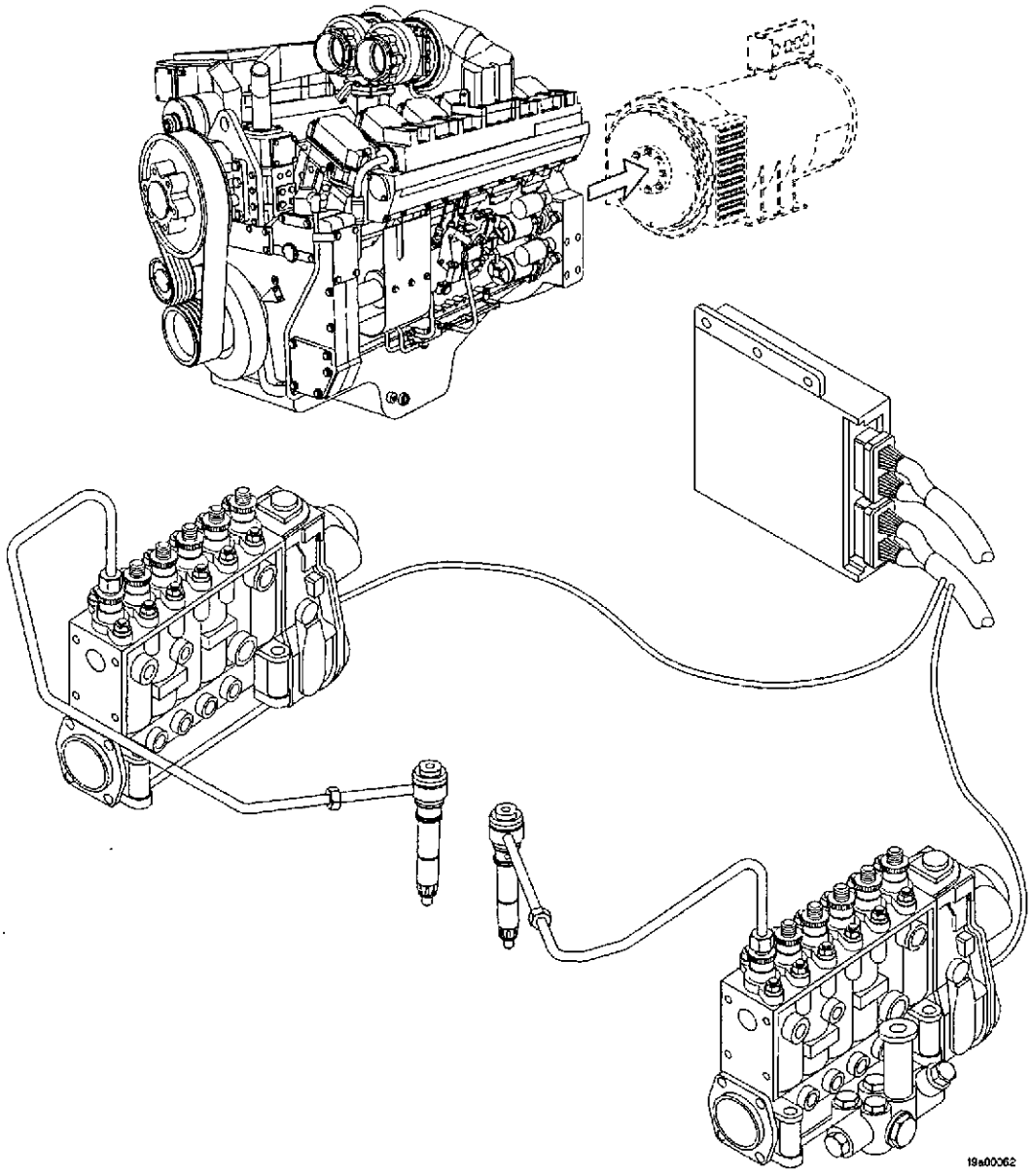

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Foreword

This manual provides instructions for troubleshooting and repairing this engine in the chassis. Component and assembly rebuild procedures are provided in the engine shop manual. Refer to Section i - Introduction for instructions on how to use this manual.

Read and follow all safety instructions. Refer to the WARNING in the General Safety Instructions in Section i - Introduction.

The manual is organized to guide a service technician through the logical steps of identifying and correcting problems related to the engine. This manual does not cover vehicle or equipment problems. Consult the vehicle or equipment manufacturer for repair procedures.

A series of specific service manuals (for example: Shop, Specifications, and Alternative Repair) are available and can be ordered by filling out and mailing the Literature Order Form located in Section L - Service Literature.

The repair procedures used in this manual are recommended by Cummins Engine Co., Inc. Some service procedures require the use of special service tools. Use the correct tools as described.

Cummins Engine Company, Inc. encourages the user of this manual to report errors, omissions, and recommendations for improvement. Please use the postage paid, pre-addressed Literature Survey Form in the back of this manual for communicating your comments.

The specifications and rebuild information in this manual is based on the information in effect at the time of printing. Cummins Engine Company, Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a Cummins Authorized Repair Location or call 1-800-DIESELS (1-800-343-7357).

The latest technology and the highest quality components are used to manufacture Cummins engines. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts. These parts can be identified by the following trademarks:

Cummins® Cummins® ReCon® HOLSET® Fleetguard® Premium Blue™

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Section i - Introduction

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About this Manual

The QST30 G-Drive Troubleshooting and Repair Manual contains general troubleshooting and repair information for the QST30 G-Drive electronic control system. The manual is intended to aid in determining the cause of electronic malfunctions and to provide recommended repair procedures.

This manual does **not** cover base engine maintenance procedures. Refer to the Operation and Maintenance Manual, Bulletin No. 3666134, for this information. Refer Section L of this manual for information about base engine manuals.

This manual does **not** cover most generator equipment maintenance or repair procedures. Consult the generator equipment manufacturer for specific maintenance and repair recommendations.

Both metric and U.S. customary values are listed in this manual. The metric value is listed first, followed by the U.S. customary value in brackets.

Numerous illustrations and symbols are used to aid in understanding the meaning of the text. Refer to page i-3 for a complete listing of symbols and their definitions.

Each section is preceded by a Section Contents to aid in locating information.

How to Use the Manual

This manual is organized to provide an easy flow from problem identification to problem correction. A list of troubleshooting symptoms containing the most common engine problems is in Section TS - *Troubleshooting Symptoms*. Complete the following steps to locate and correct the problem.

Before beginning any troubleshooting procedure, check the functions of the fault outputs. Refer to Procedure 019-046. If INSITE™, Part No. 3825145, is available, check for the correct parameter settings. Refer to the INSITE™ G-Drive User's Manual (QST30), Bulletin No. 3666196. To use the symptom trees in section TS:

(Step 1) Locate the symptom or the fault code on the contents page of the correct section (Section TF - Troubleshooting Faults, or Section TS - Troubleshooting Symptoms).

(Step 2) The top of the Troubleshooting Logic Chart indicates a probable cause, starting with the simple and easiest to repair, and continuing downward to the most difficult.

Each step provides a brief description of the corrective action with a location reference for the repair procedure.

(Step 3) Follow the chart, from the top going down, until the problem is corrected.

(Step 4) The Troubleshooting Logic Charts are based on the following assumptions:

1. The engine has been installed according to the manufacturer's specifications.
2. The easiest repairs are done first.

Symbols

The following group of symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below.

WARNING - Provides a warning to take precaution to avoid bodily injury from electrical shock or electrocution. There is in the vicinity uninsulated high A.C. voltage.

WARNING - Serious personal injury or extensive property damage can result if the warning instructions are not followed.

CAUTION - Minor personal injury can result or a part, an assembly or the engine can be damaged if the caution instructions are not followed.

Indicates a **REMOVAL or DISASSEMBLY** step.

Indicates an **INSTALLATION or ASSEMBLY** step.

INSPECTION is required.

CLEAN the part or assembly.

PERFORM a mechanical or time **MEASUREMENT**.

LUBRICATE the part or assembly.

Indicates that a **WRENCH or TOOL SIZE** will be given.

TIGHTEN to a specific torque.

PERFORM an electrical **MEASUREMENT**.

Refer to another location in this manual or another publication for additional information.

The main circuit breaker is closed and normal power is being supplied to the equipment.

The main circuit breaker must be open so that normal power is **not** being supplied to the equipment.

The generator set is on and supplying power to the equipment.

The generator set **must** be off and **not** supplying power to the equipment.

The wiring harness disconnect plug **must** be disconnected.

The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance tc lift the component.

17800001

Simbolos

Los símbolos siguientes son usados en este manual para clarificar el proceso de las instrucciones. Cuando *aparece uno de estos símbolos, su significado se especifica en la parte inferior.*

Proporciona un aviso de precaución para evitar daños corporales causados por choques eléctricos o electrocución. El peligro está en la vecindad del alto voltaje de c.a. sin aislamiento.

ADVERTENCIA - Serios daños personales o daño a la propiedad puede resultar si las instrucciones de Advertencia no se consideran.

PRECAUCION - Daños menores pueden resultar, o de piezas del conjunto o el motor puede averiarse *si las instrucciones de Precaución no se siguen.*

Indica un paso de **REMOCION** o **DESMONTAJE.**

Indica un paso de **INSTALACION** o **MONTAJE.**

Se requiere **INSPECCION.**

LIMPIESE la pieza o el montaje.

EJECUTESE una **MEDICION** mecánica o del tiempo.

LUBRIQUESE la pieza o el montaje.

Indica que se dará una **LLAVE DE TUERCAS** o el **TAMAÑO DE HERRAMIENTA.**

APRIETESE hasta un par torsor específico.

EJECUTESE una **MEDICION** eléctrica.

Para información adicional refiérase a otro emplazamiento de este manual o a otra publicación anterior.

Durante el procedimiento, **EL DISYUNTOR PRINCIPAL ESTA CERRADO.** Se suministra potencia normal al equipo.

Durante este procedimiento, **EL DISYUNTOR PRINCIPAL ESTA ABIERTO.** No se suministra potencia normal al equipo.

Este procedimiento requiere que el **GRUPO ELECTROGENO ESTE CONECTADO** para suministrar potencia al equipo.

Este procedimiento requiere que el **GRUPO ELECTROGENO ESTE DESCONECTADO.** No se suministra potencia al equipo.

Este procedimiento requiere que debe desconectarse el **HAZ PRINCIPAL DE CONDUCTORES PREFORMADO.**

El componente pesa 23 kgs [50 lb] o mas. para evitar dano corporal empleen una cabria u obtengan ayuda para elevar el componente.

17800002

Symbole

In diesem Handbuch werden die folgenden Symbole verwendet, die wesentliche Funktionen hervorheben. Die Symbole haben folgende Bedeutung:

Unfallgefahr bedingt durch elektrischen Schlag. Nichtisolierte Hochspannungsleitungen in der Nähe.

WARNUNG - Wird die Warnung **nicht** beachtet, dann besteht erhöhte Unfall- und Beschädigungsgefahr.

VORSICHT - Werden die Vorsichtsmassnahmen **nicht** beachtet, dann besteht Unfall- und Beschädigungsgefahr.

AUSBAU bzw. **ZERLEGEN.**

EINBAU bzw. **ZUSAMMENBAU.**

INSPEKTION erforderlich.

Teil oder Baugruppe **REINIGEN.**

DIMENSION - oder **ZEITMESSUNG.**

Teil oder Baugruppe **ÖLEN.**

WERKZEUGGRÖSSE wird angegeben.

ANZUG auf vorgeschriebenes Drehmoment erforderlich.

Elektrische **MESSUNG DURCHFÜHREN.**

Weitere Informationen an anderer Stelle bzw. in anderen Handbüchern.

Während des Arbeitsgangs ist der **HAUPTTRENNSCHALTER GESCHLOSSEN.** Das Gerät wird von der normalen Stromversorgung versorgt.

Während des Arbeitsgangs ist der **HAUPTTRENNSCHALTER GEÖFFNET.** Das Gerät wird nicht von der normalen Stromversorgung versorgt.

Der Arbeitsgang erfordert, daß der **LAUFENDE STROMVERSORGER** das Gerät mit Strom versorgt.

Der Arbeitsgang erfordert, daß der **STROMVERSORGER ABGESCHALTET IST** und das Gerät nicht mit Strom versorgt wird.

Dieser Arbeitsgang erfordert Abklemmen des **HAUPTKABELSTRANGS.**

Das teil weigt 23 kg [50 lb] oder mehr. Zur vermeidung von koerperverletzung winde benutzen oder hilfe beim heben des teils in anspruch nehmen.

17800003

Symboles

Les symboles suivants sont utilisés dans ce manuel pour aider à communiquer le but des instructions. Quand l'un de ces symboles apparaît, il évoque le sens défini ci-dessous:

Avertit de prendre soin d´éviter des lésions corporelles provenant de décharge électrique ou d'électrocution. Il y a dans le voisinage une haute tension C.A. non isolée.

AVERTISSEMENT - De graves lésions corporelles ou des dommages matériels considérables peuvent survenir si les instructions données sous les rubriques "Avertissement" **ne** sont **pas** suivies.

ATTENTION - De petites lésions corporelles peuvent survenir, ou bien une pièce, un ensemble ou le moteur peuvent être endommagés si les instructions données sous les rubriques "Attention" **ne** sont **pas** suivies.

Indique une opération de **DEPOSE.**

Indique une opération de **MONTAGE.**

L'INSPECTION est nécessaire.

NETTOYER la pièce ou l'ensemble.

EFFECTUER une **MESURE** mécanique ou de temps.

GRAISSER la pièce ou l'ensemble.

Indique qu'une **DIMENSION DE CLE** ou **D'OUTIL** sera donnée.

SERRER à un couple spécifique.

EFFECTUER une **MESURE** électrique.

Se reporter à un autre endroit dans ce manuel ou à une autre publication pour obtenir des informations plus complètes.

Pendant la procédure, le **DISJONCTEUR PRINCIPAL EST FERME.** L´équipement recoit l´alimentation normale.

Pendant cette procédure, le **DISJONCTEUR PRINCIPAL EST OUVERT.** L´équipement ne recoit pas l´alimentation normale.

Cette procédure nécessite que le **GROUPE ELECTROGENE SOIT EN MARCHE** pour alimenter l´équipement.

Cette procédure nécessite que le **GROUPE ELECTROGENE SOIT EN ARRET.** L´équipement n´est pas alimenté.

Cette procédure nécessite de déconnecter le **CABLAGE PRINCIPAL.**

Le Composant pese 23 kg [50 lb] ou davantage. Pour eviter toute blessure, employer un appariel de levage ou demander de l´aide pour le soulever.

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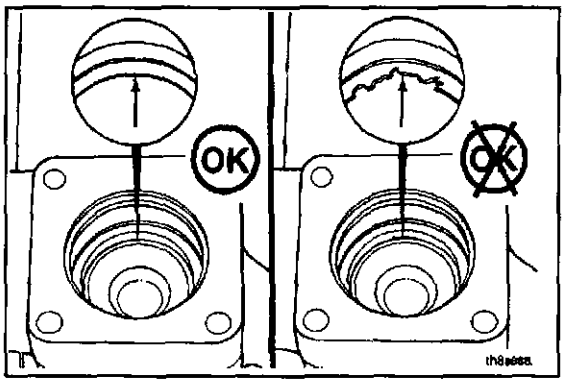
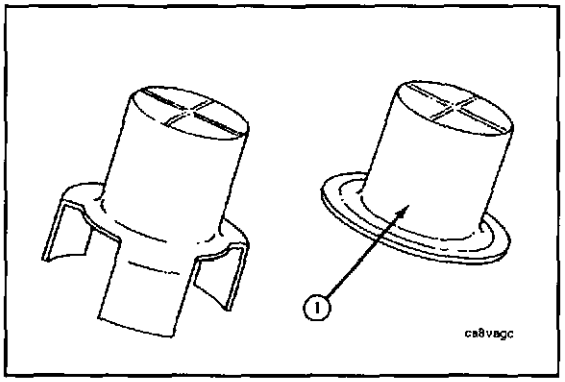
Illustrations

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.



The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.



General Safety Instructions

Important Safety Notice

⚠ WARNING ⚠

Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation or other bodily injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Make sure the work area surrounding the product is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do **not** work on anything that is supported ONLY by lifting jacks or a hoist. **Always** use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, fuel and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To prevent suffocation and frostbite, wear protective clothing and ONLY disconnect fuel and liquid refrigerant (freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.
- To avoid burns, be alert for hot parts on products that have just been turned off, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use ONLY genuine Cummins or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lessor quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.

General Repair Instructions

This engine incorporates the latest diesel technology at the time it was manufactured; yet, it is designed to be repaired using normal repair practices performed to quality standards.

- **Cummins Engine Company, Inc. does not recommend or authorize any modifications or repairs to engines or components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury or death. Below is a partial listing of components classified as safety-related:**

Air Compressor
Air Controls
Air Shutoff Assemblies
Balance Weights
Cooling Fan
Fan Hub Assembly
Fan Mounting Bracket(s)
Fan Mounting Capscrews
Fan Hub Spindle
Flywheel
Flywheel Crankshaft Adapter
Flywheel Mounting Capscrews
Fuel Shutoff Assemblies
Fuel Supply Tubes
Lifting Brackets
Throttle Controls
Turbocharger Compressor Casing
Turbocharger Oil Drain Line(s)
Turbocharger Oil Supply Line(s)
Turbocharger Turbine Casing
Vibration Damper Mounting Capscrews

- **Follow all safety instructions noted in the procedures**
  - — Follow the manufacturer's recommendations for cleaning solvents and other substances used during the repair of the engine. Some solvents and used engine oil have been identified by government agencies as toxic or carcinogenic. Avoid excessive breathing, injestion and contact with such substances. **Always** use good safety practices with tools and equipment.
- **Provide a clean environment and follow the cleaning instructions specified in the procedures**
  - — The engine and its components **must** be kept clean during any repair. Contamination of the engine or components will cause premature wear.
- **Perform the inspections specified in the procedures**
- **Replace all components or assemblies which are damaged or worn beyond the specifications**
- **Use genuine Cummins new or ReCon® service parts and assemblies**
  - — The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- **Follow the specified disassembly and assembly procedures to avoid damage to the components**

Complete rebuild instructions are available in the shop manual which can be ordered or purchased from a Cummins Authorized Repair Location. Refer to Section L — Service Literature for ordering instructions.

Welding on a Vehicle with an Electronic Controlled Fuel System

△ CAUTION △

Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground cable of the welder to the ECM cooling plate or ECM. Welding on the engine or engine mounted components is not recommended.

General Cleaning Instructions

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the engine parts. Experience has shown that the best results can be obtained using a cleaner that can be heated to 90 to 95 degrees Celsius [180 to 200 degrees Fahrenheit]. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. **Cummins Engine Company, Inc. does not recommend any specific cleaners. Always** follow the cleaner manufacturer's instructions.

Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful **not** to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.

⚠ WARNING ⚠

Acid is extremely dangerous and can damage the machinery. Always provide a tank of strong soda water as a *neutralizing agent*.

Rinse all of the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all of the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rustproofing compound. The rustproofing compound **must** be removed from the parts before installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good way to clean the oil drillings.

⚠ WARNING ⚠

Wear protective clothing to prevent personal injury from the high pressure and extreme heat.

Do **not** steam clean the following parts:

1. Electrical Components
2. Wiring
3. Injectors
4. Fuel Pump
5. Belts and Hoses
6. Bearings
7. Electronic Control Module (ECM)
8. ECM Connectors

Glass or Plastic Bead Cleaning

Glass or plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the size of the glass or plastic beads, the operating pressure, and the cleaning time.

△ CAUTION △

Do not use glass or plastic bead cleaning on aluminum piston skirts. Do not use glass bead cleaning on *aluminum ring grooves. Small particles of glass or plastic will embed in the aluminum and result in premature* wear. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.

NOTE: Plastic bead blasting media, Part No. 3822735, can be used to clean aluminum ring grooves. Do **not** use any bead blasting media on pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. The following guidelines can be used to adapt to manufacturer's instructions:

1. Bead size:
   - Use U.S. size No. 16-20 for piston cleaning with plastic bead media, Part No. 3822735.
   - *Use U.S. size No. 70 for piston domes with glass media.*
   - Use U.S. size No. 60 for general purpose cleaning with glass media.
2. Operating Pressure:
   - Glass: Use 620 kPa [90 psi] for general purpose cleaning.
   - Plastic: Use 270 kPa [40 psi] for piston cleaning.
3. Steam clean or wash the parts with solvent to remove all of the foreign material and glass or plastic beads after cleaning. Rinse with hot water. Dry with compressed air.
4. Do **not** contaminate the wash tanks with glass or plastic beads.

Acronyms and Abbreviations

AFC	Air Fuel Control
API	American Petroleum Institute
ASA	Air Signal Attenuator
ASTM	American Society of Testing and Materials
°C	Celsius
CARB	California Air Resources Board
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CPL	Control Parts List
cSt	Centistokes
ECM	Electronic Control Module
ECS	Emission Control System
EPA	Environmental Protection Agency
EPS	Engine Position Sensor
°F	Fahrenheit
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H_2O	Water
ICM	Ignition Control Module
km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquid Natural Gas
LTA	Low Temperature Aftercooling
MIP	Mixer Inlet Pressure
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NG	Natural Gas
OEM	Original Equipment Manufacturer
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
STC	Step Timing Control
VS	Variable Speed
VSS	Vehicle Speed Sensor

NOTES

Section E - System Identification

Section Contents

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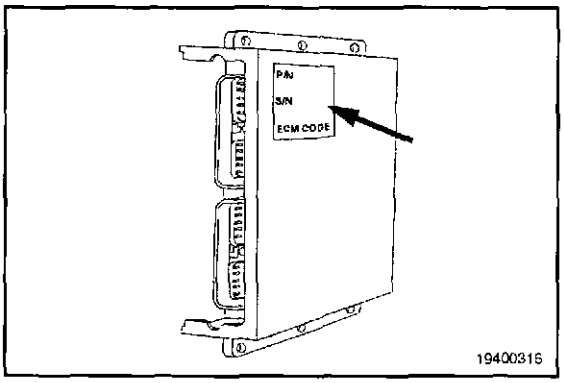
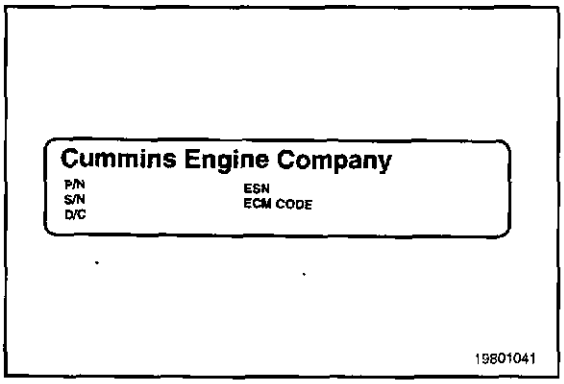
Engine Identification

ECM Dataplate

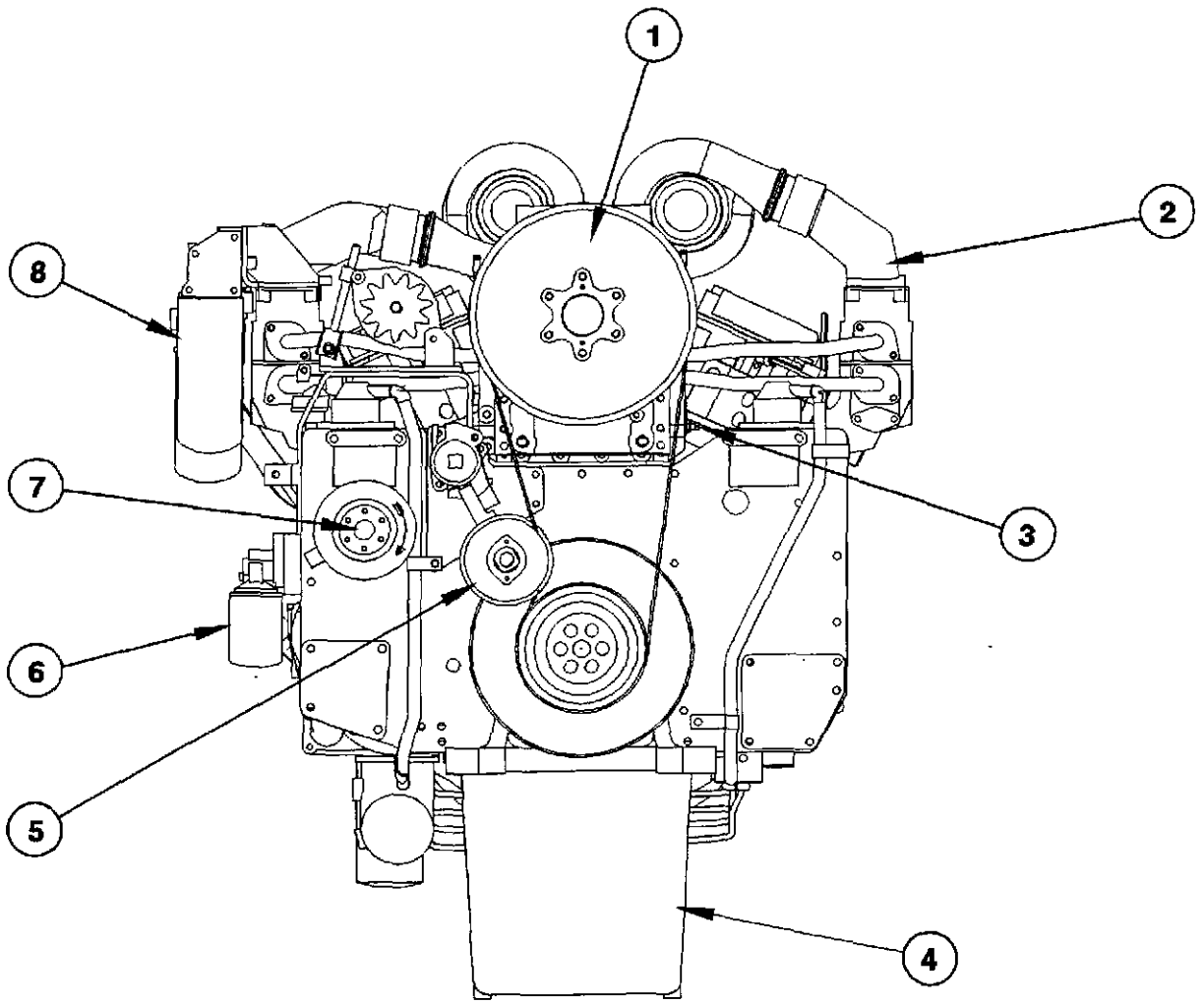
The external ECM dataplate is located on top of the ECM.



The dataplate contains the ECM part number (P/N), the ECM serial number (S/N), the manufacturing date code (D/C), the engine serial number (ESN), and the ECM code.



Engine Views



Front View

1. Fan Hub
2. Air Crossover
3. Coolant Temperature Sensor
4. Oil Pan
5. Fan Idler Tensioner
6. Water Filters
7. Engine Barring Location
8. Full Flow Oil Filters

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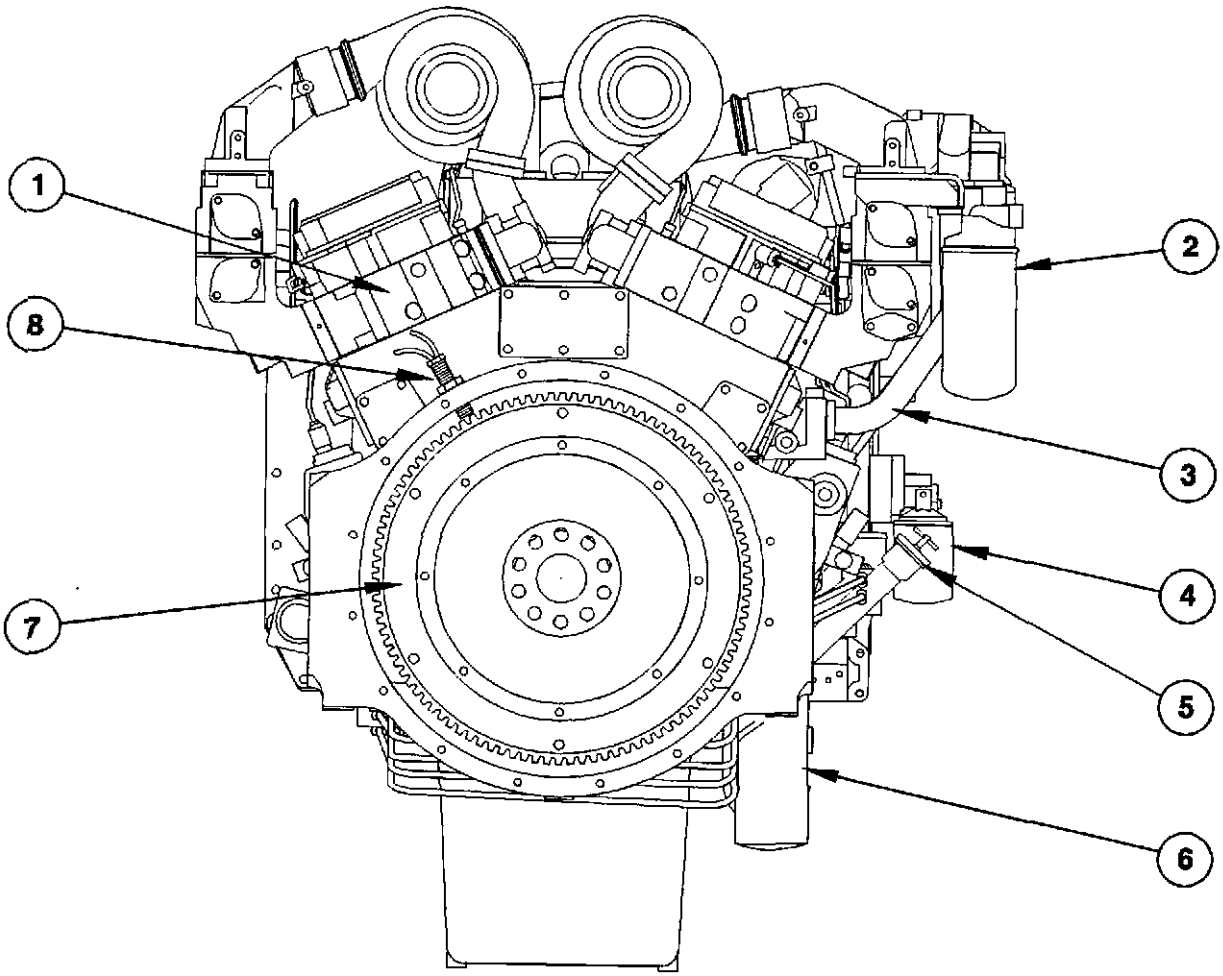

Rear View

1. Cylinder Head
2. Bypass Filters
3. Oil Transfer Tube
4. Water Filters
5. Oil Fill
6. Fuel Filters
7. Flywheel
8. Engine Speed Sensor

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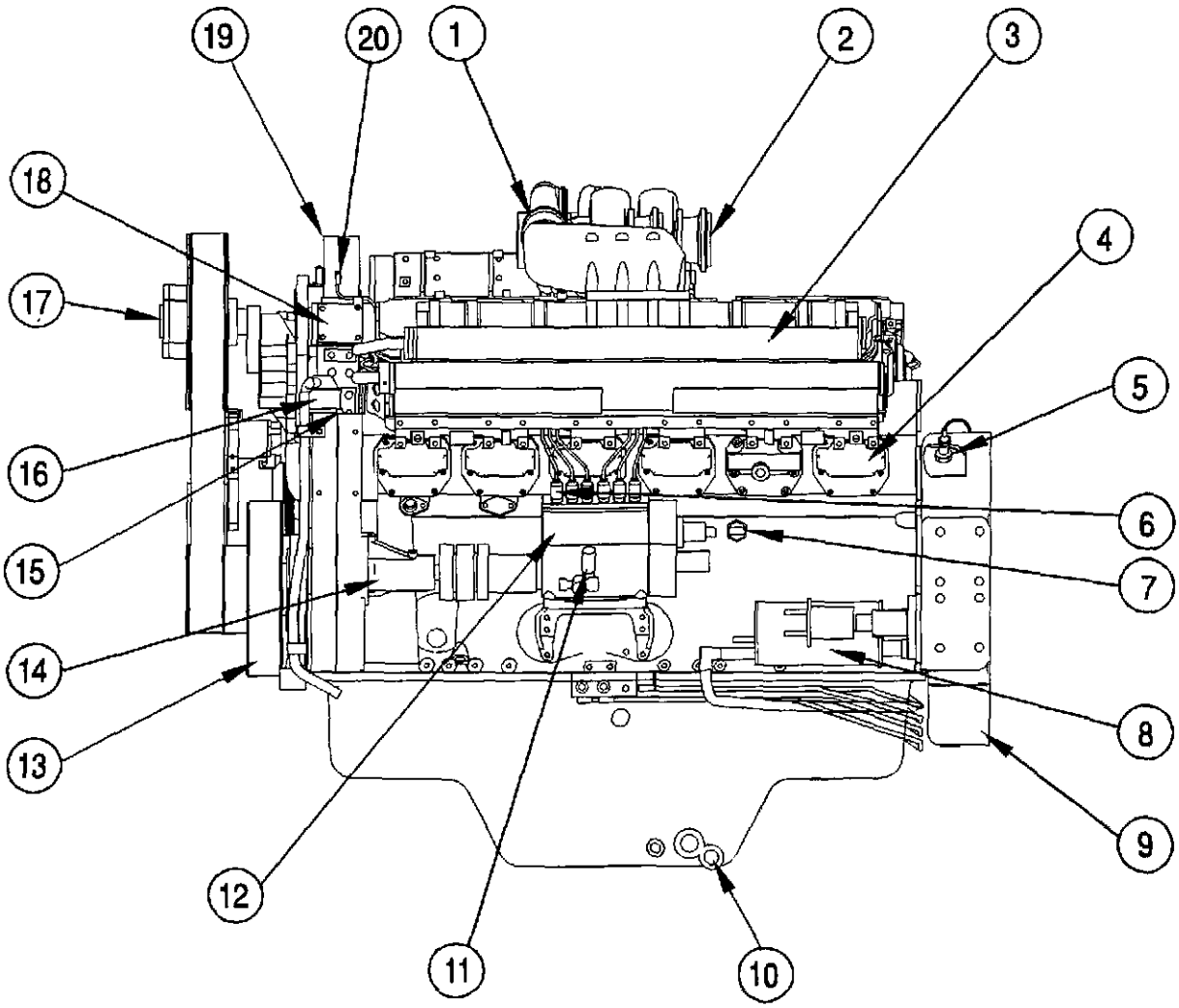

Left Bank

1. Turbocharger Inlet Connection
2. Turbocharger Outlet Connection
3. Aftercooler Housing
4. Cam Follower Cover
5. Engine Speed Sensor
6. High Pressure Fuel Supply Lines
7. Oil Pressure Sensor
8. Prelubricating Starter
9. Flywheel Housing
10. Oil Drain
11. Fuel Lift Pump
12. Fuel Pump
13. Vibration Damper
14. Fuel Pump Drive
15. Coolant Temperature Sensor
16. Crankcase Breather
17. Fan Hub
18. Thermostat Housing
19. Water Outlet Connection
20. Water Vent Tubes

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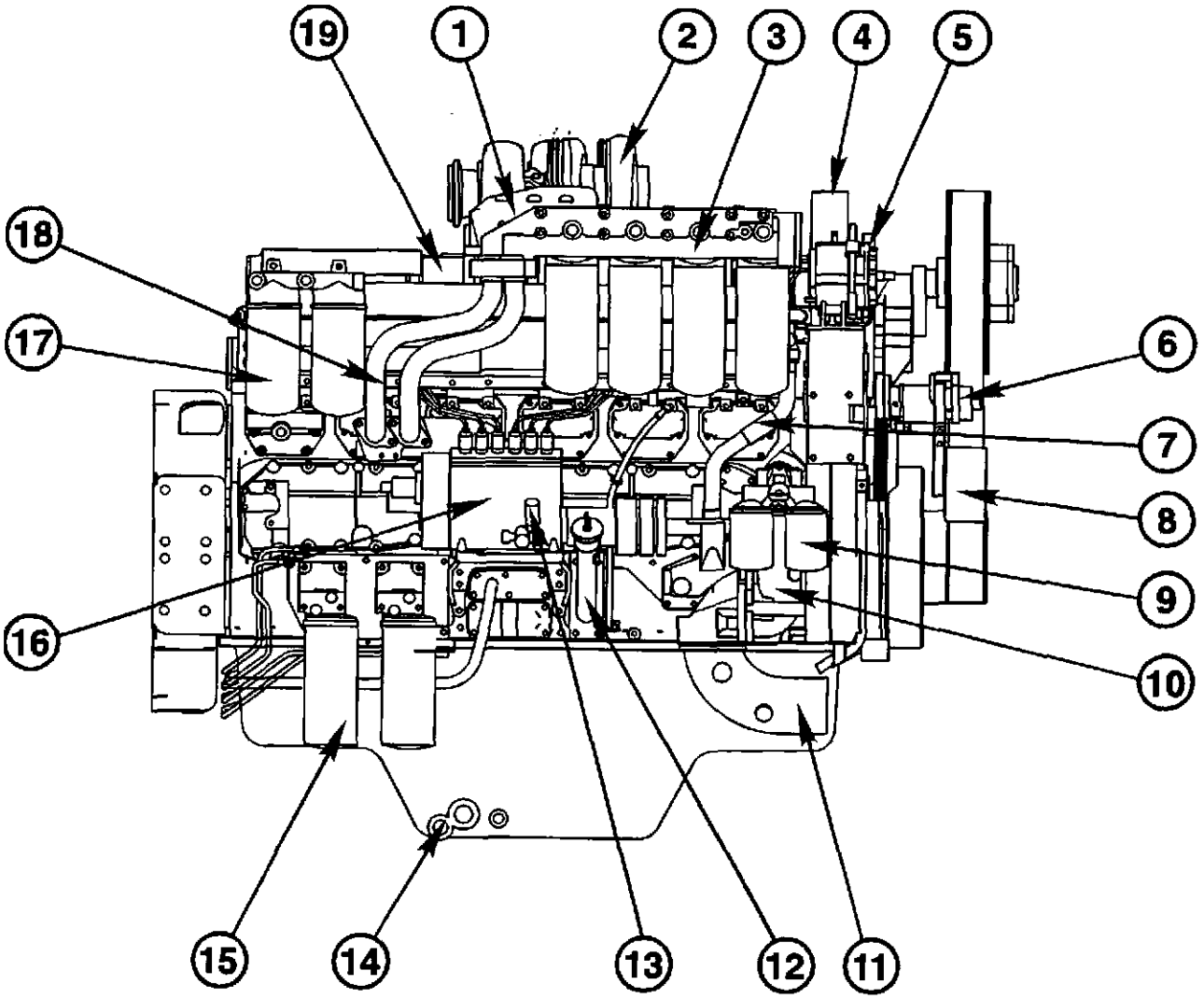
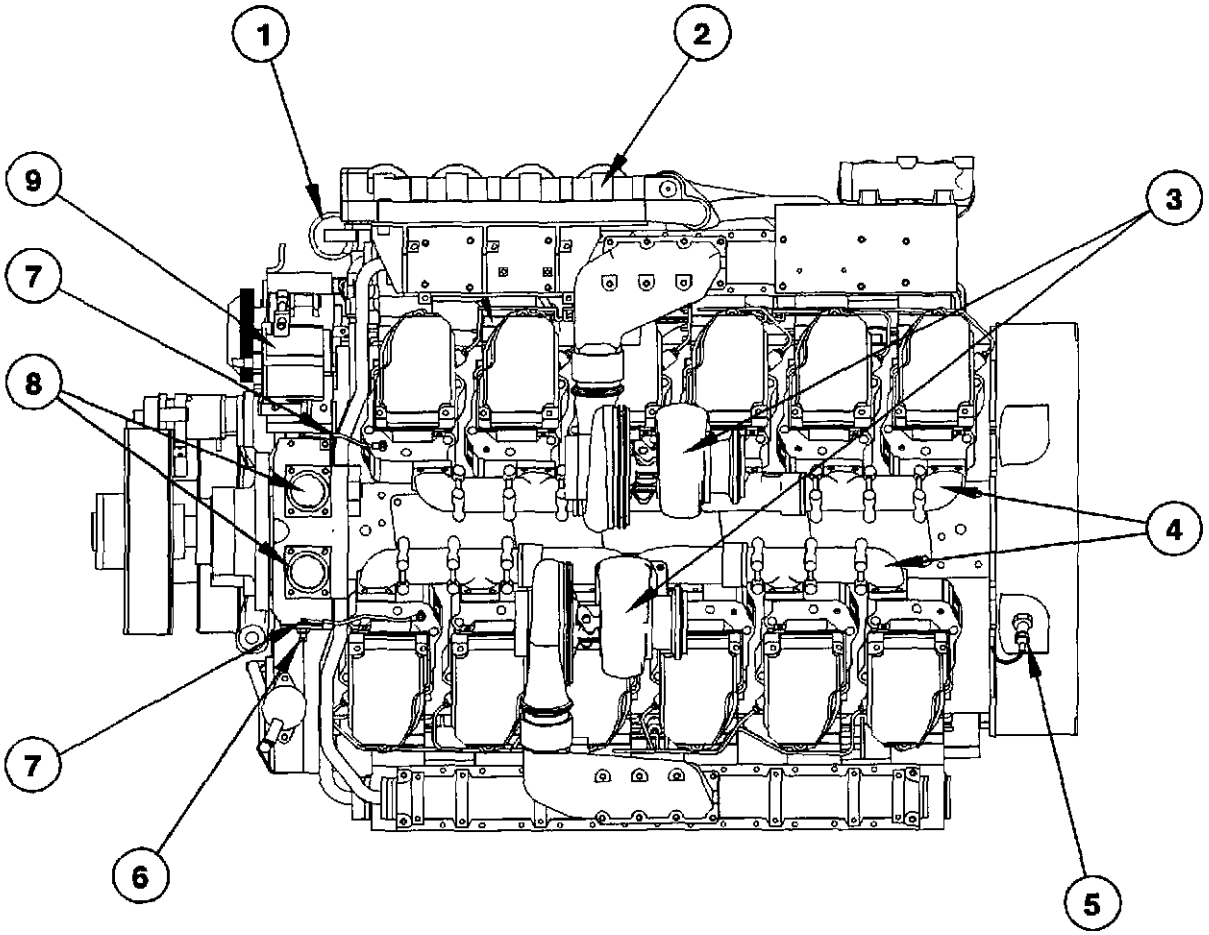


Right Bank

1. Air Crossover Housing
2. Turbocharger
3. Full Flow Oil Filters
4. Water Outlet Connection
5. Lifting Bracket
6. Fan Belt Idler Assembly
7. Water Bypass Tube
8. Fan Belt Idler Pulley
9. Water Filter
10. Water Pump
11. Water Inlet Connection
12. Oil Filler Tube
13. Lift Pump
14. Oil Drain
15. Fuel Filter
16. Fuel Pump
17. Oil Bypass Filters
18. Oil Transfer Tube
19. Intake Manifold

00a00047



Top View

1. Water Filter
2. Full Flow Oil Filters
3. Turbochargers
4. Exhaust Manifolds
5. Engine Speed Sensor
6. *Coolant Temperature Sensor*
7. Water Vent Connection
8. Water Outlet Connection
9. Alternator

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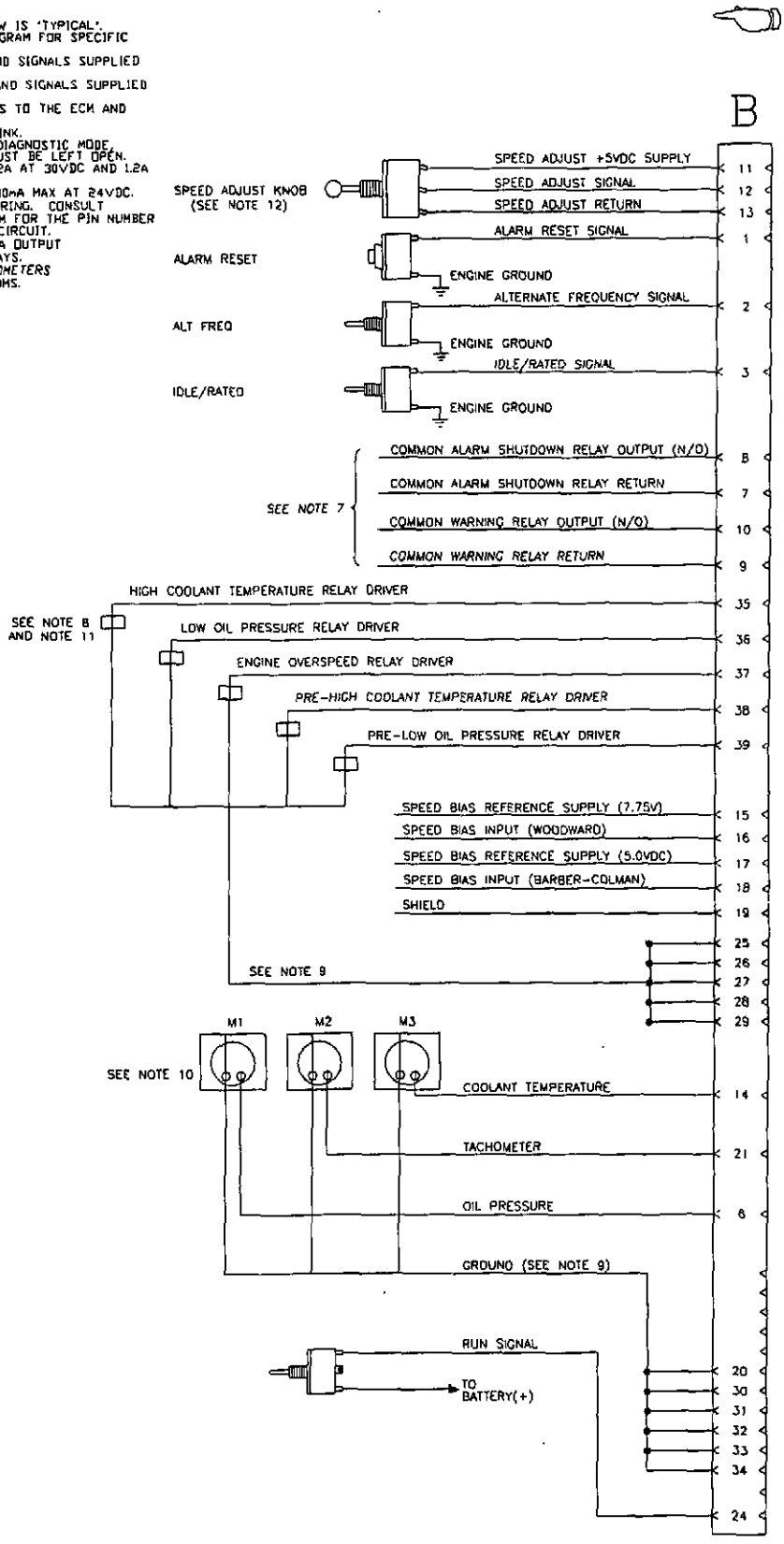
Wiring Diagram

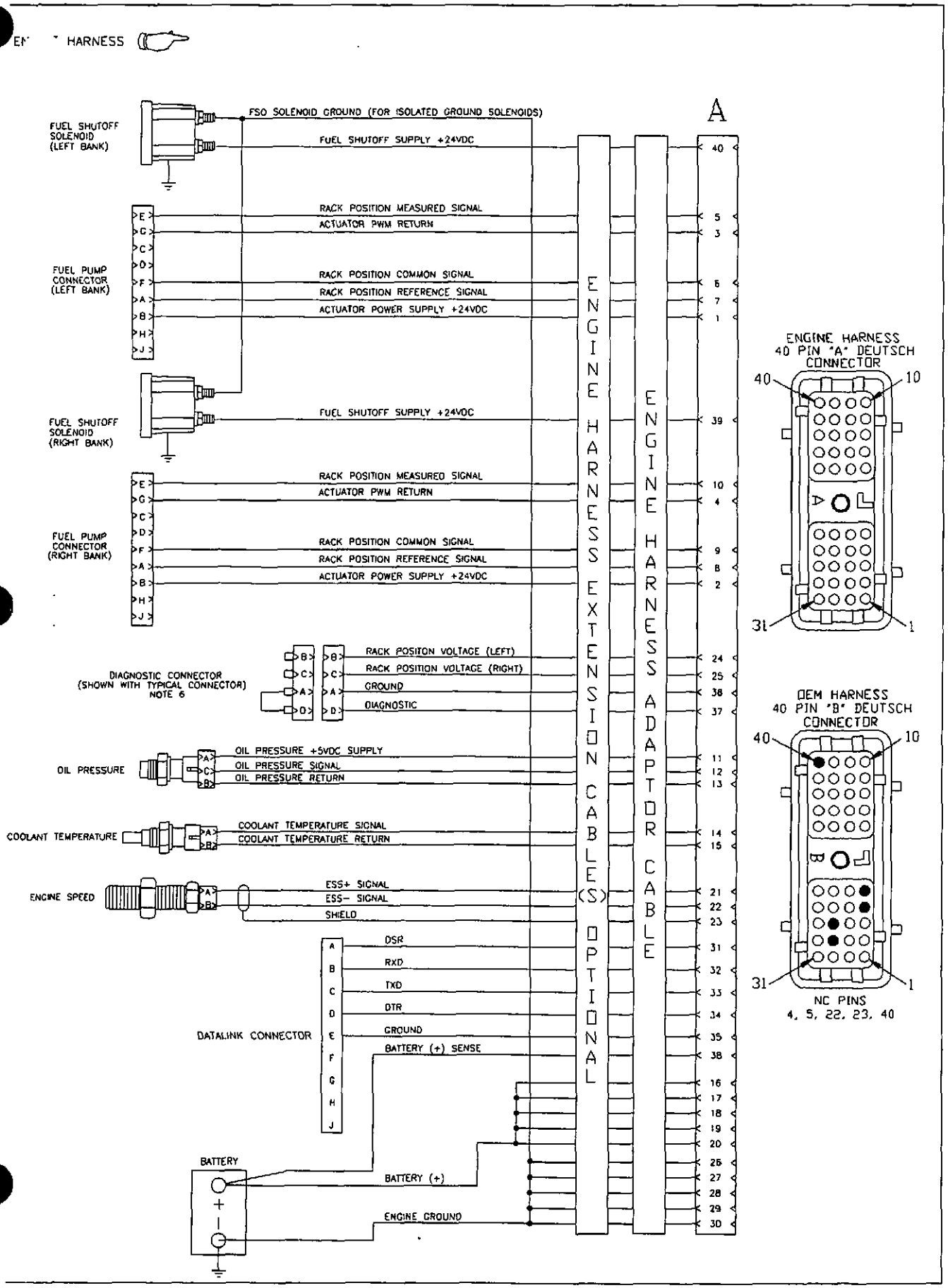
NOTES
1. OEM WIRING SHOWN BELOW IS 'TYPICAL'. CONSULT OEM WIRING DIAGRAM FOR SPECIFIC APPLICATIONS.
2. RED INDICATES POWER AND SIGNALS SUPPLIED BY THE ECM.
3. BLUE INDICATES POWER AND SIGNALS SUPPLIED TO THE ECM.
4. BLACK INDICATES RETURNS TO THE ECM AND GENERIC OEM WIRING.
5. GREEN INDICATES DATA LINK.
6. FOR THE ECM TO ENTER DIAGNOSTIC MODE, THE DIAGNOSTIC INPUT MUST BE LEFT OPEN.
7. RELAY CONTACTS RATED 2A AT 30VDC AND 1.2A AT 50VDC.
8. RELAY DRIVERS RATED 200mA MAX AT 24VDC.
9. CUSTOMER DETERMINES WIRING. CONSULT CUSTOMER WIRING DIAGRAM FOR THE PIN NUMBER AND ITS CORRESPONDING CIRCUIT.
10. METER DRIVERS: 0 TO 1mA OUTPUT
11. USE NON-POLARIZED RELAYS.
12. *RESISTANCE OF POTENTIOMETERS* MUST BE 500 TO 5,000 OHMS.



Cummins Engine Company, Inc.

QST30 G-Drive WIRING DIAGRAM (10/23/96)

(for ECM Part No'S 3094439, 3094141, and 3094440) Bulletin No. 3666185


EN HARNESS
A
FUEL SHUTOFF SOLENOID (LEFT BANK)
FSO SOLENOID GROUND (FOR ISOLATED GROUND SOLENOIDS)
FUEL SHUTOFF SUPPLY +24VDC
FUEL PUMP CONNECTOR (LEFT BANK)
RACK POSITION MEASURED SIGNAL
ACTUATOR PWM RETURN
RACK POSITION COMMON SIGNAL
RACK POSITION REFERENCE SIGNAL
ACTUATOR POWER SUPPLY +24VDC
FUEL SHUTOFF SOLENOID (RIGHT BANK)
FUEL SHUTOFF SUPPLY +24VDC
FUEL PUMP CONNECTOR (RIGHT BANK)
RACK POSITION MEASURED SIGNAL
ACTUATOR PWM RETURN
RACK POSITION COMMON SIGNAL
RACK POSITION REFERENCE SIGNAL
ACTUATOR POWER SUPPLY +24VDC
DIAGNOSTIC CONNECTOR (SHOWN WITH TYPICAL CONNECTOR) NOTE 6
RACK POSITON VOLTAGE (LEFT)
RACK POSITION VOLTAGE (RIGHT)
GROUND
DIAGNOSTIC
OIL PRESSURE
OIL PRESSURE +5VDC SUPPLY
OIL PRESSURE SIGNAL
OIL PRESSURE RETURN
COOLANT TEMPERATURE
COOLANT TEMPERATURE SIGNAL
COOLANT TEMPERATURE RETURN
ENGINE SPEED
ESS+ SIGNAL
ESS- SIGNAL
SHIELD
DATALINK CONNECTOR
DSR
RXD
TXD
DTR
GROUND
BATTERY (+) SENSE
BATTERY
BATTERY (+)
ENGINE GROUND
ENGINE HARNESS EXTENSION CABLES (S) OPTIONAL
ENGINE HARNESS ADAPTOR CABLE
ENGINE HARNESS 40 PIN "A" DEUTSCH CONNECTOR
OEM HARNESS 40 PIN "B" DEUTSCH CONNECTOR
NC PINS 4, 5, 22, 23, 40

NOTES

Section F - Familiarization

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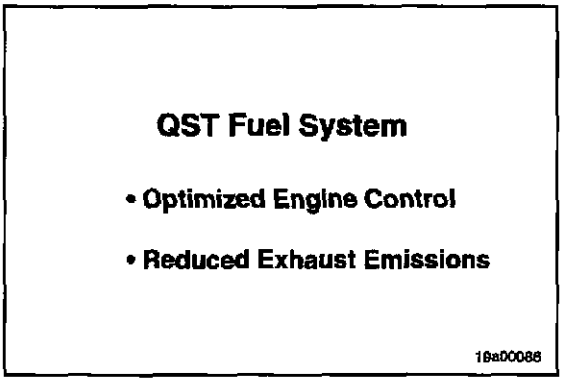
Electronic Controlled Fuel System

Quantum System Description

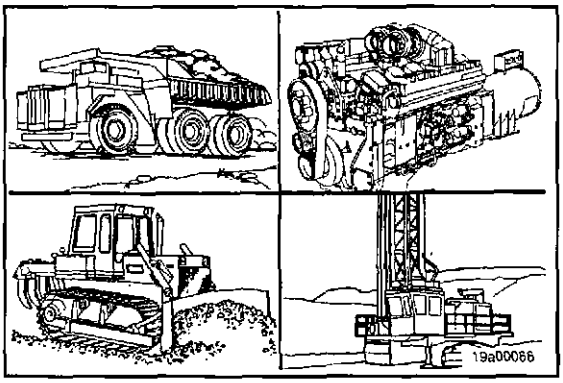
The QST Fuel System is an electronic engine control system designed to optimize engine control and reduce exhaust emissions. This system consists of two in-line fuel injection pumps (one for each engine bank) controlled by an Electronic Control Module (ECM). The QST Fuel System controls engine fueling by placing the fuel pump racks in the correct position for the desired fueling.



Programmable Features

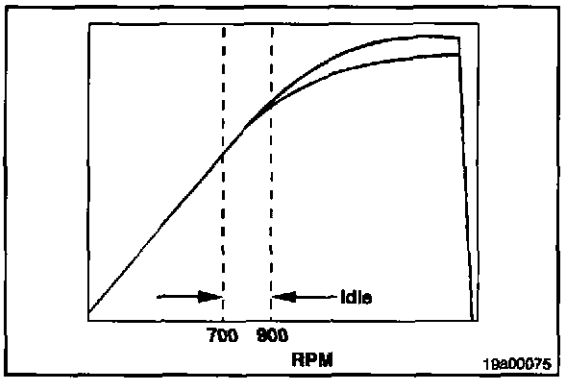
The QST Fuel System has been designed to be flexible to meet the wide variety of engine control needs for off-highway equipment. The electronic control module (ECM) can be programmed to meet the specified requirements of your application.

Enter the diagnostic mode by removing the diagnostic connector shorting cap from the engine harness.



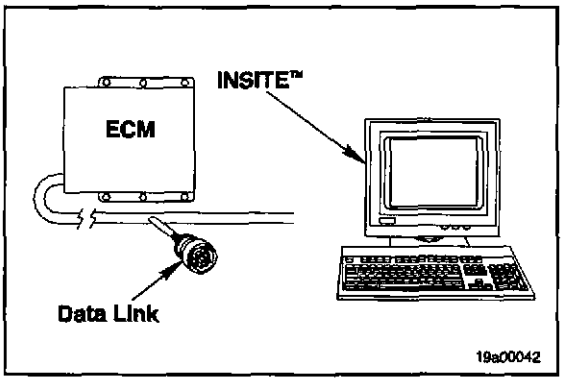
Idle Speed

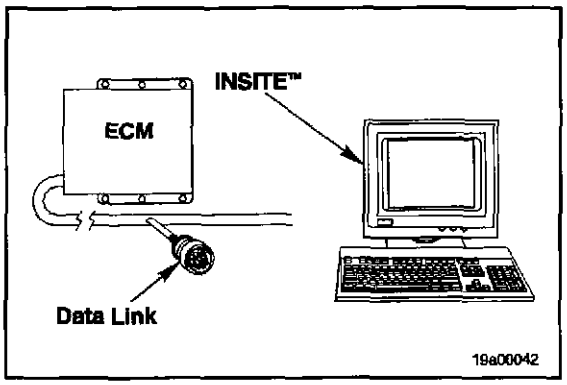
The Idle Speed feature allows the engine idle speed to be adjusted between 700 rpm and 900 rpm. This adjustment can be made using INSITE™, Part No. 3825145.



Governor Gain Adjust

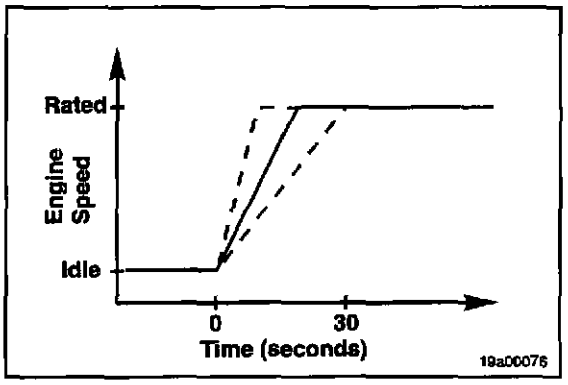
This feature allows the governor gain to be adjusted for optimum engine performance. The gain is adjusted at rated speed. The idle speed gain is then automatically calculated from the rated speed gain. The Governor Gain is adjusted by using INSITE™, Part No. 3825145.





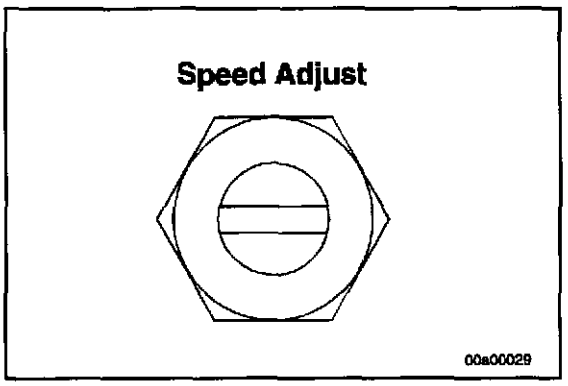
Speed Bias Input Type

This feature allows the ECM to be configured to either Woodward or Barber-Colman speed bias inputs. The input type can be changed by using INSITE™, Part No. 3825145.



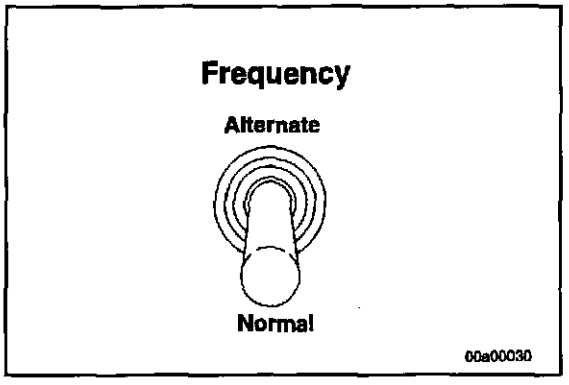
Ramp Time

This feature allows the acceleration ramp time factor to be adjusted from 0 to 30. The acceleration ramp time is the *amount of time it takes for the engine speed to accelerate* from idle to rated speed or from crank to rated speed. For actual ramp time refer to the table of ramp times in the INSITE™ QST30 G-Drive User's Manual. Each value can be adjusted with INSITE™, Part No. 3825145.



Speed Adjust Knob

The Speed Adjust Knob allows the adjustment of rated engine speed by ± 6 percent using a potentiometer with a range of 500 to 5000 ohms. This ECM input can be enabled with INSITE™, Part No. 3825145.



Alternate Frequency Switch

The Alternate Frequency switch settings can be configured using INSITE™, Part No. 3825145. The switch can be configured to one of the following options:

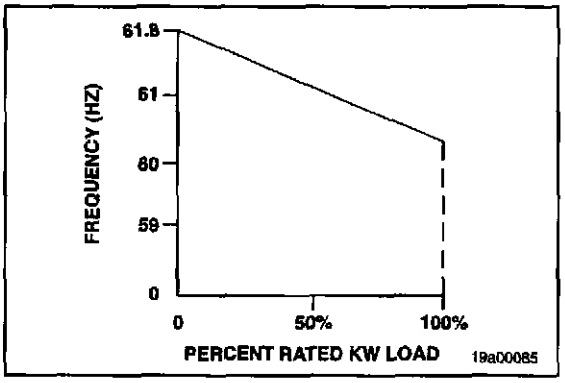
1. Normal = 50 Hz; Alternate = 60 Hz
2. Normal = 60 Hz; Alternate = 50 Hz
3. Always 50 Hz
4. Always 60 Hz

To change frequencies, the engine **must** first be shutdown or brought to idle then back to rated speed.

Governor Droop

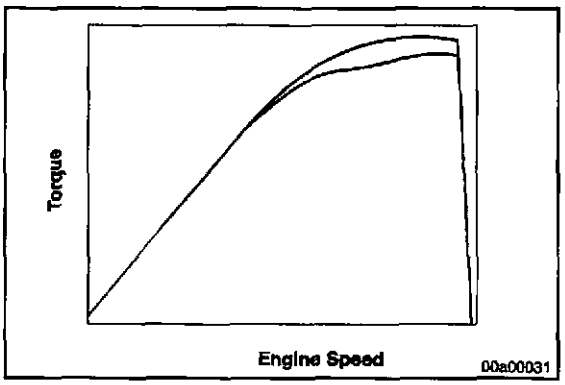
The Governor Droop feature allows the engine speed governor droop to be adjusted from 0 to 10 percent. This adjustment can be made using INSITE™, Part No. 3825145.

Speed Droop (%) = [(no load speed - full load speed)/full load speed] x 100



Torque Curve Adjustment

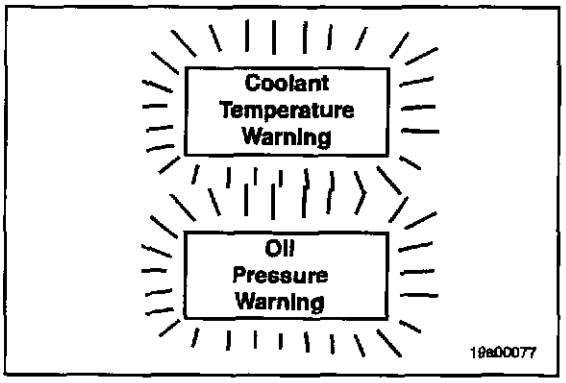
The Torque Curve Adjustment feature allows the torque curve to be adjusted slightly in order to fine tune the engine output power with the alternator input requirements. This adjustment is made using INSITE™, Part No. 3825145.



Warning Threshold Adjustment

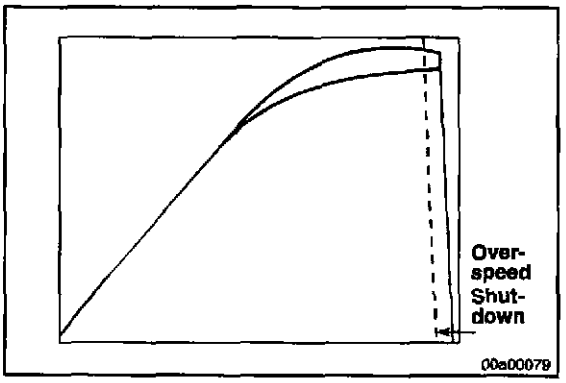
Warning thresholds are engine parameter values at which the ECM will record and report a warning fault condition. The following warning thresholds are adjustable using INSITE™, Part No. 3825145:

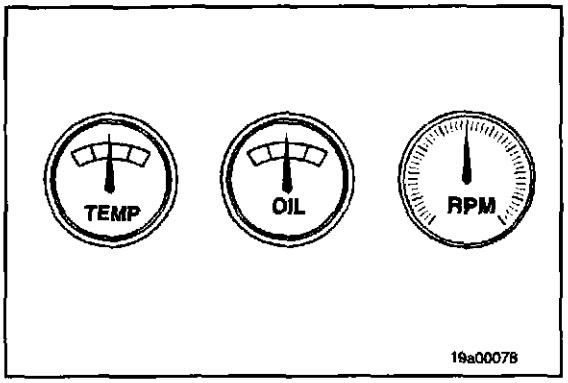
1. High Coolant Temperature Warning
2. Low Oil Pressure Warning at idle
3. Low Oil Pressure Warning at rated rpm



Overspeed Shutdown Adjustment

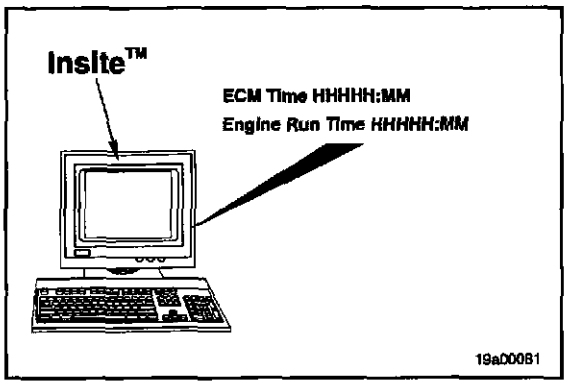
The Overspeed Shutdown Threshold is the engine speed value at which the ECM will shutoff fueling to the engine. This value can be adjusted down from the factory default value. This adjustment can be made using INSITE™, Part No. 3825145.





Meter Calibration

The Meter Calibration feature allows the GOEM installed meters for engine speed, coolant temperature, and oil pressure to be calibrated to the ECM meter drivers (0 to 1 mA). These calibrations can be performed using INSITE™, Part No. 3825145.

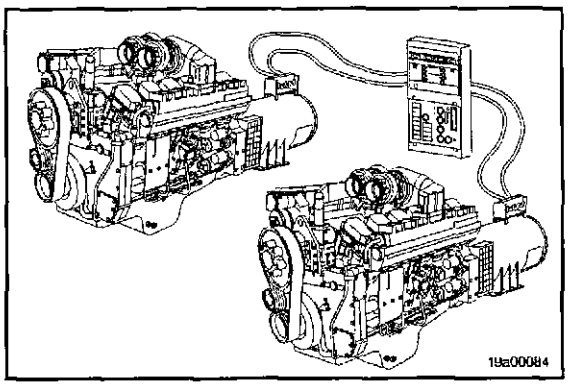


ECM Time and Engine Run Time

ECM Time is the amount of time in Hours:Minutes that the ECM has been powered up (run mode or diagnostic mode).

Engine Run Time is the amount of time in Hours:Minutes that the engine has been running (rpm > 0).

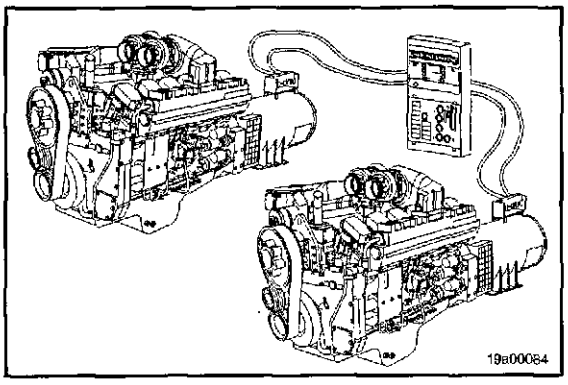
Both of these values can be displayed using INSITE™, Part No. 3825145.



Barber-Colman Scale Factor

The Barber-Colman Scale Factor allows the ECM to be adjusted for optimum paralleling operation with Barber-Colman paralleling equipment. This scale factor can be adjusted using INSITE™, Part No. 3825145.

NOTE: Do **not** adjust this parameter unless absolutely necessary.



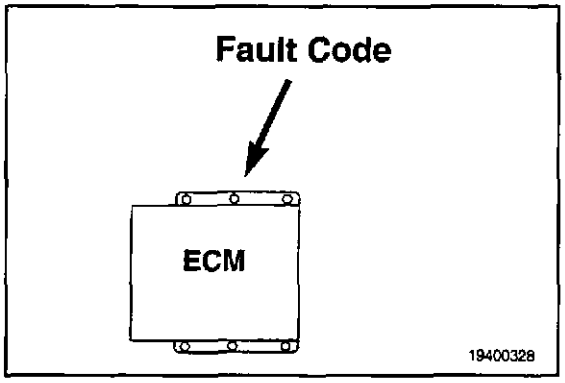
Woodward Scale Factor

The Woodward Scale Factor allows the ECM to be adjusted for optimum paralleling operation with Woodward paralleling equipment. This scale factor can be adjusted using INSITE™, Part No. 3825145.

NOTE: Do **not** adjust this parameter unless absolutely necessary.

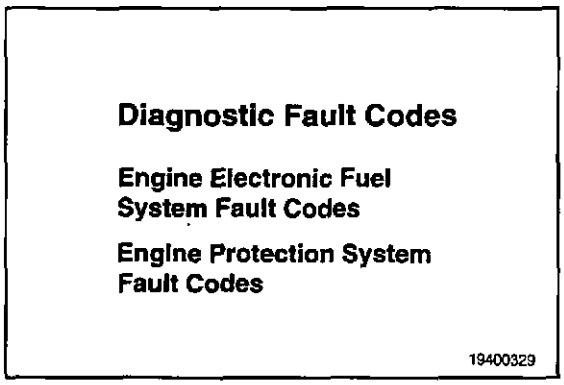
Diagnostic Fault Codes

The QST Fuel System can display and record certain detectable fault conditions. These conditions are displayed as fault codes which makes troubleshooting easier. The fault codes are retained in the electronic control module (ECM).



There are two types of fault codes. There are engine electronic fuel system fault codes and engine protection system fault codes.

All fault codes recorded will either be active (fault code is presently active on the engine) or inactive (fault code was active at some time, but is not presently active).

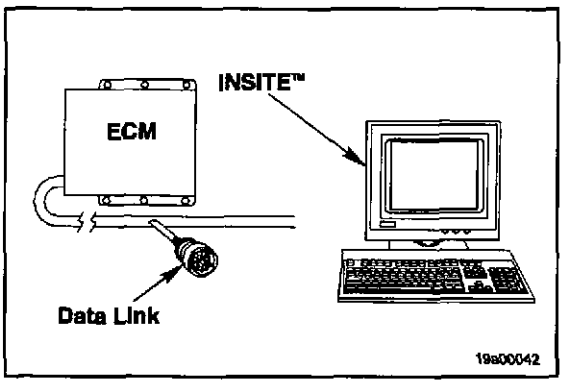


Fault codes can **only** be viewed using INSITE™, Part No. 3825145.

To read the fault codes, the ECM must be powered up either in the "Run" or "Diagnostic" mode.

To enter the diagnostic mode, remove the diagnostic connector shorting cap on the engine harness.

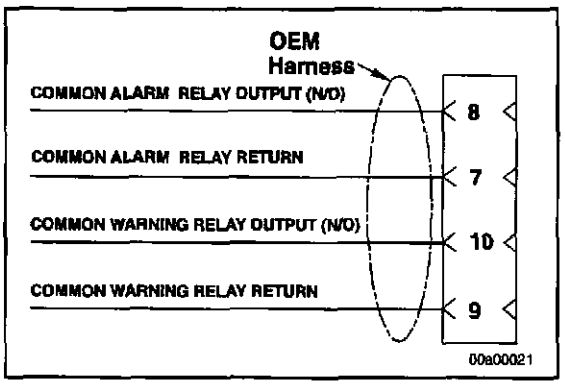
To clear fault codes the engine **must not** be running and the ECM must be in the diagnostic mode.

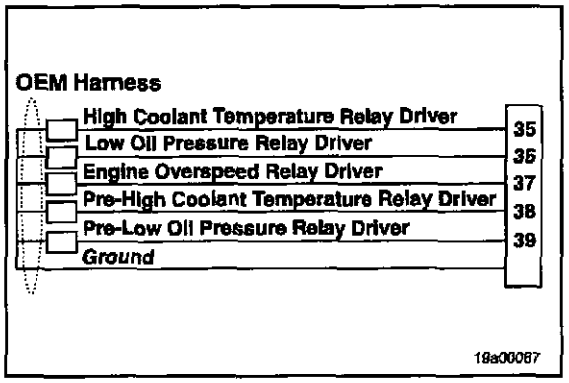


The fault conditions will cause the Common Warning or Common Alarm relay outputs (2A @ 30 VDC) to be energized by the ECM. GOEM selected devices, using these circuits, will make the operator aware that a fault condition exists.

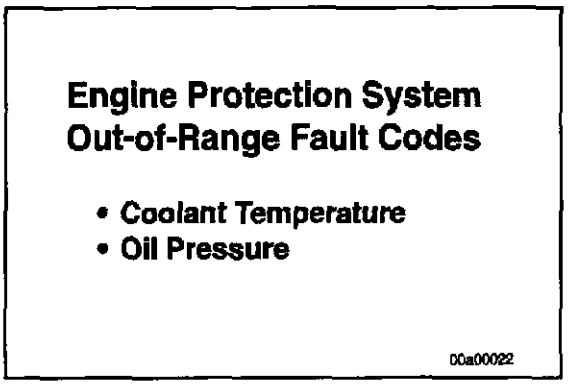
A Common Warning relay output will still allow the engine to be operated. However, if a common warning is caused by a bad sensor engine protection will be lost for that parameter. The condition **must** be repaired as soon as convenient.

A Common Alarm relay output will shutdown the engine and will **not** allow it to be operated until the Stop/Run switch is cycled.

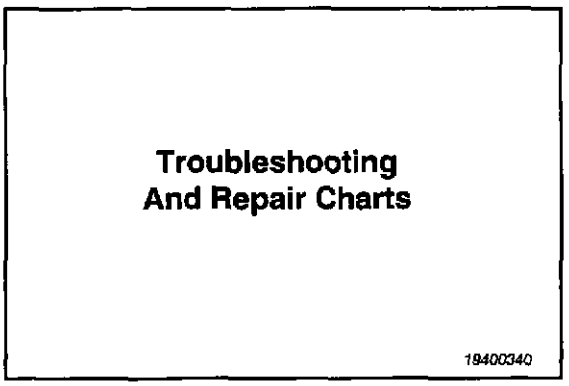




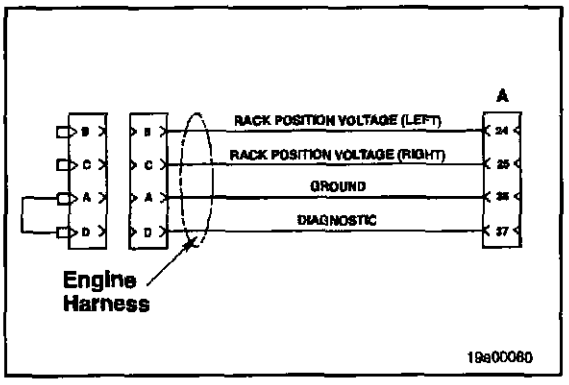
The conditions will cause the Relay Driver (200 mA @ 24 VDC) to be energized by the ECM. GOEM selected devices, using these circuits, will make the operator aware what fault condition exists.



The engine protection system records separate fault codes when an out-of-range condition is found for any of the sensors in the engine protection system.



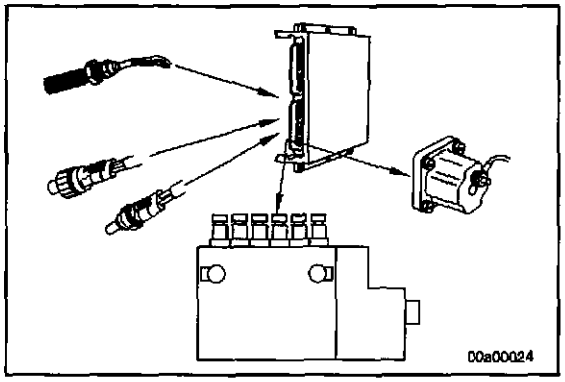
The explanation and correction of all fault codes is in the troubleshooting and repair charts, Section TF of this manual. They are listed in numerical order with an index located at the beginning of the section.



To exit the diagnostic mode, install the shorting plug in the diagnostic connector.

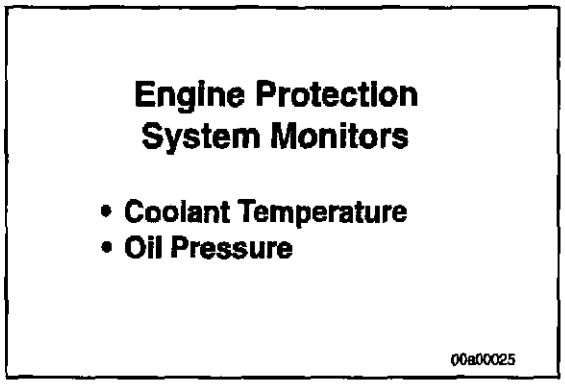
Fault Code Snapshot Data

When a diagnostic fault code is recorded in the ECM, ECM input and output data is recorded from all sensors and switches. Snapshot data allows the relationships between ECM inputs and outputs to be viewed and used during troubleshooting.



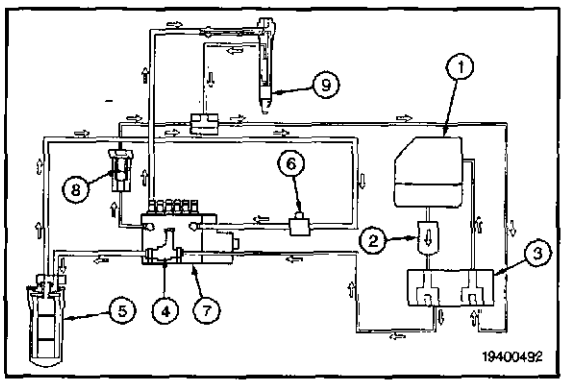
Engine Protection System

QST engines are equipped with an engine protection system. The system monitors critical engine speeds, temperature and pressure, and will log diagnostic faults when an over- or under-normal operating range condition occurs. If an out-of-range condition exists, the Common Warning circuit is energized. The operator will be alerted by an OEM selected device. The Common Alarm circuit will be energized when an out-of-range condition continues to get worse and engine shutdown occurs.

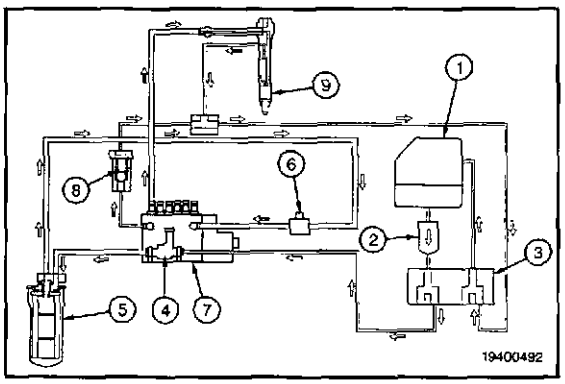


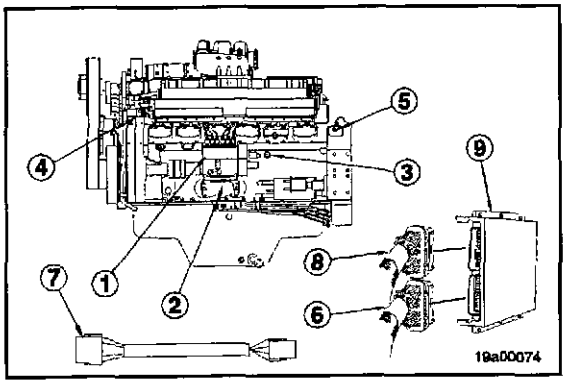
Flow Diagram

The fuel lift pump (4) draws fuel from the customer's fuel or day tank (1). The fuel is circulated through a Cummins or customer prefilter (2) and the fuel connection block (3). The fuel then enters the fuel lift pump (4) where it is placed under pressure and circulated through the on engine fuel filters (5). The fuel flows through the fuel shutoff valve (6) and then enters the injection pump (7), which builds injection pressure and sends fuel to each of the injectors (9) at the appropriate time.



The overflow valve (8) regulates the fuel supply pressure to the injection pump and sends excess fuel back to the fuel tank (1). This fuel will travel through the overflow valve (8) and through a "T" where it will join with the unused fuel from the injector's (9). The fuel will then flow through the fuel connection block (3) and back to the tank (1).



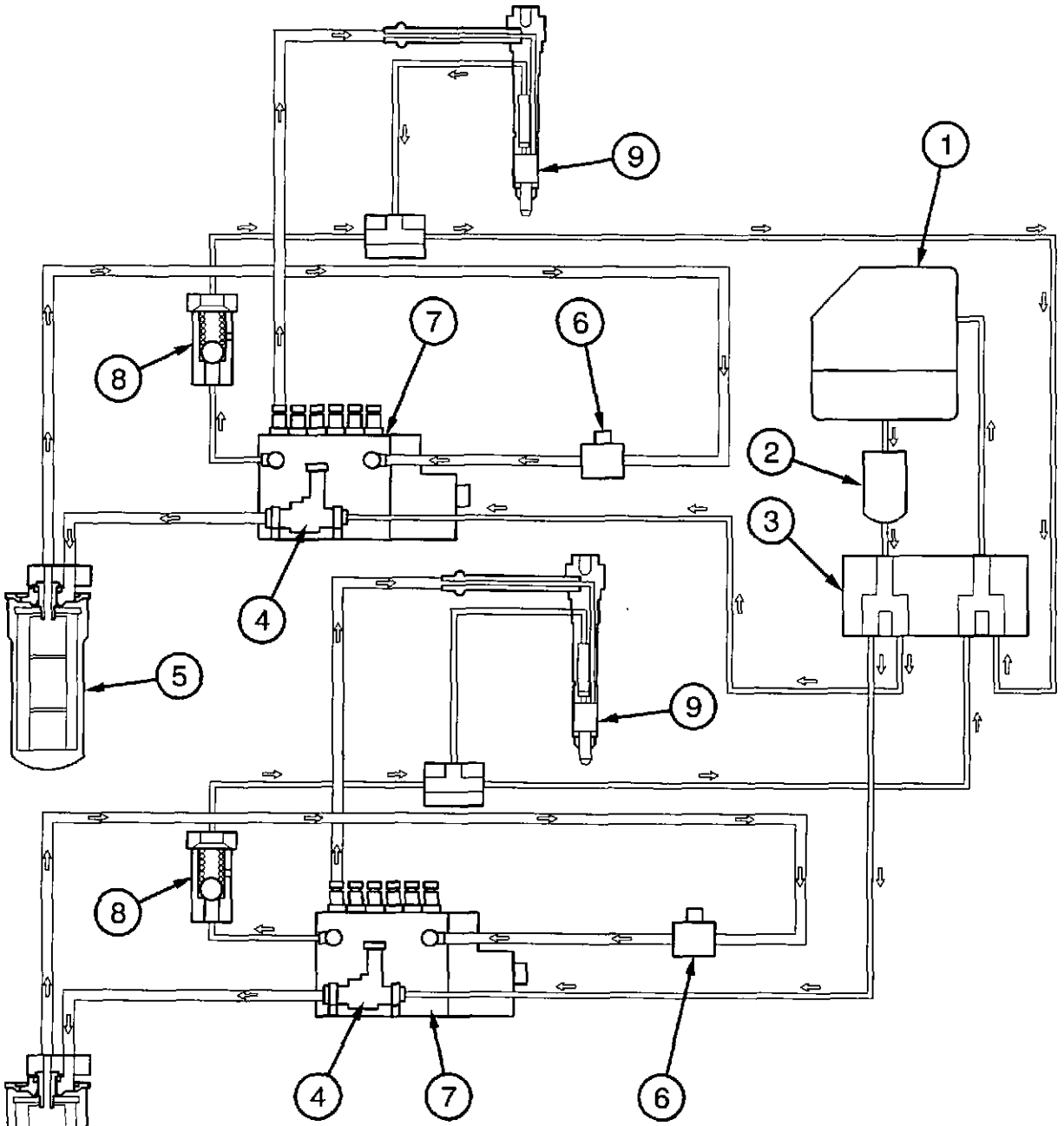


Quantum System Components

The QST system on a G-Drive engine consists of:

1. Fuel Pumps (2)
2. Fuel Shut Off Valves (FSOV) (2)
3. Oil Pressure Sensor (OPS)
4. Coolant Temperature Sensor (CTS)
5. Engine Speed Sensor (ESS)
6. Engine Harness
7. Engine Harness Adaptor Cable
8. OEM Harness
9. Electronic Control Module (ECM)

Fuel Flow Diagram



1. Fuel/Day Tank
2. Prefilter
3. Fuel Connection Block
4. Fuel Lift Pump
5. Fuel Filter
6. Shutoff Valve
7. Fuel Injection Pump
8. Overflow Valve
9. Fuel Enjection Nozzle

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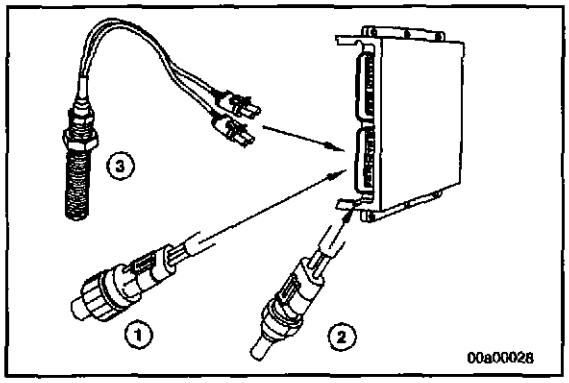
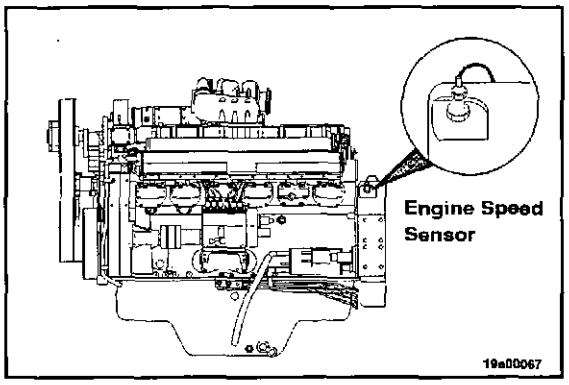
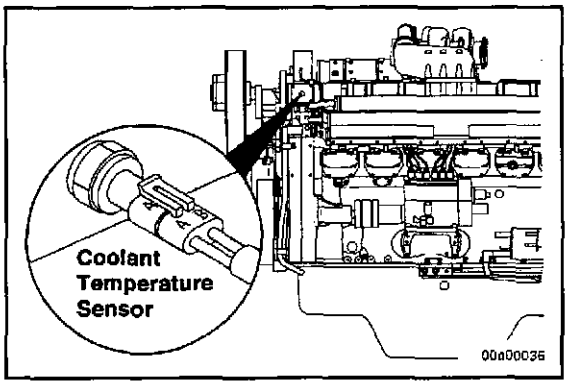


ECM Inputs

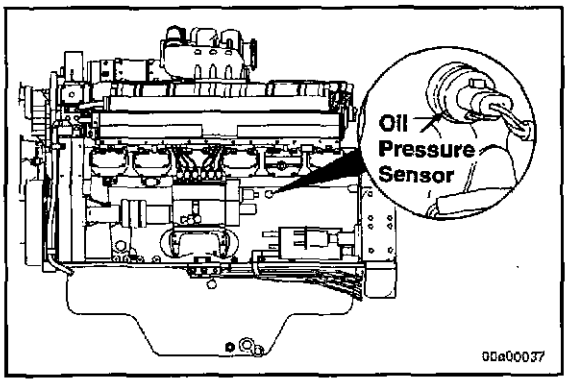
1. Oil Pressure Sensor (OPS)
2. Coolant Temperature Sensor (CTS)
3. Engine Speed Sensor (ESS)



The ESS provides engine speed information. The sensor is located in the flywheel housing.



The engine CTS sends signals to the ECM for the engine protection system. The CTS is located in the upper casing of the thermostat housing.

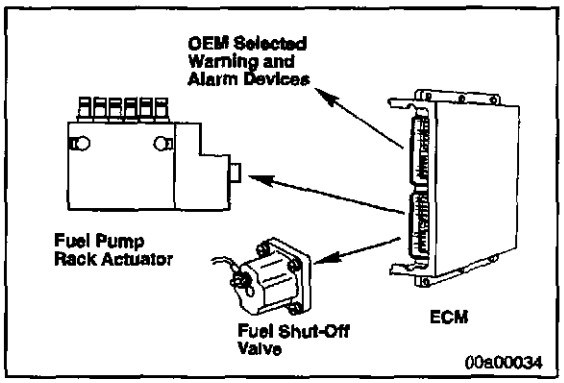


The OPS sends signals to the ECM for the engine protection system. The sensor is on the left bank side of the engine block behind the fuel pump.

ECM Outputs

The ECM processes all of the input data and then controls these output parts:

- — Fuel Shutoff Valves
- — Common Warning circuit
- — Common Alarm circuit
- — Fuel Pump Rack Actuator
- — Relay Drivers
- — Meter Drivers

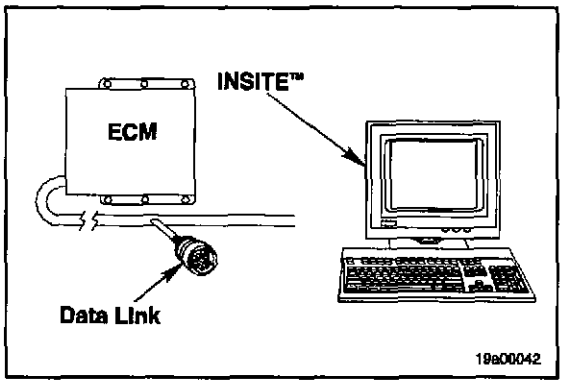


Insite™ Description

INSITE™, Part No. 3825145, is the electronic service tool for the QST30 G-Drive system. Use INSITE™ to:

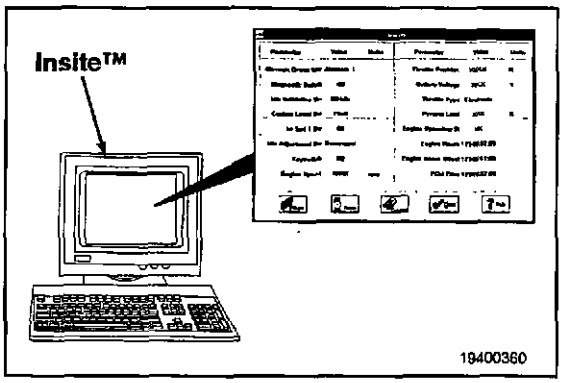
- — program owner specified information into the ECM (parameters and features)
- — aid in troubleshooting the engine
- — configure the ECM to match the application in which it is installed.

Refer to INSITE™ G-Drive User's Manual (QST30), Bulletin No. 3666196.



INSITE™ Monitor Mode

The INSITE™ monitor mode is a useful troubleshooting aid that displays the key ECM inputs and outputs. This feature can be used to spot constant or abnormally fluctuating values.



There is one screen in monitor mode. This screen is user defined by running monitor setup, and limited to 16 parameters. The ECM inputs show the data that is being fed into the ECM by the system's sensors and switches. The ECM outputs are values that the ECM commands to the QST system. Monitor mode allows the relationship between the ECM inputs and outputs to be monitored and used during troubleshooting.

The figures in this section show all of the possible parameters that can be displayed in monitor mode as they can be seen with INSITE™.

Monitor mode can be used to look for abnormally fluctuating readings while troubleshooting. Sensors that are failed in range can also be found by looking for fixed readings (for example, coolant temperature reading does **not** change with actual coolant temperature).

Data Monitor

Status indicates switch input is at Normal Frequency or Alternate Frequency.

Status indicates switch input is at Idle Speed or Rated Speed.

Indicates switch input is in Run or Stop mode.

Indicates if switch input is in or out of the Diagnostic Mode.

Unswitched battery supply voltage.

Displays the speed adjust value from the speed adjust knob (if enabled).

Displays the engine speed adjustment value and the type of speed bias device being used (if enabled).

Indicates status of alarm reset switch. When depressed, alarm and warning relay outputs are reset.

ECM Input Variables

Monitor

Parameter	Value	Units	Parameter	Value	Units
Diagnostic Switch		On/Off	Alarm Reset Switch		Released/ Depressed
Run/Stop Switch		Run/Stop	Speed Bias	+/-XXX (Note 1)	rpm
Idle/Rated Switch		Idle /Rated	Speed Adjust	+/-XXX	rpm
Alternate Frequency Switch		Normal/Alternate	Battery Voltage	XX.X	VDC
Engine Speed Meter Driver	XX.XX	%Duty Cycle	Oil Pressure Shutdown		On/Off
Oil Pressure Meter Driver	XX.XX	%Duty Cycle	Coolant Temp. Shutdown		On/Off
Coolant Temp. Meter Driver	XX.XX	%Duty Cycle	Overspeed Shutdown		On/Off
Common Alarm		On/Off	Oil Pressure Warning		On/Off
Common Warning		On/Off	Coolant Temp. Warning		On/Off

ECM Output Variables

Signal provided to an OEM selected device to give indication of a fault with which the engine can still be operated.

Signal provided to an OEM selected device to give indication of a fault which can be engine disabling.

Indicates the percent duty cycle that the engine coolant temperature meter is being driven.

Indicates the percent duty cycle that the engine oil pressure meter is being driven.

Indicates the percent duty cycle that the engine speed meter is being driven.

Indicates the status of the Pre-High Coolant Temperature warning relay driver.

Indicates the status of the Pre-Low Oil Pressure warning relay driver.

Indicates the status of the engine Overspeed shutdown relay driver.

Indicates the status of the High Coolant Temperature shutdown relay driver.

Indicates the status of the Low Oil Pressure shutdown relay driver.

Notes:
1. The input device is displayed here (i.e. Woodward or Barber-Colman).

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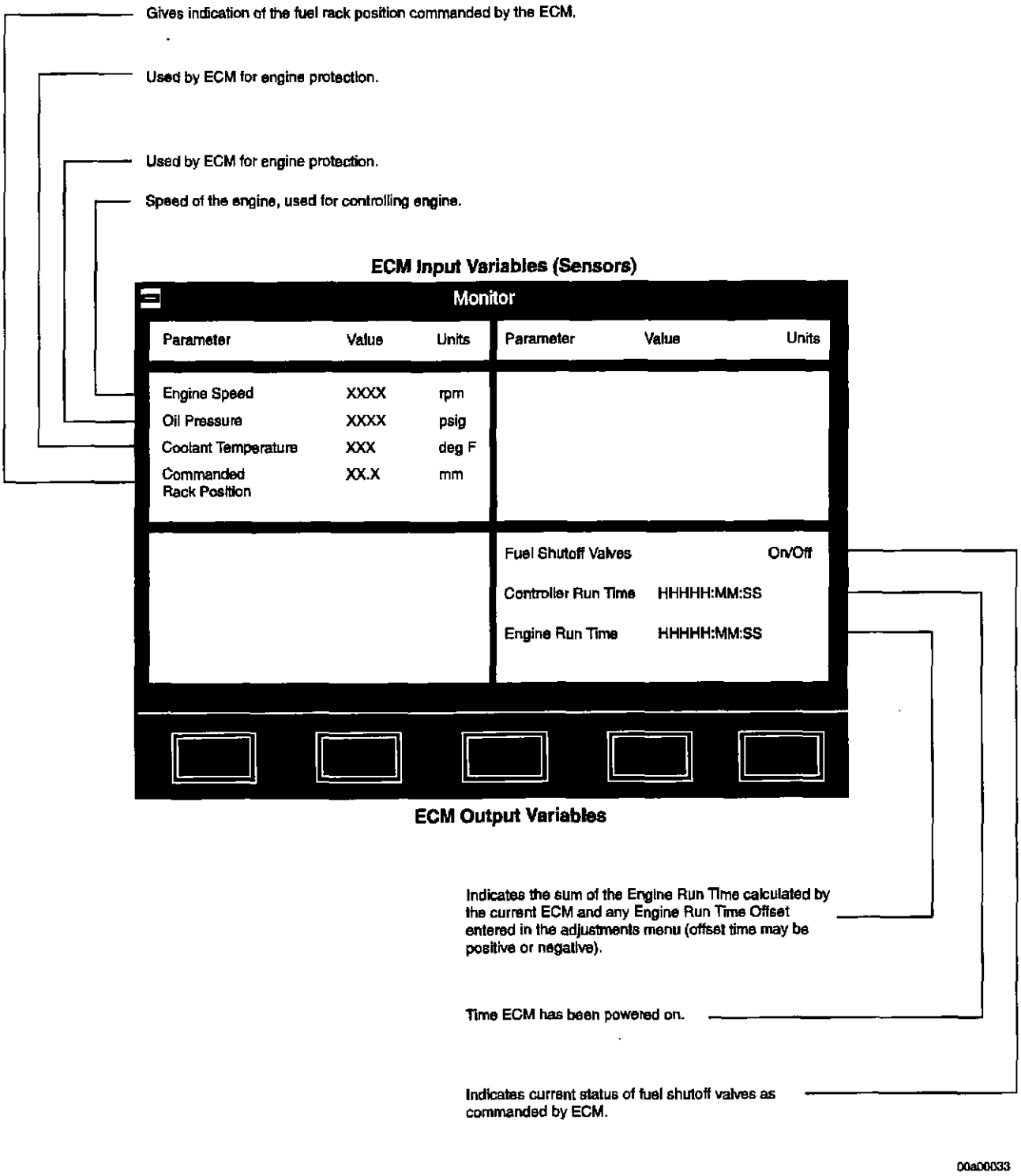
Data Monitor (continued)



Section TF - Troubleshooting Fault Codes

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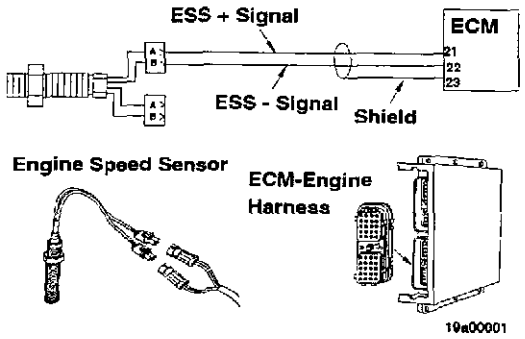
Fault Code 115

Engine Speed Sensor (ESS) Circuit

CODES	REASON	EFFECT
Fault Code: 115 PID(P), SID(S): FMI: SRT: 00-681	No engine speed detected between pins 21 and 22 of the engine harness connector.	Engine is shutdown and can **not** be run. Common Alarm output is energized.

ESS Circuit



Circuit Description:

The ESS circuit provides the engine speed signal to the electronic control module (ECM) through the engine harness.

Component Location:

The ESS is located in the Flywheel Housing.

Shop Talk:

- If the problem occurs at a certain engine temperature, be sure to check the ESS circuit while the engine is at that particular temperature.
- Clean sensor tip; debris can cause intermittent signals.
- The sensor **must** be adjusted properly to obtain a good signal. Make sure the sensor is ½ to ¾ turns out from contacting a flywheel tooth and that the locking nut is tight and properly torqued.

TROUBLESHOOTING SUMMARY

⚠ CAUTION ⚠

To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3823996 - *female* Weather-Pack test lead
Part No. 3822758 - male Deutsch/Metri-Pack test lead.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the ESS.		
STEP 1A: Inspect the ESS and the engine harness connector pins.	No damaged pins	
STEP 1B: Inspect the ESS.	No damaged ESS	
STEP 1C: Check for an open circuit in the ESS.	Less than 1500 ohms	
STEP 1D: Check for a short circuit to ground in the ESS.	More than 10M ohms	
STEP 1E: Check for a short circuit between coils of the ESS.	More than 10M ohms	
STEP 2: Check the engine harness.		
STEP 2A: Inspect the engine harness and ECM connector pins.	No damaged pins	
STEP 2A-1: Inspect the engine harness adaptor cable and the engine harness extension cables.	No damaged pins	
STEP 2B: Check for an open circuit in the signal and return wires.	Less than 1500 ohms	
STEP 2B-1: Check for an open circuit in the engine harness adaptor cable and the engine harness extension cables.	Less than 10 ohms	
STEP 2C: Check for a short circuit to ground in the signal and return wires with the engine harness adaptor cable, and any extension cables used, installed.	More than 10M ohms	
STEP 2C-1: Check for a short circuit to ground in the engine harness signal and return wires.	More than 10M ohms	
STEP 2D: Check for a short circuit from the signal and return wires to all other wires in the engine harness.	More than 10M ohms	
STEP 2D-1: Check for a short circuit from pin to pin in the engine harness adaptor cable, and any engine harness extension cables used.	More than 10M ohms	
STEP 3: Clear fault codes.		
STEP 3A: Clear fault codes.	All fault codes cleared	

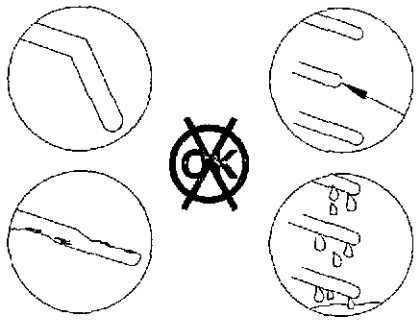
TROUBLESHOOTING STEP

STEP 1: Check the ESS.

STEP 1A: Inspect the ESS and engine harness connector pins.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the ESS from the engine harness.

Action	Specifications/Repair	Next Step
Inspect the ESS and engine harness connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	1B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or ESS, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 19-202. • Replace the engine harness. Refer to Procedure 019-043. • Replace the ESS. Refer to Procedure 019-042.	3A



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STEP 1B: Inspect the ESS.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the ESS from the engine harness.
- Remove the ESS.

Action	Specifications/Repair	Next Step
Inspect the ESS for the following: • metal debris on the end of the sensor • damage to the end of the sensor caused by contact with the flywheel • oil leakage or insulation problems such as swelling • damaged electrical potting in the sensing end of the sensor.	**OK** **No damaged ESS**	1C
	NOT OK **Clean or replace the ESS** • Clean the ESS. Refer to Procedure 019-042. • Replace the ESS. Refer to Procedure 019-042.	3A

STEP 1C: Check for an open circuit in the ESS.

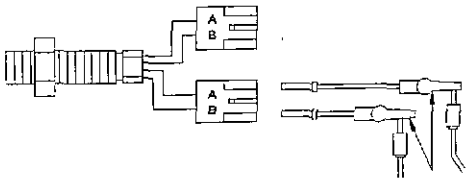
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3823996 - female Weather-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect the ESS from the engine harness.

Action	Specifications/Repair	Next Step
Check for an open circuit in the ESS. • *Measure resistance from pin A to pin B of the first ESS coil.* • Measure resistance from pin A to pin B of the second ESS coil.	**OK** **Less than 1500 ohms**	1D
	NOT OK **Replace the ESS** Refer to Procedure 019-042.	3A



Part No. 3823996
(part of Part No. 3822926)

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STEP 1D: Check for a short circuit to ground in the ESS.

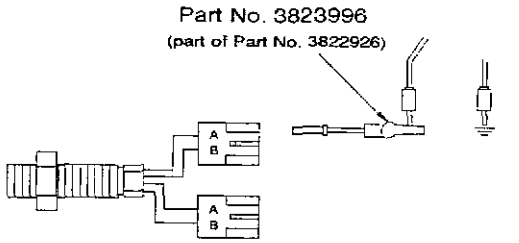
⚠CAUTION⚠

To avoid pin and harness damage, use the following test lead when taking a measurement: Part No. 3823996 - female Weather-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the ESS from the engine harness.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the ESS. • Measure resistance from pin A of the first ESS coil to engine block ground. • Measure resistance from pin A of the second ESS coil to engine block ground.	**OK** **More than 10M ohms**	1E
	NOT OK **Replace the ESS** Refer to Procedure 019-042.	3A



STEP 1E: Check for a short circuit between coils of the ESS.

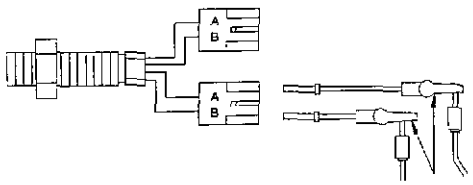
△CAUTION△

To avoid pin and harness damage, use the following test lead when taking a measurement: Part No. 3823996 - female Weather-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect ESS from the engine harness.

Action	Specifications/Repair	Next Step
Check for a short circuit between coils of the ESS. • Measure resistance from pin A of the first ESS coil to pin A of second ESS coil.	**OK** ***More than 10M ohms***	2A
	NOT OK ***Replace the ESS*** Refer to Procedure 019-042.	3A



Part No. 3823996
(part of Part No. 3822926)

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STEP 2: Check the engine harness.

STEP 2A: Inspect engine harness and ECM.

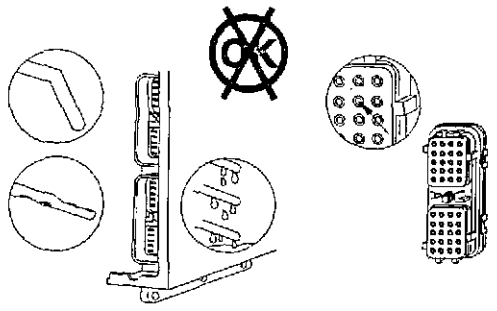
⚠CAUTION⚠

To avoid damaging a new ECM, all active fault codes must be investigated prior to replacing the ECM.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the engine harness adaptor cable connector and the ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK **Repair damaged pins** Repair or replace the engine harness adaptor cable or ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM procedures.	3A



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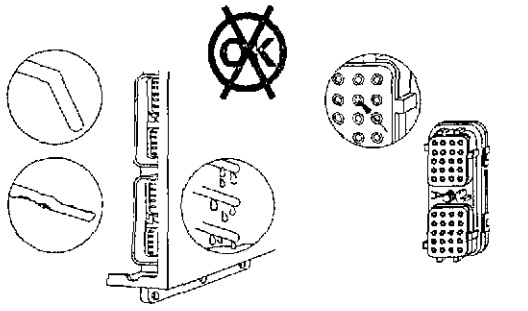
STEP 2A-1: Inspect engine harness connector and engine harness extension cables.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect engine harness extension cables from the engine harness.

Action	Specifications/Repair	Next Step
Inspect engine harness connector and engine harness extension cable connector pins for the *following:* • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair damaged pins** *Repair or replace the engine harness or* engine harness extension cable, whichever has the damaged pins. • Repair the engine harness or engine harness extension cable. Refer to Procedure 019-240. • Replace the engine harness or engine harness extension cable. Refer to Procedure 019-043.	3A



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STEP 2B: Check for an open circuit in the signal and return wires.

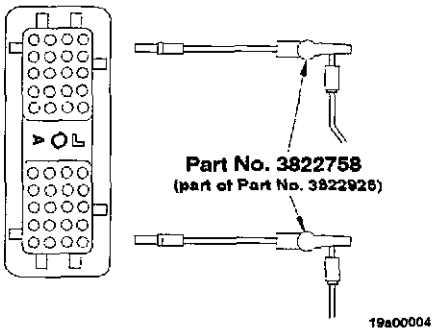
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable connector from the ECM.
- Connect the ESS to the engine harness.
- Connect the engine harness to the engine harness adaptor cable.

Action	Specifications/Repair	Next Step
Check for an open circuit in the signal and return wires. • Measure the resistance from pin 22 to pin 21 of the 40 pin on the engine harness adaptor connector.	**OK** **Less than 1500 ohms**	2C
	NOT OK	2B-1



STEP 2B-1: Check for an open circuit in the engine harness adaptor cable and engine harness extension cables.

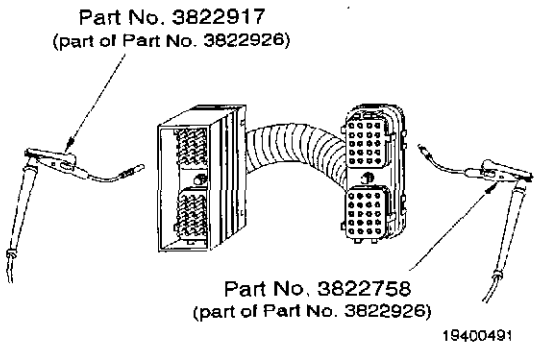
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable connector from the ECM.
- Disconnect the engine harness from the engine harness extension cable.

Action	Specifications/Repair	Next Step
Check for an open circuit in the engine harness adaptor cable and engine harness extension cables. • Measure the continuity of pin 22 of each cable used between the engine harness and the ECM. • Measure the continuity of pin 21 of each cable used between the engine harness and the ECM.	**OK** **Less than 10 ohms** **Repair or replace the engine harness.** • **Repair the engine harness. Refer to *Procedures 019-202 and 019-240.*** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or an engine harness extension cable, whichever is found faulty** • *Repair the engine harness adaptor cable* or an engine harness extension cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable or an engine harness extension cable. Refer to Procedure 019-043.	3A



STEP 2C: Check for a short circuit to ground in the signal and return wires with the engine harness adaptor cable, and any extension cables used, installed.

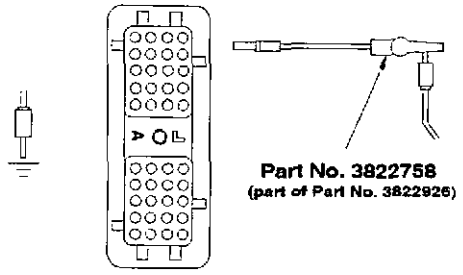
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the ESS from the engine harness.
- Connect the engine harness to the engine harness adaptor cable.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the signal and return wires. • Measure the resistance from pin 22 of the engine harness adaptor cable connector to engine block ground. • Measure the resistance from pin 21 of the engine harness adaptor cable connector to engine block ground.	**OK** **More than 10M ohms**	2D
	NOT OK	2C-1



Part No. 3822758
(part of Part No. 3822926)

19s00005

STEP 2C-1: Check for a short circuit to ground in the signal and return wires.

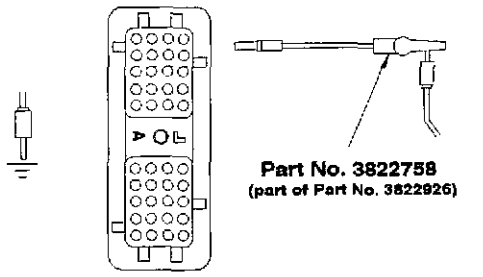
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the ESS from the engine harness.
- Disconnect the engine harness from the engine harness extension cables.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the signal and return wires. • Measure the resistance from pin 22 of the engine harness to engine block ground. • Measure the resistance from pin 21 of the engine harness to engine block ground.	**OK** **More than 10M ohms**	2D-1
	NOT OK **Repair or replace the engine harness** • Repair the engine harness. Refer to Procedures 019-202 and 019-240. • Replace the engine harness. Refer to Procedure 019-043.	3A



Part No. 3822758
(part of Part No. 3822926)

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STEP 2D: Check for a short circuit from pin to pin in the engine harness adaptor cable, and any engine harness extension cables used.

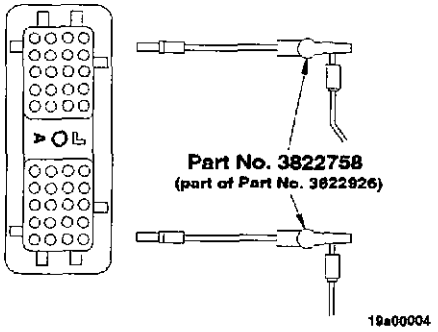
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cables.
- Disconnect the ESS from the engine harness.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal and return wires to all other wires in the Engine Harness. • Measure the resistance from pin 22 of the engine harness connector to all other pins in the engine harness connector. • Measure the resistance from pin 21 of the engine harness connector to all other pins in the engine harness connector.	**OK** **More than 10M ohms**	3A
	NOT OK	2D-1



STEP 2D-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and the engine harness extension cables.

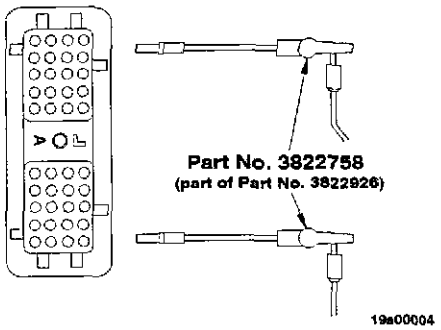
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness extension cables from the engine harness.

Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin in the engine harness adaptor cable and the engine harness extension cables. • Measure the resistance from pin 22 of the engine harness adaptor cable and engine harness extension cable to all other pins in the applicable cable. • Measure the resistance from pin 21 of the engine harness adaptor cable and engine harness extension cable to all other pins in the applicable cable.	**OK** **More than 10M ohms**	3A
	NOT OK **Repair or replace the engine harness *adaptor cable or the engine harness* extension cable, whichever is faulty** • Repair the engine harness adaptor cable or the engine harness extension cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable or the engine harness extension cable. Refer to Procedure 019-043.	3A

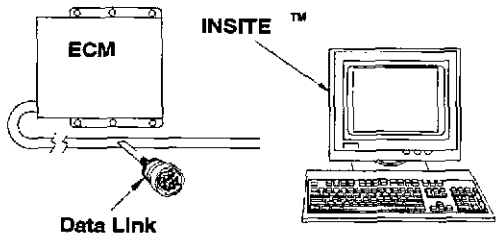


STEP 3: Clear fault codes.

STEP 3A: Clear fault codes.

Condition: Connect all components.

Action	Specifications/Repair	Next Step
Clear fault codes. • Clear Fault Code 115 using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **Fault Code 115 cleared**	Repair complete
	NOT OK Refer to the appropriate troubleshooting charts for any remaining active fault codes.	Go to the appropriate trouble-shooting charts

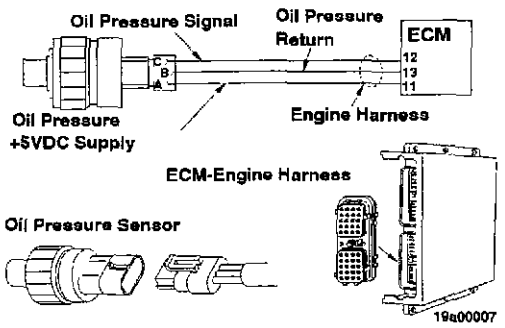


Fault Code 135

Oil Pressure Sensor (OPS) Circuit

CODES	REASON	EFFECT
Fault Code: 135 PID(P), SID(S): FMI: SRT: 00-352	High voltage detected at engine oil pressure sensor signal pin 12 of the engine harness Electronic Control Module (ECM) Connector.	No effect on performance. Common Warning output is energized.

OPS Circuit



Circuit Description:

The OPS monitors oil pressure and passes information to the ECM through pin 12 of the engine harness. The ECM monitors the voltage on pin 12 and expects to see the voltage vary between 0.5 and 4.5 VDC during normal engine operation.
Voltage above 4.89 VDC on pin 12 will trip Fault Code 135 and can be caused by shorts in the supply, signal, or return wires, an open in the return wire or a failed sensor.

Component Location:

The OPS is located on the left bank of the engine block above the fuel pump.

Shop Talk:

Does the fault occur only in cold weather? If so, allow the oil to warm up and see if the fault goes inactive.

TROUBLESHOOTING SUMMARY

⚠ CAUTION ⚠

To avoid pin and harness damage use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the oil pressure sensor.		
STEP 1A: Inspect the oil pressure sensor and engine harness connector pins.	No damaged pins	
STEP 1B: Check the ECM oil pressure supply voltage.	4.75 to 5.25 VDC	
STEP 1C: Check the ECM oil pressure signal voltage.	0.42 to 0.58 VDC	
STEP 2: Check the engine harness.		
STEP 2A: Inspect the engine harness adaptor cable and the ECM connector pins.	No damaged pins	
STEP 2A-1: Inspect the engine harness and engine harness extension cable(s) connector pins.	No damaged pins	
STEP 2B: Check for a short circuit from pin to pin.	More than 100k ohms	
STEP 2B-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and extension cable(s).	More the 100k ohms	
STEP 2C: Check for an open circuit in the return wire.	Less than 10 ohms	
STEP 2C-1: Check for an open circuit from pin to pin in the engine harness adaptor cable and extension cable(s).	Less than 10 ohms	
STEP 3: Clear the fault code.		
STEP 3A: Disable the fault code.	Fault Code 135 inactive	
STEP 3B: Clear the inactive fault codes.	All faults cleared	

TROUBLESHOOTING STEP

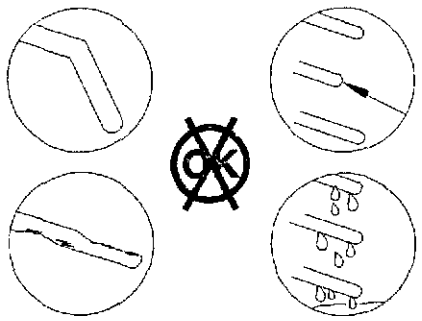
STEP 1: *Check the oil pressure sensor.*

STEP 1A: Inspect the oil pressure sensor and engine harness connector pins.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- *Disconnect the engine harness connector from the oil pressure sensor.*

Action	Specifications/Repair	Next Step
Inspect the harness and the sensor connector pins for the following: • *bent or broken pins* • pushed back or expanded pins • corroded pins • moisture in or on the connector • missing connector seal.	**OK** **No damaged pins**	1B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the oil pressure sensor, whichever has the damaged pins. • *Repair the engine harness. Refer to* Procedure 019-203. • Replace the engine harness. Refer to Procedure 19-043. • Replace the oil pressure sensor. Refer to Procedure 019-066. • Dry the connector by using an electrical contact cleaner, Part No. 3824510. • *Replace the connector seal.*	3A



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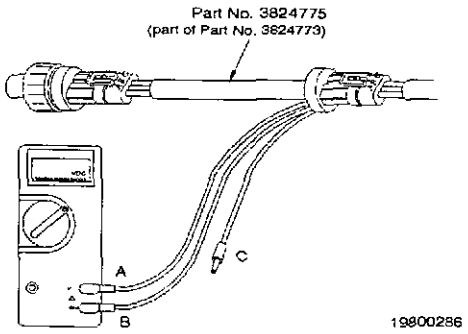
STEP 1B: Check the ECM oil pressure supply voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

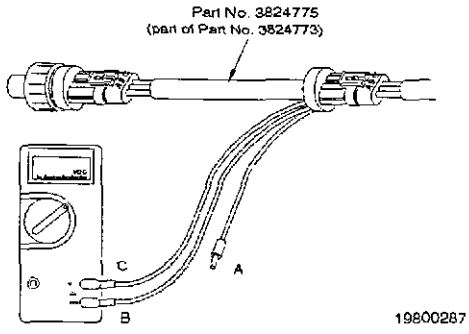
Action	Specifications/Repair	Next Step
Check the ECM oil pressure supply voltage. • Install the oil pressure sensor breakout cable, Part No. 3824775, between the sensor and the sensor harness connector. • Measure the supply voltage by installing the breakout cable's supply (pin A) and return (pin B) connectors into the multimeter.	**OK** **4.75 to 5.25 VDC**	1C
	NOT OK	2A



STEP 1C: Check the ECM oil pressure signal voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Check the ECM oil pressure signal voltage. • Measure the signal voltage by installing the breakout cable's signal (pin C) and return (pin B) connectors into the multimeter.	**OK** **0.42 to 0.58 VDC**	2A
	NOT OK **Replace oil pressure sensor** Refer to Procedure 019-066.	3A



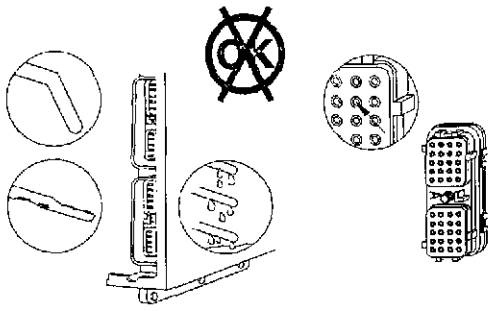
STEP 2: Check the engine harness.

STEP 2A: Inspect the engine harness adaptor cable and the ECM connector pins.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- *Disconnect the engine harness adaptor cable from the ECM.*

Action	Specifications/Repair	Next Step
Inspect the engine harness adaptor cable and the ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • *moisture in or on the connector.*	**OK** **No damaged pins**	2A-1
	NOT OK **Repair the damaged pins** Repair or replace the engine harness adaptor cable or ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor *cable. Refer to Procedure 019-043.* • Replace the ECM. Refer to OEM Procedures. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A

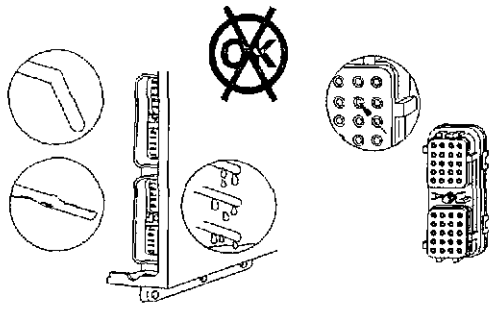


19400007

STEP 2A-1: Inspect the engine harness and engine harness extension cable(s) connector pins.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Inspect the engine harness and engine harness extension cable(s) connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the engine harness extension cable(s), whichever has the damaged pins. • Repair the engine harness or the engine harness extension cable(s). Refer to Procedure 019-240. • Replace the engine harness or the engine harness extension cable(s). Refer to Procedure 019-043. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



19400007

STEP 2B: Check for a short circuit from pin to pin.

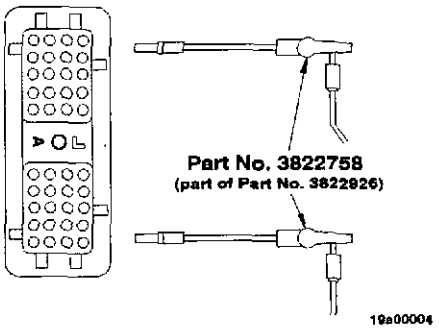
⚠CAUTION⚠

**To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.**

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the OPS.
- Disconnect the engine harness from the coolant temperature sensor.

Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin. • *Measure the resistance from the engine* harness adaptor cable connector pin 12 to all other pins in the engine harness adaptor *cable connector.* • Measure the resistance from the engine harness adaptor cable connector pin 13 to all other pins in the engine harness adaptor cable connector. • Measure the resistance from the engine harness adaptor cable connector pin 11 to all other pins in the engine harness cable connector.	**OK** ***More than 100k ohms***	2C
	NOT OK	2B-1



STEP 2B-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and extension cable(s).

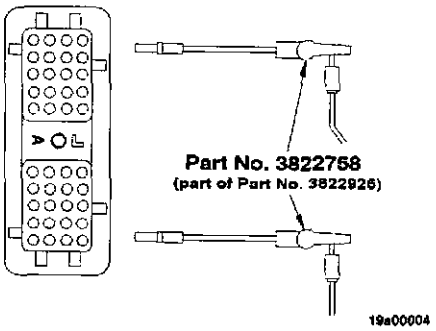
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin in the engine harness adaptor cable. • Measure the resistance from the engine harness adaptor cable and engine harness extension cable(s) connector pin 12 to all other pins in the connector. • Measure the resistance from the engine harness adaptor cable and engine harness extension cable(s) connector pin 13 to all other pins in the connector. • Measure the resistance from the engine harness adaptor cable and engine harness extension cable(s) connector pin 11 to all other pins in the connector.	**OK** **More than 100k ohms** **Repair or replace the engine harness.** • **Repair the engine harness. Refer to Procedure 019-240.** • **Replace the engine harness. Refer to Procedure 019–043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-240. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019–043.	3A



STEP 2C: Check for an open circuit in the return wire.

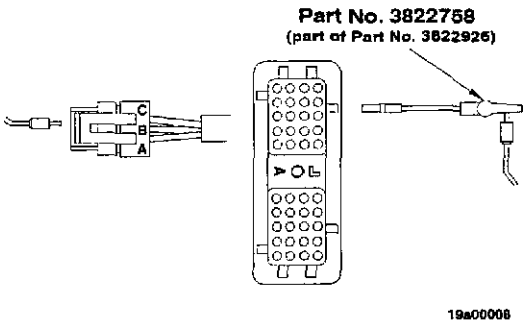
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the OPS.

Action	Specifications/Repair	Next Step
Check for an open circuit in the return wire. • Measure the resistance from engine harness adaptor cable connector pin 13 to pin B of the OPS connector on the harness side.	**OK** **Less than 10 ohms**	3A
	NOT OK	2C-1



STEP 2C-1: Check for an open circuit from pin to pin in the engine harness adaptor cable and extension cable(s).

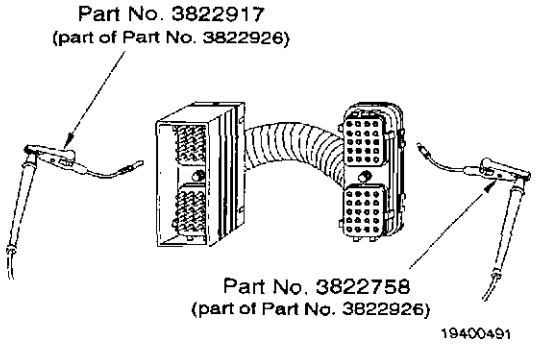
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check for an open circuit from pin to pin in the engine harness adaptor cable. • Measure the continuity of pin 13 of the engine harness adaptor cable connector and any engine harness extension cables.	**OK** **Less than 10 ohms** **Repair or replace the engine harness.** • **Repair the engine harness. Refer to Procedure 019-240.** • **Replace the engine harness. Refer to Procedure 019–043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-240. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019–043.	3A

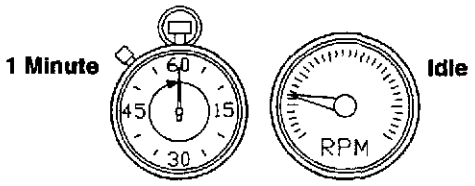


STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code as follows: • connect all components • start the engine and idle for one minute • verify that Fault Code 135 is inactive.	**OK** **Fault Code 135 inactive**	3B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A



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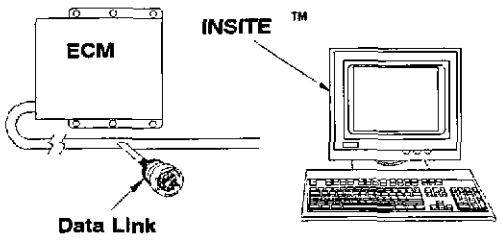
STEP 3B: Clear the inactive fault codes.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart



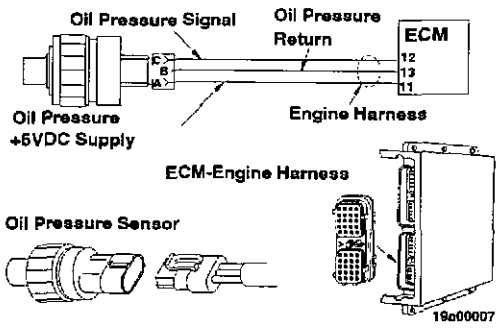
19a00006

Fault Code 141

Oil Pressure Sensor (OPS) Circuit

CODES	REASON	EFFECT
Fault Code: 141 PID(P), SID(S): FMI: SRT: 00-353	Low voltage detected at engine oil pressure sensor signal pin 12 of the engine harness Electronic Control Module (ECM) Connector.	No effect on performance. Common Warning output is energized.

OPS Circuit



Circuit Description:

The OPS monitors oil pressure and passes information to the ECM through pin 12 of the engine harness. The ECM monitors the voltage on pin 12 and expects to see the voltage vary between 0.5 and 4.5 VDC during normal engine operation.

Voltage below 0.35 VDC on pin 12 will trip Fault Code 141 and can be caused by shorts in the supply, signal, or return wires, an open in the supply or signal wires, low supply voltage from the ECM, or a failed sensor.

Component Location:

The OPS is located on the left bank of the engine block above the fuel pump.

Shop Talk:

If Fault Code 143 or 415 are **not** present, the problem is **not** base engine related.

TROUBLESHOOTING SUMMARY

⚠ CAUTION ⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the oil pressure sensor.		
STEP 1A: Inspect the oil pressure sensor and engine harness connector pins.	No damaged pins	
STEP 1B: Check the ECM oil pressure supply voltage.	4.75 to 5.25 VDC	
STEP 1C: Check the ECM oil pressure signal voltage.	0.42 to 0.58 VDC	
STEP 2: Check the engine harness.		
STEP 2A: Inspect the engine harness adaptor cable and the ECM connector for damaged pins.	No damaged pins	
STEP 2A-1: Inspect the engine harness connector and the engine harness extension cable(s) for damaged pins.	No damaged pins	
STEP 2B: Check for an open circuit.	Less than 10 ohms	
STEP 2B-1: Check for an open in the engine harness adaptor cable and any engine harness extension cables used.	Less than 10 ohms	
STEP 2C: Check for a short circuit to ground.	More than 100k ohms	
STEP 2C-1: Check engine harness for short circuit to ground.	More than 100k ohms	
STEP 2D: Check for a short circuit from pin to pin.	More than 100k ohms	
STEP 2D-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any engine harness extension cable used.	More than 100k ohms	
STEP 3: Clear the fault code.		
STEP 3A: Disable the fault code.	Fault Code 141 inactive	
STEP 3B: Clear any inactive fault codes.	All faults cleared	

TROUBLESHOOTING STEP

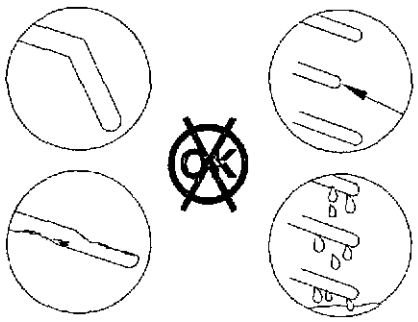
STEP 1: Check the oil pressure sensor.

STEP 1A: Inspect the oil pressure sensor and engine harness connector pins.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the oil pressure sensor.

Action	Specifications/Repair	Next Step
Inspect the harness and the OPS connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or the connector • missing connector seal.	**OK** **No damaged pins**	1B
	NOT OK **Repair damaged pins** Repair or replace the engine harness or the OPS, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-203. • Replace the engine harness. Refer to Procedure 019-043. • Replace the OPS. Refer to Procedure 019-061. • Dry the connector by using electrical contact cleaner, Part No. 3824510. • Replace the connector seal.	3A



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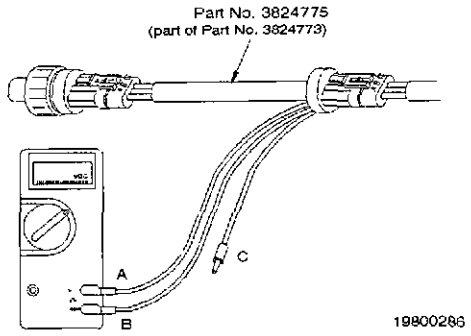
STEP 1B: Check the ECM oil pressure supply voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

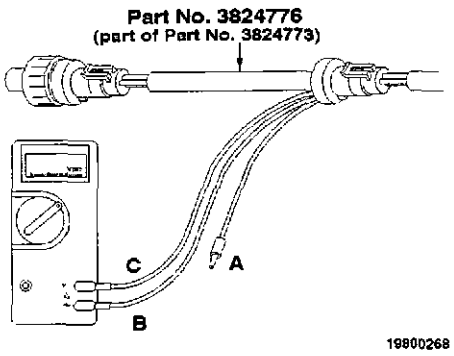
Action	Specifications/Repair	Next Step
Check the ECM oil pressure supply voltage. Install the oil pressure sensor break out cable, Part No. 3824775, between the sensor and the sensor harness connector. Measure the supply voltage by installing the break out cable's supply (pin A) and return connectors (pin B) into the multimeter.	**OK** **4.75 to 5.25 VDC**	1C
	NOT OK	2A



STEP 1C: Check the ECM oil pressure signal voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Check the ECM oil pressure signal voltage. Measure the signal voltage by installing the break out cable's signal (pin C) and return connectors (pin B) into the multimeter.	**OK** **0.42 to 0.58 VDC**	2A
	NOT OK **Replace the oil pressure sensor** *Refer to Procedure 019-066.*	3A



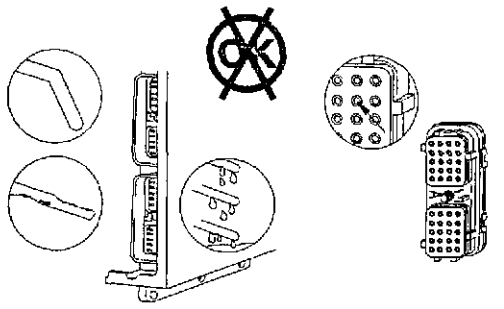
STEP 2: Check the engine harness.

STEP 2A: Inspect the engine harness adaptor cable and the ECM connector for damaged pins.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the engine harness adaptor cable and the ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK **Repair the damaged pins** Repair or replace the engine harness adaptor cable or the ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM Procedures. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



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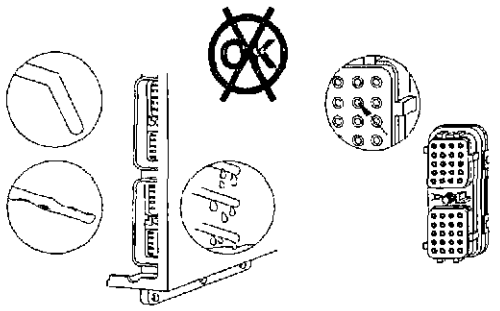
STEP 2A-1: Inspect the engine harness connector and the engine harness expansion cable(s) for damaged pins.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness expansion cable(s).

Action	Specifications/Repair	Next Step
Inspect the engine harness connector and each engine harness expansion cable for damaged pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the engine harness expansion cable, whichever has the damaged pins. • Repair the engine harness or the engine harness expansion cable. Refer to Procedure 019-240. • Replace the engine harness or the engine harness expansion cable. Refer to Procedure 019-043. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



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STEP 2B: Check for an open circuit.

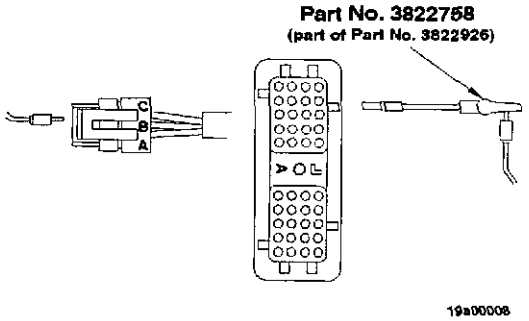
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the OPS.

Action	Specifications/Repair	Next Step
Check for an open circuit in the oil pressure signal and +5 VDC supply wire. • Measure the resistance from engine harness adaptor cable connector pin 12 to oil pressure signal, pin C, of the OPS connector harness side. • Measure the resistance from engine harness adaptor cable connector pin 11 and +5 VDC supply, pin A, of the OPS connector harness side.	**OK** **Less than 10 ohms**	2C
	NOT OK	2B-1



STEP 2B-1: Check for an open in the engine harness adaptor cable and any engine harness extension cables used.

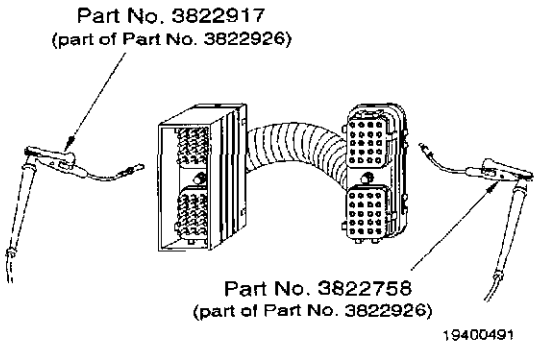
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- *Stop/Run switch in the "STOP" position.*
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the engine harness expansion cable(s).

Action	Specifications/Repair	Next Step
Check for an open circuit in the engine harness adaptor cable and any engine harness expansion cables used. • Measure the continuity of pin 12 for the engine harness adaptor cable and any engine harness expansion cable being used. • Measure the continuity of pin 11 for the engine harness adaptor cable and any engine harness expansion cable being used.	**OK** **Less than 10 ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedure 019-203 and 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or the engine harness expansion cable, whichever is faulty** • Repair the engine harness adaptor cable or the engine harness expansion cable. *Refer to Procedure 019-240.* • Replace the engine harness adaptor cable or the engine harness expansion cable. Refer to Procedure 019-043.	3A



STEP 2C: Check for a short circuit to ground.

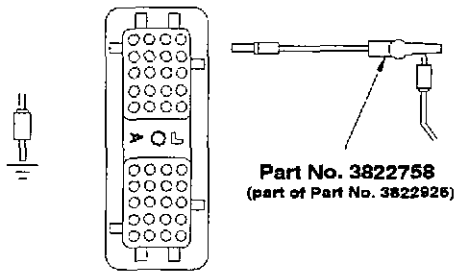
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the OPS.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal, return, and +5 VDC supply wires to ground as follows: • measure the resistance from engine harness adaptor cable connector pin 12 to engine block ground • measure the resistance from engine harness adaptor cable connector pin 13 to engine block ground • measure the resistance from engine harness adaptor cable connector pin 11 to engine block ground.	**OK** **More than 100k ohms**	2D
	NOT OK	2C-1



STEP 2C-1: Check for a short circuit to ground.

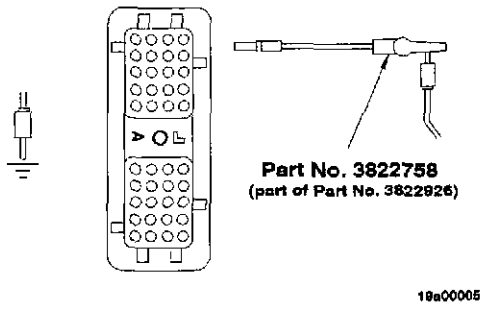
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the OPS.
- Disconnect the engine harness from the engine harness extension cables.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal, return, and +5 VDC supply wires to ground as follows: • measure the resistance from engine harness connector pin 12 to engine block ground • measure the resistance from engine harness connector pin 13 to engine block ground • measure the resistance from engine harness connector pin 11 to engine block ground.	**OK** **More than 100k ohms**	2D-1
	NOT OK **Repair or replace the engine harness** • Repair the engine harness. Refer to Procedure 019-240. • Replace the engine harness. Refer to Procedure 019-043.	3A



Part No. 3822758
(part of Part No. 3822926)

19a00005

STEP 2D: Check for a short circuit from pin to pin.

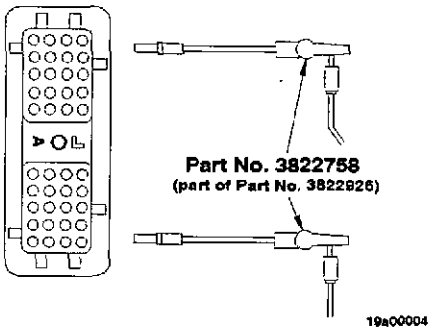
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the OPS.
- Disconnect the engine harness from the coolant temperature sensor.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal, return, and +5 VDC supply wires to all other wires in the engine harness connector as follows: • measure the resistance from engine harness adaptor cable connector pin 12 to all other pins in the connector • measure the resistance from engine harness adaptor cable connector pin 13 to all other pins in the connector • measure the resistance from engine harness adaptor cable connector pin 11 to all other pins in the connector.	**OK** **More than 100k ohms** **Replace the ECM. Refer to OEM Procedures.**	3A
	NOT OK	2D-1



STEP 2D-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any engine harness extension cable used.

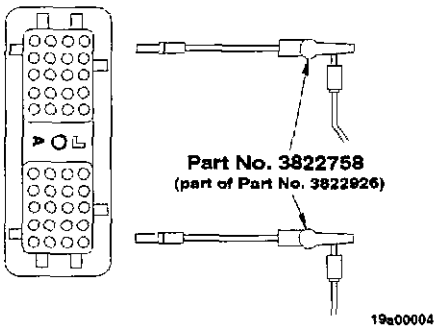
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* **not** *in the diagnostic mode.*
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the engine harness expansion cable(s).

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal, return, and +5 VDC supply wires to all other wires in the engine harness connector as follows: • measure the resistance from pin 12 of the engine harness adaptor cable and any engine harness expansion cable used, to all other pins in the engine harness connector • measure the resistance from pin 13 of the engine harness adaptor cable and any engine *harness expansion cable used, to all other* pins in the engine harness connector • measure the resistance from pin 11 of the engine harness adaptor cable and any engine harness expansion cable used, to all other pins in the engine harness connector.	**OK** **More than 100k ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedure 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or the engine harness expansion cable, whichever is faulty** • Repair the engine harness adaptor cable or the engine harness expansion cable. Refer to Procedure 019-240. • Replace the *engine harness adaptor* cable or the engine harness expansion cable. Refer to Procedure 019-043.	3A

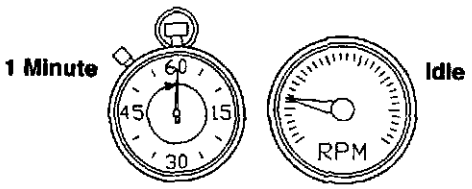


STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code as follows: • connect all components • start the engine and idle for one minute • verify that Fault Code 141 is inactive.	**OK** **Fault Code 141 inactive**	3B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A

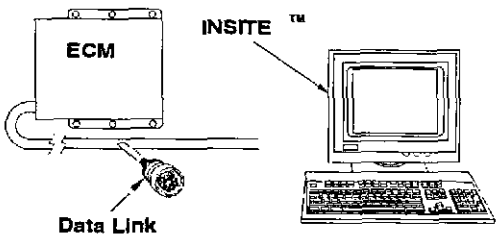


19400011

STEP 3B: Clear the inactive fault codes.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart



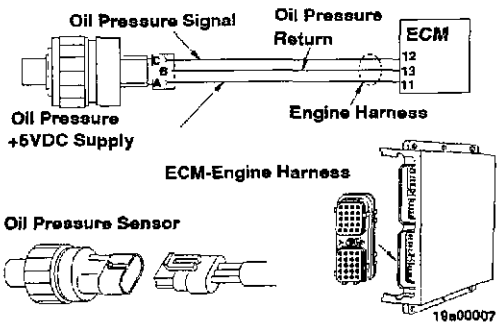
19a00006

Fault Code 143

Oil Pressure - Pre-Low Oil Pressure (LOP) Warning

CODES	REASON	EFFECT
Fault Code: 143 PID(P), SID(S): FMI: SRT: 00-354	Engine oil pressure has dropped below the warning threshold for low oil pressure.	No effect on performance. Common Warning output is energized. Pre-Low Oil Pressure (LOP) relay driver is energized.

Oil Pressure Sensor Circuit



Circuit Description:

The oil pressure sensor is used by the Electronic Control Module (ECM) to monitor the lubricating oil pressure. The ECM monitors the voltage on the signal pin and converts this to a pressure value. The oil pressure value is used by the ECM for the engine protection system.

Component Location:

The oil pressure sensor (OPS) is located on the left bank of the engine block above the fuel pump.

Shop Talk:

- Confirm that the oil pressure sensor supply voltage is between 4.75 and 5.25 VDC at the sensor. See Fault Code 141.
- Oil pressure is a function of engine speed, oil level, and regulator function. Operating the engine at a low speed under load will **not** cause the oil pressure to be low unless oil is hot, oil at a low level, regulator has malfunctioned, or a loss is occurring somewhere in the system.
- The threshold for the pre-low oil pressure warning is adjustable with INSITE™, Part No. 3825145.

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the sensor accuracy.		
STEP 1A: Verify sensor accuracy with a mechanical gauge.	Sensor reading is correct	
STEP 2: Clear the fault code.		
STEP 2A: Disable the fault code.	Fault Code 143 inactive	
STEP 2B: Clear any inactive fault codes.	All faults cleared	

TROUBLESHOOTING STEP

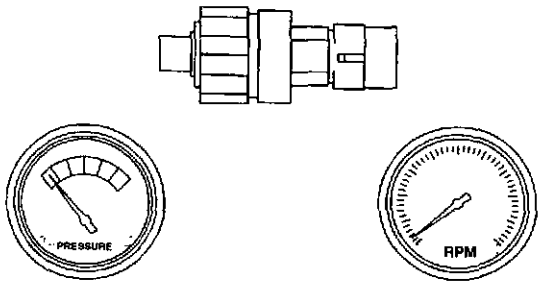
STEP 1: Check the sensor accuracy.

STEP 1A: Verify sensor accuracy with a mechanical gauge.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Verify the sensor accuracy with a mechanical gauge. • Connect a mechanical oil pressure gauge of known quality and calibration to the engine at one of the plugs on top of the oil filter head. • Connect INSITE™, Part No. 3825145, to the data link. • Start engine and compare the oil pressure reading on the INSITE™, Part No. 3825145, monitor screen to the reading on mechanical oil pressure gauge. **NOTE:** The engine rpm will need to be increased to make it easier to see differences in the readings.	**OK** **Sensor reading is correct** **Refer to the Base Engine Troubleshooting and Repair Manual for correct specifications.**	2A
	NOT OK	Go to Fault Code 141



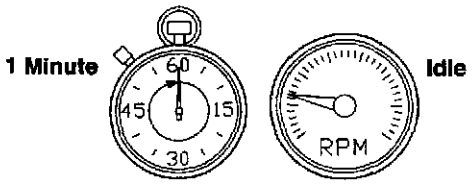
19400141

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

Condition:
- *Connect all components.*

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all of the components. • Start engine and let it idle for one minute. **NOTE:** If the fault was at a particular rpm, run engine at that rpm to verify the problem is corrected.	**OK** **Fault Code 143 inactive**	2B
	NOT OK Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and rechecked.	1A

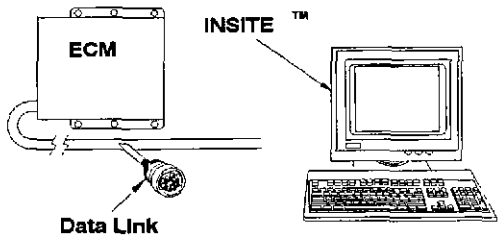


19400011

STEP 2B: Clear any inactive fault codes.

Condition:
- Connect all of the components.

Action	Specifications/Repair	Next Step
Clear any inactive fault codes. • Erase any inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting *chart*



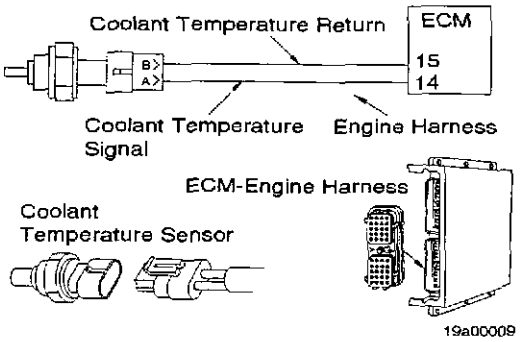
19a00006

Fault Code 144

Coolant Temperature Sensor (CTS) Circuit

CODES	REASON	EFFECT
Fault Code: 144 PID(P), SID(S): FMI: SRT: 00-355	High voltage detected at engine coolant temperature sensor signal pin 14 of the engine harness Electronic Control Module (ECM) Connector.	None on performance. Common Warning output is energized.

CTS Circuit



Circuit Description:

The CTS is used by the ECM to monitor the temperature of the engine coolant. The coolant temperature is used by the ECM for the engine protection system and fueling control.
The ECM monitors the voltage on pin 14. The ECM expects to see the voltage vary between 0.32 and 4.69 VDC. If the voltage is above 4.60 VDC, then the ECM will log Fault Code 144.
Voltage above 4.60 VDC on pin 14 can be caused by, opens in the signal or return wires, voltage shorts to the signal or return wires, or a failed open sensor.

Component Location:

The CTS is located on the side of the thermostat housing.

Shop Talk:

If the coolant temperature is below -18° C [0° F] the engine should be warmed and checked to see if fault goes inactive.
All Temperature Sensors

- The resistance of the sensor varies with the temperature. The reading that you observe will compare to the following table if the sensor is functioning properly.

NOTE: High voltages correspond to low temperatures and low voltages correspond to high temperatures.

Temperature (° C)	Temperature (° F)	Resistance (ohms)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

⚠ CAUTION ⚠

To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead
Part No. 3823256 - Metri-Pack 2-way connector test lead.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the CTS.		
STEP 1A: Inspect the harness and the sensor connector pins.	No damaged pins	
STEP 1B: Check the resistance of the CTS.	600 ohms to 36k ohms See temperature/resistance *table under shop talk for correct value.*	
STEP 2: Check the engine harness.		
STEP 2A: Inspect the ECM and the engine harness *adaptor cable connector pins.*	No damaged pins	
STEP 2A-1: Inspect the engine harness and the engine harness extension cable(s) connector pins.	No damaged pins	
STEP 2B: Check for an open in the signal and return wires.	Less than 10 ohms	
STEP 2B-1: Check for an open in the engine harness adaptor cable and any engine harness extension cable used.	Less than 10 ohms	
STEP 2C: Check for a short circuit from the signal and return pins to all other pins.	More than 100k ohms	
STEP 2C-1: *Check for a short circuit from* pin to all other pins in the engine harness adaptor cable and any engine harness extension cable used.	*More than 100k ohms*	
STEP 3: Clear the fault code.		
STEP 3A: Disable the fault code.	Fault Code 144 inactive	
STEP 3B: Clear the inactive fault code.	All faults cleared	

TROUBLESHOOTING STEP

STEP 1: Check the CTS.

STEP 1A: Inspect the harness and the sensor connector pins.

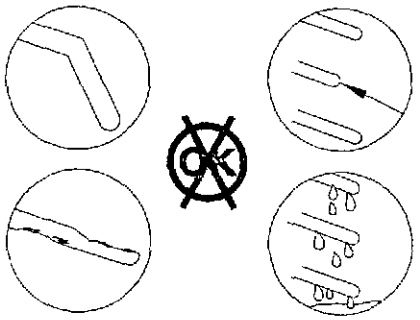
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Inspect the harness and the sensor connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector • missing connector seal.	**OK** **No damaged pins**	1B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the CTS, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-202. • Replace the engine harness. Refer to Procedure 019-043. • Replace the CTS. Refer to Procedure 019-019. • Dry connector by using electrical contact cleaner, Part No. 3824510. • Replace the connector seal.	3A



19400002

STEP 1B: Check resistance of CTS.

⚠CAUTION⚠

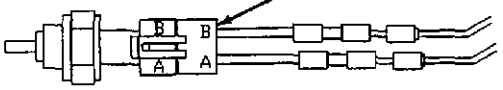
To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3823256 - Metri-Pack 2-Way connector test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check the resistance of the CTS. • *Measure the resistance between the two pins on the sensor side of the CTS connection.*	**OK** ***600 ohms to 36k ohms***	2A
	NOT OK ***Replace the CTS*** Refer to Procedure 019-019.	3A

Part No. 3823256
(part of Part No. 3822926)



19400020

STEP 2: Check the engine harness.

STEP 2A: Inspect the ECM and the harness connector pins.

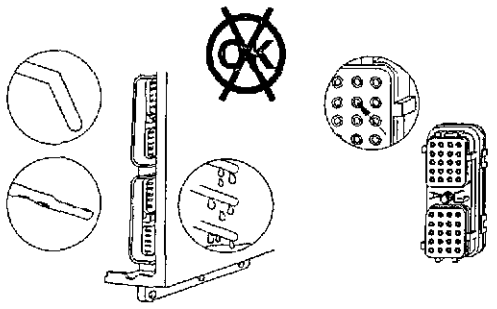
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the ECM and the engine harness adaptor cable connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the ECM, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-240. • Replace the engine harness. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM Procedures . • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



19400007

STEP 2A-1: Inspect the ECM and the harness connector pins.

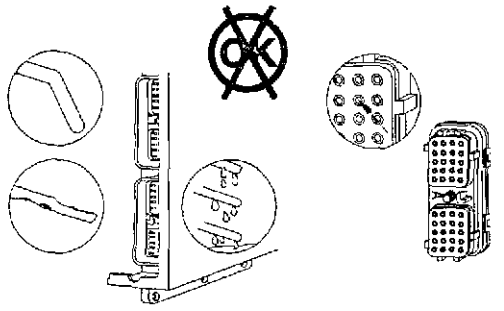
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the ECM and the engine harness *adaptor cable connector pins for the following:* • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** ***No damaged pins***	2A-1
	NOT OK ***Repair the damaged pins*** Repair or replace the engine harness adaptor cable or the ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable. Refer to Procedure 019-043. • Replace the ECM. Refer to *OEM Procedures* . • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



19400007

STEP 2B: Check for an open in the signal and return wires.

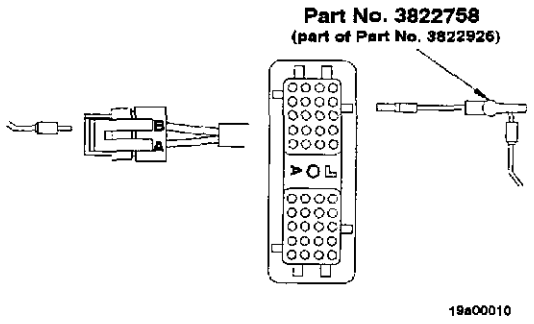
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check for an open in the signal and return wires. • Measure the resistance from pin 14 of the engine harness adaptor cable connector to pin A on the harness side of the CTS connector. • Measure the resistance from pin 15 of the engine harness adaptor cable connector to pin B on the harness side of the CTS connector.	**OK** **Less than 10 ohms**	2C
	NOT OK	2B-1



STEP 2B-1: Check for an open in the engine harness adaptor cable and any engine harness extension cable used.

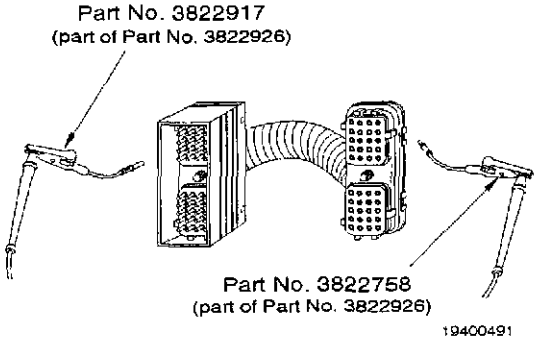
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check for an open in the signal and return wires of the engine harness adaptor cable and *any extension cable used.* • Measure the continuity for pin 14 of the engine harness adaptor cable connector and any engine harness expansion cable used. • Measure the continuity for pin 15 of the engine harness adaptor cable connector and any engine harness expansion cable used.	**OK** **Less than 10 ohms** ***Repair or replace the engine harness*** • **Repair the engine harness. Refer to Procedures 019-199, 019-202 and 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedures 019-199, 019-202 and 019-240. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	3A



STEP 2C: Check for a short circuit from the signal and return pins to all other pins.

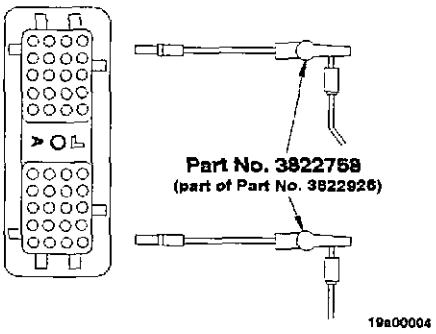
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal and return pins to all other pins as follows: • measure the resistance from pin 14 in the engine harness adaptor cable connector to all other pins in the connector • measure the resistance from pin 15 in the engine harness adaptor cable connector to all other pins in the connector.	**OK** **More than 100k ohms**	3A
	NOT OK	2C-1



STEP 2C-1: Check for a short circuit from pin to all other pins in the engine harness adaptor cable and any engine harness extension cable used.

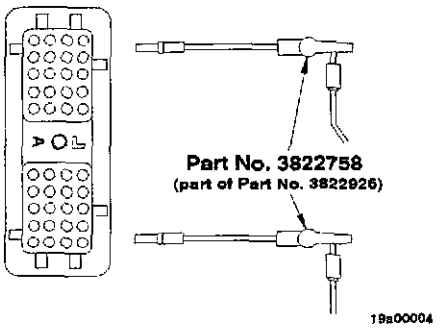
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal and *return pins to all other pins as follows:* • measure the resistance from pin 14 in the engine harness adaptor cable connector and *any engine harness extension cables used, to* all other pins in the connector • measure the resistance from pin 15 in the *engine harness adaptor cable connector and* any engine harness extension cables used, to all other pins in the connector	**OK** **More than 100k ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to *Procedure 019-199 and 019-240.*** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedures 019-199, 019-202 and 019-240. • *Replace the engine harness adaptor* cable or engine harness extension cable(s). Refer to Procedure 019-043.	3A



STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

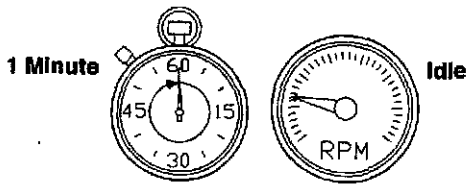
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all components. • Start the engine and let idle for one minute. • Verify Fault Code 144 is inactive.	**OK** **Fault Code 144 inactive**	3B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A



19400011

STEP 3B: Clear the inactive fault codes.

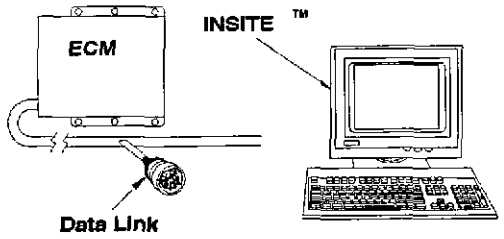
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart

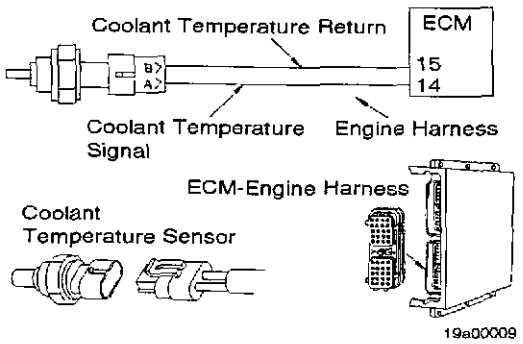


Fault Code 145

Coolant Temperature Sensor (CTS) Circuit

CODES	REASON	EFFECT
Fault Code: 145 PID(P), SID(S): FMI: SRT: 00-356	Low voltage detected at engine coolant temperature sensor signal pin 14 of the engine harness Electronic Control Module (ECM) Connector.	No effect on performance. Common Warning output is energized.

CTS Circuit



Circuit Description:

The CTS is used by the ECM to monitor the temperature of the engine coolant. The coolant temperature is used by the ECM for the engine protection system and fueling control.
The ECM monitors the voltage on pin 14. The ECM expects to see the voltage vary between .32 and 4.69 VDC. If the voltage is below .24 VDC for more than 2 seconds, then the ECM will log Fault Code 145.
Voltage below .24 VDC on pin 14 can be caused by shorts to ground on the supply or return wires or an internally grounded failed sensor.

Component Location:

The CTS is located on the side of the thermostat housing.

Shop Talk:

All Temperature Sensors

- The resistance of the sensor varies with the temperature. The reading that you observe will compare to the following table if the sensor is functioning properly.

NOTE: High voltages correspond to low temperatures and low voltages correspond to high temperatures.

Temperature (° C)	Temperature (° F)	Resistance (ohms)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

△ CAUTION △

To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead
Part No. 3823256 - *Metri-Pack 2-way connector test lead.*

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the CTS.		
STEP 1A: Inspect harness and sensor connector pins.	No damaged pins	
STEP 1B: Check the *resistance* of the CTS.	*600 ohms to 36k ohms* See temperature/resistance table under shop talk for correct value.	
STEP 1C: Check for a short circuit to ground in the sensor.	More than 100k ohms	
STEP 2: Check the engine harness.		
STEP 2A: *Inspect the engine harness adaptor* cable and the ECM connector pins.	*No damaged pins*	
STEP 2A-1: Inspect the engine harness and the engine harness extension cable(s).	No damaged pins	
STEP 2B: Check for a short circuit from the signal and return pins to all other pins.	More than 100k ohms	
STEP 2B-1: *Check for a short circuit from* the signal and return pins to all other pins.	More than 100k ohms	
STEP 2C: Check for a short circuit to ground in the supply and signal wire.	More than 100k ohms	
STEP 2C-1: Check for a short circuit to ground in the supply and signal wire.	More than 100k ohms	
STEP 2D: Check for an open in the signal and return wires.	Less than 10 ohms	
STEP 2D-1: Check for an open in the engine harness adaptor cable and any engine harness extension cable used.	Less than 10 ohms	
STEP 3: Clear the fault code.		
STEP 3A: Disable the fault code.	Fault Code 145 inactive	
STEP 3B: Clear the inactive fault codes.	All faults cleared	

TROUBLESHOOTING STEP

STEP 1: Check the CTS.

STEP 1A: Inspect the harness and the sensor connector pins.

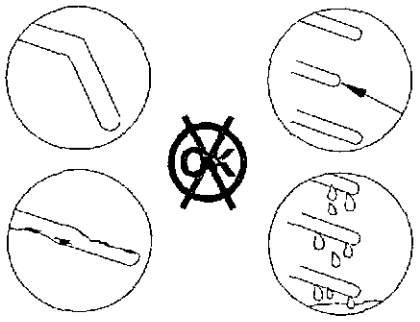
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Inspect the harness and the sensor connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector • missing connector seal.	**OK** **No damaged pins**	1B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the CTS, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-202. • Replace the engine harness. Refer to Procedure 019-043. • Replace the CTS. Refer to Procedure 019-019. • Dry the connector by using electrical contact cleaner, Part No. 3824510. • Replace the connector seal.	3A



19400002

STEP 1B: Check the resistance of the CTS.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

⚠CAUTION⚠

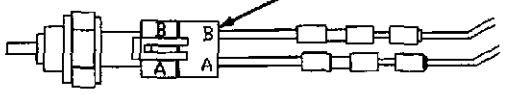
To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3823256 - Metri-Pack 2-Way connector test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check the resistance of the CTS. • *Measure the resistance between the two pins* on the sensor side of the CTS connector.	**OK** ***600 ohms to 36k ohms*** **See Temperature/Resistance Table under Shop Talk for correct value.**	1C
	NOT OK **Replace the CTS** Refer to Procedure 019-019.	3A

Part No. 3823256
(part of Part No. 3822926)



19400020

STEP 1C: Check for a short circuit to ground in the sensor.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

△CAUTION△

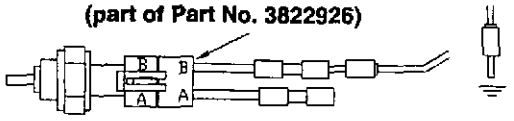
**To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3823256 - Metri-Pack 2-Way connector**

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the sensor. • Measure the resistance from one of the pins on the sensor side of the CTS connector to the engine block ground.	**OK** **More than 100k ohms**	2A
	NOT OK **Replace the CTS** Refer to Procedure 019-019.	3A

**Part No. 3823256
(part of Part No. 3822926)**



19400021

STEP 2: *Check the engine harness.*

STEP 2A: Inspect the engine harness adaptor cable and the ECM connector pins.

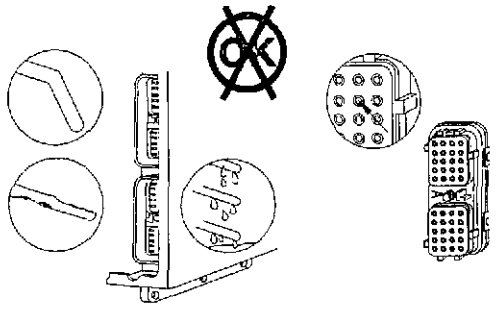
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the engine harness adaptor cable and the ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK ***Repair the damaged pins*** Repair or replace the engine harness adaptor cable or the ECM, whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-240. • Replace the engine harness. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM procedures. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



19400007

STEP 2A-1: Inspect the engine harness and the engine harness extension cable(s) connector pins.

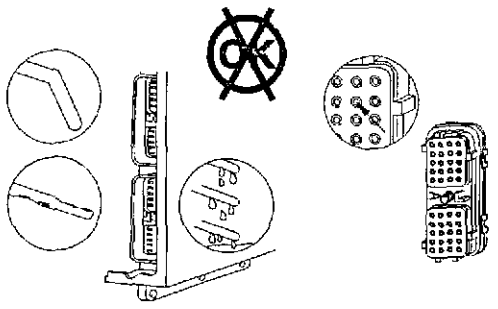
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Inspect the engine harness and any engine harness expansion cables connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the engine harness expansion cable(s), whichever has the damaged pins. • Repair the engine harness or the engine harness expansion cable(s). Refer to Procedure 019-240. • Replace the engine harness or the engine harness expansion cable(s). Refer to Procedure 019-043. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	3A



19400007

STEP 2B: Check for a short circuit from the signal and return pins to all other pins.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

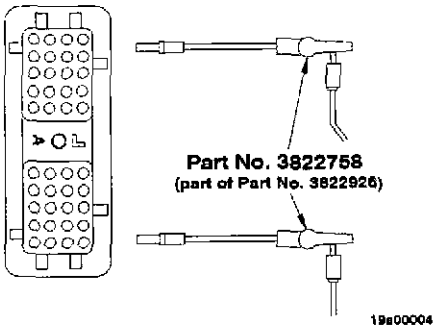
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the CTS.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal and return pins to all other pins. • Measure the resistance from pin 14 of the engine harness adaptor cable connector to all other pins in the connector. • Measure the resistance from pin 15 of the *engine harness adaptor cable connector to all* other pins in the connector.	**OK** **More than 100k ohms**	2C
	NOT OK	2B-1



STEP 2B-1: Check for a short circuit from the signal and return pins to all other pins.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

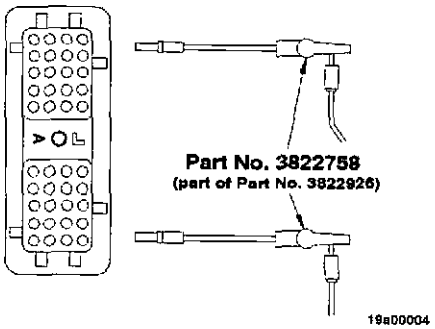
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the engine harness extension cables.

Action	Specifications/Repair	Next Step
Check for a short circuit from the signal and return pins to all other pins. • Measure the resistance of pin 14 of the engine harness adaptor cable connector and any engine harness extension cable used, to all other pins in the connector. • Measure the resistance of pin 15 of the engine harness adaptor cable connector and any engine harness extension cable used, to all other pins in the connector.	**OK** **More than 100k ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedure 019-199 and 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or the engine harness expansion cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or the engine harness expansion cable(s). Refer to Procedure 019-240. • Replace the engine harness adaptor cable or the engine harness expansion cable(s). Refer to Procedure 019-043.	3A



STEP 2C: Check for a short circuit to ground in the supply and signal wire.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

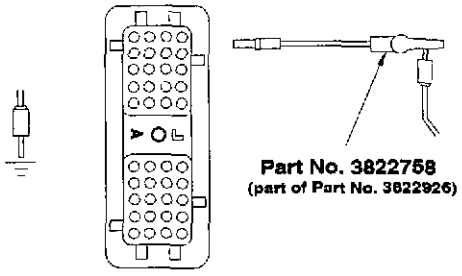
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect engine harness from CTS.
- Disconnect engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the signal and return wire. • Measure the resistance from pin 14 of the engine harness adaptor cable connector to engine block ground. • Measure the resistance from pin 15 of the engine harness adaptor cable connector to engine block ground.	**OK** **More than 100k ohms** • **Replace the CTS. Refer to Procedure 019-019.**	3A
	NOT OK	2C-1



STEP 2C-1: Check for a short circuit to ground in the supply and signal wire.

⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

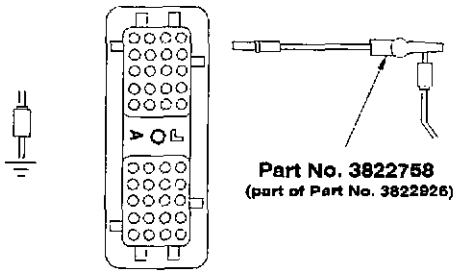
△CAUTION△

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect engine harness from CTS.
- Disconnect engine harness from the engine harness expansion cable.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the signal and return wire. • Measure the resistance from pin 14 of the engine harness connector to engine block ground. • Measure the resistance from pin 15 of the engine harness connector to engine block ground.	**OK** **More than 100k ohms** • **Replace the CTS. Refer to Procedure 019-019.**	2D
	NOT OK **Repair or replace the engine harness** • Repair the engine harness. Refer to Procedure 019-199 and 019-240. • Replace the engine harness. Refer to Procedure 019-043.	3A



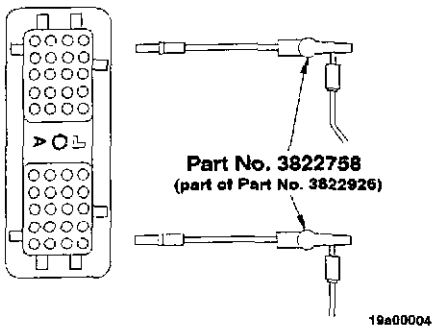
Part No. 3822758
(part of Part No. 3822926)

19a00005

STEP 2D: Check for an open in the signal and return wires.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect engine harness adaptor cable from ECM.

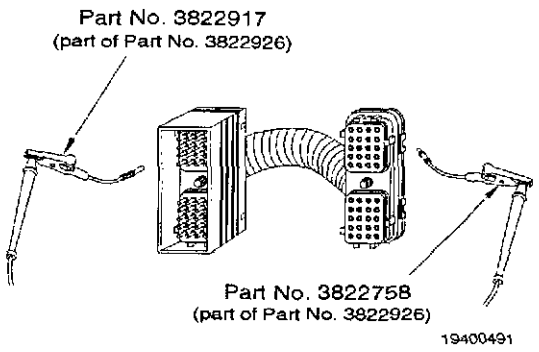
Action	Specifications/Repair	Next Step
Check for an open in the signal and return wires. • Measure the resistance from pin 14 of the engine harness adaptor cable to pin 15 of the connector.	**OK** **Less than 10 ohms**	3A
	NOT OK	2D-1



STEP 2D-1: Check for an open in the engine harness adaptor cable and any engine harness extension cable used.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect engine harness adaptor cable from ECM.
- Disconnect engine harness from the engine harness expansion cable.

Action	Specifications/Repair	Next Step
Check for an open in the signal and return wires. • Measure the continuity for pin 14 of the engine harness adaptor cable and any engine harness extension cable used. • Measure the continuity for pin 15 of the engine harness adaptor cable and any engine harness extension cable used.	**OK** **Less than 10 ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedures 019-202 and 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	3A
	NOT OK **Repair or replace the engine harness adaptor cable or the engine harness expansion cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or the engine harness expansion cable(s). Refer to Procedure 019-240. • Replace the engine harness adaptor cable or the engine harness expansion cable(s). Refer to Procedure 019-043.	3A



STEP 3: Clear the fault code.

STEP 3A: Disable the fault code.

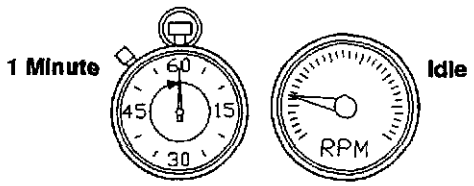
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all components. • Start the engine and idle for one minute.	**OK** **Fault Code 145 inactive**	3B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A



19400011

STEP 3B: Clear the inactive fault codes.

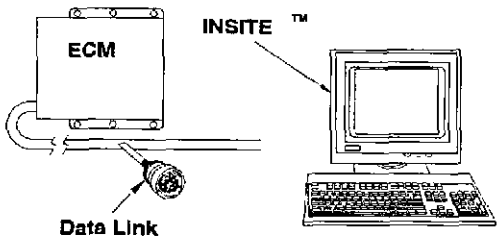
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart

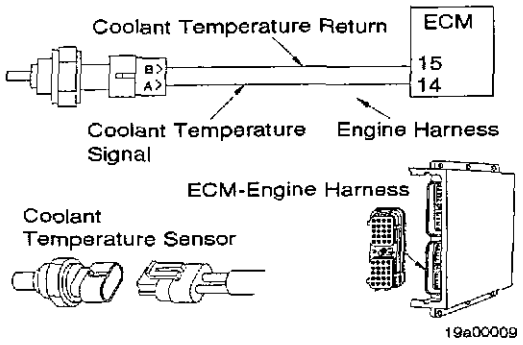


Fault Code 146

Coolant Temperature - Engine Protection

CODES	REASON	EFFECT
Fault Code: 146 PID(P), SID(S): FMI:	Engine coolant temperature has exceeded the warning threshold for high coolant temperature.	No effect on performance. Common Warning output is energized. Pre-High Coolant Temperature relay driver is energized.

Coolant Temperature Sensor (CTS) Circuit



Circuit Description:

The CTS is used by the electronic control module (ECM) to monitor the temperature of the engine coolant. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The coolant temperature is used by the ECM for the engine protection system and fueling control.

Component Location:

The CTS is located on the side of the thermostat housing.

Shop Talk:

- Make sure the air flow through the radiator is **not** obstructed.
- The resistance of all the temperature sensors varies with the temperature. The reading that you observe should compare to the following table if the sensor is functioning properly.
- The threshold for the coolant temperature warning is adjustable with INSITE™, Part No. 3825145. Ensure the threshold is set to the appropriate value.

Temperature (° C)	Temperature [° F]	Resistance (ohms)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the sensor accuracy.		
STEP 1A: Verify the sensor accuracy with a thermocouple or similar temperature probe.	Sensor reading is correct	
STEP 2: Clear the fault code.		
STEP 2A: Disable the fault code.	Fault Code 146 inactive	
STEP 2B: Clear the inactive fault codes.	All faults cleared	

TROUBLESHOOTING STEP

STEP 1: Check the sensor accuracy.

STEP 1A: Verify the sensor accuracy with a thermocouple or similar temperature probe.

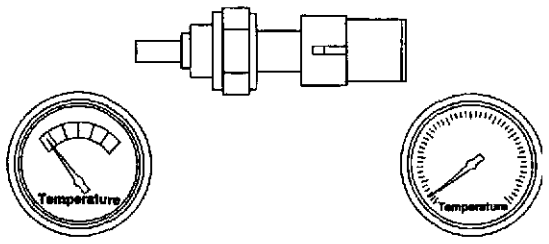
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Verify the sensor accuracy with a thermocouple or similar temperature probe. • Connect the temperature probe to the engine near the CTS. • Connect INSITE™, Part No. 3825145, to the equipment data link. • Compare the coolant temperature reading on the service tool monitor screen to the reading from the temperature probe. **NOTE:** If no temperature measuring device is available, then answer "OK" to this step.	**OK** **Sensor reading is correct.** **Refer to the Base Engine Troubleshooting and Repair Manual for correct specifications.**	2A
	NOT OK **Go to Fault code 145**	Fault code 145



19400068

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

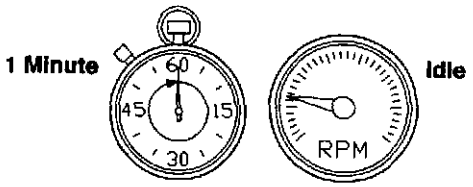
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all the components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all the components. • Start the engine and let it warm up to normal operating temperature to verify that the fault has been fixed.	**OK** **Fault Code 146 inactive**	2B
	NOT OK Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all the steps have been completed and checked again.	1A



19400011

STEP 2B: Clear the inactive fault codes.

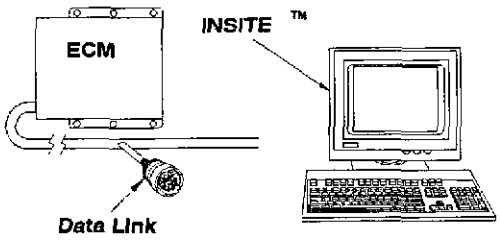
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all the components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared.**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart

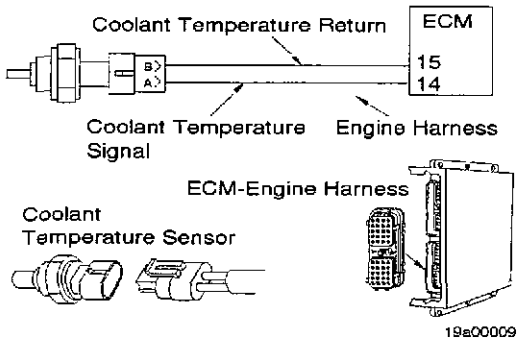


Fault Code 151

Coolant Temperature - Engine Protection

CODES	REASON	EFFECT
Fault Code: 151 PID(P), SID(S): FMI: SRT: 00-357	Engine coolant temperature has exceeded the alarm (shutdown) threshold for high coolant temperature.	Engine will shutdown. Common Alarm output is energized. High Coolant Temperature (HCT) relay driver is energized.

Coolant Temperature Sensor (CTS) Circuit



Circuit Description:

The CTS is used by the electronic control module (ECM) to monitor the temperature of the engine coolant. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The coolant temperature is used by the ECM for the engine protection system and fueling control.

Component Location:

The CTS is located on the side of the thermostat housing.

Shop Talk:

- Make sure the air flow through the radiator is **not** obstructed.
- The resistance of all the temperature sensors varies with the temperature. The reading that you observe should compare to the following table if the sensor is functioning properly.
- The threshold for the coolant temperature warning is adjustable with INSITE™, Part No. 3825145. Ensure the threshold is set to the appropriate value.

Temperature (° C)	Temperature [° F]	Resistance (ohms)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

TROUBLESHOOTING SUMMARY

⚠ WARNING ⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the sensor accuracy.		
STEP 1A: Verify the sensor accuracy with a thermocouple or similar temperature probe.	Sensor reading is correct	
STEP 2: Clear the fault code.		
STEP 2A: Disable the fault code.	Fault Code 151 inactive	
STEP 2B: Clear the inactive fault codes.	All Faults cleared	

TROUBLESHOOTING STEP

STEP 1: Check the sensor accuracy.

STEP 1A: Verify the sensor accuracy with a thermocouple or similar temperature probe.

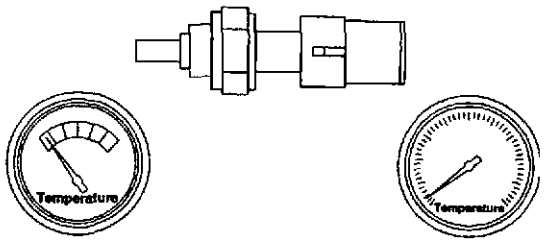
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Verify the sensor accuracy with a thermocouple or similar temperature probe. • Connect the temperature probe to the engine near the CTS. • Connect INSITE™, Part No. 3825145, to the data link. • Compare the coolant temperature reading on the service tool monitor screen to the reading from the temperature probe. **NOTE:** If no temperature measuring device is available, then answer "OK" to this step.	**OK** **Sensor reading is correct.** **Refer to Base Engine Troubleshooting and Repair Manual for correct specifications.**	2A
	NOT OK **Go to Fault Code 145**	Fault Code 145



19400068

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

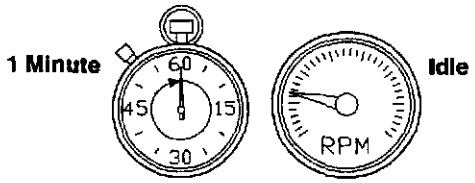
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all the components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all the components. • Start the engine and let it warm up to normal operating temperature to verify that the fault has been fixed.	**OK** **Fault Code 151 inactive**	2B
	NOT OK Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all the steps have been completed and checked again.	1A



19400011

STEP 2B: Clear the inactive fault codes.

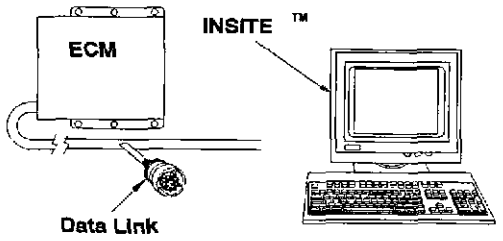
⚠WARNING⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap or the CTS. Failure to do so can cause personal injury from heated coolant spray.

Condition:

- Connect all the components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared.**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart

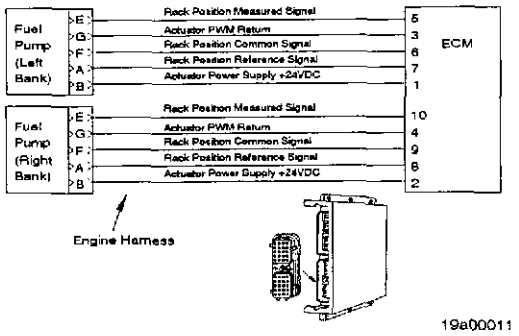


Fault Code 171

Rack Position

CODES	REASON	EFFECT
Fault Code: 171 PID(P), SID(S): FMI:	Fuel pump rack position fault. One or both of the left bank or right bank fuel pump racks is **not** at the commanded position.	Performance could be sluggish or slow to respond. Common Warning output is energized.

Fuel Pump and Rack Circuit



Circuit Description:

The rack position sensor circuit's measured, reference and common signals are used by the electronic control module (ECM) to verify that the rack has been properly positioned by the rack actuator. The actuator power supply and PWM return circuits are used by the ECM to drive the actuator to the desired position.

Component Location:

The rack position sensor is located in the governor housing of the fuel pump. The QST30 G-Drive engine has one on each engine bank.

Shop Talk:

- Fault Code 171 will be recorded if the measured rack position for either bank is **not** at commanded rack position. First determine which bank is causing the error, then determine what part of that circuit is at fault.
- Fault Code 171 may be recorded if the fuel pump rack is sticking at one particular point within its travel path. You may need to load the engine to make the fault go active.

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Determine which bank is at fault.		
STEP 1A: Perform fuel pump rack test.	The measured voltage matches the service tool voltage reading (±0.2 VDC)	
STEP 1A-1: Monitor the rack position voltages while the engine is in operation.	Voltage reading at pins B and C are identical (±0.2 VDC)	
STEP 2: Check engine harness.		
STEP 2A: Inspect engine harness adaptor cable and ECM connector pins.	No damaged pins	
STEP 2A-1: Inspect engine harness and fuel pump connector pins.	No damaged pins	
STEP 2A-2: Inspect engine harness connector and any engine harness extension cable used.	No damaged pins	
STEP 2B: Check rack position sensor and rack actuator circuits for short circuit from pin to pin.	More than 100k ohms	
STEP 2B-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any engine harness extension cable used.	More than 100k ohms	
STEP 2C: Check rack position sensor and rack actuator circuits for an open circuit.	Less than 10 ohms	
STEP 2C-1: Check for an open circuit in the engine harness adaptor cable and any engine harness extension cable used.	Less than 10 ohms	
STEP 2D: Check rack position sensor and rack actuator circuits for short circuit to ground.	More than 100k ohms	
STEP 2D-1: Check for short circuit to ground in the engine harness.	More than 100k ohms	
STEP 3: Check rack actuator.		
STEP 3A: Check the resistance of rack actuator coil.	0.55 to 0.90 ohms	
STEP 3B: Verify rack movement.	Full range of rack movement	
STEP 4: Check rack position sensor.		
STEP 4A: Check resistance of rack position sensor coil.	17 to 23 ohms	
STEP 4B: Check resistance of rack position sensor reference coil.	17 to 23 ohms	
STEP 5: Check ECM.		

STEP 5A: Check rack position sensor signal pins for proper voltage levels. — 2.4 to 2.6 VDC

STEP 6: Clear the fault code.

STEP 6A: Disable the fault code. — Fault Code 171 inactive

STEP 6B: Clear inactive fault codes. — All faults cleared

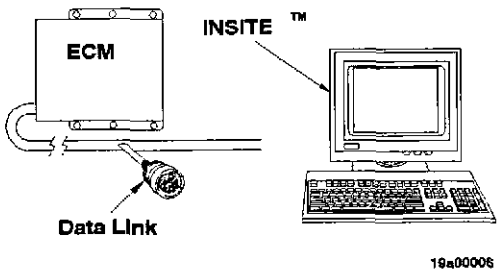
TROUBLESHOOTING STEP

STEP 1: Determine which bank is at fault.

STEP 1A: Perform fuel pump rack test.

Condition:
- Stop/Run switch in the "STOP" position.
- *Controller in the diagnostic mode.*

Action	Specifications/Repair	Next Step
Perform fuel pump rack test. Using INSITE™, Part No. 3825145, perform fuel pump rack test. • Gradually ramp the fuel pump rack from it's lower limit of travel (0 mm) to it's maximum limit of travel (20 mm) while reading the voltage from pin B to pin A at the diagnostic connector for the left bank fuel pump. • Gradually ramp the fuel pump rack from it's lower limit of travel (0 mm) to it's maximum limit of travel (20 mm) while reading the voltage from pin C to pin A at the diagnostic connector for the right bank fuel pump.	**OK** **The measured voltage matches the rack position voltages as indicated by the service tool (±0.2 VDC)**	1A-1
	NOT OK Proceed with the following steps (Step 2A) for the engine bank in error.	2A



STEP 1A-1: Monitor the rack position voltages while the engine is in operation.

Condition:
- Stop/Run switch in the "RUN" position.

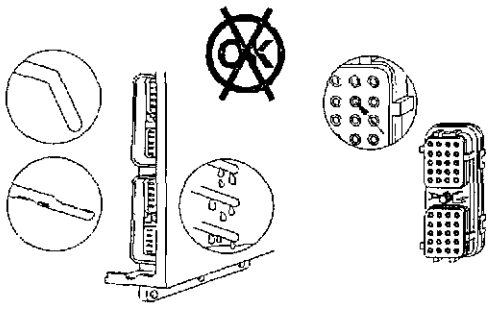
Action	Specifications/Repair	Next Step
Monitor the rack position voltages while the engine is in operation. Read the voltages at the diagnostic connector pins B (left bank fuel pump) to pin A (ground) and pin C (right bank fuel pump) to pin A (ground) at various levels of engine load.	**OK** **Voltage readings between pins A and B are identical (±0.2 VDC) at a given load condition and both voltage reading fluctuate with varying load (fueling) conditions.**	6A
	NOT OK	2A

STEP 2: Check engine harness.

STEP 2A: Inspect engine harness adaptor cable and ECM connector pins.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect engine harness adaptor cable and ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK **Repair the damaged pins** Repair or replace the engine harness adaptor cable or the ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM procedures. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	6A

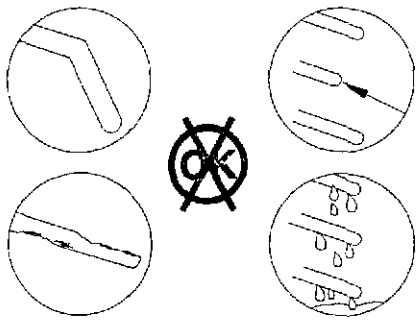


19400007

STEP 2A-1: Inspect engine harness and fuel pump connector pins.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Inspect the engine harness and fuel pump connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-2
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the fuel pump whichever has the damaged pins. • Repair the engine harness. Refer to Procedure 019-209. • Replace the engine harness. Refer to Procedure 019-043. • Replace the fuel pump. Refer to Base Engine Troubleshooting and Repair Manual. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	6A

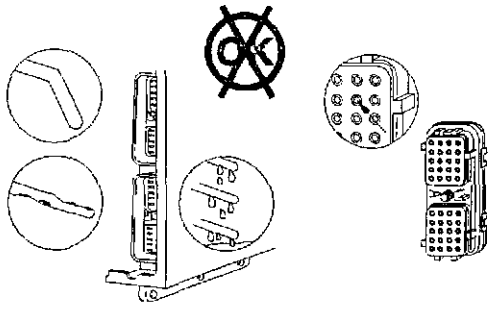


19400002

STEP 2A-2: Inspect engine harness connector and any engine harness extension cable used.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Inspect the engine harness and fuel pump connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the engine harness extension cable(s), whichever has the damaged pins. • Repair the engine harness or the engine harness extension cable(s). Refer to Procedure 019-209. • Replace the engine harness or the engine harness extension cable(s). Refer to Procedure 019-043. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	6A



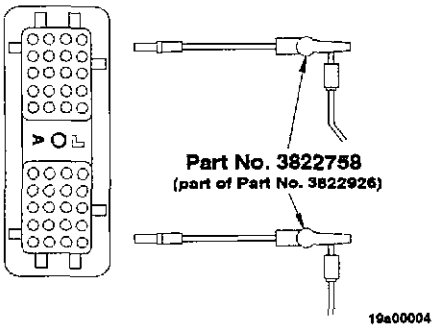
19400007

STEP 2B: Check rack position sensor and rack actuator circuits for short circuit from pin to pin.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check rack position sensor and rack actuator circuits for short circuit from pin to pin. • Measure the resistance from pin 5 (pin 10 for the right fuel pump) of the engine harness adaptor cable connector to all other pins in the connector. • Measure the resistance from pin 3 (pin 4 for the right fuel pump) of the engine harness adaptor cable connector to all other pins in the connector. • Measure the resistance from pin 6 (pin 9 for the right fuel pump) of the engine harness adaptor cable connector to all other pins in the connector. • Measure the resistance from pin 7 (pin 8 for the right fuel pump) of the engine harness adaptor cable connector to all other pins in the connector. • Measure the resistance from pin 1 (pin 2 for the right fuel pump) of the engine harness adaptor cable connector to all other pins in the connector.	**OK** **More than 100k ohms**	2C
	NOT OK	2B-1

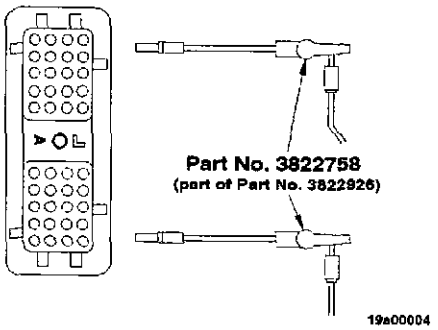


STEP 2B-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any engine harness extension cable used.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin. • Measure the resistance from pin 5 (pin 10 for the right fuel pump) of the engine harness adaptor cable connector and any engine harness extension cable connector to all other pins in the connector. • Measure the resistance from pin 3 (pin 4 for the right fuel pump) of the engine harness adaptor cable connector and any engine harness extension cable connector to all other pins in the connector. • Measure the resistance from pin 6 (pin 9 for the right fuel pump) of the engine harness adaptor cable connector and any engine harness extension cable connector to all other pins in the connector. • Measure the resistance from pin 7 (pin 8 for the right fuel pump) of the engine harness adaptor cable connector and any engine harness extension cable connector to all other pins in the connector. • Measure the resistance from pin 1 (pin 2 for the right fuel pump) of the engine harness adaptor cable connector and any engine harness extension cable connector to all other pins in the connector.	**OK** **More than 100k ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedure 019-209 or 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	6A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-209 or 019-240. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	6A

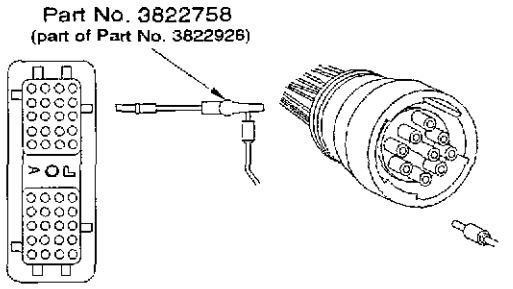


STEP 2C: Check rack position sensor and rack actuator circuits for an open circuit.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the fuel pump.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check rack position sensor and rack actuator circuits for an open circuit. • Measure the resistance from pin 5 (pin 10 for the right bank fuel pump) on the engine harness adaptor cable connector to pin E on the harness side of the fuel pump connector. • Measure the resistance from pin 3 (pin 4 for the right bank fuel pump) on the engine harness adaptor cable connector to pin G on the harness side of the fuel pump connector. • Measure the resistance from pin 6 (pin 9 for the right bank fuel pump) on the engine harness adaptor cable connector to pin F on the harness side of the fuel pump connector. • Measure the resistance from pin 7 (pin 8 for the right bank fuel pump) on the engine harness adaptor cable connector to pin A on the harness side of the fuel pump connector. • Measure the resistance from pin 1 (pin 2 for the right bank fuel pump) on the engine harness adaptor cable connector to pin B on the harness side of the fuel pump connector.	**OK** **Less than 10 ohms**	2D
	NOT OK	2C-1

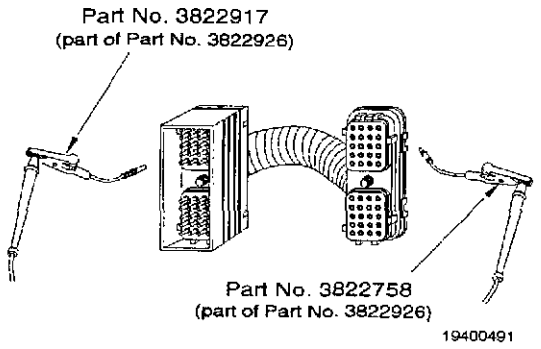


STEP 2C-1: Check for an open circuit in the engine harness adaptor cable and any engine harness extension cable used.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the engine harness extension cable(s).
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check for an open circuit. • Measure the continuity for pin 5 (pin 10 for the right bank fuel pump) on the engine harness adaptor cable and any engine harness extension cables used. • Measure the continuity for pin 3 (pin 4 for the right bank fuel pump) on the engine harness adaptor cable and any engine harness extension cables used. • Measure the continuity for pin 6 (pin 9 for the right bank fuel pump) on the engine harness adaptor cable and any engine harness extension cables used. • Measure the continuity for pin 7 (pin 8 for the right bank fuel pump) on the engine harness adaptor cable and any engine harness extension cables used. • Measure the continuity for pin 1 (pin 2 for the right bank fuel pump) on the engine harness adaptor cable and any engine harness extension cables used.	**OK** **Less than 10 ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedure 019-209 or 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	6A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-209 or 019-240. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	6A

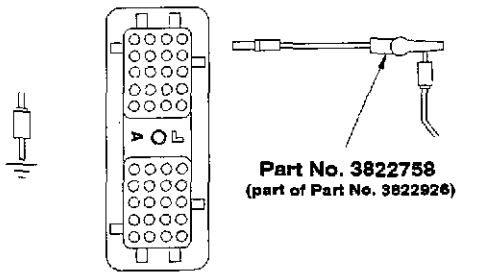


STEP 2D: Check rack position sensor and rack actuator circuits for short circuit to ground.

Condition:

- Stop/Run switch in the "STOP" position.
- *Controller* ***not*** *in the diagnostic mode.*
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check rack position sensor and rack actuator circuits for short circuit to ground. • Measure the resistance from pin 5 (pin 10 for the right bank fuel pump) on the engine harness adaptor cable to engine block ground. • Measure the resistance from pin 3 (pin 4 for the right bank fuel pump) on the engine harness adaptor cable to engine block ground. • Measure the resistance from pin 6 (pin 9 for the right bank fuel pump) on the engine harness adaptor cable to engine block ground. • Measure the resistance from pin 7 (pin 8 for the right bank fuel pump) on the engine harness adaptor cable to engine block ground. • Measure the resistance from pin 1 (pin 2 for the right bank fuel pump) on the engine harness adaptor cable to engine block ground.	**OK** **Greater than 100k ohms**	3A
	NOT OK	2D-1



Part No. 3822758
(part of Part No. 3822926)

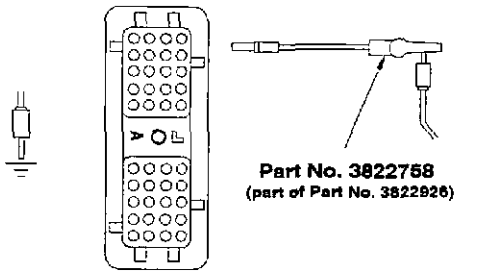
19a00005

STEP 2D-1: Check for short circuit to ground in the engine harness.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the engine harness extension cable(s).
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check for short circuit to ground. • Measure the resistance from pin 5 (pin 10 for the right bank fuel pump) on the engine harness connector to engine block ground. • Measure the resistance from pin 3 (pin 4 for the right bank fuel pump) on the engine harness connector to engine block ground. • Measure the resistance from pin 6 (pin 9 for the right bank fuel pump) on the engine harness connector to engine block ground. • Measure the resistance from pin 7 (pin 8 for the right bank fuel pump) on the engine harness connector to engine block ground. • Measure the resistance from pin 1 (pin 2 for the right bank fuel pump) on the engine harness connector to engine block ground.	**OK** **Greater than 100k ohms**	3A
	NOT OK **Repair or replace the engine harness** • Repair the engine harness. Refer to Procedure 019-209 or 019-240. • Replace the engine harness. Refer to Procedure 019-043.	6A



Part No. 3822758
(part of Part No. 3822926)

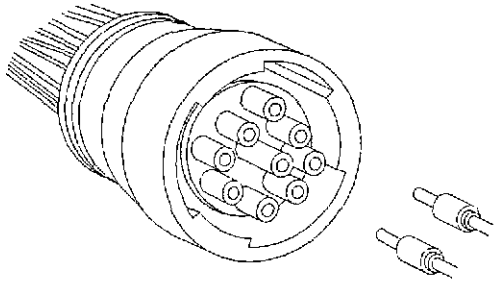
19a00005

STEP 3: Check rack actuator.

STEP 3A: Check the resistance of the rack actuator coil.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check the resistance of the rack actuator coil. • Measure the resistance from pin B to pin G of the fuel pump connector.	**OK** **Less than 10 ohms**	3B
	NOT OK **Replace the fuel pump** Refer to Base Engine Troubleshooting and Repair Manual.	6A



19a00012

STEP 3B: Verify rack movement

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Verify rack movement. Using INSITE™, Part No. 3825145, perform a rack movement test. Insert upper and lower limits of fuel pump rack positions. Remove the cap on the front of the fuel pump and verify rack movement. **Note:** If the cap on the fuel pump is **not** *accessible for visual verification of rack movement*, proceed with steps 4 and 5 prior to removing the fuel pump.	**OK** **Full range of rack movement**	4A
	NOT OK **Replace the fuel pump** Refer to Base Engine Troubleshooting and Repair Manual.	6A

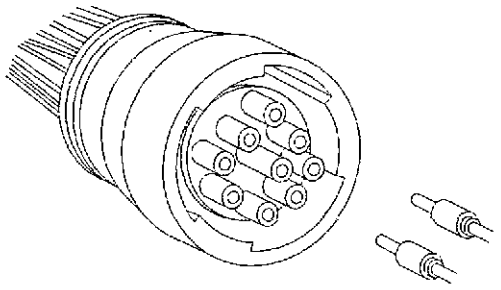
STEP 4: Check rack position sensor.

STEP 4A: Check resistance of rack position sensor coil.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check resistance of rack position sensor coil. • Measure the resistance from pin E to pin F of the fuel pump connector.	**OK** **17 to 23 ohms**	4B
	NOT OK **Replace the fuel pump** Refer to Base Engine Troubleshooting and Repair Manual.	6A

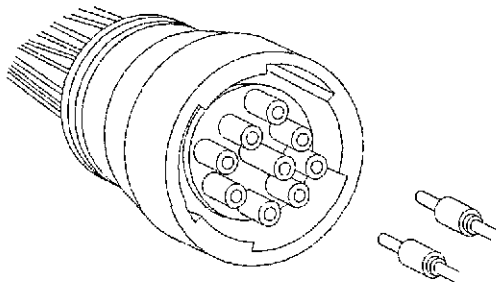


19a00012

STEP 4B: Check resistance of rack position sensor reference coil.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness connector from the fuel pump.

Action	Specifications/Repair	Next Step
Check resistance of rack position sensor reference coil. • Measure the resistance from pin A to pin F of the fuel pump connector.	**OK** **17 to 23 ohms**	5A
	NOT OK **Replace the fuel pump** Refer to Base Engine Troubleshooting and Repair Manual.	6A



19a00012

STEP 5: Check ECM

STEP 5A: Check rack position sensor signal pins for proper voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.
- Disconnect engine harness from fuel pump.

Action	Specifications/Repair	Next Step
Check rack position sensor signal pins for proper voltage. • Measure the signal voltage from pin A on the harness side of the fuel pump connector to ground. • Measure the signal voltage from pin E on the harness side of the fuel pump connector to ground. • Measure the signal voltage from pin F on the harness side of the fuel pump connector to ground.	**OK** **2.4 to 2.6 VDC**	6A
	NOT OK **Replace the ECM** Refer to OEM procedures.	6A

STEP 6: Clear the fault code.

STEP 6A: Disable the fault code.

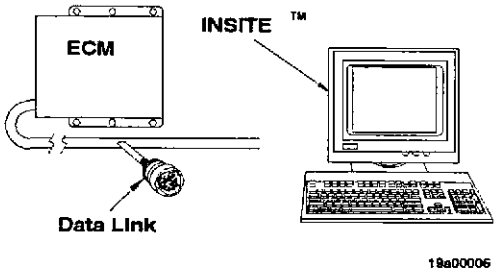
Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code as follows: • connect all components • start the engine and let it idle for one minute • verify Fault Code 171 is inactive.	**OK** **Fault Code 171 inactive**	6B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A

STEP 6B: Clear the inactive fault codes.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart

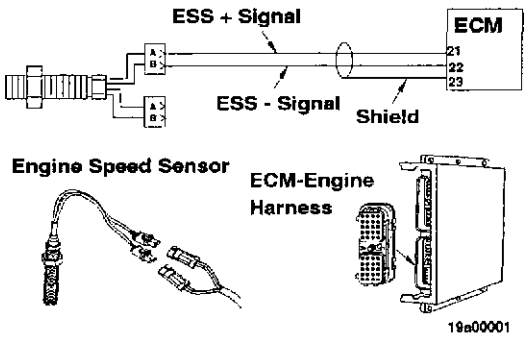


Fault Code 234

Engine Overspeed - Engine Protection

CODES	REASON	EFFECT
Fault Code: 234 PID(P), SID(S): FMI:	Engine Speed Sensor (ESS) signal on pins 21 and 22 of the engine harness electronic control module (ECM) connector indicates engine speed greater than alarm (shut-down) threshold.	Fuel shutoff valves are de-energized (valves closed). Common Alarm output is energized. Overspeed relay driver is energized.

ESS Circuit



Circuit Description:

The ESS circuit provides the engine speed signal to the ECM through the engine harness.

Component Location:

The ESS is located in the flywheel housing.

Shop Talk:

This fault code indicates that the engine speed was above the maximum allowable engine speed. An engine overspeed can be caused by either a fuel system problem or the engine being driven or reverse powered past its maximum allowable speed.

The threshold for the engine overspeed shutdown is adjustable with INSITE™, Part No. 3825145. Ensure the threshold is set to the appropriate value.

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Identify the reason for the overspeed.		
STEP 1A: Check for Fault Code 171.	Fault Code 171 not present	
STEP 1B: Check for motoring of engine (reverse power).	Engine not reverse powered	
STEP 1C: Check for alternate fuel source.	No alternate fuel source	
STEP 1D: Check engine rpm with service tool monitor.	Correct rpm reading	
STEP 2: Clear fault codes.		
STEP 2A: Disable the fault code.	Fault Code 234 inactive	
STEP 2B: Clear the inactive fault codes.	All faults cleared	

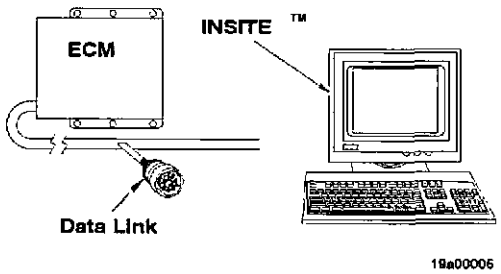
TROUBLESHOOTING STEP

STEP 1: Identify the reason for the overspeed.

STEP 1A: Check for Fault Code 171.

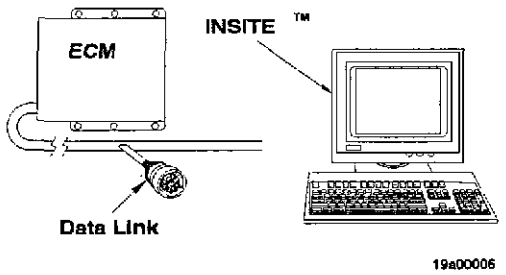
Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Read the fault codes. • Read the fault codes using INSITE™, Part No. 3825145.	**OK** **Fault Code 171 not present**	1B
	NOT OK	Go to Fault Code 171



STEP 1B: Check for motoring of engine (reverse power).

Condition:		
Action	**Specifications/Repair**	**Next Step**
Check for motoring of engine (reverse power). • Check snapshot data for indications of reverse power.	**OK** **Engine not reverse powered**	1C
	NOT OK **Check engine for damage caused by overspeed condition.**	2A



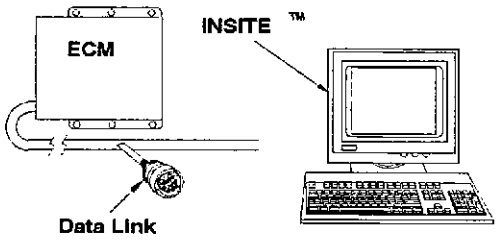
STEP 1C: Check for alternate fuel source.

Condition: • Stop/Run switch in the "STOP" position. • Controller **not** in the diagnostic mode.		
Action	**Specifications/Repair**	**Next Step**
Check for alternate fuel source.	**OK** **No alternate fuel source**	1D
	NOT OK **Locate the alternate fuel source.** Locate and remove any alternate fuel source.	2A

STEP 1D: Check engine rpm with service tool monitor.

Condition:
- Stop/Run switch in the "RUN" position.

Action	Specifications/Repair	Next Step
Check engine rpm with service tool monitor. • Monitor the engine rpm using INSITE™, Part No. 3825145.	**OK** **Correct rpm reading**	2A
	NOT OK **Inspect engine speed sensor** Refer to Procedure 019–042.	2A



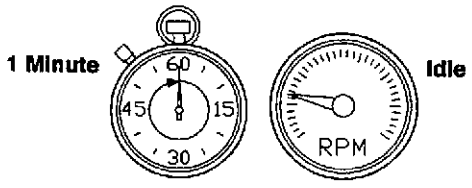
19a00006

STEP 2: Clear fault codes.

STEP 2A: Disable the fault code.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all components. • Start the engine and idle for one minute. • Verify Fault Code 234 is inactive.	**OK** **Fault Code 234 inactive.**	2B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and checked again.	1A

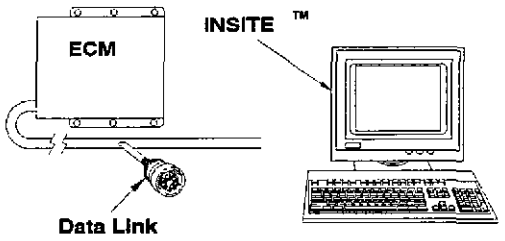


19400011

STEP 2B: Clear inactive fault codes.

Condition:
- Connect all components.

Action	Specifications/Repair	Next Step
Clear the inactive fault codes. • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault Faults.**	Appropriate trouble-shooting chart

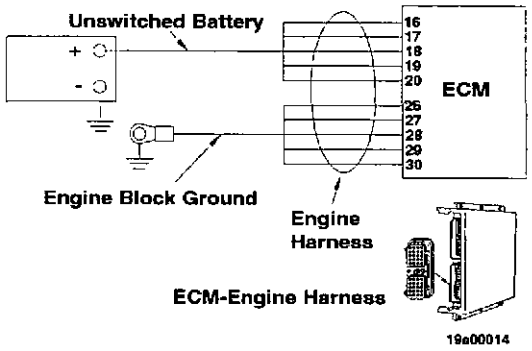


Fault Code 342 or 346

Electronic Control Module (ECM) Memory - Area Faults

CODES	REASON	EFFECT
Fault Code: 342 or 346 PID(P), SID(S): FMI:	FC 342 - The ECM has detected a memory check sum error in the memory containing critical engine parameters. FC 346 - The ECM has detected a memory check sum error in the memory containing non-critical engine parameters.	FC 342 - Engine will shutdown. Common Alarm output is energized. FC 346 - None on performance. Common Warning output is energized. **NOTE:** ECM data may be lost, including fault code data, adjustable parameter settings, ECM time, and engine run time).

Unswitched Battery Circuit



Circuit Description:

The QST30 G-Drive ECM is a computer that is responsible for engine control, diagnostics, and engine features.

Component Location:

The QST30 G-Drive ECM is installed by the generator set OEM. It can usually be found mounted near the generator utility panel.

Shop Talk:

This is a fault with the internal memory of the ECM. This fault can be caused by a power interruption to the ECM or a loss of battery power. A partial or master controller reset may be necessary to clear the fault.

TROUBLESHOOTING SUMMARY

⚠ CAUTION ⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the equipment battery system.		
STEP 1A: Inspect the battery cable connections.	No damaged connections	
STEP 1B: Check the battery voltage.	17.3 to 34.7 VDC (24 Volt System)	
STEP 2: Check the engine harness.		
STEP 2A: Inspect the engine harness adaptor cable and ECM connector pins.	No damaged pins	
STEP 2A-1: Inspect the engine harness and engine harness extension cable(s) connector pins.	No damaged pins	
STEP 2B: Check for an open circuit in the unswitched battery supply circuit.	Less than 10 Ohms	
STEP 2B-1: Check for an open in the engine harness adaptor cable and any extension cable used.	Less than 10 Ohms	
STEP 2C: Check for a short circuit from pin to pin in the unswitched battery supply.	More than 100k ohms	
STEP 2C-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any extension cable used.	More than 100k ohms	
STEP 2D: Check the engine harness ground connection.	No damaged connections	
STEP 2E: Check for an open circuit in the block ground circuit.	Less than 10 ohms	
STEP 2E-1: Check for an open circuit in the block ground circuit in the engine harness adaptor cable and any extension cable used.	Less than 10 ohms	
STEP 3: Perform a Controller Reset.		
STEP 3A: Perform a partial reset on the controller.	Fault Code 342 or 346 inactive	
STEP 3B: Perform a master reset on the controller.	Fault Code 342 or 346 inactive	
STEP 4: Clear the fault code.		
STEP 4A: Disable the fault code.	Fault Code 342 or 346 inactive	
STEP 4B: Clear any inactive fault codes.	All fault codes cleared	

TROUBLESHOOTING STEP

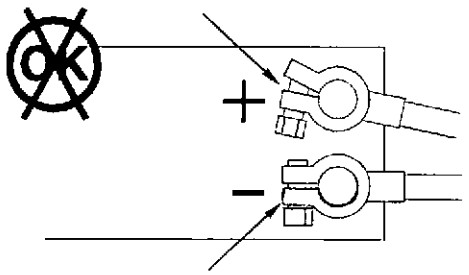
STEP 1: Check the equipment battery system.

STEP 1A: Inspect the battery cable connections.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.

Action	Specifications/Repair	Next Step
Inspect the battery cable connections for the following: • corrosion • loose connections.	**OK** **No damaged connections**	1B
	NOT OK **Repair damaged connections** • Repair or replace the battery connections. Refer to the OEM Troubleshooting and Repair Manual.	4A

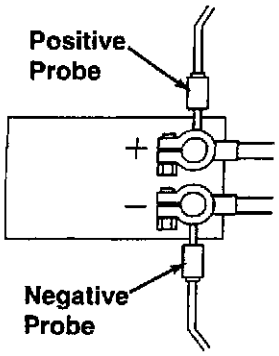


19400082

STEP 1B: Check the battery voltage.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.

Action	Specifications/Repair	Next Step
Check the battery voltage as follows: • measure the battery voltage.	**OK** **17.3 to 34.7 Volts DC (24 Volt System)**	2A
	NOT OK **Replace the battery** Refer to OEM Procedures.	4A



19400083

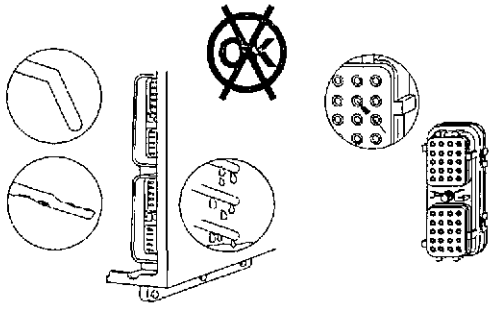
STEP 2: Check the engine harness.

STEP 2A: Inspect the engine harness adaptor cable and the ECM connector pins.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Inspect the engine harness adaptor cable and the ECM connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2A-1
	NOT OK **Repair the damaged pins** Repair or replace the engine harness adaptor cable or the ECM, whichever has the damaged pins. • Repair the engine harness adaptor cable. Refer to Procedure 019-240. • Replace the engine harness adaptor cable. Refer to Procedure 019-043. • Replace the ECM. Refer to OEM troubleshooting procedures. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	4A

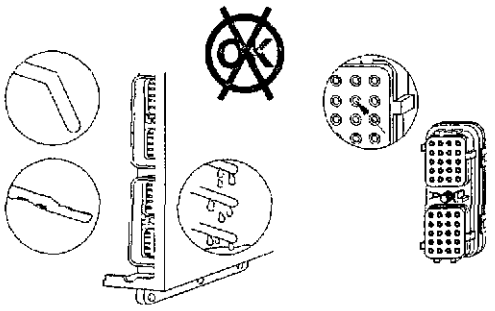


19400007

STEP 2A-1: Inspect the engine harness and any engine harness extension cable(s).

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Inspect the engine harness and any engine harness extension cable(s) connector pins for the following: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or the engine harness extension cable(s), whichever has the damaged pins. • Repair the engine harness or the engine harness extension cable(s). Refer to Procedure 019-240. • Replace the engine harness or the engine harness extension cable(s). Refer to Procedure 019-043. • Dry the connector by using electrical contact cleaner, Part No. 3824510.	4A



19400007

STEP 2B: Check for an open circuit in the unswitched battery supply circuit.

⚠CAUTION⚠

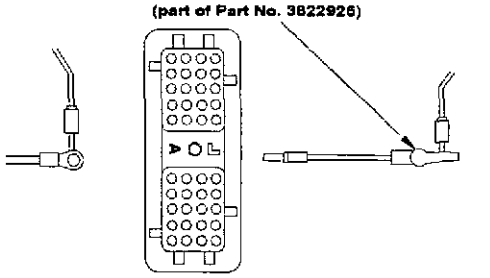
To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male AMP/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the battery.

Action	Specifications/Repair	Next Step
Check for an open circuit in the unswitched battery supply circuit as follows: • measure the resistance from pin 38 of the engine harness adaptor cable connector to the positive battery connection on the engine harness • measure the resistance from pin 16 thru pin 20 of the engine harness adaptor cable connector to the positive battery connection on the engine harness.	**OK** **Less than 10 Ohms**	2C
	NOT OK	2B-1

Part No. 3822758
(part of Part No. 3822926)



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STEP 2B-1: Check for an open in the engine harness adaptor cable and any extension cable used.

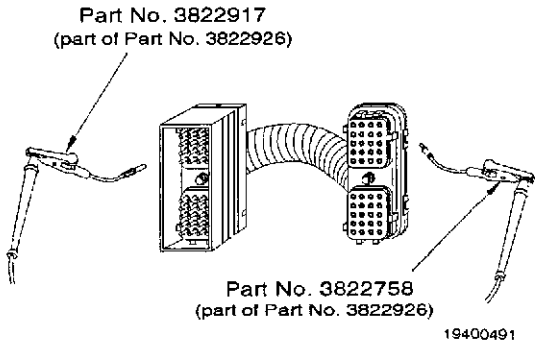
⚠CAUTION⚠

**To avoid pin and harness damage, use the following test leads when taking a measurement:
Part No. 3822758 - male AMP/Metri-Pack test lead.**

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from any engine harness extension cable(s).

Action	Specifications/Repair	Next Step
Check for an open circuit in the unswitched battery supply circuit as follows: • measure the continuity for pin 38 of the engine harness adaptor cable and any engine *harness extension cable(s) used.* • measure the continuity for pins 16 thru 20 of the engine harness adaptor cable and any engine harness extension cable(s) used.	**OK** **Less than 10 Ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to *Procedures 019-240 and 019-197.*** • **Replace the engine harness. Refer to Procedure 019-043.**	4A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedures 019-240 and 019-197. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	4A



STEP 2C: Check for a short circuit from pin to pin in the unswitched battery supply.

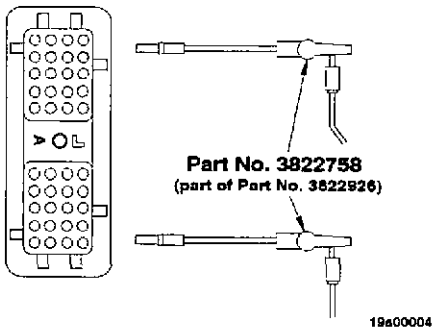
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the battery.

Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin in the unswitched battery supply as follows: • measure the resistance from pin 38 of the engine harness adaptor cable connector to all other pins in the connector except pins 16 thru 20 • measure the resistance from pins 16 thru 20 of the engine harness adaptor cable connector to all other pins in the connector except pins 38 and 16 thru 20.	**OK** **More than 100k ohms**	2D
	NOT OK	2C-1



STEP 2C-1: Check for a short circuit from pin to pin in the engine harness adaptor cable and any extension cable used.

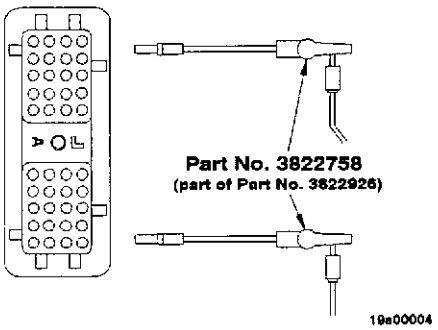
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).
- Disconnect the engine harness adaptor cable from the ECM.

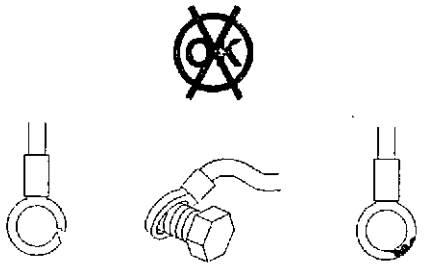
Action	Specifications/Repair	Next Step
Check for a short circuit from pin to pin in the unswitched battery supply as follows: • measure the resistance from pin 38 of the engine harness adaptor cable connector and any engine harness extension cable connectors to all other pins in the connector except pins 16 thru 20 • measure the resistance from pins 16 thru 20 of the engine harness adaptor cable connector and any engine harness extension cable connectors to all other pins in the connector except pins 38 and 16 thru 20.	**OK** **More than 100k ohms** **Repair or replace the engine harness** • **Repair the engine harness. Refer to Procedures 019-240 and 019-197.** • **Replace the engine harness. Refer to Procedure 019-043.**	4A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedures 019-240 and 019-197. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	4A



STEP 2D: Check the engine harness ground connection.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from the battery.

Action	Specifications/Repair	Next Step
Check the engine harness ground connection for the following: • broken connections • corroded connections • loose connections • excessive paint, oil, or dirt.	**OK** **No damaged connections**	2E
	NOT OK **Repair or replace engine harness** • Repair the engine harness. Refer to Procedure 019-197. • Replace the engine harness. Refer to Procedure 019-043.	4A



19400088

STEP 2E: Check for an open circuit in the block ground circuit.

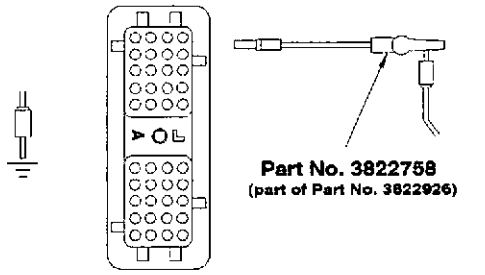
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness adaptor cable from the ECM.
- Disconnect the engine harness from engine block ground.

Action	Specifications/Repair	Next Step
Check for an open circuit in the block ground circuit as follows: • measure the resistance from pins 26 thru 30 of the engine harness adaptor cable connector to the engine block ground connection on the engine harness.	**OK** **Less than 10 ohms**	3A
	NOT OK	2E-1



Part No. 3822758
(part of Part No. 3822926)

19a00005

STEP 2E-1: Check for an open circuit in the block ground circuit in the engine harness adaptor cable and any extension cable used.

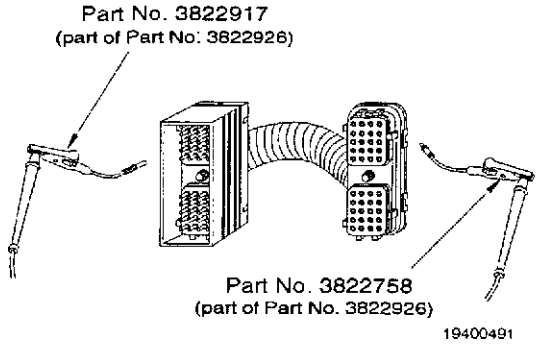
⚠CAUTION⚠

To avoid pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller **not** in the diagnostic mode.
- Disconnect the engine harness from the engine harness extension cable(s).
- Disconnect the engine harness adaptor cable from the ECM.

Action	Specifications/Repair	Next Step
Check for an open circuit in the block ground circuit as follows: • measure the continuity for pins 26 thru 30 of the engine harness adaptor cable and any engine harness extension cable(s) used.	**OK** **Less than 10 ohms** **Repair or replace engine harness** • **Repair the engine harness. Refer to Procedure 019-197 and 019-240.** • **Replace the engine harness. Refer to Procedure 019-043.**	4A
	NOT OK **Repair or replace the engine harness adaptor cable or engine harness extension cable(s), whichever is found faulty** • Repair the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedures 019-240 and 019-197. • Replace the engine harness adaptor cable or engine harness extension cable(s). Refer to Procedure 019-043.	4A



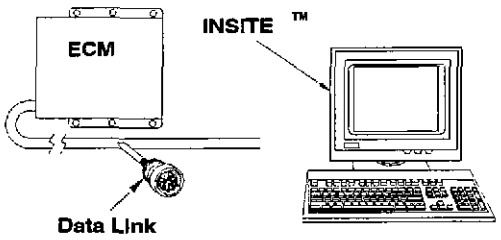
STEP 3: Perform a controller reset.

STEP 3A: Perform a partial controller reset.

Condition:

- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

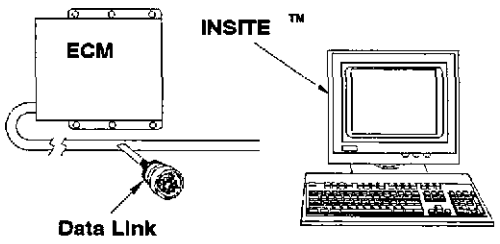
Action	Specifications/Repair	Next Step
Perform a partial reset on the controller. • Using INSITE™, Part No. 3825145, pull down the "Tools" menu and select "Controller Partial Reset".	**OK** **Fault Code 342 or 346 inactive**	3B
	NOT OK	3B



STEP 3B: Perform a master controller reset.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Perform a master reset on the controller. • Using INSITE™, Part No. 3825145, pull down the "Tools" menu and select "Controller Master Reset". **NOTE:** Performing a master reset on the controller will cause all data (fault code data, parameter settings, ECM time and engine run time) in the ECM to be lost. You must configure all adjustable parameters to their original settings after performing the reset.	**OK** **Fault Code 342 or 346 inactive**	4A
	NOT OK	

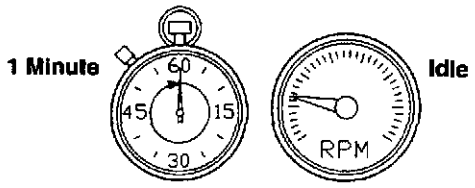


STEP 4: Clear the fault code.

STEP 4A: Disable the fault code.

Condition:
- *Connect all of the components.*

Action	Specifications/Repair	Next Step
Disable the fault code as follows: • connect all components • start engine and idle for one minute	**OK** **Fault Code 342 or 346 inactive**	4B
	NOT OK Return to troubleshooting steps or contact your local Cummins Authorized Repair Location if all steps have been completed and rechecked.	1A

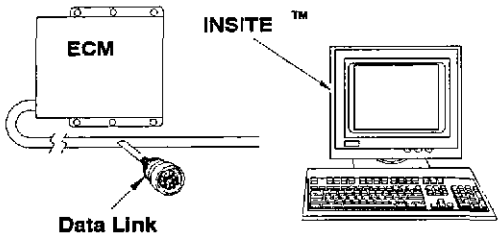


19400011

STEP 4B: Clear any inactive fault codes.

Condition:
- Connect all of the components.

Action	Specifications/Repair	Next Step
Clear any inactive fault codes. • Erase inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes.**	Appropriate trouble-shooting chart



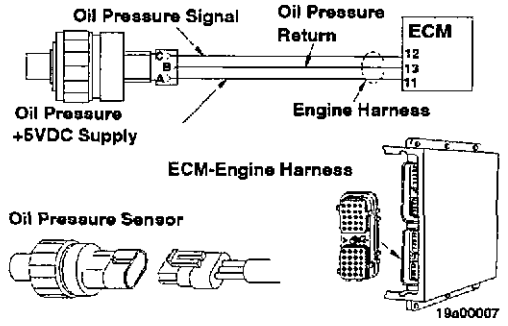
19a00006

Fault Code 415

Oil Pressure - Engine Protection

CODES	REASON	EFFECT
Fault Code: 415 PID(P), SID(S): FMI: SRT: 00-367	Engine oil pressure has dropped below the alarm (shutdown) threshold for low oil pressure.	Engine will shutdown. Common Alarm output is energized. Low Oil Pressure (LOP) relay driver is energized.

Oil Pressure Sensor (OPS) Circuit



Circuit Description:

The OPS is used by the electronic control module (ECM) to monitor the lubricating oil pressure. The ECM monitors the voltage on the signal pin and converts this to a pressure value. The oil pressure value is used by the ECM for the engine protection system.

Component Location:

The OPS is located on the left bank of the engine block above the fuel pump.

Shop Talk:

- Confirm that the OPS supply voltage is between 4.75 and 5.25 VDC at the sensor. See Fault Code 141.
- Oil pressure is a function of the engine speed, oil level and regulator function. Operating the engine at a low speed under load will **not** cause the oil pressure to be low unless the oil is hot, at a low level, regulator has malfunctioned or a loss is occurring somewhere in the system.

TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the sensor accuracy.		
STEP 1A: Verify the sensor accuracy with a mechanical gauge.	Sensor reading is correct	
STEP 2: Clear the fault code.		
STEP 2A: Disable the fault code.	Fault Code 415 inactive	
STEP 2B: Clear the inactive fault codes.	All the faults cleared	

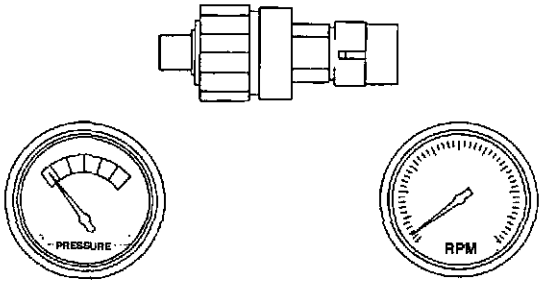
TROUBLESHOOTING STEP

STEP 1: Check the sensor accuracy.

STEP 1A: Verify the sensor accuracy with a mechanical gauge.

Condition:
- Stop/Run switch in the "STOP" position.
- Controller in the diagnostic mode.

Action	Specifications/Repair	Next Step
Verify the sensor accuracy with a mechanical gauge. • Connect a mechanical oil pressure gauge of known quality and calibration to the engine at one of the plugs on top of the oil filter head. • Connect INSITE™, Part No. 3825145, to the data link. • Start the engine and compare the oil pressure reading on the monitor screen to the reading on the mechanical oil pressure gauge. **NOTE:** The engine speed will have to be increased to make it easier to see the differences in the readings.	**OK** ***Sensor reading is correct.***	2A
	NOT OK **Go To Fault Code 141**	Fault Code 141



19400141

STEP 2: Clear the fault code.

STEP 2A: Disable the fault code.

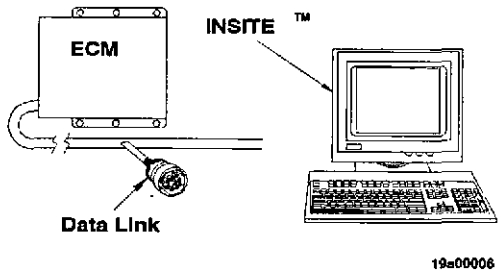
Condition:
- Connect all the components.

Action	Specifications/Repair	Next Step
Disable the fault code. • Connect all the components. • Start the engine and let it idle for one minute. **NOTE:** If fault was at a particular speed, run engine at that speed to verify problem is corrected.	**OK** **Fault Code 415 inactive**	2B
	NOT OK Return to the troubleshooting steps or contact your local Cummins Authorized Repair Location if all the steps have been completed and checked again.	1A

STEP 2B: Clear the inactive fault codes.

Condition:
- Connect all the components.

Action	Specifications/Repair	Next Step
Clear inactive fault codes • Erase the inactive fault codes using INSITE™, Part No. 3825145. **NOTE:** The datalink connector is located on the right bank of the flywheel housing.	**OK** **All the faults cleared**	Repair complete
	NOT OK **Troubleshoot any remaining active fault codes**	Appropriate trouble-shooting chart



NOTES

Section TS - Troubleshooting Symptoms

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Procedures and Techniques

A thorough analysis of the customer's complaint is the key to successful troubleshooting. The more information known about a complaint, the faster and easier the problem can be solved.

The Troubleshooting Symptom Charts are organized so that a problem can be located and corrected by doing the easiest and most logical things first. Complete all steps in the sequence shown from top to bottom.

It is **not** possible to include all the solutions to problems that can occur; however, these charts are designed to stimulate a thought process that will lead to the cause and correction of the problem.

Follow these basic troubleshooting steps:

- Get all the facts concerning the complaint
- Analyze the problem thoroughly
- Relate the symptoms to the basic engine systems and components
- Consider any recent maintenance or repair action that can relate to the complaint
- Double-check before beginning any disassembly
- Solve the problem by using the symptom charts and doing the easiest things first
- Determine the cause of the problem and make a thorough repair
- After repairs have been made, operate the engine to make sure the cause of the complaint has been corrected

Troubleshooting Symptoms Charts

Use the charts on the following pages of this section to aid in diagnosing specific engine symptoms. Read each row of blocks from top to bottom. Follow through the chart to identify the corrective action.

Communication Error — Electronic Service Tool or Control Device

This is symptom tree T016.

Cause	Correction
Verify that INSITE™ is working and that the correct software is being used	Refer to the INSITE™ QST30 G-Drive User's Manual.
OK ▼	
INSITE™ is addressing the wrong communication port	Select System Menu/User Options and change the communication port setting. Refer to Communication Messages in the INSITE™ Help menu and the appropriate INSITE™ User's Manual.
OK ▼	
Data link cable is **not** connected correctly	Check the cable connections. Refer to the electronic service tool manual.
OK ▼	
Electronic control module (ECM) is **not** powered	Make sure the ECM is operating in either diagnostic mode or run mode. Refer to Section F.
OK ▼	
Data link circuit is malfunctioning	Check the data link circuit. Refer to Procedure 019-026.
OK ▼	
Moisture in the wiring harness connectors	Dry the connectors with Cummins electronic cleaner, Part No. 3824510.
OK ▼	
Battery voltage supply to the electronic control module (ECM) has been lost	Check the battery connections. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134. Check the *unswitched battery supply circuit. Refer to* Procedure 019–087.
OK ▼	
Electronic control module (ECM) is malfunctioning	Replace the ECM. Refer to Procedure 019-031.

Engine Acceleration or Response Poor

This is symptom tree T033.

Cause	Correction
Verify the complaint	Test the engine operation while under load. Perform an engine acceleration test. Perform an engine load test. Observe the commanded rack position with INSITE™.
OK ↓	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ↓	
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool manual.
OK ↓	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ↓	
Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to the OEM specifications.
OK ↓	
Intake manifold air temperature is below specification	Refer to the Coolant Temperature Below Normal symptom tree in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Coolant temperature sensor is malfunctioning	Check the coolant temperature sensor. Refer to Procedure 019-019.
OK ↓	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ↓	

(Continued)

Engine Acceleration or Response Poor (Continued)

Cause	Correction
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel drain line restriction	Check the fuel drain lines for restriction. Clear or replace the fuel lines, check valves, or tank vents as necessary.
OK ▼	
Engine is operating above recommended altitude	Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
OK ▼	
Air intake or exhaust leaks	Visually inspect the air intake and exhaust systems for air leaks. Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting.
OK ▼	
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	

(Continued)

Engine Acceleration or Response Poor (Continued)

Cause	Correction
Exhaust system restriction	Check the exhaust system for restrictions.
OK ↓	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Debris in the fuel passages	Check the fuel tubes, fuel manifold, and cylinder head drillings for debris.
OK ↓	
Fuel inlet temperature to pump is above specification	Fill the fuel tank, turn off or bypass the fuel heaters, and check the fuel cooler. Refer to the OEM service manuals.
OK ↓	
Debris in the fuel passages	Check the fuel tubes, fuel manifold, and cylinder head drillings for debris.
OK ↓	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ↓	
Fuel transfer pump inlet screen is plugged	Clean or replace the fuel pump inlet screen.
OK ↓	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Decelerates Slowly

This is symptom tree T041.

Cause	Correction
Electronic fault codes active or high counts of inactive fault codes	*Refer to Section TF for fault code troubleshooting.*
OK ↓	
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool manual.
OK ↓	
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.

Engine Difficult to Start or Will Not Start (Exhaust Smoke)

This is symptom tree T043.

Cause	Correction
Fuel level low in the tank	Fill the supply tank.
OK ▼	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ▼	
Starting aid is necessary for cold weather or starting aid is malfunctioning	Check for correct operation of the starting aid. Refer to the manufacturer's instructions. Refer to Cold Weather Starting Aids in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	
Engine cranking speed is too low	Check the engine cranking speed with a hand held tachometer or electronic service tool.If the cranking speed is lower than 150 rpm, refer to the Engine Will Not Crank or Cranks Slowly symptom tree. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Engine idle speed is set too low (electronic controlled fuel systems)	Verify the correct idle speed setting. Increase the idle speed with INSITE™.
OK ▼	
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. Refer to Procedure 019-042 and 019–106.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	

(Continued)

Engine Difficult to Start or Will Not Start (Exhaust Smoke) (Continued)

Cause	Correction
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel transfer pump inlet screen is plugged	Clean or replace the fuel pump inlet screen.
OK ↓	
Fuel shutoff valve(s) closed (electronic controlled injection)	Check the fuel shutoff valve and circuit. Refer to Procedures 019-049 and 019-050.
OK ↓	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Exhaust system restriction	Check the exhaust system for restrictions.
OK ↓	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Debris in the fuel passages	Check the fuel tubes, fuel manifold, and cylinder head drillings for debris.
OK ↓	

(Continued)

Engine Difficult to Start or Will Not Start (Exhaust Smoke) (Continued)

Cause	Correction
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Difficult to Start or Will Not Start (No Exhaust Smoke)

This is symptom tree T044.

Cause	Correction
Fuel level low in the tank	Fill the supply tank.
OK	
Fuel shutoff valve(s) closed (electronic controlled injection)	Check the fuel shutoff valve and circuit. Refer to Procedures 019-049 and 019-050.
OK	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK	
Battery voltage supply to the electronic control module (ECM) has been lost	Check the battery connections. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134. Check the unswitched battery supply circuit. Refer to Procedure 019–087.
OK	
Run signal to the ECM has been lost	Check the Stop/Run switch and circuit. Refer to Procedures 019–014 and 019–015.
OK	
Fuel inlet restriction	Check for fuel inlet restriction.
OK	
In-line check valve(s) are installed backwards or have incorrect part number	Check the check valve(s) for correct installation and part number.
OK	
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK	

(Continued)

Engine Difficult to Start or Will Not Start (No Exhaust Smoke) (Continued)

Cause	Correction
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. Refer to Procedure 019-042 and 019–106.
OK ▼	
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Exhaust system restriction	Check the exhaust system for restrictions.
OK ▼	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Power Output Low

This is symptom tree T057.

Cause	Correction
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ▼	
Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to the OEM specifications.
OK ▼	
Lubricating oil level is above specification	Check the oil level. Verify the dipstick calibration and oil pan capacity. Fill the system to the specified level. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel level low in the tank	Fill the supply tank.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	*Refer to Section TF for fault code troubleshooting.*
OK ▼	
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool manual.
OK ▼	
Electronic control module (ECM) is **not** *correct*	Check the ECM part number and compare it to the Control Parts List, Bullectin No. 3379133. Replace the ECM if necessary. Refer to Procedure 019–031.
OK ▼	

(Continued)

Engine Power Output Low (Continued)

Cause	Correction
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. Refer to Procedure 019-042 and 019–106.
OK ▼	
Fuel leaks	Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	
Fuel drain line restriction	Check the fuel drain lines for restriction. Clear or replace the fuel lines, check valves, or tank vents as necessary.
OK ▼	
Intake manifold air temperature is above specification	Check the aftercooler element for coolant restriction and refer to the Coolant Temperature is Above Specification symptom trees in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Intake manifold air temperature is below specification	Refer to the Coolant Temperature Below Normal symptom tree in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Exhaust system restriction	Check the exhaust system for restrictions.
OK ▼	

(Continued)

Engine Power Output Low (Continued)

Cause	Correction
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ▼	
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel transfer pump inlet screen is plugged	Clean or replace the fuel pump inlet screen.
OK ▼	
Air intake or exhaust leaks	Visually inspect the air intake and exhaust systems for air leaks. Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting.
OK ▼	
Turbocharger is **not** correct	Check the turbocharger part number and compare it to the Control Parts List (CPL), Bulletin No. 3379133. Replace the turbocharger if necessary.
OK ▼	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel inlet temperature to pump is above specification	Fill the fuel tank, turn off or bypass the fuel heaters, and check the fuel cooler. Refer to the OEM service manuals.
OK ▼	

(Continued)

Engine Power Output Low (Continued)

Cause	Correction
Static injection timing is **not** correction	Check the static injection timing when installing the fuel injection pump. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Debris in the fuel passages	Check the fuel tubes, fuel manifold, and cylinder head drillings for debris.
OK ↓	
Engine is operating above recommended altitude	Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
OK ↓	
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Runs Rough or Misfires

This is symptom tree T062.

Cause	Correction
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	
Fuel drain line restriction	Check the fuel drain lines for restriction. Clear or replace the fuel lines, check valves, or tank vents as necessary.
OK ▼	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	
Electronic control module (ECM) is **not** correct	Check the ECM part number and compare it to the Control Parts List, Bullectin No. 3379133. Replace the ECM if necessary. Refer to Procedure 019–031.
OK ▼	
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. *Refer to Procedure 019-042 and 019–106.*
OK ▼	
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	

(Continued)

Engine Runs Rough or Misfires (Continued)

Cause	Correction
Static injection timing is **not** correction	Check the static injection timing when installing the fuel injection pump. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ↓	
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Engine mounts are worn, damaged, or **not** correct	Visually check the engine mounts. Refer to the OEM service manual.
OK ↓	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Debris in the fuel passages	Check the fuel tubes, fuel manifold, and cylinder head drillings for debris.
OK ↓	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Shuts Off Unexpectedly or Dies During Deceleration

This is symptom tree T064.

Cause	Correction
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	
If engine will **not** restart	Refer to the Engine Difficult to Start or Will Not Start symptom tree T043 and T044.
OK ▼	
Battery voltage supply to the electronic control module (ECM) has been lost	Check the battery connections. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134. Check the unswitched battery supply circuit. Refer to Procedure 019–087.
OK ▼	
Run signal to the ECM has been lost	Check the Stop/Run switch and circuit. Refer to Procedures 019–014 and 019–015.
OK ▼	
Fuel shutoff valve(s) closed (electronic controlled injection)	Check the fuel shutoff valve and circuit. Refer to Procedures 019-049 and 019-050.
OK ▼	
OEM engine protection system is malfunctioning	Isolate the OEM engine protection system. Follow the OEM service manuals to check for a malfunction.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	

(Continued)

Engine Shuts Off Unexpectedly or Dies During Deceleration (Continued)

Cause	Correction
Fuel drain line restriction	Check the fuel drain lines for restriction. Clear or replace the fuel lines, check valves, or tank vents as necessary.
OK ⬇	
Electronic control module (ECM) is malfunctioning	Replace the ECM. Refer to Procedure 019-031.
OK ⬇	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Speed Surges at Low or High Idle

This is symptom tree T066.

Cause	Correction
Fuel level low in the tank	Fill the supply tank.
OK ⬇	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ⬇	
Air in the fuel system	Check for air in the fuel system. Completely bleed air from the fuel system. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ⬇	
Engine idle speed is set too low (electronic controlled fuel systems)	Verify the correct idle speed setting. Increase the idle speed with INSITE™.
OK ⬇	
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. Refer to Procedure 019-042 and 019–106.
OK ⬇	
Fuel transfer pump inlet screen is plugged	Clean or replace the fuel pump inlet screen.
OK ⬇	
Alternator is malfunctioning	Temporarily disconnect the alternator and run the engine. Replace the alternator if necessary. Refer to the OEM service manuals.
OK ⬇	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ⬇	

(Continued)

Engine Speed Surges at Low or High Idle (Continued)

Cause	Correction
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Static injection timing is **not** correction	Check the static injection timing when installing the fuel injection pump. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ↓	
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.

Engine Will Not Reach Rated Speed (RPM)

This is symptom tree T080.

Cause	Correction
Tachometer is **not** calibrated or is malfunctioning	Compare the tachometer reading with a hand tachometer or an electronic service tool reading. Calibrate or replace the tachometer as necessary. Refer to the OEM service manuals.
OK ▼	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool manual.
OK ▼	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to the OEM specifications.
OK ▼	
Engine speed sensor (ESS) or circuit is malfunctioning	Check the ESS for correct adjustment and for debris on the sensor. Check the ESS circuit. Refer to Procedure 019-042 and 019–106.
OK ▼	

(Continued)

Engine Will Not Reach Rated Speed (RPM) (Continued)

Cause	Correction
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Engine Will Not Shut Off

This is symptom tree T081.

Cause	Correction
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ↓	
Stop/Run switch circuit is malfunctioning	Check the Stop/Run switch circuit. Refer to Porcedure 019–015.
OK ↓	
Engine is running on fumes drawn into the air intake	Check the air intake ducts. Locate and isolate the source of the fumes. Repair as necessary. Refer to the OEM service manuals.
OK ↓	
Turbocharger oil seal is leaking	Check the turbocharger oil seals for leaks.

Fuel Consumption Excessive

This is symptom tree T087.

Cause	Correction
Fuel leaks	Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks.
OK ▼	
Lubricating oil level is above specification	Check the oil level. Verify the dipstick calibration and oil pan capacity. Fill the system to the specified level. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Lubricating oil does **not** meet specifications for operating conditions	Change the oil and filters. Use the lubricating oil type recommended in Section V. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Environmental factors are affecting fuel consumption	Consider altitude and ambient air temperature when evaluating fuel consumption. Refer to the engine data sheets for altitude derate information.
OK ▼	
Engine parasitics are excessive	Check engine driven units for correct operation. Check the cooling fan for correct operation and cycle time. Refer to the OEM service manual.
OK ▼	
Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to the OEM specifications.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	

(Continued)

Fuel Consumption Excessive (Continued)

Cause	Correction
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool manual.
OK ⬇	
Air intake or exhaust leaks	Visually inspect the air intake and exhaust systems for air leaks. Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting.
OK ⬇	
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	
Exhaust system restriction	Check the exhaust system for restrictions.
OK ⬇	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	
Turbocharger is **not** correct	Check the turbocharger part number and compare it to the Control Parts List (CPL), Bulletin No. 3379133. Replace the turbocharger if necessary.
OK ⬇	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	

(Continued)

Fuel Consumption Excessive (Continued)

Cause	Correction
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ▼	
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Fuel in Coolant

This is symptom tree T091.

Cause	Correction
Bulk coolant supply is contaminated	Check the bulk coolant supply. Drain the coolant and replace with non-contaminated coolant. Replace the coolant filters. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel heater is malfunctioning (if equipped)	Check the fuel heater and replace if necessary. Refer to the manufacturer's instructions.

Fuel in the Lubricating Oil

This is symptom tree T092.

Cause	Correction
Bulk oil supply is contaminated	Check the bulk oil. Drain the oil and replace with non-contaminated oil. Replace the oil filters. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Engine idle time is excessive	Low oil and coolant temperatures can be caused by long idle time (greater than 10 minutes). Shut off the engine rather than idle for long periods. If idle time is necessary, raise the idle speed. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134
OK ▼	
Fuel pump or injector is leaking fuel	Perform the fluorescent dye tracer test. Check the fuel pump. Check the overhead for an injector leak. Replace the fuel pump or injector(s) if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Smoke, Black — Excessive

This is symptom tree T116.

Cause	Correction
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ⬇	
Air intake system restriction	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	
Exhaust system restriction	Check the exhaust system for restrictions.
OK ⬇	
Air intake or exhaust leaks	Visually inspect the air intake and exhaust systems for air leaks. Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting.
OK ⬇	
Static injection timing is **not** correction	Check the static injection timing when installing the fuel injection pump. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	
Turbocharger is **not** correct	Check the turbocharger part number and compare it to the Control Parts List (CPL), Bulletin No. 3379133. Replace the turbocharger if necessary.
OK ⬇	
Turbocharger oil seal is leaking	Check the turbocharger oil seals for leaks.
OK ⬇	
Overhead adjustments are **not** correct	*Adjust the overhead settings. Refer to the* Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ⬇	

(Continued)

Smoke, Black — Excessive (Continued)

Cause	Correction
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Fuel injection pump is malfunctioning	Remove and test the fuel injection pump. Replace the pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

Smoke, White — Excessive

This is symptom tree T118.

Cause	Correction
Starting aid is necessary for cold weather or starting aid is malfunctioning	Check for correct operation of the starting aid. Refer to the manufacturer's instructions. Refer to Cold Weather Starting Aids in the Operation and Maintenance Manual, QST30 Engines, Bulletin No. 3666134.
OK ▼	
Engine is cold	Allow the engine to warm to operating temperature. *If the engine will* ***not*** *reach operating* temperature, refer to the Coolant Temperature Below Normal symptom tree in the Operation and Maintenance Manual, QST30 Engines, Bulletin No. 3666134.
OK ▼	
Electronic fault codes active or high counts of inactive fault codes	Refer to Section TF for fault code troubleshooting.
OK ▼	
Coolant temperature sensor is malfunctioning	Check the coolant temperature sensor. Refer to Procedure 019-019.
OK ▼	
Coolant temperature is below specification	Refer to the Coolant Temperature Below Normal symptom tree in the Operation and Maintenance Manual, QST30 Engines, Bulletin No. 3666134.
OK ▼	
Fuel inlet restriction	Check for fuel inlet restriction.
OK ▼	
Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of good fuel. Refer to Fuel Recommendations and Specifications in the Operation and Maintenance Manual, QST30 Engines, Bulletin No. 3666134.
OK ▼	
Overhead adjustments are **not** correct	Adjust the overhead settings. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ▼	

(Continued)

Smoke, White — Excessive (Continued)

Cause	Correction
Static injection timing is **not** correction	Check the static injection timing when installing the fuel injection pump. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Injector is malfunctioning	Replace the malfunctioning injector. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Fuel pump overflow valve is malfunctioning	Check the overflow valve for correct operation.
OK ↓	
Fuel transfer pump is malfunctioning	Check the lift pump for correct operation. Check the pump output pressure. Replace the transfer pump if necessary. Refer to the Operation and Maintenance Manual, QST30 Engine, Bulletin No. 3666134.
OK ↓	
Coolant is leaking into the combustion chamber	Pressurize the cooling system to check for internal coolant leaks. Check the aftercooler, air compressor, and cylinder head.
OK ↓	
Injector protrusion is **not** correct	Check the injector protrusion. Correct protrusion is 4.65 to 5.65 mm [0.183 to 0.222 in].
OK ↓	
Base engine problem	Check the engine for high crankcase pressure, low compression, static injection timing, damaged pistons, camshaft, and other parts.

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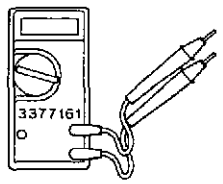
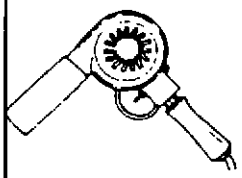
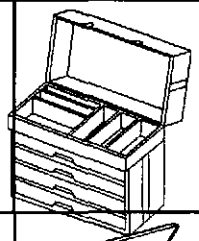
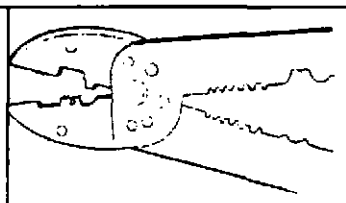
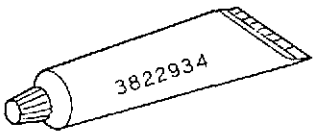
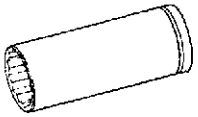
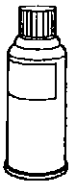
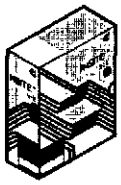
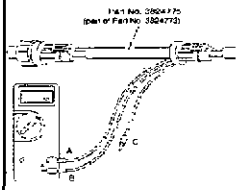
Service Tools

Electronic Engine Controls

The following special tools are recommended to perform procedures in this section. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Cummins Authorized Repair Location.

Tool No.	Tool Description	Tool Illustration
3377161	**Multimeter** Measure electrical circuits; voltage (volts), resistance (ohms), and current (amps).	
3822608	**Weather-Pack Terminal Removal Tool** Used to repair Weather-Pack connectors.	
3822760	**Deutsch Terminal Removal Tool** Used to repair Deutsch 9-Pin connectors.	
3822860	**Heat Gun** Used to repair connector wires.	
3824904	**Wiring Repair Kit** Contains a variety of connectors, pins, seals, terminals, test leads, and other tools used to repair connectors.	
3825189	**QST30 G-Drive Wiring Repair Kit** Contains a variety of connectors, pins, seals, terminals, test leads, and other tools used to repair connectors for the QST30 G-Drive.	

Tool No.	Tool Description	Tool Illustration
3822930	**Wire Crimping Pliers** Used when repairing connector wires.	
3822934	**Lubricant DS-ES** Used to lubricate connector before installation.	
3823843	**Deep Well Socket (1-1/4 inch)** Used to remove and install sensors and actuators.	
3824510	**Electrical Contact Cleaner** Used to clean electrical contacts and connectors.	
3825145	**INSITE™ Software Kit** Used to troubleshoot, program, and adjust QST30 G-Drive system	
3824815	**Deutsch Terminal Removal Tool** Used to repair Deutsch 40-Pin connectors.	
3824775	**Pressure Sensor Break Out Cable** Used to troubleshoot pressure sensor issues.	

3825189 QST 30 G-Drive Engine Wiring Repair Kit Contents

Contents List 3886096

Butt Splice #18-22 — 3823336

Butt Splice #14-16 — 3824001

Cavity Plug Weatherpack — 3823343

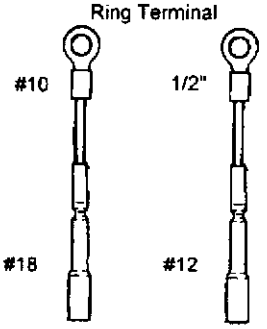
Cavity Plug Deutch — 3824002

Cable Tie 8 Inch — 3822924

Cable Tie 6 Inch — 3822925

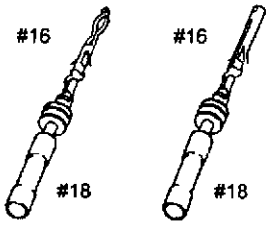
Repair Wires

Ring Terminal



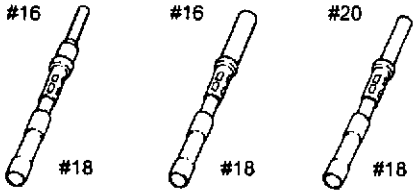
3823760 — 3825181

Weather-Pack



Male 3822922 — Female 3822923

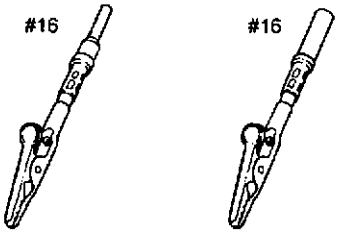
Deutsch



Female 3822920 — Female 3822921 — Female 3824810

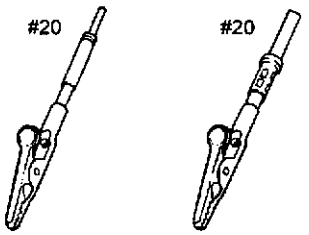
Test Leads

Deutsch



Male 3823993 — Female 3823994

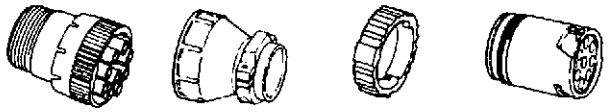
Deutsch / Amp / Cannon / Metri-Pack



Male 3822758 — Female 3822917

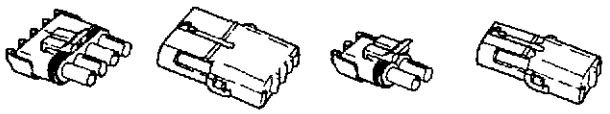
Connectors

Deutsch 9-Terminal



Plug 3824016 — Retainer 3824017 — Receptacle Cap 3825184 — Receptacle 3825182

Weatherpack

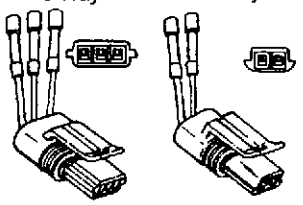


4-Way: Tower 3823342 — Shroud 3823341

2-Way: Tower 3823338 — Shroud 3823337

Connectors

Metri-Pack



3-Way 3823254 — 2-Way 3823256

Connector Seals

Weatherpack

4-Way 3824027 — 2-Way 3824025

Tools

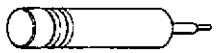
Deutsch Terminal Removal Tool

3822608

Deutsch Terminal Removal Tool

#20 Red 3824815
#16 Blue 3822760

Metri-Pack Term. Pressure Gauge



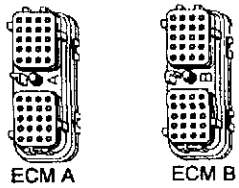
3824792

Terminal Removal Tool Instructions 3377581

Connectors

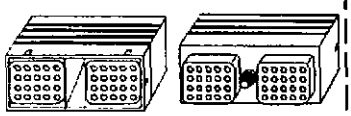
Deutsch

40 Terminal #20 Size



ECM A 3824817 — ECM B 3824818

40 Terminal #16 Size

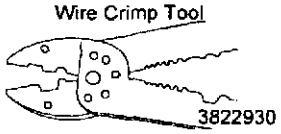


Receptacle 3825179 — Plug 3825180

Optional Items

3822934

Wire Crimp Tool



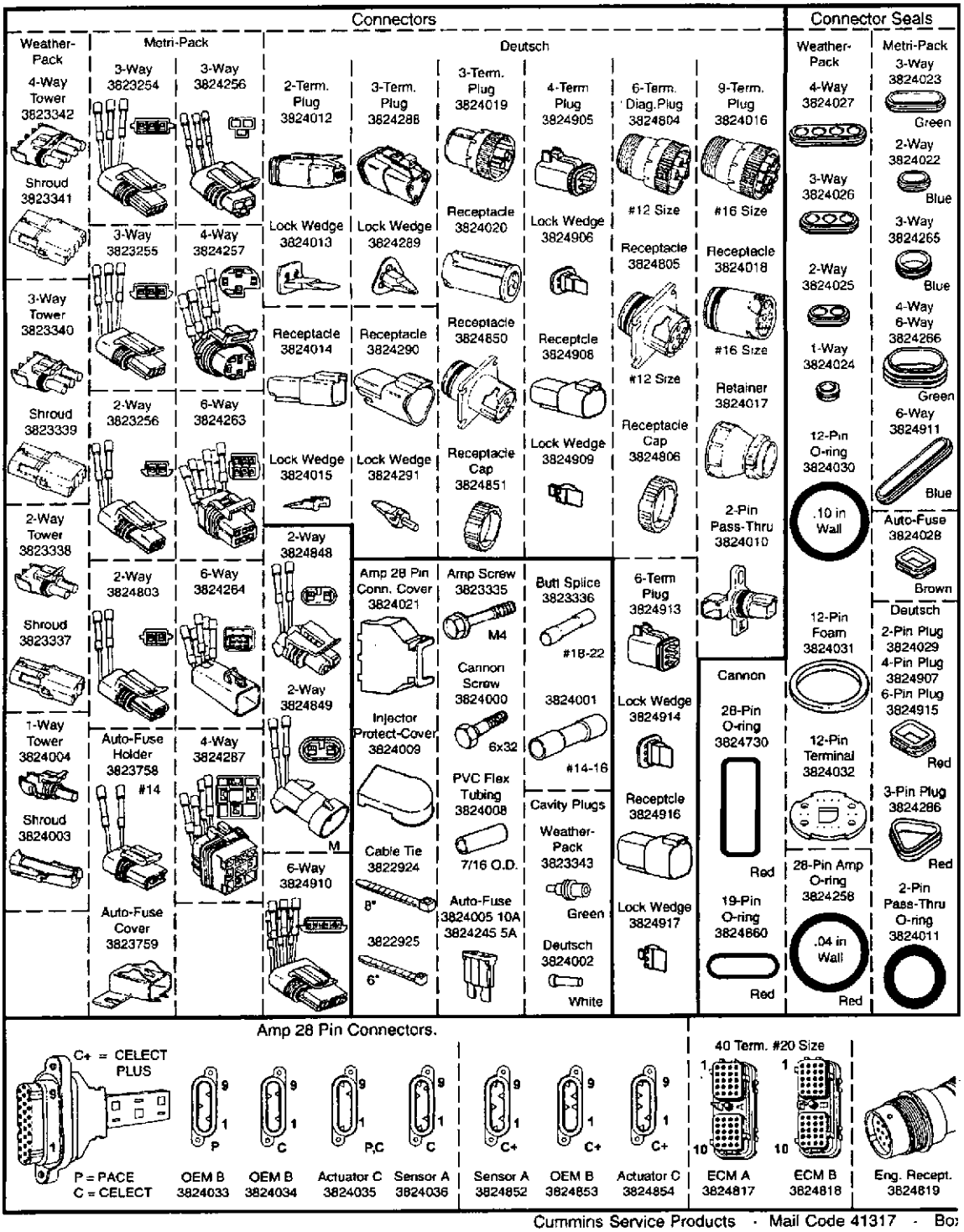
3822930

Storage Box

3822933

19a00102

3824904 CELECT / PACE / PACER / CENTRY / CENSE / QUANTUM Engine Wiring Repair Kit Contents



19400493

Contents List 3377690

Repair Wires

Ring Terminal

5/16" 3824006 — #18
#10 3823760 — #18
1/4" 3824733 — #18
3/8" 3824007 — #14
1/2" 3823761 — #18

Weather-Pack

Male

3823998 — #12 / #14
3822922 — #16 / #18

Female

3823999 — #12 / #14
3822923 — #16 / #18

Deutsch

Male

3824807 — #12 / #18
3822920 — #16 / #18
3824809 — #20 / #18

Female

3824808 — #12 / #18
3822921 — #16 / #18
3824810 — #20 / #18

Amp

Female

3822919 — #18

Test Leads

Weather-Pack

Male

3823995 — #12
3824811 — #16

Female

3823996 — #12
3824812 — #16

Deutsch

Male

3823993 — #16
3822758 — #20

Female

3823994 — #16
3822917 — #20

Deutsch Amp/Cannon Metri-Pack

Male

3822758 — #20

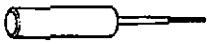
Female

3822917 — #20

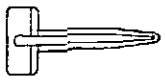
Captive Nut 3823252

Push-On 3823253

Amp Terminal Removal Tool — 3822759

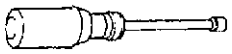


Deutsch Terminal Removal Tool



#20 Red	3824815
#16 Blue	3822760
#12 Yellow	3824816

Braid Removal Tool — 3822932

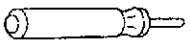


Nut Driver

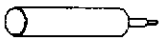
1/4 in.	3824244
7 mm	3823257

Terminal Removal Tool Instructions — 3377581

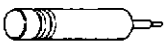
Weather-Pack Terminal Removal Tool — 3822608



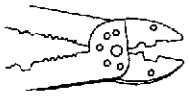
Amp Terminal Depth/Press. Gauge — 3823383



Metri-Pack Terminal Pressure Gauge — 3824792



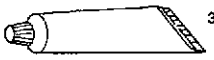
Wire Crimp Tool — 3822930



Storage Box 3822933

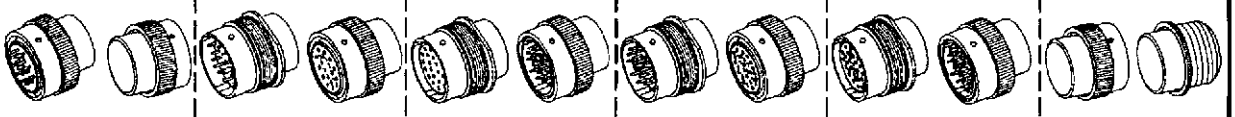
Not part of Kit. Available on request.

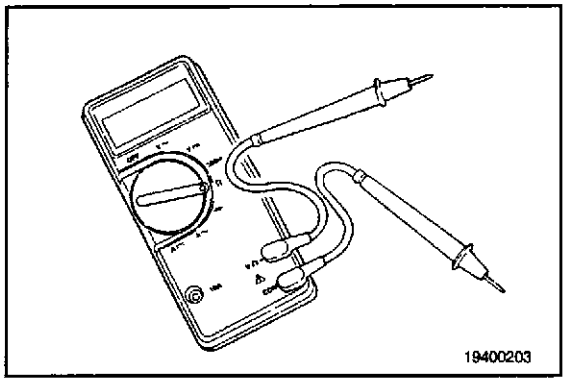
Lubricant — 3822934



Deutsch 40, 14, 21, 23, 31 and 33 Terminal Connectors.

14-Term.		21-Term.		23-Term.		31-Term.		33-Term.		21, 23, 31, and 33-Term.	
OEM Plug 3824820	Recept. Cap 3824821	Eng. Recept. 3824823	OEM Plug 3824824	Eng. Recept. 3824813	Eng. Plug 3824814	Eng. Recept. 3824825	OEM Plug 3824826	Eng. Recept. 3824802	Eng. Plug 3824874	Recept. Cap 3824827	Plug Cap 3824828





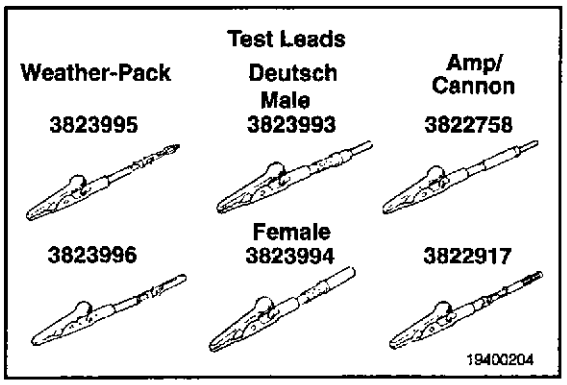
Electronic Engine Controls - General Information

General Information

How To Use A Multimeter

On most meters, the negative (black) meter lead **must** be plugged in the "COM" position and the positive (red) meter lead **must** be plugged into one of the positions marked for current, resistance, or voltage. Refer to the manufacturer's instructions for more detail.

NOTE: When measuring to a block ground, use a clean unpainted metal surface to obtain an accurate measurement.

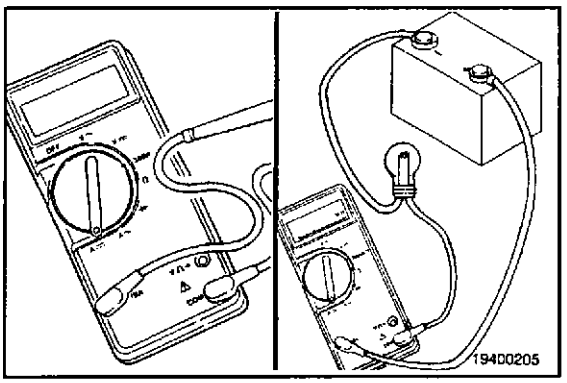


Use of Special Test Leads

⚠ CAUTION ⚠

To avoid pin and harness damage, use the following test leads when taking a measurement:

- Male Cannon, Metri-Pack and Deutsch test lead, Part No. 3822758
- Female Amp, Metri-Pack and Deutsch test lead, Part No. 3822917
- Male Deutsch test lead, Part No. 3823993
- Female Deutsch test lead, Part No. 3823994
- Male Weather-Pack test lead, Part No. 3823995
- Female Weather-Pack test lead, Part No. 3823996



How To Measure Current

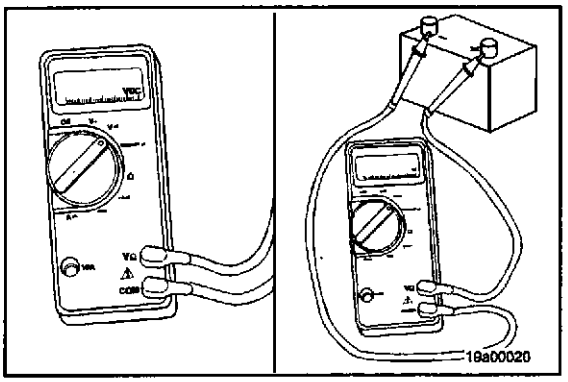
Make an open circuit at the place where the current needs to be measured.

Select the AC current (A ~) or DC current (A –) function on the meter.

Turn on the power in the circuit being measured.

Put the leads of the meter across the open circuit to measure the current.

Read the displayed measurement.



How To Measure Voltage

Select the AC voltage (V ~) or DC voltage (V –) function on the meter.

Turn on the power in the circuit being measured.

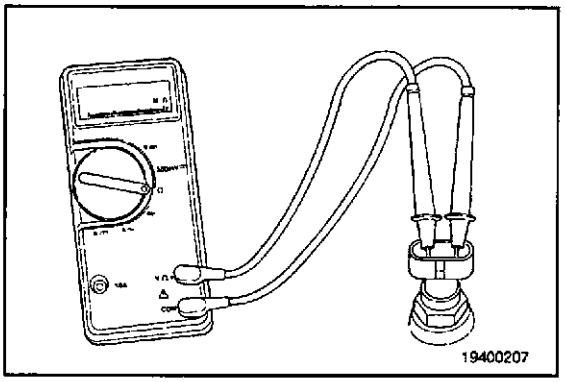
Put the leads of the meter in parallel with the component to measure the voltage potential difference between the two points of the component.

How To Measure Resistance

Select the resistance function on the meter.

Verify that there is **no** power to the components being tested.

Put the leads of the meter in parallel with the component to measure resistance.



How To Find The Internal Resistance of The Meter

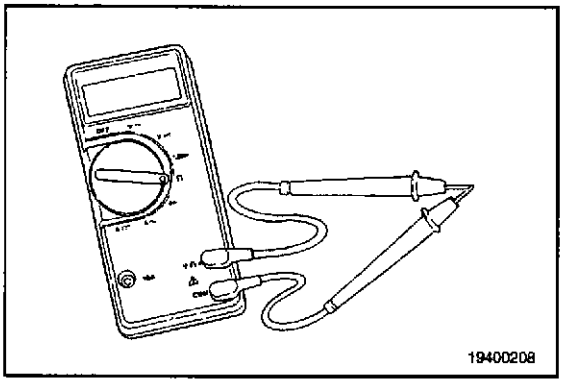
It is important to know the internal resistance of the meter when measuring small resistances. To accurately measure small resistances, the internal resistance of the meter **must** be subtracted from the measured resistance.

Turn the meter on.

Set the meter to the lowest ohm scale.

Measure the resistance across the meter test leads (including special test leads if they are being used).

"ZERO" the meter or subtract this value when taking measurements.



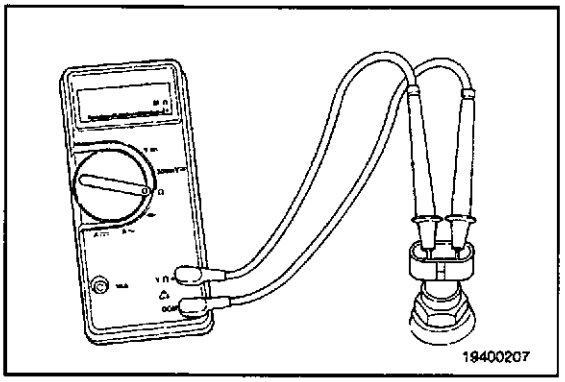
How To Test For Continuity

Select the continuity function on the meter (usually marked with a diode symbol).

Make sure there is **no** power to the component being measured.

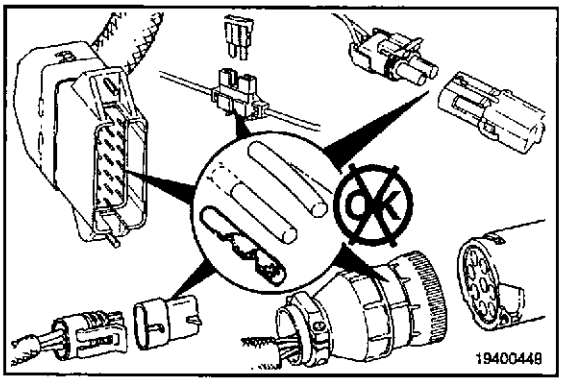
Put the leads of the meter in parallel with the component to test continuity.

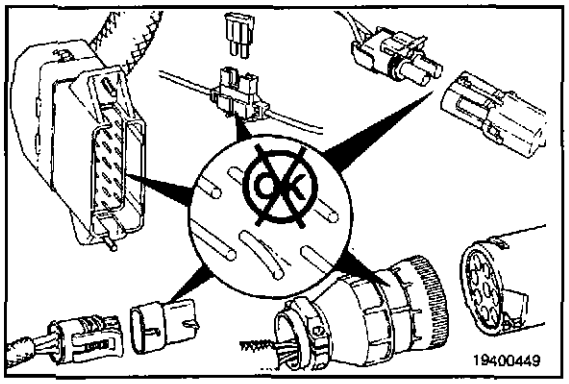
The meter will beep if the resistance is less than about 150 Ohms. If there is an open circuit, the meter will **not** beep.



Connector Pins — Checking

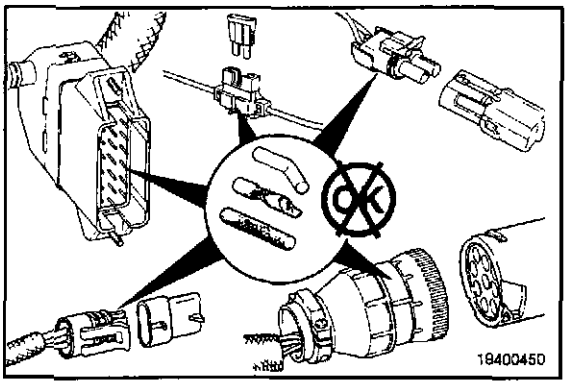
When disconnecting connectors during troubleshooting, the pins **must always** be inspected to make sure they are **not** the cause of a bad connection. The three things to look for are bent, corroded, and pushed back pins.





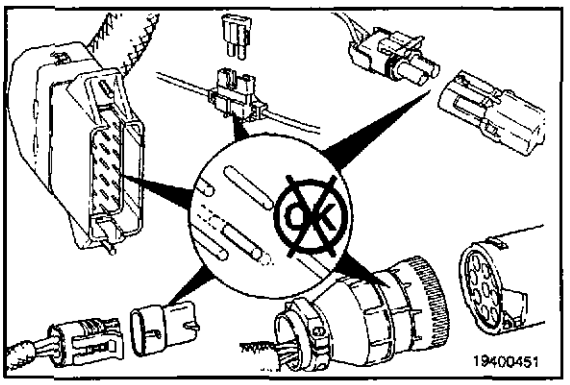
Bent Pins

Inspect the male terminals of the connector. If any of the terminals are bent so that they will **not** easily mate with the other side of the connector, then the pin **must** be replaced. Refer to the connector repair section for the specific connector in question.



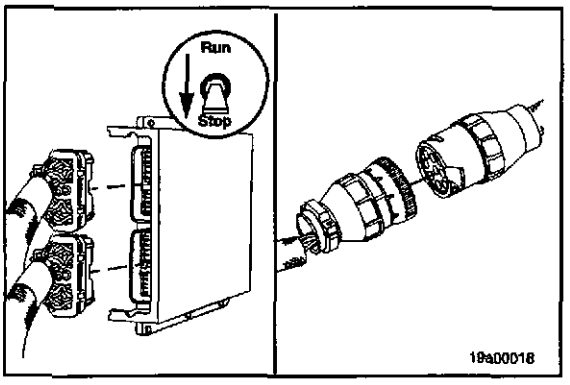
Corroded Pins

Inspect both the male and female terminals for corrosion which can cause a poor electrical connection within the connector. If any corrosion is evident on the pins then the corroded pins **must** be replaced. Refer to the connector repair section for the specific connector in question.



Pushed Back Pins

Inspect both the male and female terminals for pins that can **not** make contact because they are pushed back in the connector. To repair, push the pin into the connector body from the back of the connector. Make sure the terminal locks into place. If the terminal will **not** lock into place then replace it. Refer to the connector repair section for the specific connector in question.



Short Circuit To Ground — Check

Short circuit to ground is a condition where a connection from a wire to ground exists when it is **not** supposed to.

The procedure for checking for a short circuit to ground is as follows:

place the Stop/Run switch in the "Stop" position

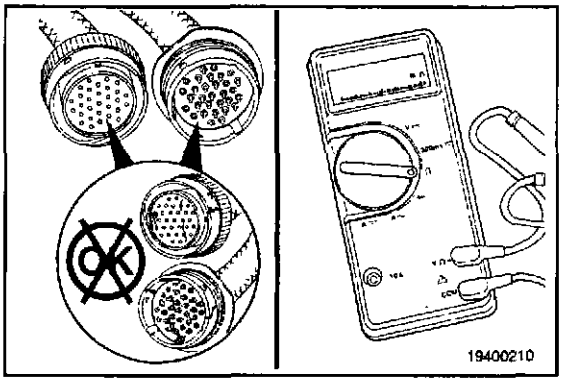
ensure controller is **not** in the diagnostic mode

disconnect the connectors that need to be tested.

When testing a sensor, only the sensor needs to be disconnected. When testing a harness, the harness connector at the ECM and the connector at the sensor or multiple sensors will need to be disconnected.

Identify the pins that need to be tested.

Turn the dial on the multimeter to measure resistance.

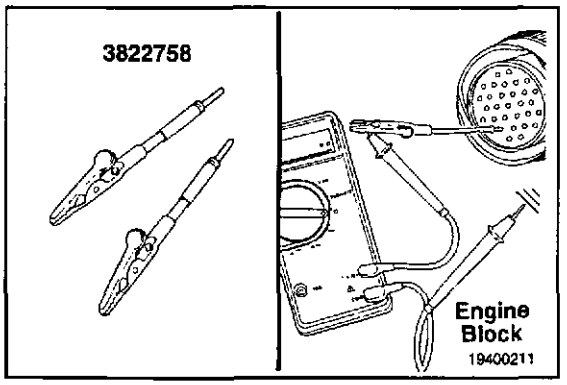


Use the appropriate test leads from the wiring harness repair kit, Part No. 3825189, to avoid damage to the connector pins.

Touch one of the multimeter leads to the correct pin to be tested.

Touch the other lead of the multimeter to the engine block.

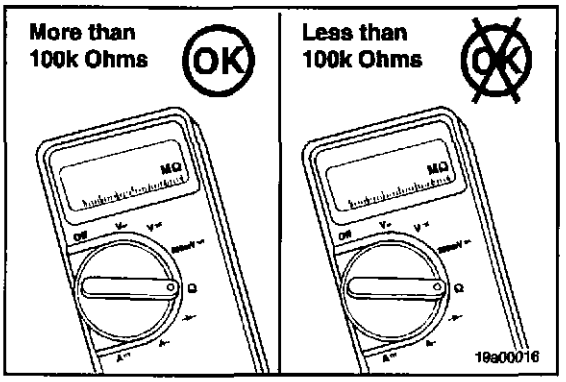
Read the value on the multimeter display.



The multimeter **must** show greater than 100k ohms, which is an open circuit.

If the circuit is **not** open, the wire being checked has a short to ground or to the engine block.

Repair or replace the component or wire.



Short Circuit From Pin To Pin — Check

Short circuit from pin to pin is a condition where an electrical path exists between two pins where it is **not** supposed to exist.

The procedure for checking short circuit from pin to pin is as follows:

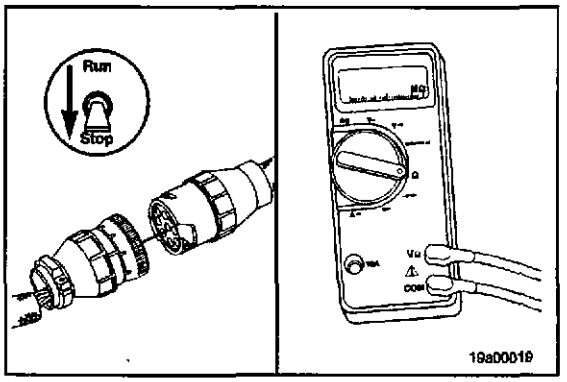
place the Stop/Run switch in the "Stop" position

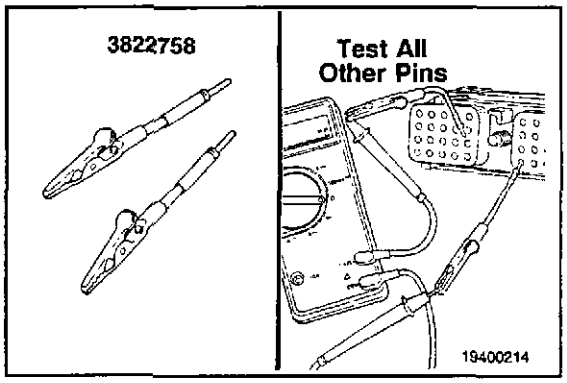
ensure the controller is **not** in the diagnostic mode

disconnect the connector that needs to be tested

identify the pins that need to be tested

turn the dial on the multimeter to measure resistance.

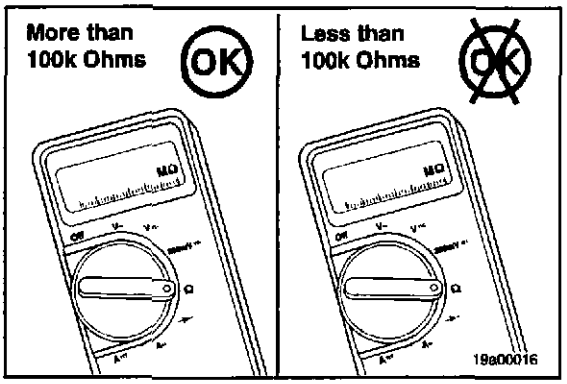




Use the appropriate test leads from the wiring harness repair kit, Part No. 3825189, to avoid damage to the connector pins.

Touch one of the multimeter leads to the correct pin to be tested on the harness side of the connector.

Touch the other lead of the multimeter to all other pins on the harness side of this connector.



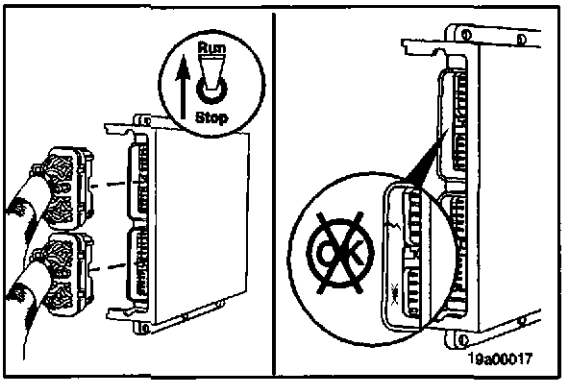
Read the value on the multimeter display.

The multimeter **must** show greater than 100k ohms which is an open circuit.

If the circuit is **not** open, the pins being checked are electrically connected.

Inspect the harness connectors for water which can cause an electrical connection.

Repair or replace the harness.



Voltage Checking

Voltage check is a procedure to measure the difference in voltage potential between two points.

The procedure for checking voltage is as follows:

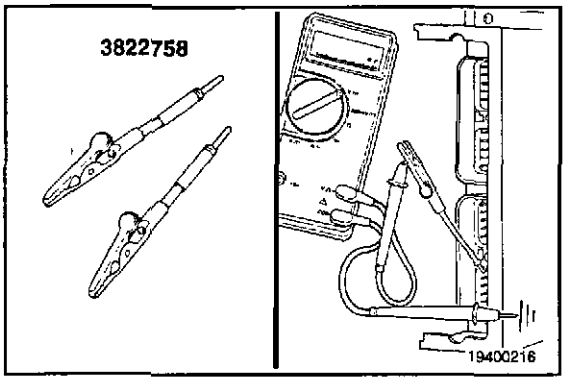
place the Stop/Run switch in the "Run" position

ensure the controller is **not** in the diagnostic mode

disconnect the connectors that need to be tested

identify the pins that need to be tested

turn the dial on the multimeter to AC voltage (V~) or DC voltage (V-), whichever is under test.



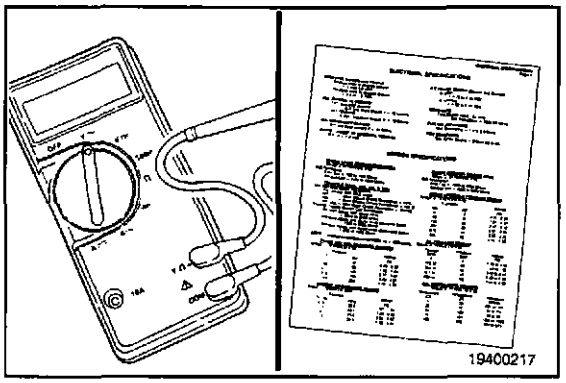
Use the appropriate test leads from the wiring harness repair kit, Part No. 3825189, to avoid damage to the connector pins.

Touch one of the multimeter test leads to the correct lead to be tested.

Touch the other lead of the multimeter to a clean unpainted surface on the engine block.

Read the value on the multimeter display. Compare the measured value to the range of voltage given in the specifications.

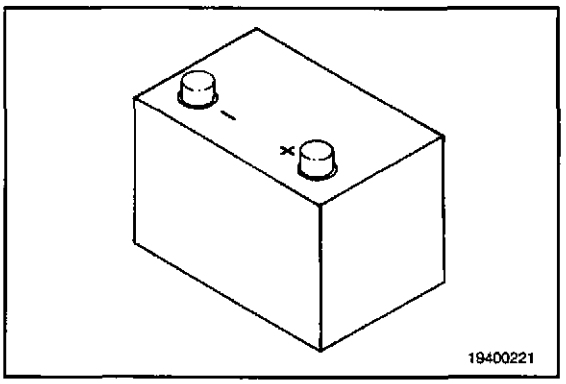
If the measured value falls outside of the specified range, refer to the applicable procedures in this manual for the electrical component that is being checked for the appropriate action.



Polarity Check

A battery will be used as an example to check polarity of a circuit.

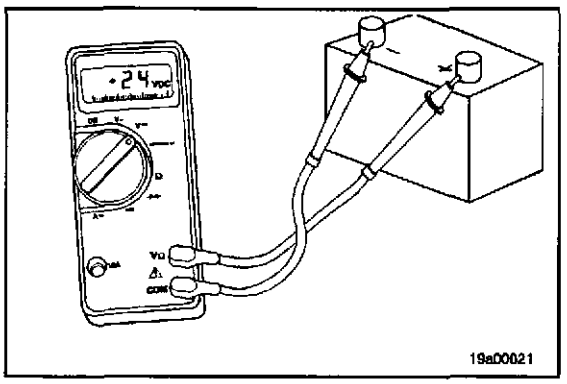
The terminals of a battery are marked for polarity. The multimeter displays the voltage difference of the positive lead (red) to the negative lead (black).



The polarity is correct when the positive (red) lead of the multimeter is on the positive terminal of the battery and the negative (black) lead of the multimeter is on the negative terminal of the battery.

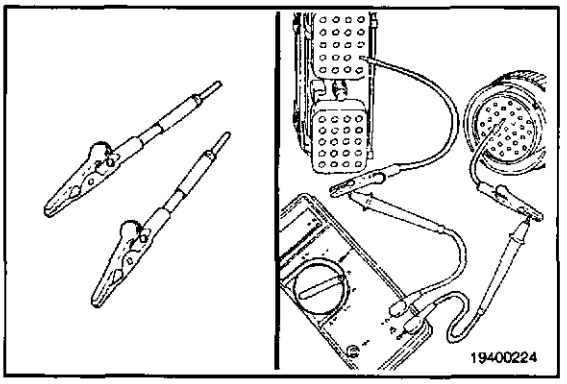
The multimeter will display positive voltage if the polarity is correct.

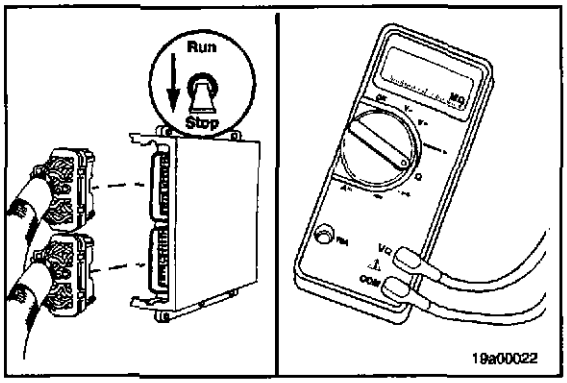
If the multimeter leads are reversed, the multimeter will display negative voltage.



Continuity Check

Continuity is an electrical connection between two pins that is less than a certain resistance value. For harness wires, the specification is less than 10 ohms.





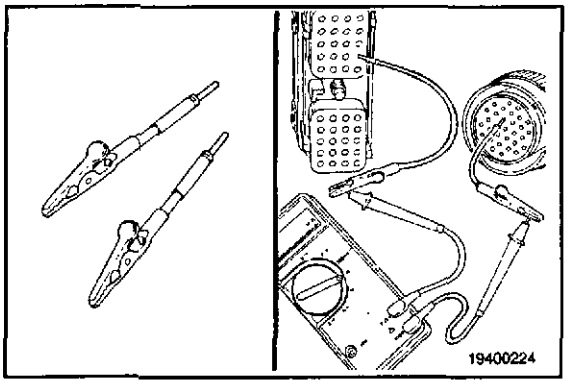
The procedure for conducting a continuity check is as follows:

place the Stop/Run switch in the "Stop" position

ensure the controller is **not** in the diagnostic mode

disconnect the harness connectors to be tested

turn the dial of the multimeter to measure resistance.



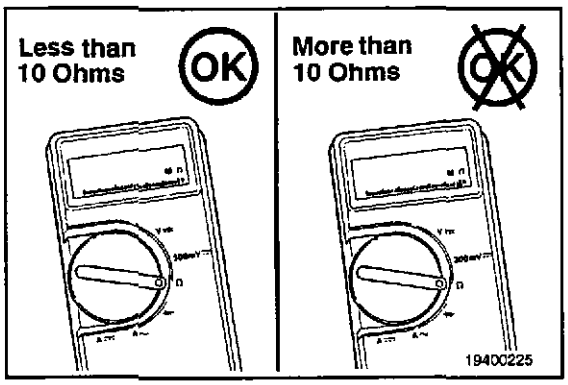
△ *CAUTION* △

Use the appropriate test leads from the wiring harness repair kit, Part No. 3825189, to avoid damage to the connector pins.

Touch one of the multimeter test leads to the pin of the wire being tested.

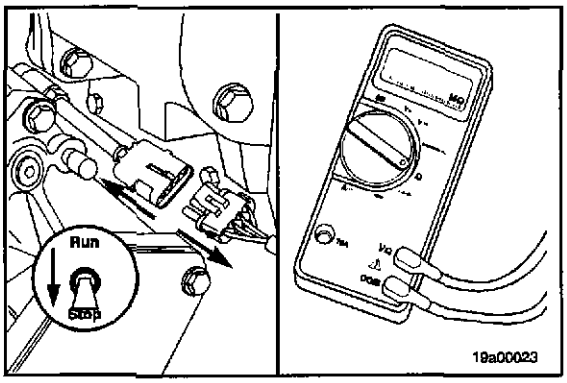
Touch the other lead of the multimeter to the pin at the other end of the wire being tested.

Read the value on the multimeter display.



The multimeter **must** display less than 10 ohms for wire continuity.

If the multimeter displays greater than 10 ohms, the wire **must** be repaired or the harness replaced.



Resistance Check - Coil

To conduct a resistance check on a coil:

place the Stop/Run switch in the "Stop" position

ensure the controller is **not** in the diagnostic mode

disconnect the harness from the coil

turn the dial of the multimeter to measure resistance

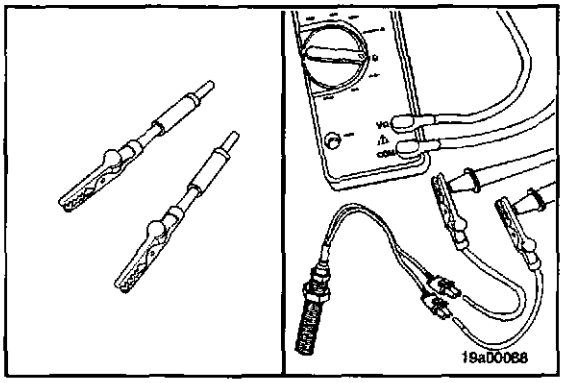
⚠ CAUTION ⚠

Use the appropriate test leads from the wiring harness repair kit, Part No. 3825189, to avoid damage to the connector pins.

NOTE: For internally grounded coils, touch one multimeter lead to the coil terminal and the other multimeter lead to the engine block.

Touch one of the multimeter leads to the coil connector pin.

Touch the other multimeter test lead to the other coil connector pin.



Read the measured resistance on the multimeter display.

Check the measured resistance against the resistance specification for the coil.

NOTE: The internal resistance of the multimeter is significant in some coil resistance checks.

Engine Speed Sensor

Torque = 34 to 47 N•m [25 to 35 ft-lb]

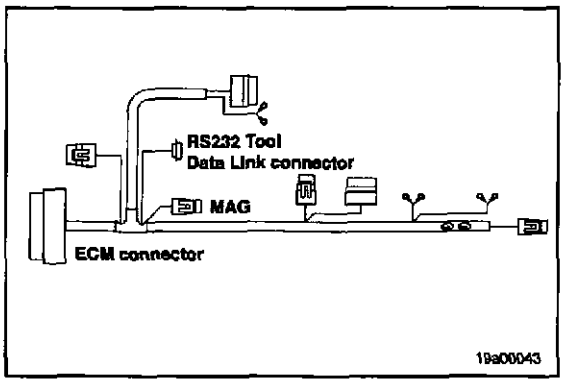
Coil Resistance:
First Coil = 750 to 1100 Ohms
Second Coil = 1100 to 1500 Ohms

19a00024

Data Link, Service Tool (019-006)

General Information

The service tool data link circuit is used for INSITE™, Part No. 3825145, to communicate with the ECM and to electronically communicate information with other on-board electronic devices.



The data link uses a 9-pin Deutsch connector. The wiring positions follow:

Pin A — DSR

Pin B — RXD

Pin C — TXD

Pin D — DTR

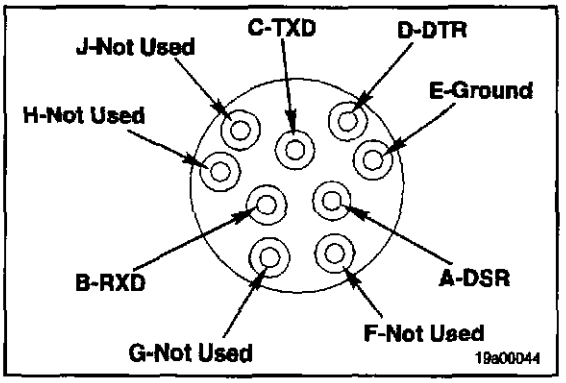
Pin E — Engine Block ground

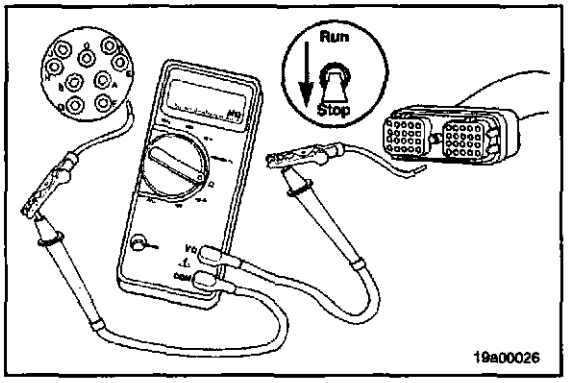
Pin F — Not used

Pin G — Not used

Pin H — Not used

Pin J — Not used





Resistance Check (019-006-038)

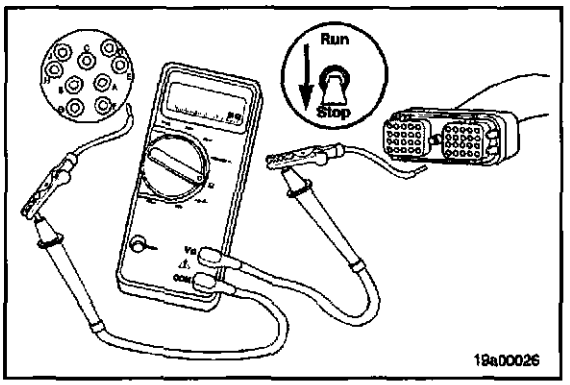
Place the Stop/Run switch in the "Stop" position.

Ensure the controller is **not** in the diagnostic mode.

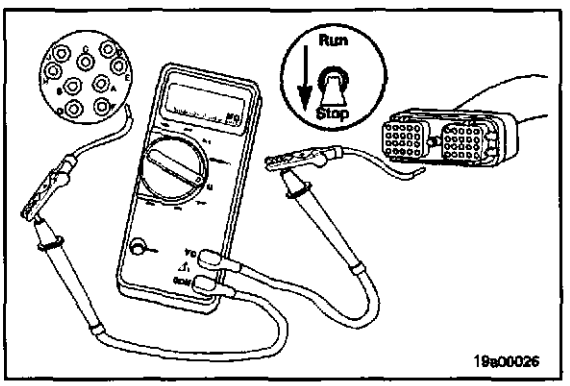
Remove the engine harness connector from the ECM. Refer to Procedure 019-043.

Use test lead, Part No. 3822758, on the ECM connector and use test lead, Part No. 3824811, on the 9-pin Deutsch connector.

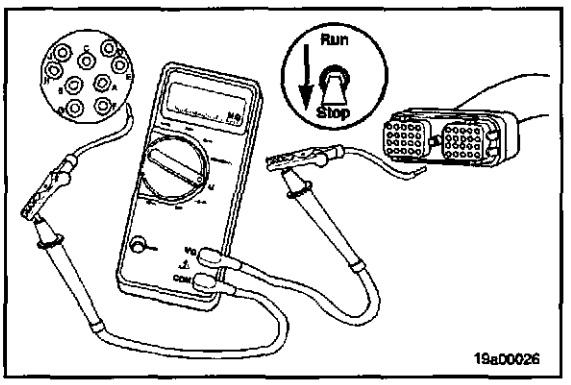
Measure the resistance from pin 31 of the engine harness connector to pin A of the 9-pin Deutsch connector. The multimeter **must** show a closed circuit (10 ohms or less).



Measure the resistance from pin 32 of the engine harness connector to pin B of the 9-pin Deutsch connector. The multimeter **must** show a closed circuit (10 ohms or less).



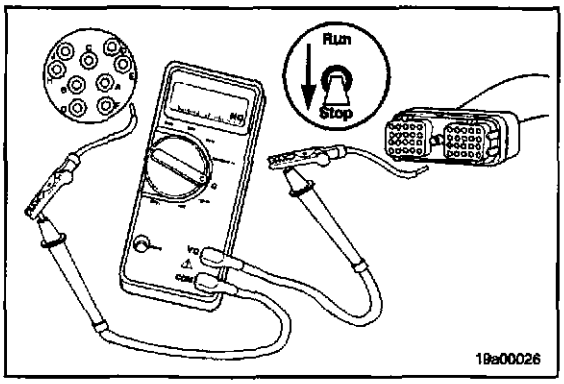
Measure the resistance from pin 33 of the engine harness connector to pin C of the 9-pin Deutsch connector. The multimeter **must** show a closed circuit (10 ohms or less).



Measure the resistance from pin 34 of the engine harness connector to pin D of the 9-pin Deutsch connector. The multimeter **must** show a closed circuit (10 ohms or less).

Measure the resistance from pin 35 of the engine harness connector to pin E of the 9-pin Deutsch connector. The multimeter **must** show a closed circuit (10 ohms or less).

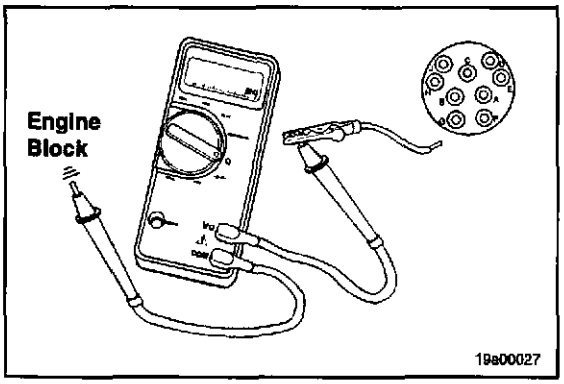
If the circuit is **not** closed in any of the previous steps, repair or replace the engine harness. Refer to Procedures 019-209, 019-240, and 019-043.



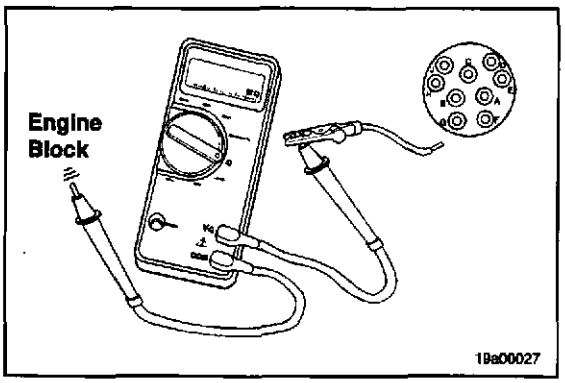
Check for Short Circuit to Ground (019-006-039)

Use test lead, Part No. 3824811, for the 9-pin Deutsch connector.

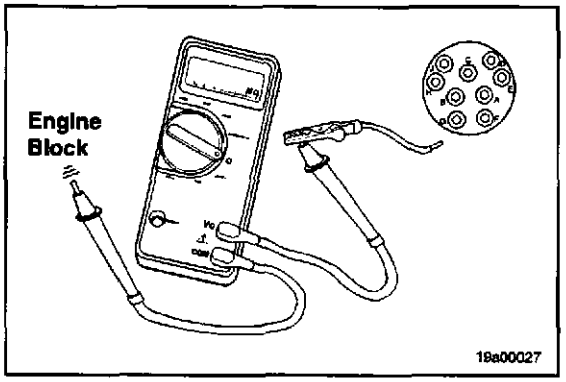
Measure the resistance from pin A of the Deutsch connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).

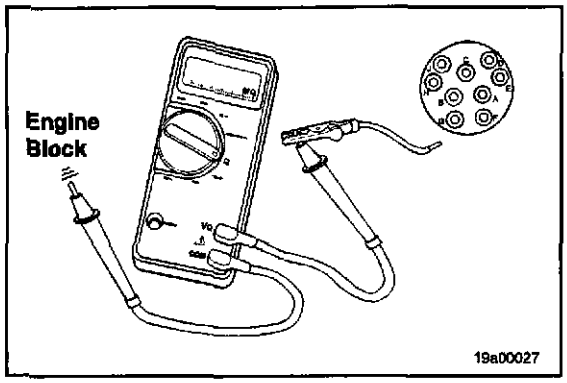


Measure the resistance from pin B of the 9-pin Deutsch connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).



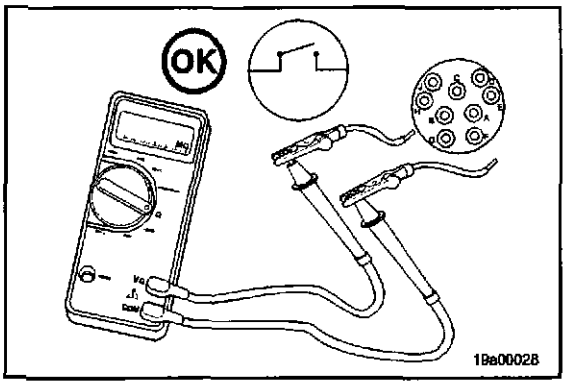
Measure the resistance from pin C of the 9-pin Deutsch connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).





Measure the resistance from pin D of the 9-pin Deutsch connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open in any of the previous steps, repair or replace the engine harness. Refer to Procedures 019-209, 019-240, and 019-043.

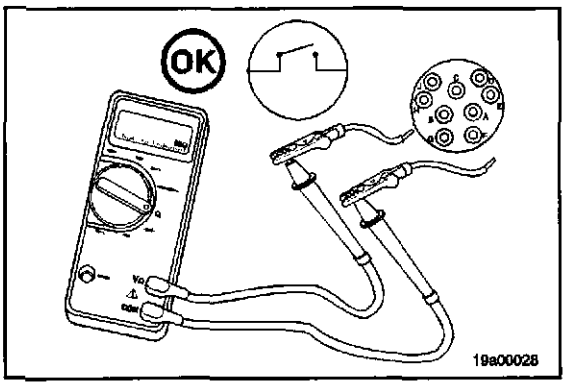


Check for Short Circuit from Pin to Pin (019-006-040)

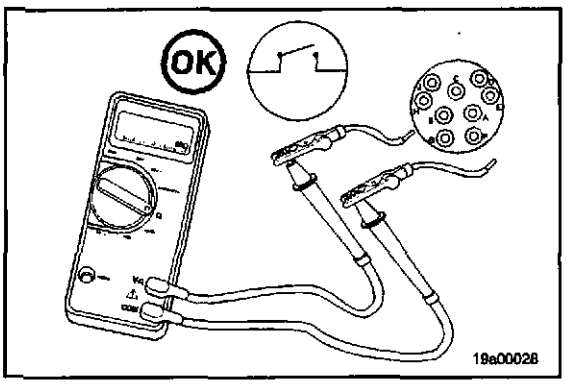
Deutsch Connector

Use test lead, Part No. 3824811, for the 9-pin Deutsch connector.

Measure the resistance from pin A of the Deutsch connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).

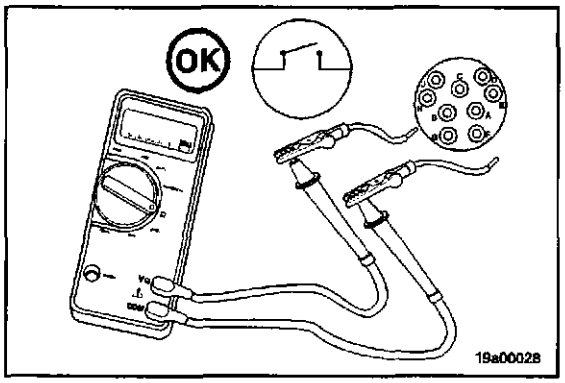


Measure the resistance from pin B of the 9-pin Deutsch connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).



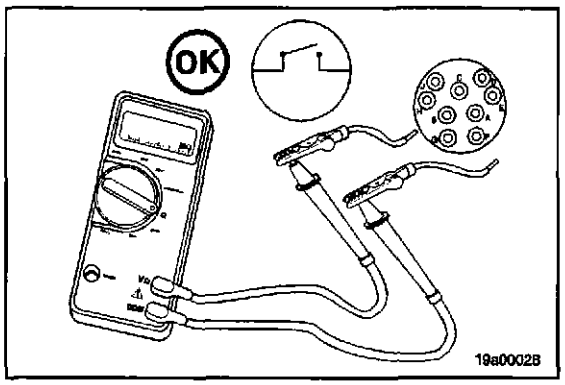
Measure the resistance from pin C of the 9-pin Deutsch connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).

Measure the resistance from pin D of the 9-pin Deutsch connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).



Measure the resistance from pin E of the 9-pin Deutsch connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open in any of the previous steps, repair or replace the engine harness. Refer to Procedures 019-209 and 019-043.

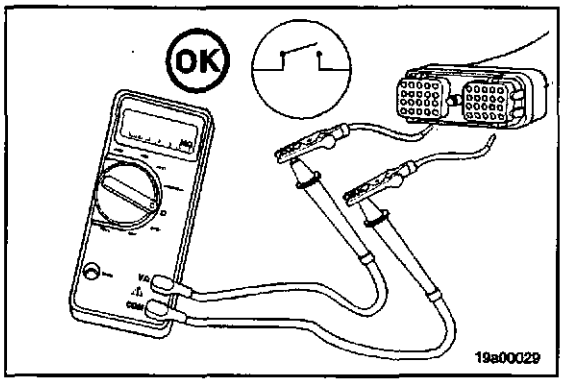


Engine Harness Connector

Disconnect the engine harness from the ECM.

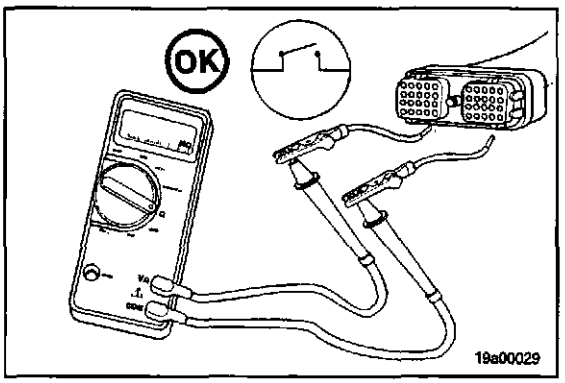
Use test lead, Part No. 3822758, for the engine harness connector.

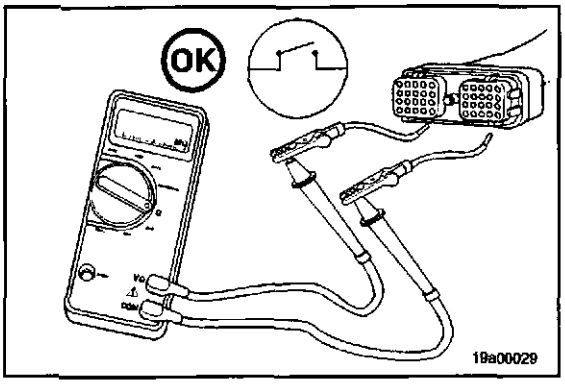
Measure the resistance from pin 31 to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).



Measure the resistance from pin 32 to all other pins in the connector.

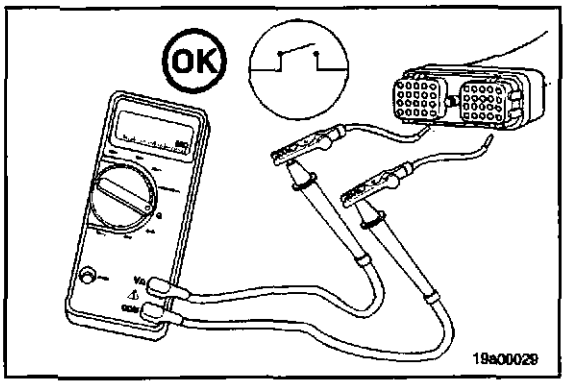
The multimeter **must** show an open circuit (100k ohms or more).





Measure the resistance from pin 33 to all other pins in the connector.

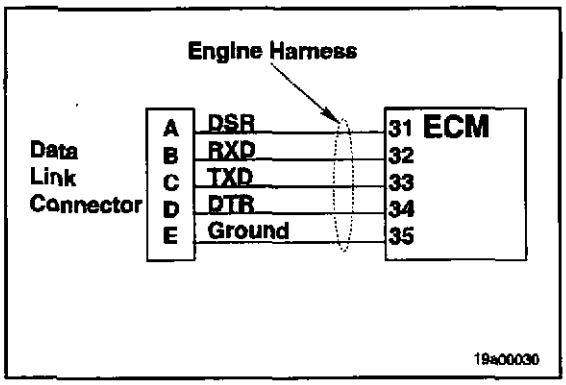
The multimeter **must** show an open circuit (100k ohms or more).



Measure the resistance from pin 34 to all other pins in the connector.

The multimeter **must** show an open circuit (100k ohms or more).

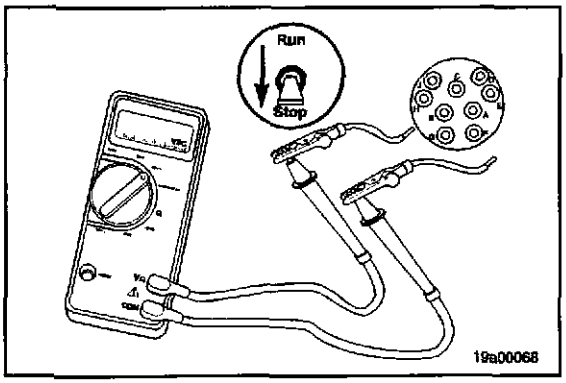
If the circuit is **not** open in any of the previous steps, repair or replace the engine harness. Refer to Procedures 019-240 and 019-043.



Voltage Check (019-006-041)

Locate the service tool data link connector on the engine harness.

The data link circuit is shown.



Place the Stop/Run switch in the "Stop" position.

Place the controller in the diagnostic mode.

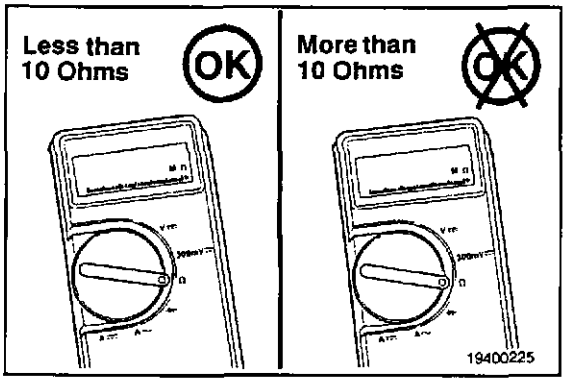
Turn the dial on the multimeter to measure DC voltage.

With the service tool disconnected from the engine harness, press the "Connect to ECM" command on the service tool and simultaneously measure the voltage, from pin B to pin E (ground), on the service tool cable connector. The multimeter **must** show -5 to -15 VDC.

If the voltage reading is incorrect ensure the tool is setup correctly.

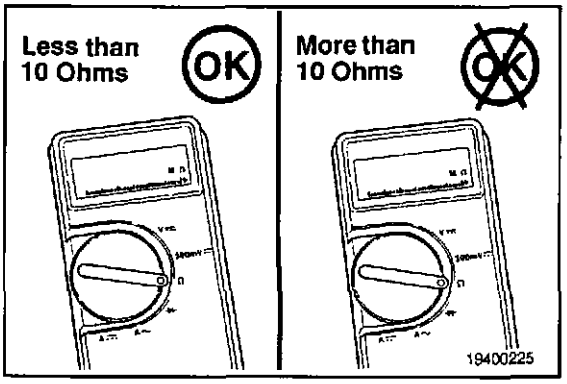
If the service tool is setup correctly, conduct the following procedures.

Measure the continuity for pin B of the INSITE™ cable, Part No. 3825183. The multimeter **must** show less than 10 ohms.



Measure the continuity for pin C of the INSITE™ cable. The multimeter **must** show less than 10 ohms.

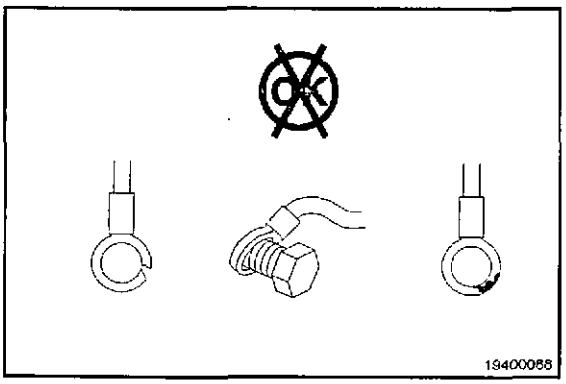
If the circuit is **not** closed in any of the previous steps, replace the INSITE™ cable, Part No. 3825183.



Battery Ground Circuit (019-008)

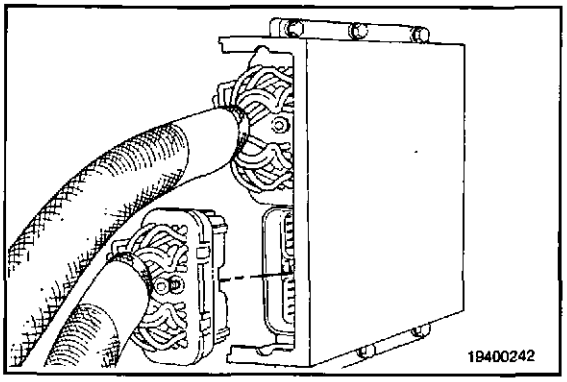
Initial Check (019-008-001)

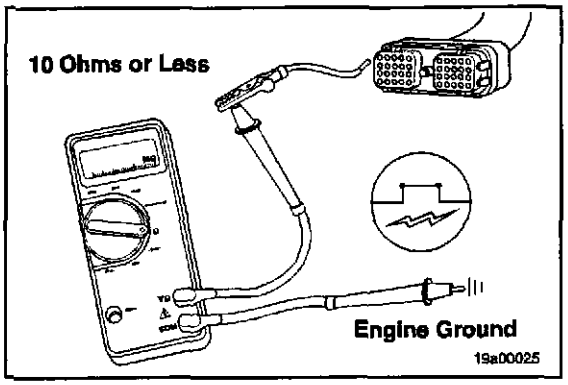
Check the engine harness ground connection for loose, corroded, or broken connections. Repair the connections. Refer to procedure 019-197.



Resistance Check (019-008-038)

Disconnect the engine harness connector from the ECM. Check for damaged pins in the ECM and the harness.

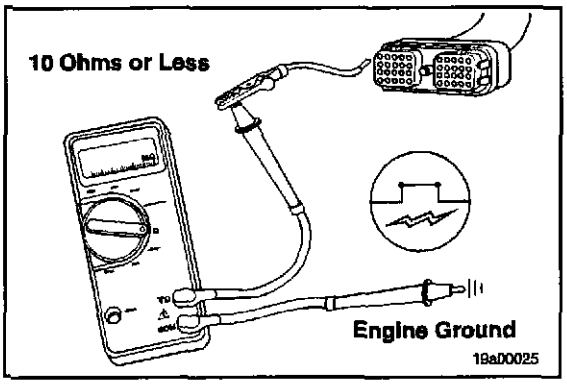




⚠ CAUTION ⚠

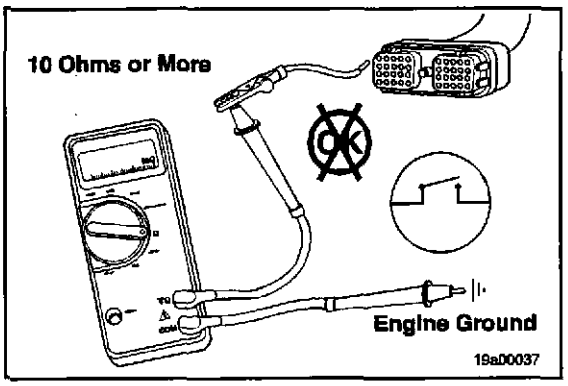
Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight in the connector without expanding the pins in the connector.

Insert the lead into pin 26 of the engine harness. Connect the alligator clip to the multimeter probe. Touch the other multimeter probe to the engine block. Measure the resistance. The resistance **must** be 10 ohms or less.

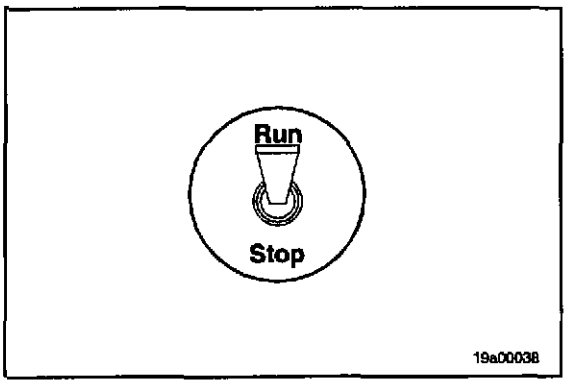


Remove the lead from pin 26 and insert it into pin 27 of the engine harness. Touch the other probe to the engine block. Measure the resistance. The resistance **must** be 10 ohms or less.

NOTE: Repeat this step for pins 28 through 30.



If more than 10 ohms are measured in any check, there is *an open circuit. If the circuit has been checked for proper* grounding at the engine block, then repair or replace the engine harness. Refer to Procedures 019-197, 019-199, 019-043 and 019-240.



Stop/Run Switch (019-014)

General Information

The Stop/Run switch supplies an input signal to the ECM which "Starts" or "Stops" the ECM.

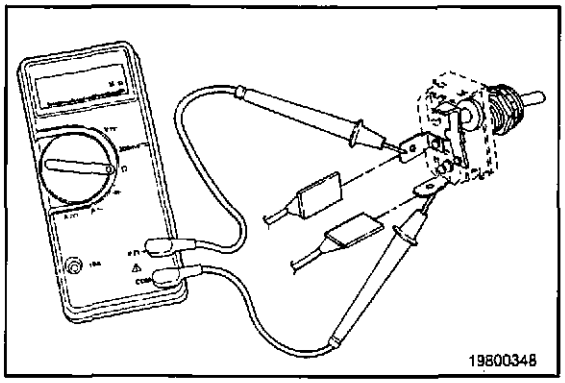
The switch must be in the "Stop" position for the controller to be in the diagnostic mode.

Resistance Check (019-014-038)

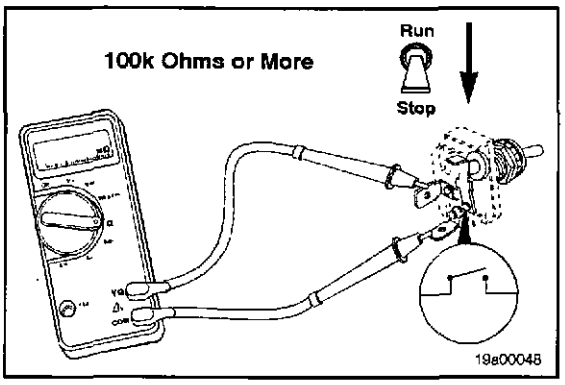
Using INSITE™, Part No. 3825145, in the monitor mode, toggle the Stop/Run switch between "Stop" and "Run" checking for proper operation.

If the switch does **not** operate properly, follow the trouble-shooting procedures in this section.

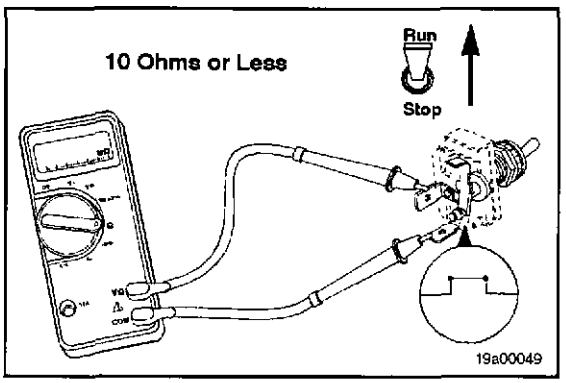
Remove and tag the connectors from the terminals on the switch. Place the multimeter leads on each terminal.



Place the Stop/Run switch in the "Stop" position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM Troubleshooting and Repair manual for replacement instructions.



Move the switch to the "Run" position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM Troubleshooting and Repair manual for replacement instructions.



Stop/Run Switch Circuit (019-015)

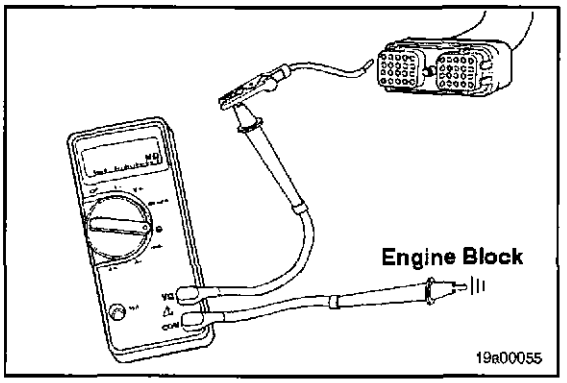
Resistance Check (019-015-038)

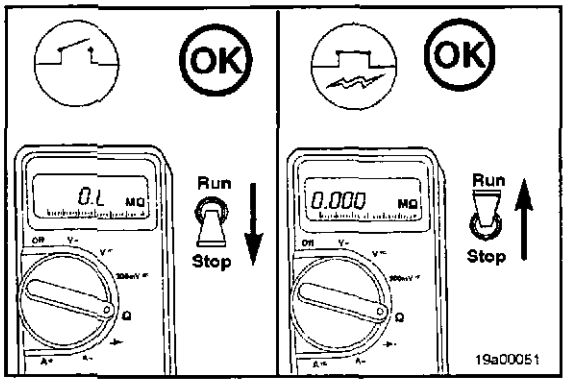
△ CAUTION △

Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight in the connector without expanding the pins in the connector.

Disconnect the connector from the positive battery terminal.

Disconnect the OEM connector from the ECM.





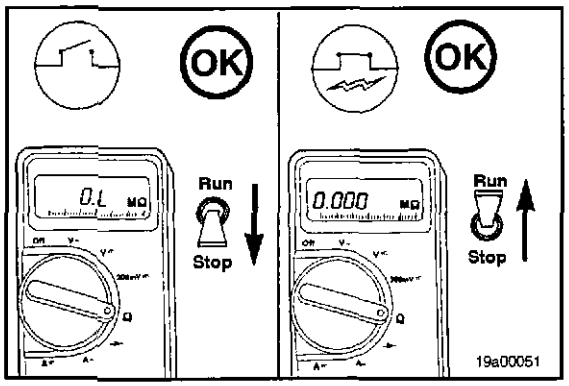
Insert a test lead into pin 63 of the OEM harness connector.

Measure the resistance from pin 63 to the positive battery connector.

Place the Stop/Run switch in the "Run" position. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, check for an open circuit in the Stop/Run switch wiring, considering the switch has already been checked.

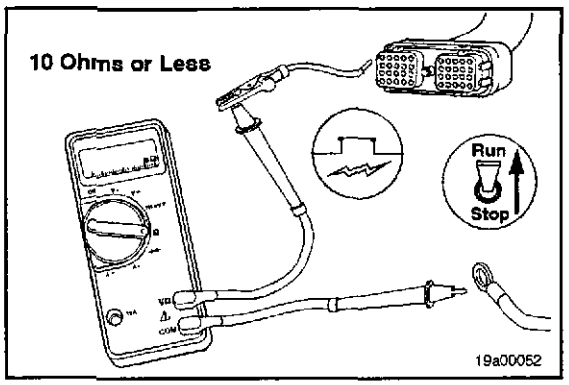
Repair or replace the OEM harness. Refer to OEM Troubleshooting and Repair Procedures.



Move the Stop/Run switch to "Stop". The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, a short circuit exists in the Stop/Run switch wiring, providing the switch has already been checked.

Repair or replace the OEM harness. Refer to OEM Troubleshooting and Repair Procedures.



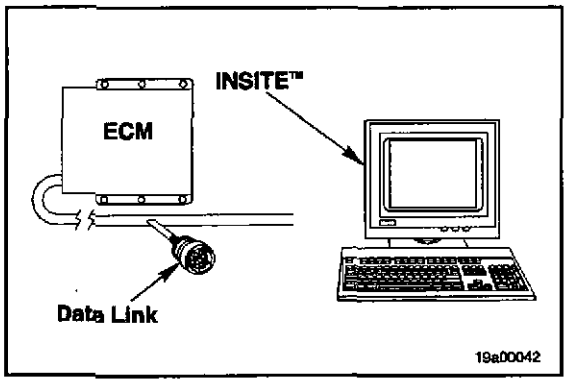
Check for Short Circuit from Pin to Pin (019-015-040)

Disconnect the OEM harness from the ECM.

Disconnect the connector from the positive battery lead.

Measure the resistance from pin 63 of the OEM harness connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or less).

If any check shows less than 100k ohms, repair or replace the OEM harness. Refer to OEM Troubleshooting and Repair Procedures.



Coolant Temperature Sensor (019-019)

Initial Check (019-019-001)

Cold Engine

Connect an electronic Service Tool to the data link connector.

Place the Stop/Run Switch in the "Run" position.

Controller **not** in the diagnostic mode.

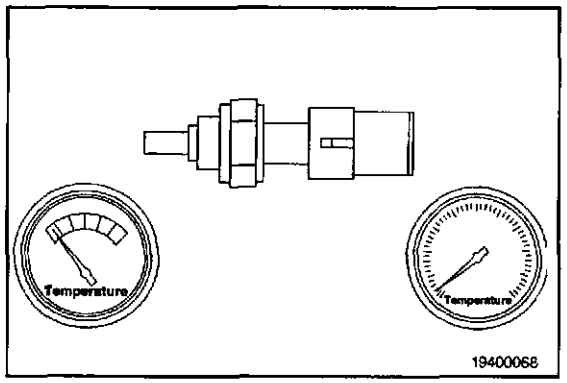
Start the engine and let it idle.

Monitor the coolant temperature with the electronic Service Tool.

Compare the cool temperature value with the water temperature gauge, or connect a temperature probe to the engine near the coolant temperature sensor and compare the reading on the service tool with the temperature probe reading.

If the coolant temperature on the electronic Service Tool is excessively higher than the water temperature, replace the coolant temperature sensor.

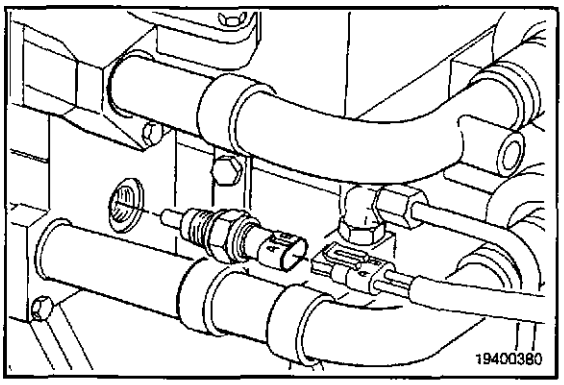
If the coolant temperature on the electronic Service Tool does **not** increase with the water temperature, replace the coolant temperature sensor.



Warm Engine

Remove the coolant temperature sensor. Refer to Procedure 019-019-002.

Connect the coolant temperature sensor to the engine harness.



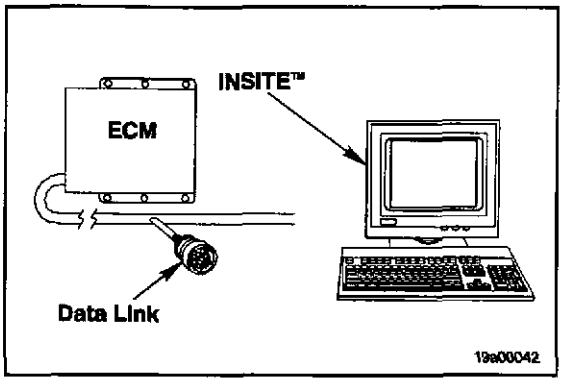
Connect an electronic Service Tool to the data link.

Place the Stop/Run switch in the "STOP" position.

Controller in the diagnostic mode.

Monitor the coolant temperature with the electronic Service Tool.

If the coolant temperature does not decrease to the current ambient air temperature, replace the coolant temperature sensor.

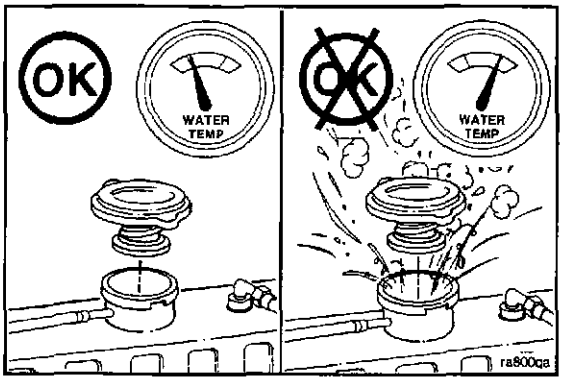


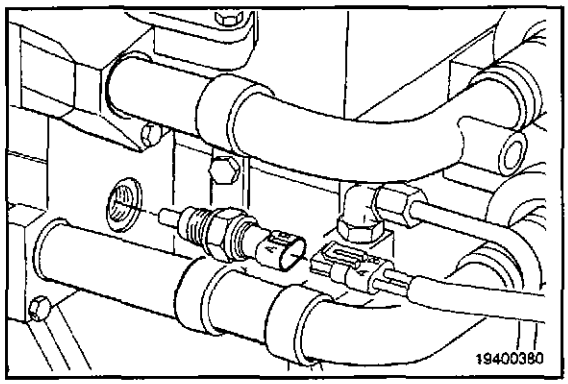
Remove (019-019-002)

⚠ WARNING ⚠

Wait until the coolant temperature is below 50° C [120° F] before removing the coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.

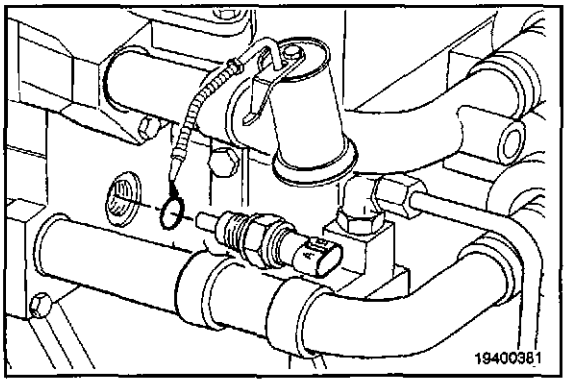
Drain the cooling system. Refer to the Base Engine Troubleshooting and Repair Manual.





Lift up on the locking tab and pull the electrical connectors apart.

Remove the sensor.



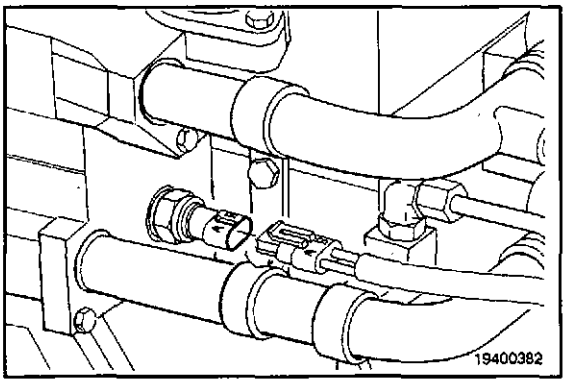
Install (019-019-026)

Make sure the new sensor has an o-ring installed.

Lubricate the o-ring with clean engine oil.

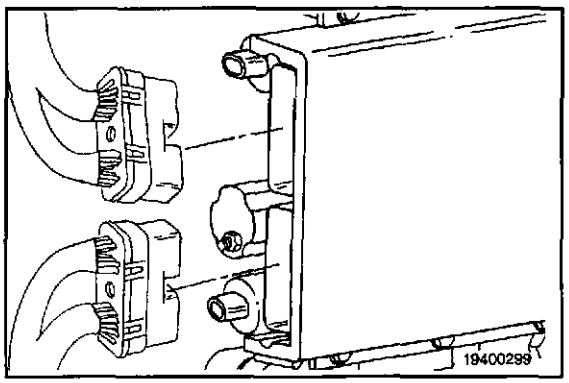
Install the new sensor into the engine. Tighten the sensor.

Torque Value: 14 N•m [10 ft-lb]



Push the connectors together until they lock.

Fill the cooling system and operate the engine to check for leaks. Refer to Base Engine Troubleshooting and Repair Manual for proper procedures.



Electronic Control Module (ECM) (019-031)

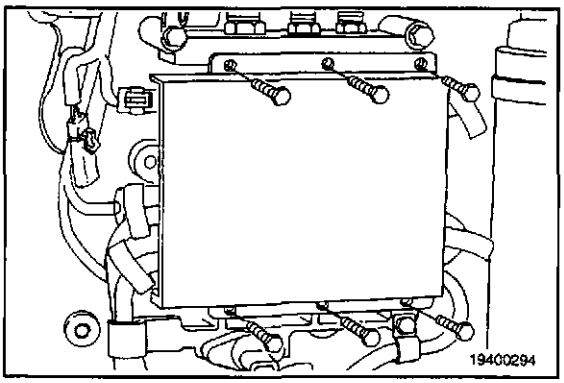
Remove (019-031-002)

Disconnect the OEM harness and engine harness connectors from the ECM.

NOTE: Record all of the programmable parameters, features and calibration information from the old ECM for programming the new ECM.

Remove the six capscrews which hold the ECM to it's securing platform.

Remove the ECM from it's platform.

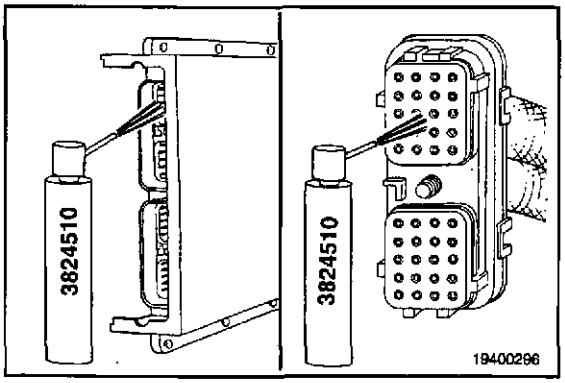


Install (019-031-026)

△ CAUTION △

Do not blow compressed air into the ECM ports or connectors. Compressed air can contain moisture due to condensation.

Use quick-dry electrical contact cleaner, Part No. 3824510, to remove all dirt and moisture from the ECM connector ports and the harness connectors.

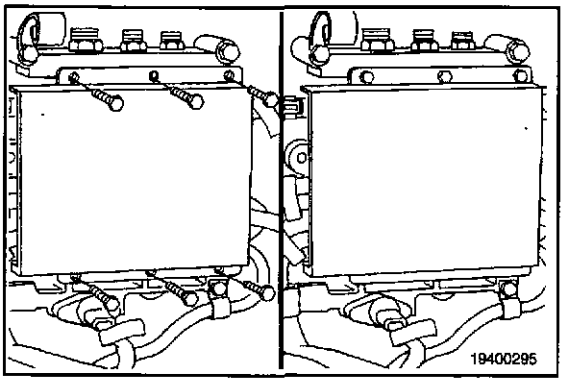


△ CAUTION △

Make sure there is no grease or dirt between the ECM and it's securing platform.

Install the new ECM to it's securing platform. Tighten the six capscrews.

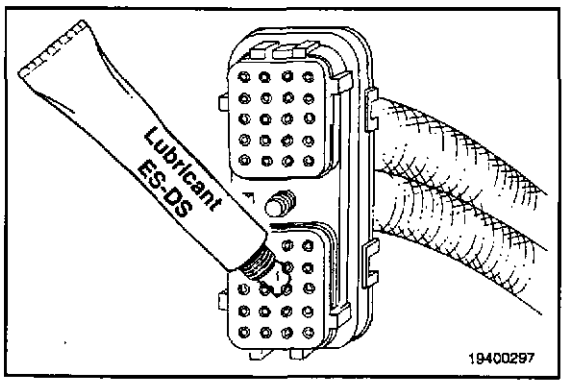
Torque Value: 8 N•m [72 in-lb]

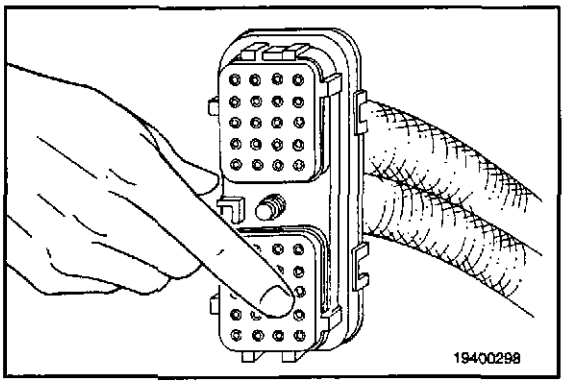


△ CAUTION △

Use only Cummins recommended lubricate DS-ES, Part No. 3822934. Other lubricating oil or grease in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

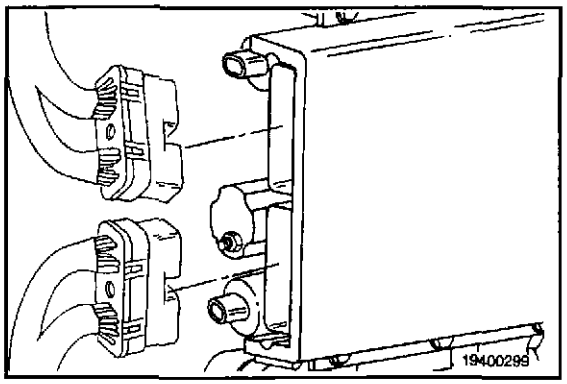
Apply a thin coating of lubricant to the connector nose piece.





Spread the lubricant across the connector nose piece so it enters every pin hole and lubricates the contacts.

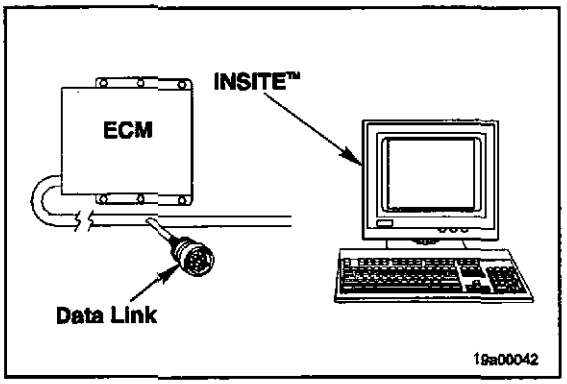
Lubricant **must not** be visible on the surface of the nose piece.



Connect the OEM and engine harness connectors to the ECM. Tighten the connector capscrews.

Torque Value: 3 N•m [25 in-lb]

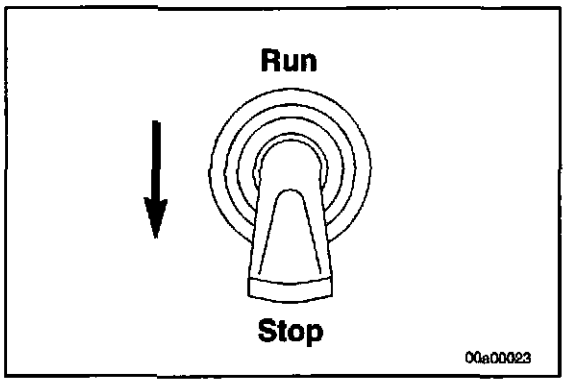
NOTE: When an ECM is replaced, the new ECM **must** be calibrated. Use INSITE™, Part No. 3825145, to calibrate the ECM.



ECM Calibration (019-032)

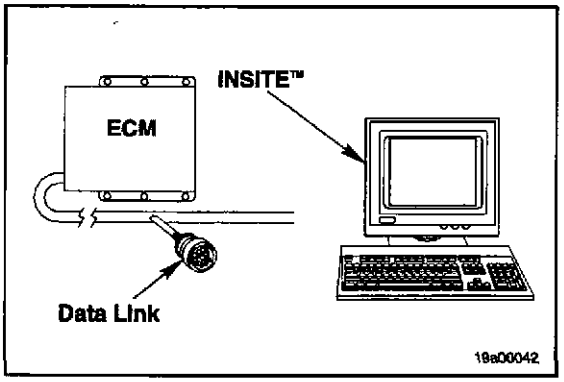
General Information

ECM calibrations can be performed by INSITE™, Part No. 3825145.

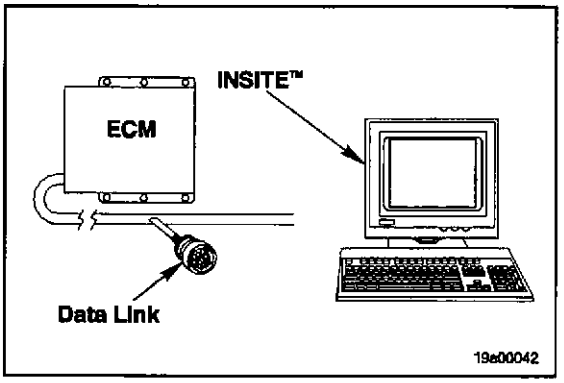


The ECM calibration process for QST30 G-Drive engines occurs with the Start/Run switch in the "STOP" position and the Controller in the diagnostic mode. **Always** follow the instructions on the service screens.

Connect the electronic service tool to the service tool data link which is located on the engine.



Refer to the INSITE™ G-Drive User's Manual (QST30), Bulletin No. 3666196, for detailed ECM calibration instructions.



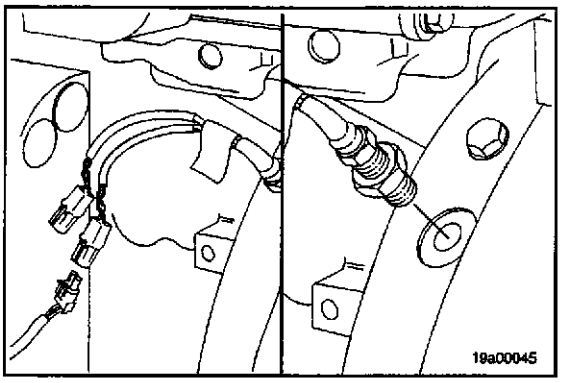
Engine Speed Sensor (ESS) (019-042)

Remove (019-042-002)

Disconnect the engine speed sensor (ESS) connector from the engine harness.

Loosen the locknut.

Turn the ESS out of the flywheel housing.

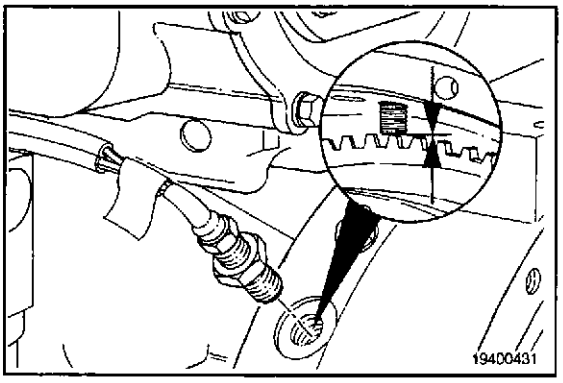


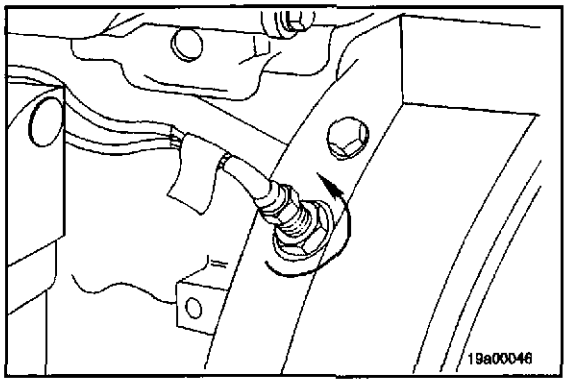
Install (019-042-026)

Make sure a gear tooth is aligned with the hole in the flywheel housing.

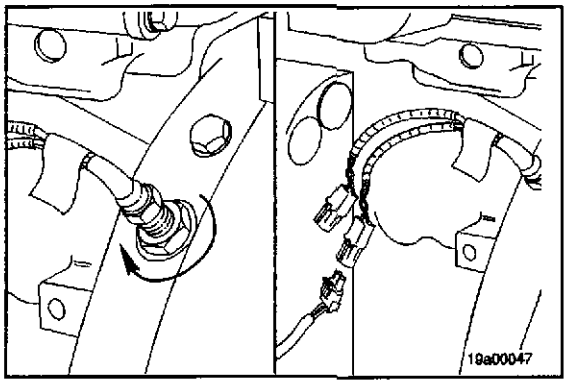
Install the ESS into the hole until it touches the gear tooth.

NOTE: If the ESS does **not** turn in with finger pressure, check the flywheel housing hole threads and sensor threads for damage.





Turn the ESS out ½ to ¾ turn **counterclockwise.**

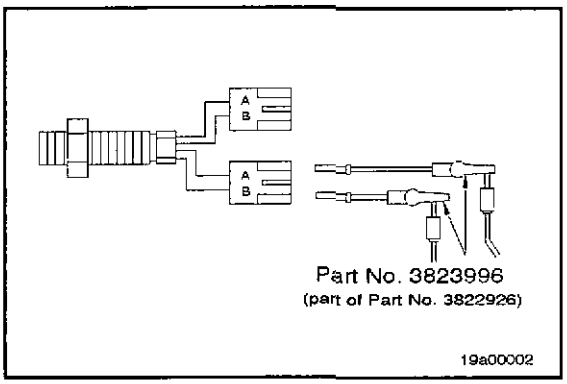


Tighten the locknut against the flywheel housing.

Torque Value: 34 to 47 N•m [25 to 35 ft-lb]

NOTE: Over-tightening the locknut can damage the sensor.

Install the connector. Make sure it locks into place.



Resistance Check (019-042-038)

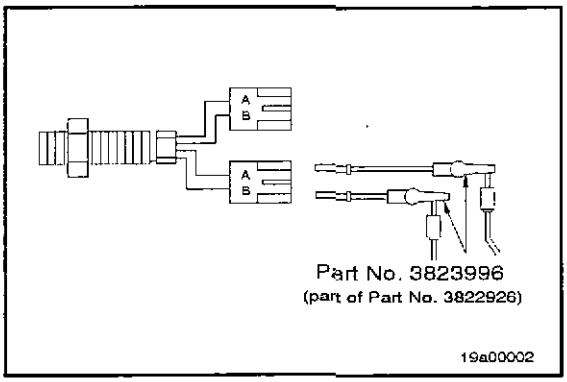
Remove the engine harness connector from the ESS.

Place the Stop/Run switch in the "STOP" position.

Controller **not** in diagnostic mode.

Measure the resistance from pin A to pin B of the first ESS coil. The multimeter **must** show a resistance of less than 1500 ohms.

If the resistance is **not** less than 1500 ohms, replace the ESS. Refer to Procedure 019-042.



Measure the resistance from pin A to pin B of the second ESS coil. The multimeter **must** show a resistance of less than 1500 ohms.

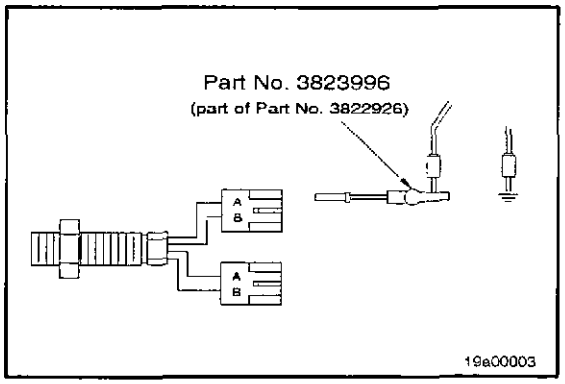
If the resistance is **not** less than 1500 ohms, replace the ESS. Refer to Procedure 019-042.

Check for Short Circuit to Ground (019-042-039)

Use test lead, Part No. 3823996, for the Weather-Pack connector.

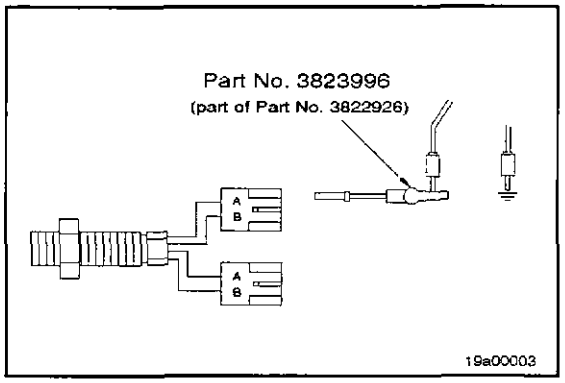
Measure the resistance from pin A of the ESS connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, replace the ESS. Refer to Procedure 019-042.



Measure the resistance from pin B of the ESS connector to the engine block. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, replace the ESS. Refer to Procedure 019-042.



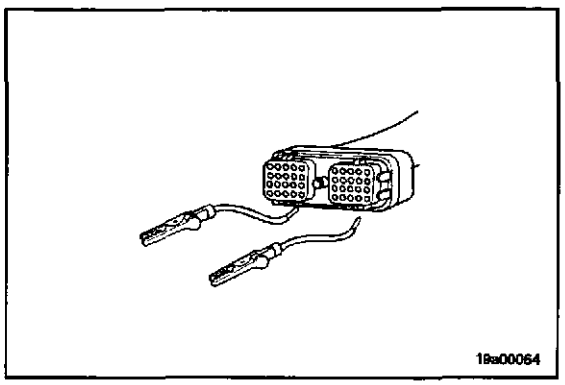
Engine Speed Sensor Circuit (019-106)

Resistance Check (019-106-038)

⚠ CAUTION ⚠

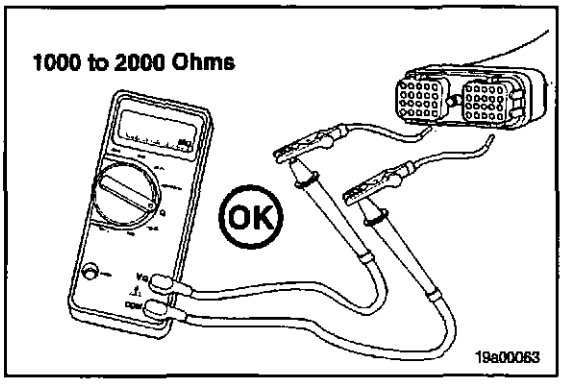
Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight in the connector without expanding the pins of the connector.

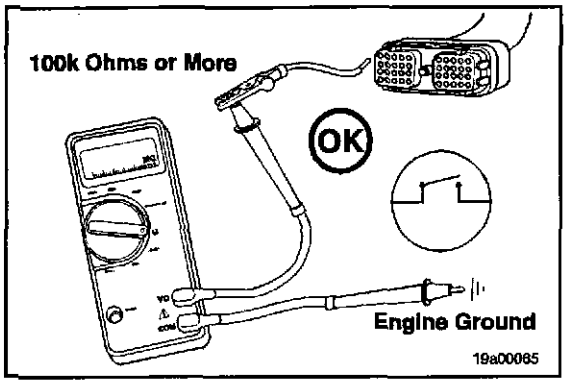
Insert the one of the leads into pin 21 of the engine harness adaptor cable connector. Insert the other lead into pin 22.



Make sure the ESS is connected to the sensor harness.

Measure the resistance. The resistance value **must** be less than 1500 ohms. If the resistance is **not** correct, there is a problem with the engine harness, provided the sensor was previously checked. Refer to Procedures 019-202, 019-240, and 019-043.

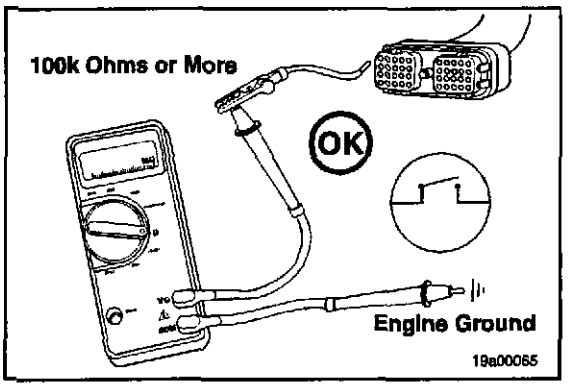




Check for Short Circuit to Ground (019-106-039)

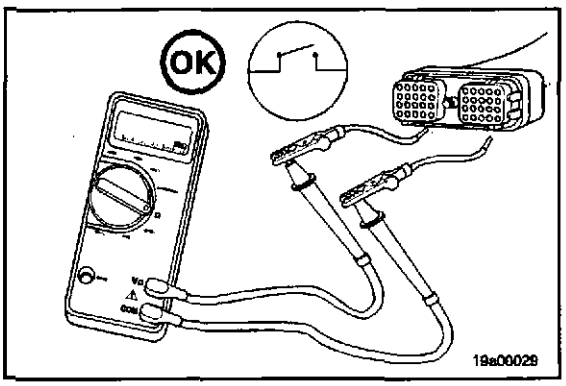
Disconnect the engine harness adaptor cable from the ECM.

Insert the lead into pin 21. Touch the other Multimeter probe to the engine block. Measure the resistance. The Multimeter **must** show an open circuit (more than 100k ohms).



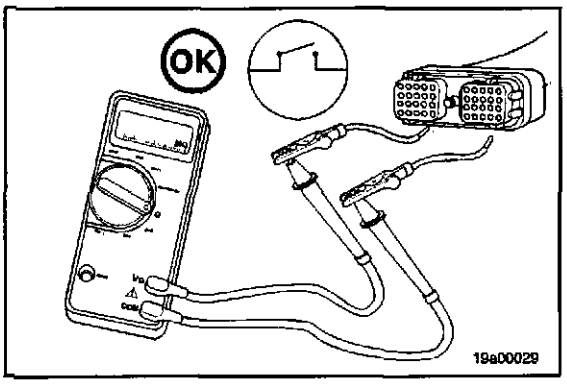
Remove the lead from pin 21 and place it into pin 22. Touch the other Multimeter probe to the engine block. Measure the resistance. The Multimeter **must** show an open circuit (more than 100k ohms).

If the resistance values in any of the previous checks are **not** within the specification, there is a short circuit to ground, provided the ESS sensor has been previously checked. Repair or replace the engine harness. Refer to Procedure 019-199, 019-240 or 019-043.



Check for Short Circuit from Pin to Pin (019-106-040)

Disconnect the engine harness adaptor cable from the ECM. Insert one of the multimeter leads into pin 21. Check the resistance to every other pin in the connector. The multimeter **must** show an open circuit (more than 100k ohms).



Remove the lead from pin 21 and place it into pin 22, and again check the resistance to every other pin in the connector. The multimeter **must** show an open circuit (more than 100k ohms) at all pins.

If the resistance values in any of the previous checks are **not** within specification, there is a short circuit from pins 21 or 22 to any pin that measures less than 100k ohms. Repair or replace the engine harness. Refer to Procedures 019-199, 019-240, or 019-043.

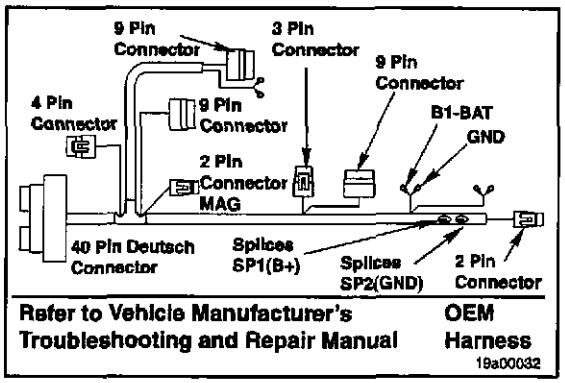
Engine Wiring Harness (019-043)

General Information

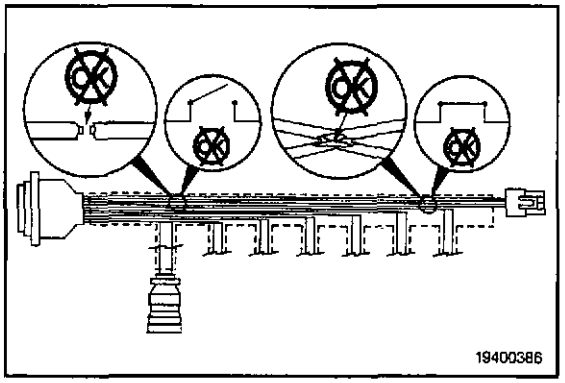
The QST30 G-Drive engine uses two (2) separate wiring harnesses to control the engine and some of the equipment operations

1. Engine Harness
2. OEM Harness

The QST30 G-Drive also uses extension cables and an adaptor cable to attach the engine harness to the ECM

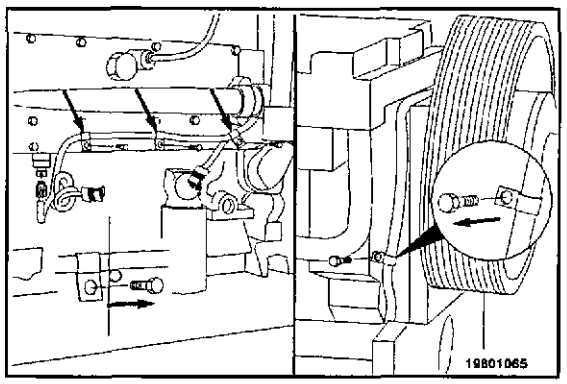


Replace a harness, or extension/adaptor cable, if there is an open circuit or a short circuit is found under the protective covering of the harness body.

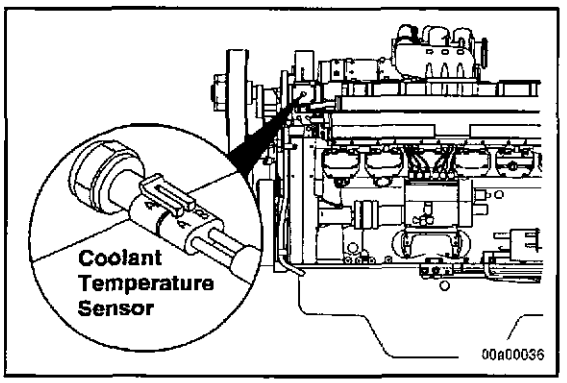


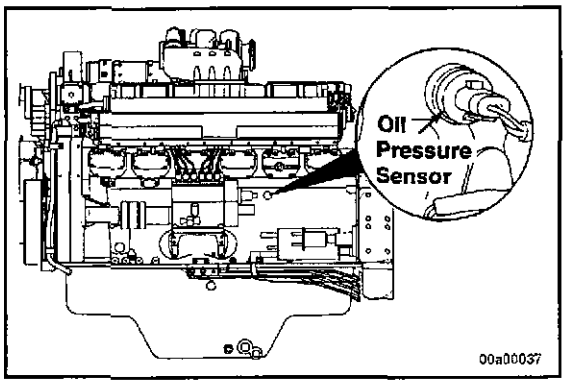
Remove (019-043-002)

Remove the engine harness clamps.

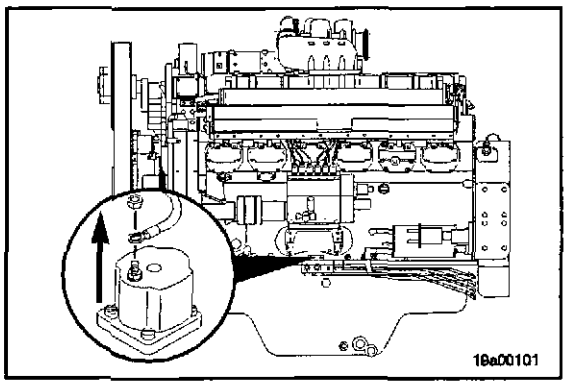


Disconnect the coolant temperature sensor.

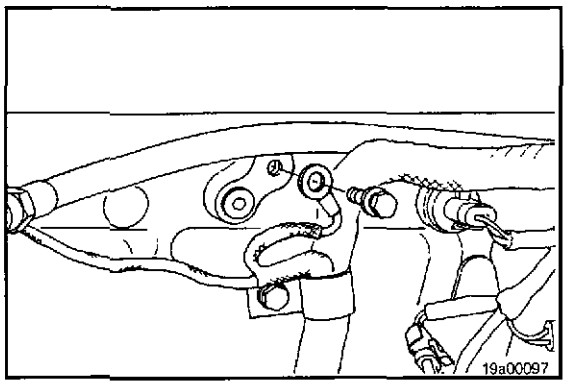




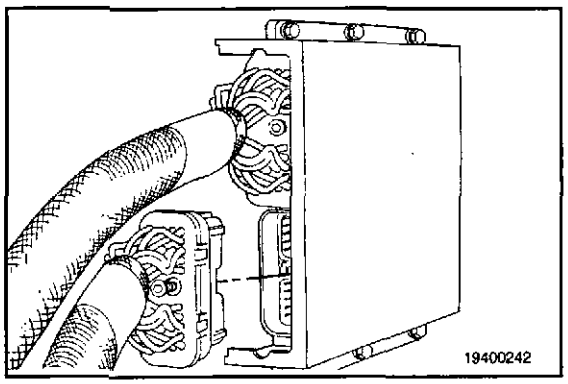
Disconnect the engine harness from the oil pressure sensor.



Disconnect the fuel shut off control wires to the fuel shut off solenoids (left bank and right bank).



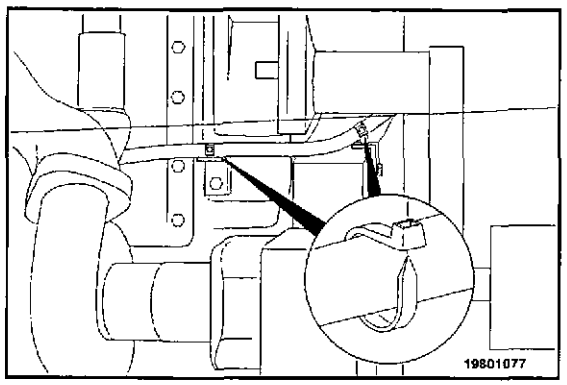
Disconnect the engine block ground from the block.



Use a 4 mm [5/32 inch] hex head wrench to disconnect the engine harness Deutsch connector from any engine harness extension used or the engine harness adaptor cable.

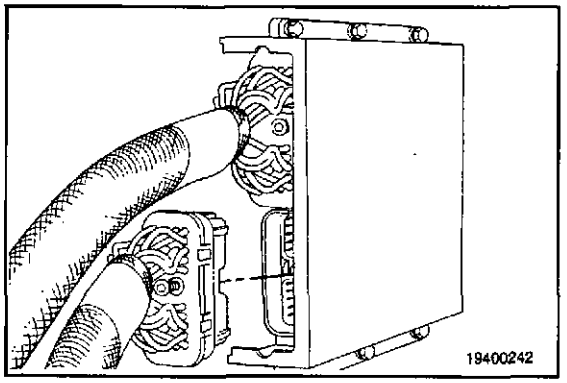
Cut the remaining ties holding the engine harness to the engine.

Remove the engine harness.



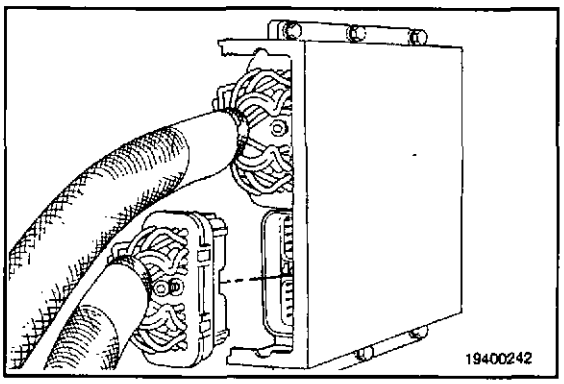
Engine Harness Extension Cable

Use a 4 mm [5/32 inch] hex head wrench to disconnect the attached cable's Deutsch connectors.



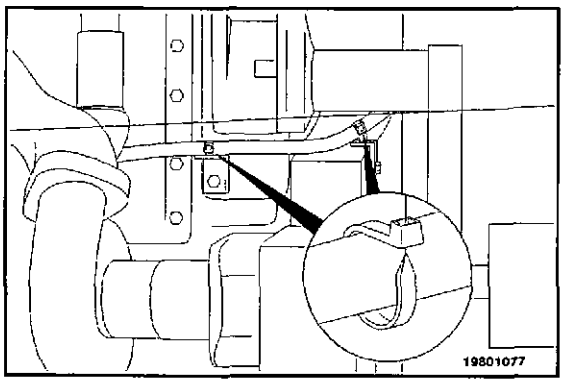
Engine Harness Adaptor Cable

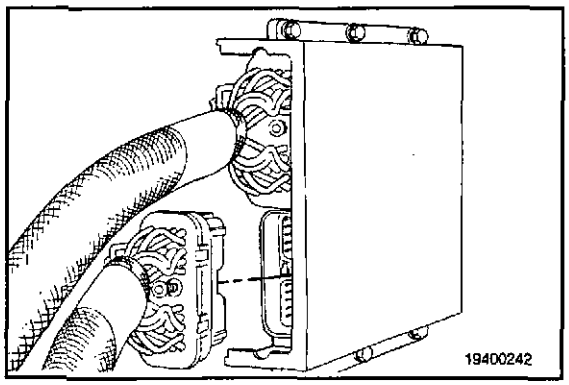
Use a 4 mm [5/32 inch] hex head wrench to disconnect the attached cables Deutsch connectors from the ECM.



Install (019-043-026)

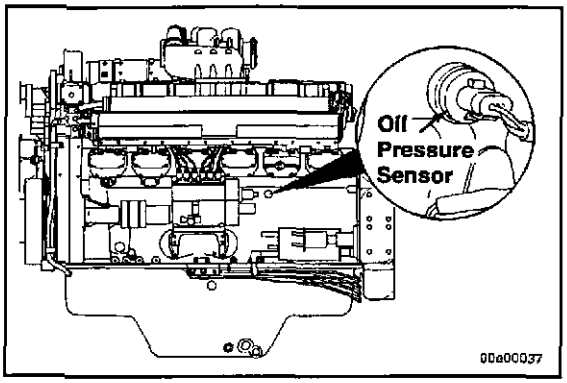
Connect the engine harness to the engine using cable ties.



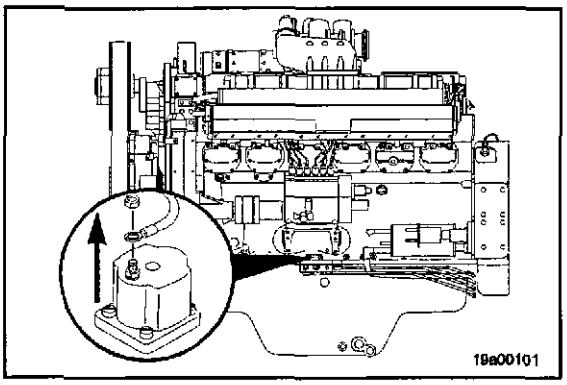


Connect the engine harness Deutsch connector to the engine harness extension cable, if used, or the engine harness adaptor cable. Use a 4 mm [5/32 inch] hex head wrench to tighten.

Torque Value: 3 N•m [25 in-lb]

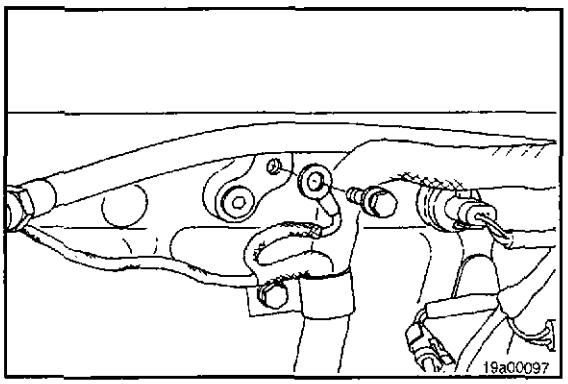


Connect the engine harness to the oil pressure sensor.



Connect the fuel shut off control wires to the fuel shut off solenoids (left bank and right bank). Tighten the retaining nut.

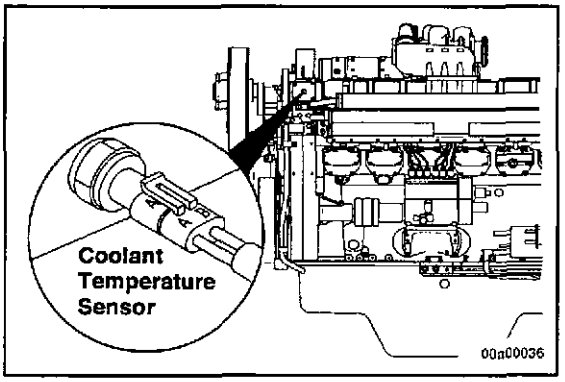
Torque Value: 3 N•m [25 in-lb]



Connect the engine block ground to the engine block.

Torque Value: 20 N•m [15 ft-lb]

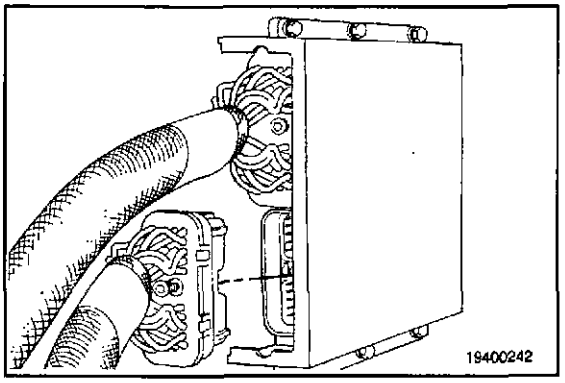
Connect the coolant temperature sensor.



Engine Harness Extension Cable

Connect the connectors of the extension cable to the wiring harness. Use a 4 mm [5/32 inch] hex head wrench to tighten.

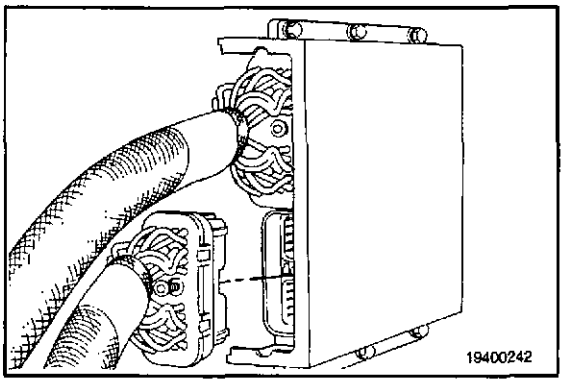
Torque Value: 3 N•m [25 in-lb]



Engine Harness Adaptor Cable

Connect the engine harness, any engine harness extension cable used, and the ECM Deutsch connectors to the engine harness adaptor cable. Use a 4 mm [5/32 inch] hex head wrench to tighten.

Torque Value: 3 N•m [25 in-lb]



Fault Lamp Circuit (019-047)

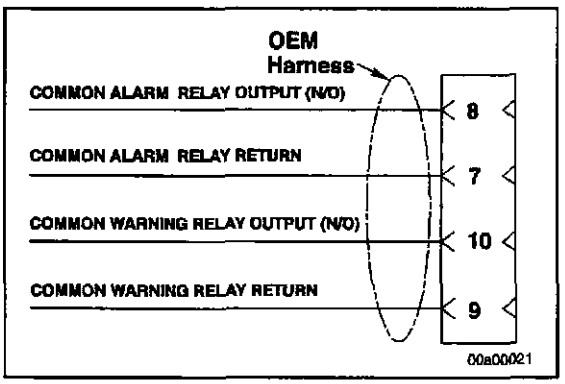
General Information

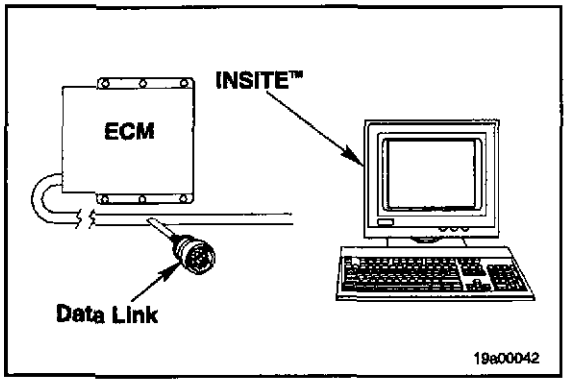
The Common Warning and Common Alarm circuits are used to signal that a fault has occurred.

The Common Warning circuit is energized when a fault has occurred and the engine is still allowed to operate. The engine will lose some system features, which sometimes result in a power loss.

The Common Alarm circuit is energized when a fault has occurred and the engine will **not** be allowed to operate until the Start/Run switch is cycled.

These circuits energize OEM selected devices that indicate to the operator that a fault has occurred.





Voltage Check (019-047-041)

Place the Stop/Run switch in the "Stop" position.

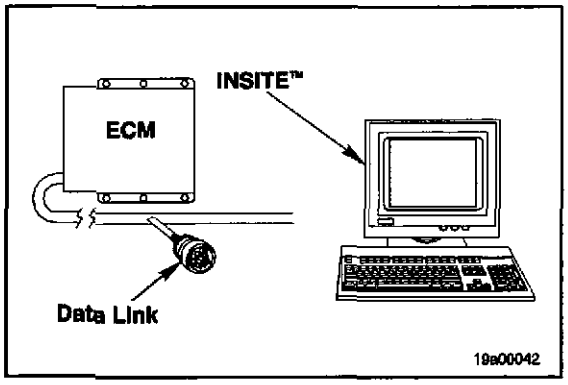
Controller in the diagnostic mode.

Using INSITE™, Part No. 3825145, in the Relay Driver Tests section, turn on the Common Warning relay driver output.

Touch the positive (+) lead of the multimeter to the fault indicator connector for the Common Warning relay output line.

Touch the negative (-) lead to engine block ground.

The multimeter **must** show battery voltage.



Place the Stop/Run switch in the "Stop" position.

Controller in the diagnostic mode.

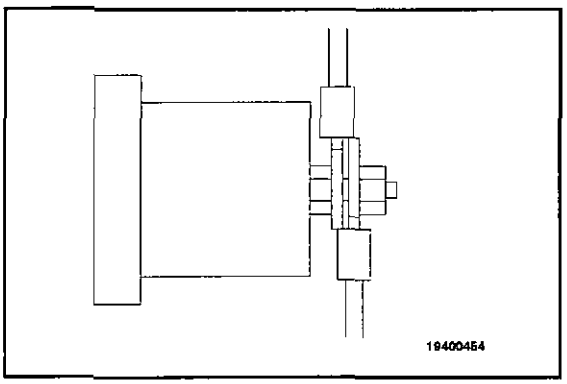
Using INSITE™, Part No. 3825145, in the Relay Driver Tests section, turn on the Common Alarm relay driver output.

Touch the positive (+) lead of the multimeter to the fault indicator connector for the Common Alarm relay output line.

Touch the negative (-) lead to engine block ground.

The multimeter **must** show battery voltage.

If either of the previous steps fail, repair or replace the OEM harness or OEM selected device(s). Refer to OEM Troubleshooting and Repair Procedures.



Fuel Shutoff Valve (FSOV) Circuit (019-049)

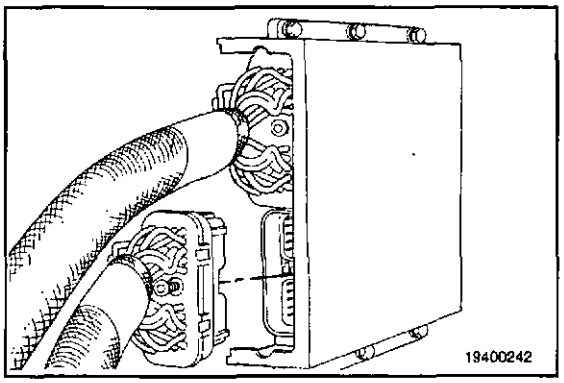
Initial Check (019-049-001)

Inspect the fuel shutoff solenoid post for extra wires that may be connected to supply power to another device. Remove the extra wires that are found connected to the solenoid post.

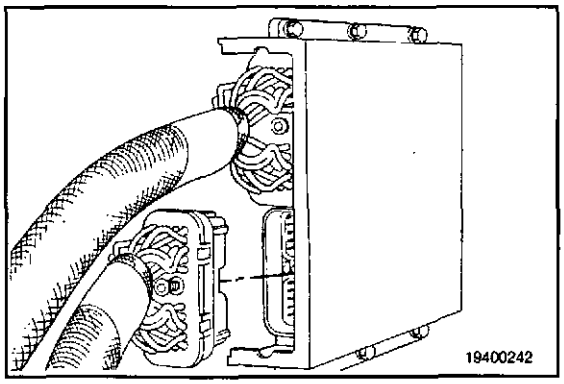
NOTE: Be sure to check both fuel shutoff solenoids.

Resistance Check (019-049-038)

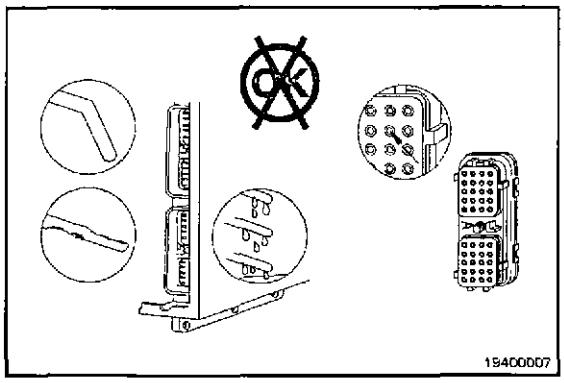
The fuel shutoff valve circuits are B+ signal wires, pins 39 and 40, of the engine harness to the fuel shutoff valve solenoids. The solenoids are grounded through the harness ground wires, which are attached to a mounting bolt or a post on the solenoid provided on isolated fuel solenoid shutoff valves, which are optional.



Use a 4 mm [5/32 in] hex head wrench to disconnect the engine harness Deutsch connector from the ECM.

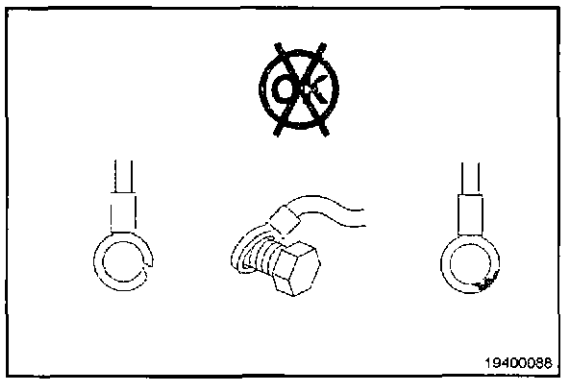


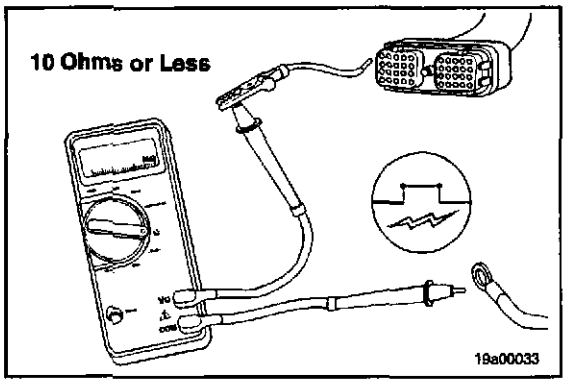
Check the ECM and engine harness connector pins for damage.



Disconnect the fuel shutoff solenoid wire from the solenoid post. Check the solenoid wire ring terminal for damage.

NOTE: Be sure to check both fuel shutoff solenoids.

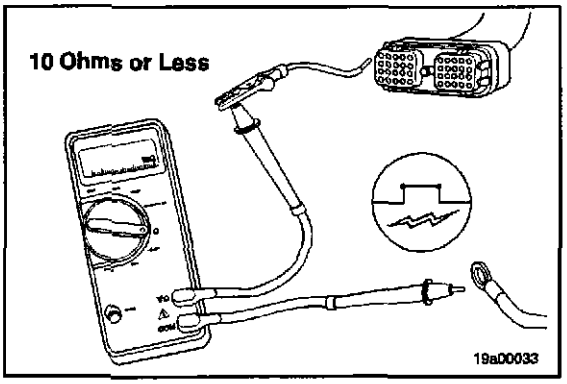




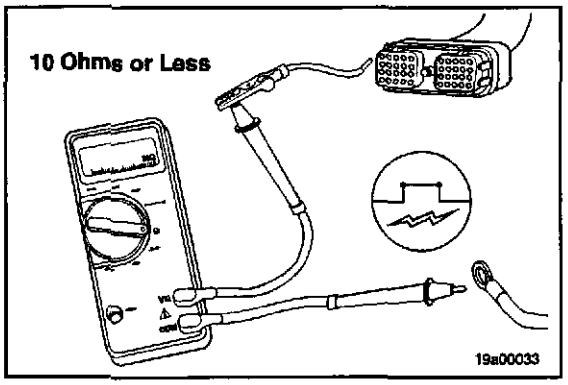
⚠ CAUTION ⚠

Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight *in the connector without expanding the pins of the* connector.

Insert the pin of one lead into pin 39 of the engine harness connector. Connect the alligator clip to the multimeter probe.

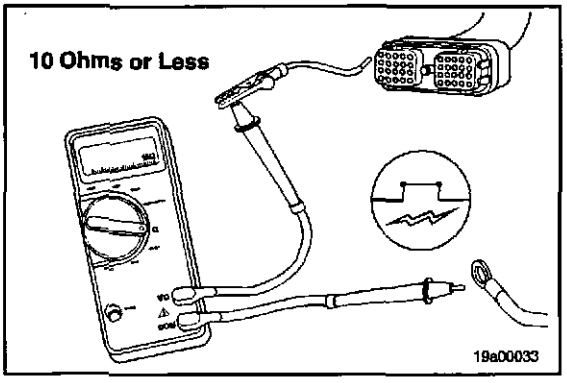


Touch the other multimeter lead to the corresponding fuel shutoff valve solenoid wire. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, repair or replace the engine harness. Refer to procedures 019-197, 019-199, 019-240, or 019-043. If the circuit is closed, it **must** still be checked for a short to ground and a short from pin to pin.



Insert the pin of one lead into pin 40 of the engine harness connector. Connect the alligator clip to the multimeter probe.

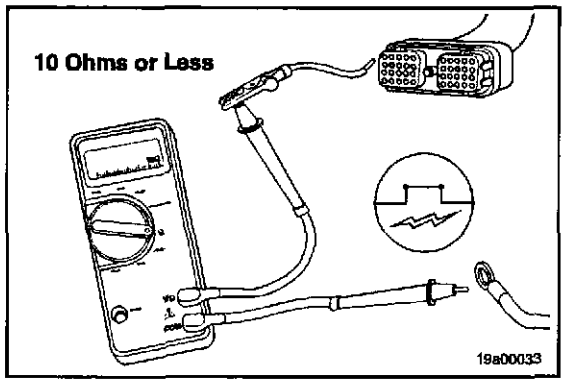
Touch the other multimeter lead to the corresponding fuel shutoff valve solenoid wire. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, repair or replace the engine harness. Refer to procedures 019-197, 019-199, 019-240, or 019-043. If the circuit is closed, it **must** still be checked for a short to ground and a short from pin to pin.



Check for Short Circuit to Ground (019-049-039)

Insert the lead into pin 39. Touch the other multimeter probe to engine block. The ring terminal at the corresponding solenoid **must** be disconnected and can **not** touch anything that is grounded. Measure the resistance. The multimeter **must** show an open circuit (more than 100k ohms). If the circuit is **not** open, there is a short to ground in the wire connected to pin 39. Repair or replace the engine harness. Refer to procedures 019-197, 019-240, and 019-043.

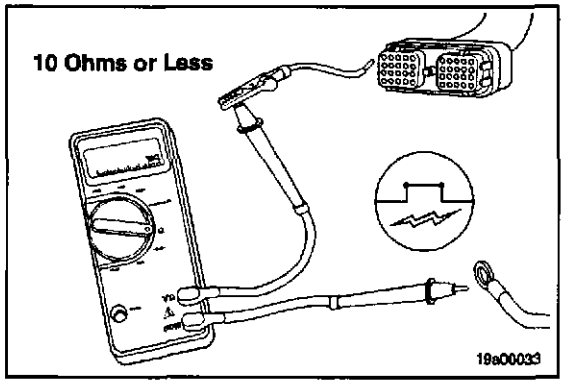
Insert the lead into pin 40. Touch the other multimeter probe to engine block. The ring terminal at the corresponding solenoid **must** be disconnected and can **not** touch anything that is grounded. Measure the resistance. The multimeter **must** show an open circuit (more than 100k ohms). If the circuit is **not** open, there is a short to ground in the wire connected to pin 40. Repair or replace the engine harness. Refer to procedures 019-197, 019-240, and 019-043.



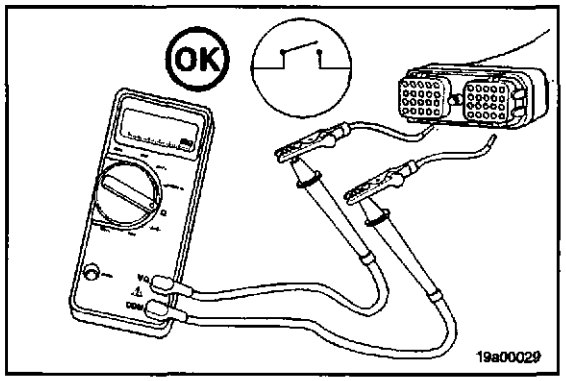
Check for Short Circuit from Pin to Pin (019-049-040)

Check for a short circuit from pin 39 to all of the other pins in the engine harness connector. Connect one test lead to pin 39. Use the other probe to test all of the other pins in the connector.

The ring terminal at the corresponding solenoid **must** be disconnected and can **not** touch anything that is grounded.

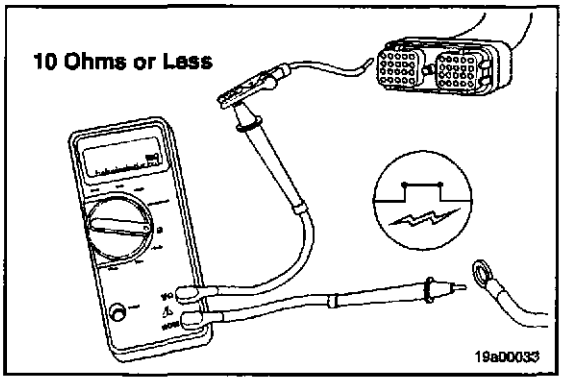


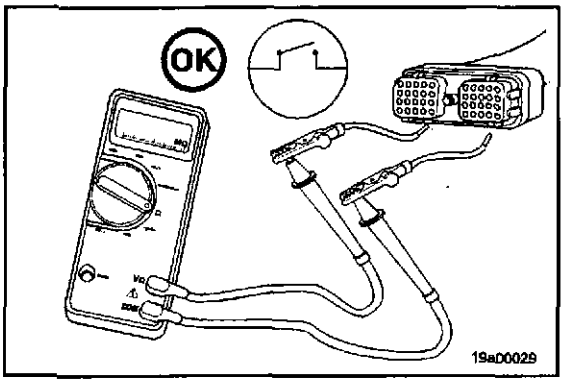
Measure the resistance. The multimeter **must** show an open circuit (more than 100k ohms). If the circuit is **not** open, there is a short between pin 39 and any pin that measured a closed circuit. Repair or replace the engine harness. Refer to procedures 019-199, 019-240, and 019-043.



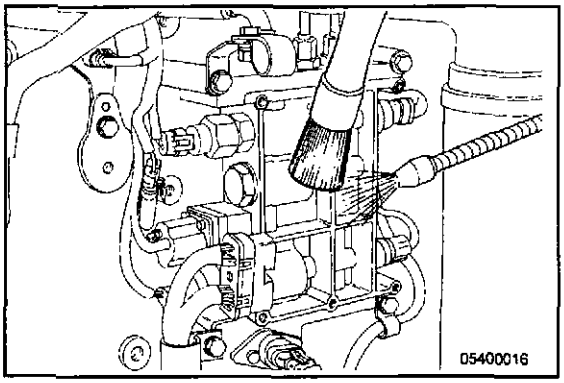
Check for a short circuit from pin 40 to all of the other pins in the engine harness connector. Connect one test lead to pin 40. Use the other probe to test all of the other pins in the connector.

The ring terminal at the corresponding solenoid **must** be disconnected and can **not** touch anything that is grounded.





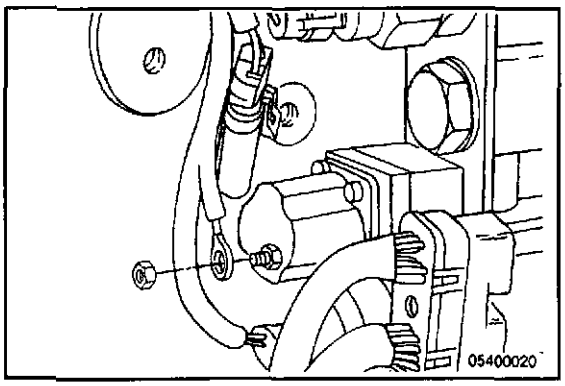
Measure the resistance. The multimeter **must** show an open circuit (more than 100k ohms). If the circuit is **not** open, there is a short between pin 40 and any pin that measured a closed circuit. Repair or replace the engine harness. Refer to procedures 019-199, 019-240, and 019-043.



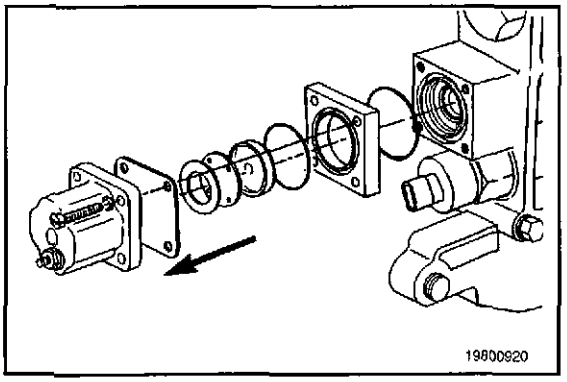
Fuel Shutoff Valve (FSOV) Solenoid (019-050)

Remove (019-050-002)

Clean the fuel shutoff valve and surrounding area.



Remove the nut holding the electrical connection of the fuel shutoff valve solenoid. Remove the connection.



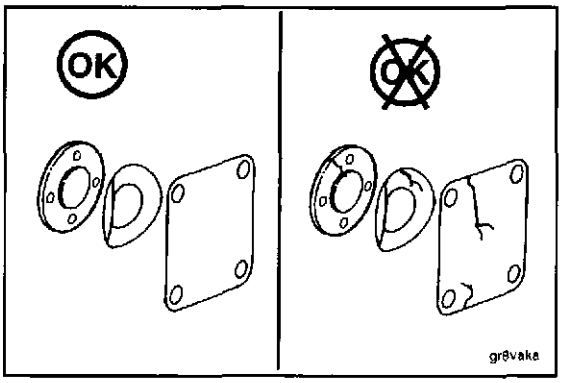
Remove the four mounting capscrews. Remove the solenoid housing, fuel shield, spring washer, valve disc, actuator disc, and actuator housing. Discard the o-rings.

Inspect for Reuse (019-050-007)

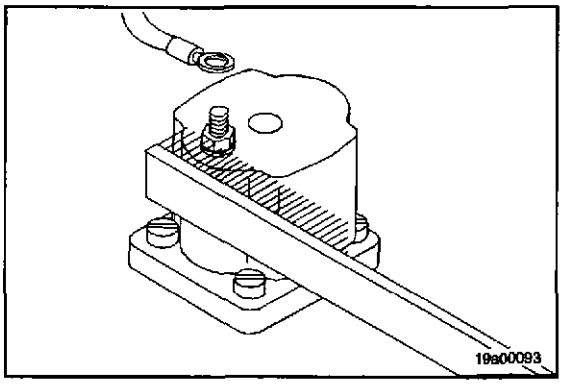
NOTE: Do not get solution on the solenoid. Clean the solenoid with a dry cloth. Use 200 grit emery cloth and a flat surface to polish the solenoid surface.

Use mineral spirits to clean all of the parts except the solenoid.

Visually check the fuel shield, spring washer, valve disc, actuator disc, and actuator housing for dirt, bonding separation, corrosion, cracks, or wear. Replace any parts if necessary.

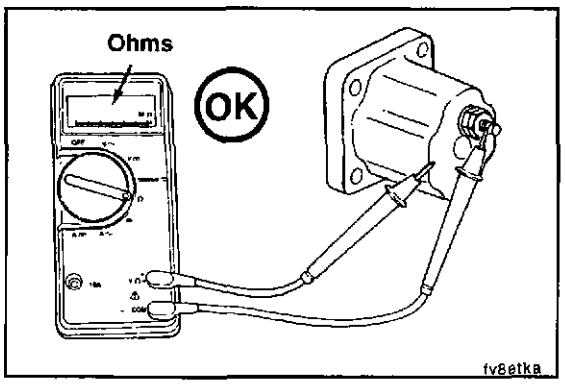


Use a wire brush to clean any corrosion from the solenoid terminal.

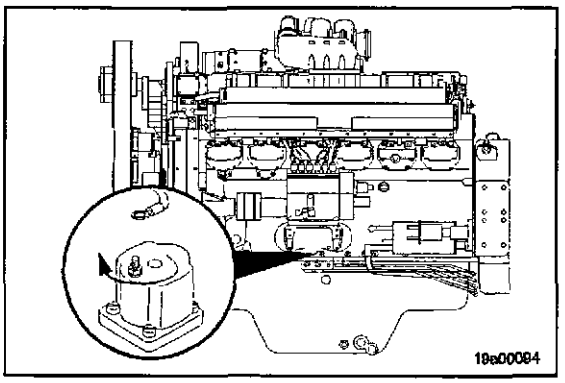


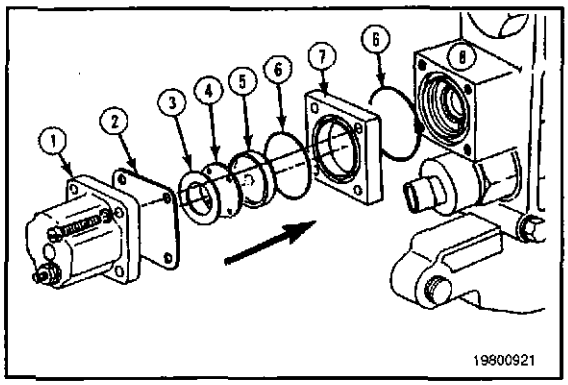
Check the solenoid with a multimeter. Replace the solenoid if the resistance is not between 28 to 32 ohms.

NOTE: If the solenoid shows 0 ohms, there is an electrical short in the coil.



Tighten the nut that holds the electrical connection post on the fuel shutoff valve solenoid.



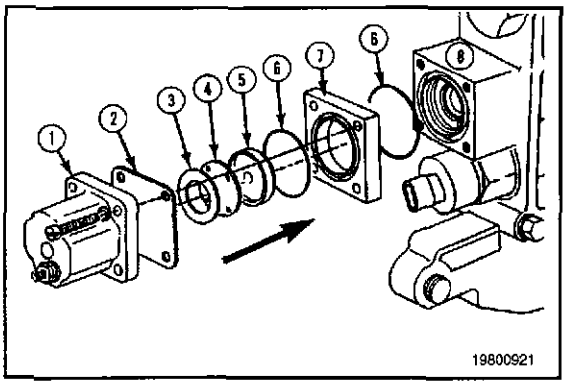


Install (019-050-026)

Assemble the shutoff valve as shown. Install these parts as follows.

Install a new o-ring (6) between the spacer (7) and the electronic control valve body (8).

Install the spacer (7) o-ring groove toward the coil. Install the actuator disc (5) with the cup side toward the solenoid. Install the spring washer (3) with the cup side toward the solenoid.



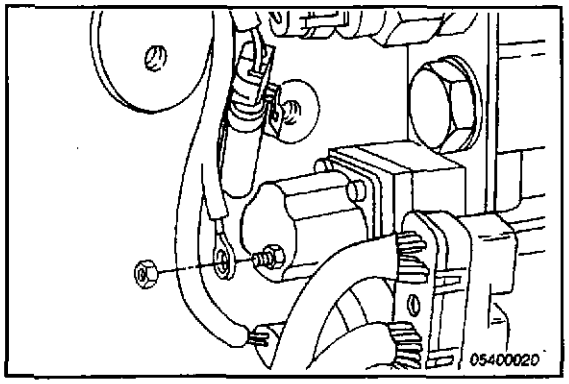
Align the actuator disc (5), spacer (7), and valve disc (4) on the electronic control valve body (8). Install a new o-ring (6).

Put the spring washer (3) on the valve disc (4), with the cavity side positioned upward, in a position around the valve locator.

NOTE: The solenoid **must** be orientated with the electrical connection post on the bottom.

Install the fuel shield (2) and solenoid (1) on the electronic control valve body (8). Install a new o-ring and tighten the capscrews.

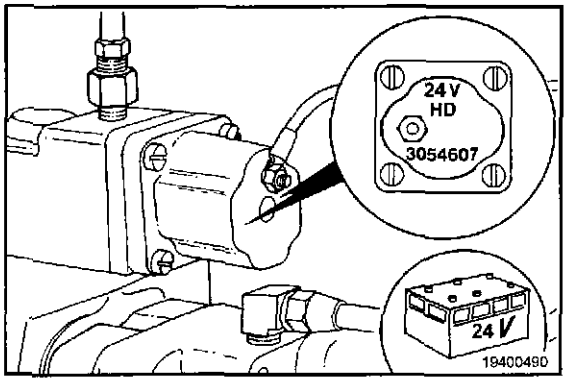
Torque Value: 8 N•m [72 in-lb]



Install the electrical connection of the fuel shutoff valve. Install the nut on the threaded post of the solenoid.

Use two wrenches. Hold the post of the nut firmly while tightening the connection nut.

Torque Value: 2 N•m [15 in-lb]



Resistance Check (019-050-038)

Make sure the shutoff valve coil is the correct voltage (24 volts).

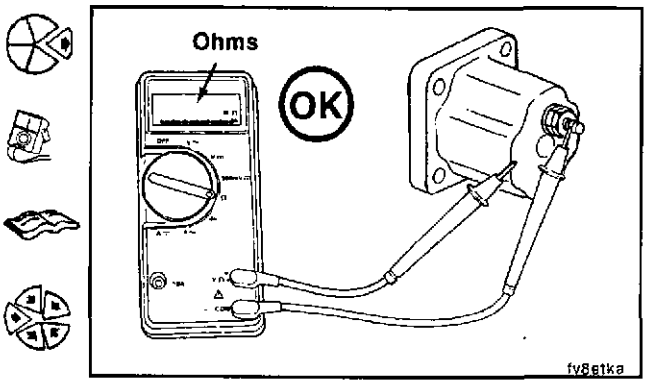
The coil voltage and part number are cast into the terminal connection end of the coil.

Remove the solenoid wire.

Use the multimeter to check the coil resistance. The coil resistance **must** be 28 to 32 ohms for 24 VDC solenoids.

If the coil resistance does **not** meet specification, the coil **must** be replaced. Refer to Procedure 019-050.

Install the solenoid wire when the repair is complete.



Voltage Check (019-050-041)

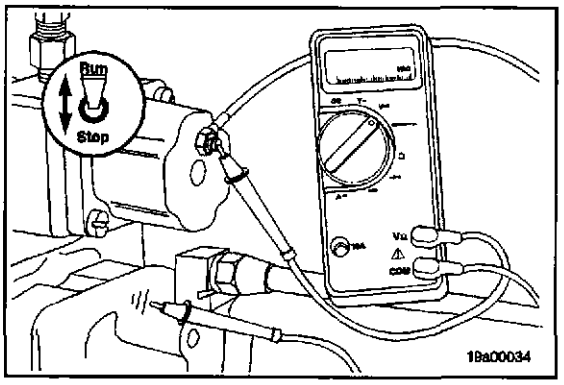
Place the Stop/Run switch in the "RUN" position.

Controller **not** in the diagnostic mode.

Use a multimeter to check the DC voltage to the coil.

The voltage **must** be the same as the battery voltage.

Place the Stop/Run switch in the "STOP" position.

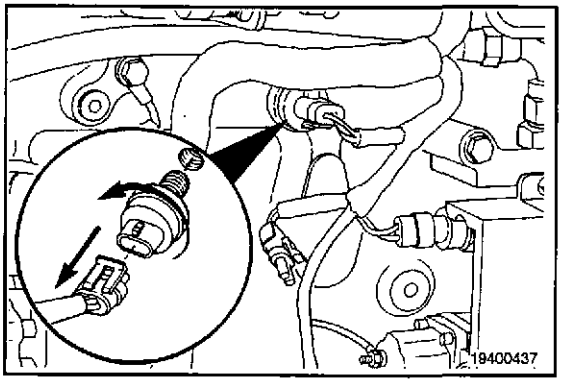


Lubricating Oil Pressure Sensor (019-066)

Remove (019-066-002)

Lift up on the tab and disconnect the connector from the sensor.

Remove the sensor from the engine block. Use a deep flank drive socket, Part No. 3823843.



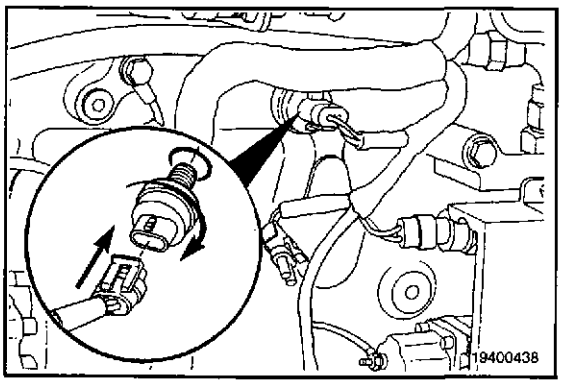
Install (019-066-026)

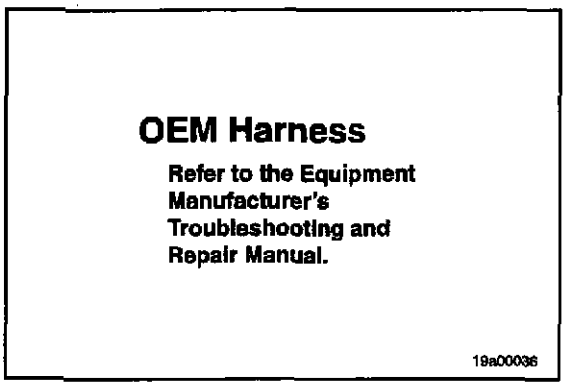
Make sure the new sensor has an o-ring around the surface where it seals against the engine block.

Install the sensor in the engine block.

Torque Value: 14 N•m [10 ft-lb]

Push the connectors together until they lock.

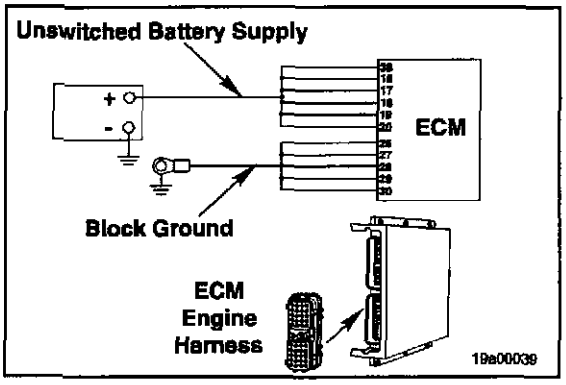




OEM Wiring Harness (019-071)

General Information

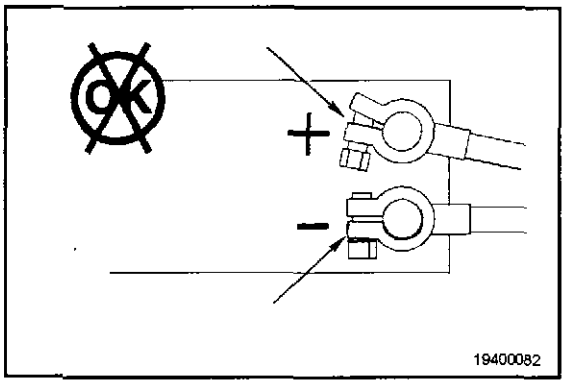
The OEM harness is supplied and installed by the equipment manufacturer. Follow the equipment manufacturer's instructions. If replacement is necessary, refer to the equipment manufacturer's troubleshooting and repair manual.



Unswitched Battery Supply Circuit (019-087)

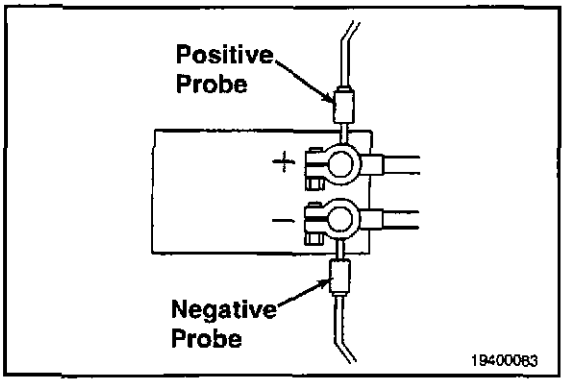
General Information

The ECM receives constant voltage from the battery through the unswitched battery wires that are connected directly to the (+) positive battery post.



Initial Check (019-087-001)

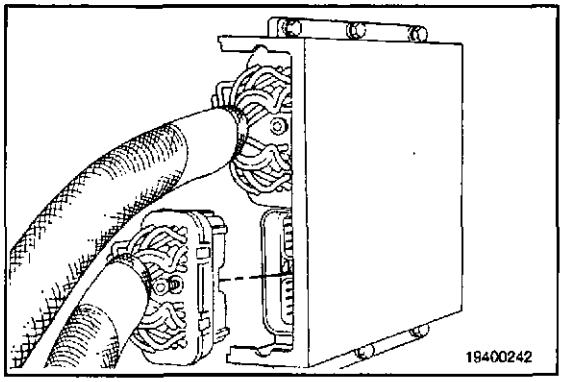
Inspect the battery cable connections for loose or corroded connections. Repair or replace the battery connections. Refer to the OEM manual.



Check the battery voltage. Place the multimeter's positive probe on the positive (+) terminal of the battery. Place the multimeter's negative probe on the negative (-) terminal of the battery. Measure the battery voltage. The voltage should be 17.3 to 34.7 volts DC for a 24 volt system. If the battery voltage is below 17.3 volts replace the battery. Refer to the Base Engine Troubleshooting and Repair Manual for battery replacement.

Resistance Check (019-087-038)

Disconnect the engine harness from the ECM. Check the ECM and engine harness for damaged pins.

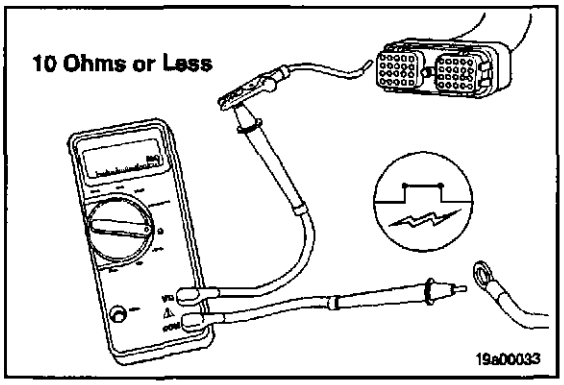


⚠ CAUTION ⚠

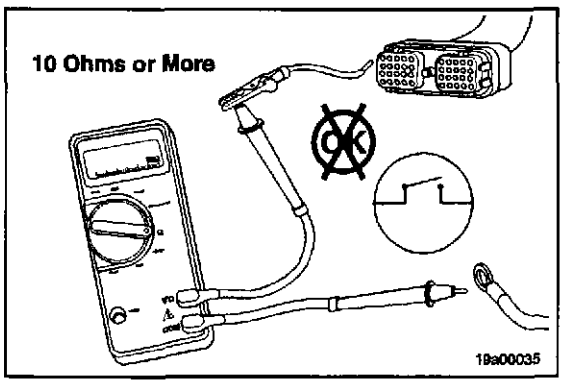
Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight in the connector without expanding the pins in the connector.

Insert the test lead into pin 38 of the engine harness. Connect the alligator clip to the multimeter probe. Touch the other probe to the battery connection on the engine harness. Measure the resistance. The resistance **must** be 10 ohms or less.

Repeat this step for pins 16 thru 20.



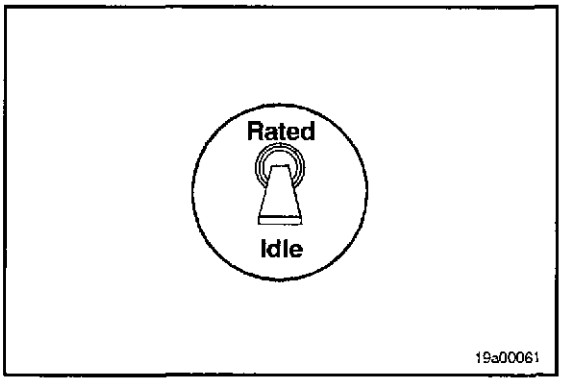
If more than 10 ohms are measured in any check, there is an open circuit. Repair or replace the engine harness. Refer to Procedures 019-199, 019-240, and 019-043.

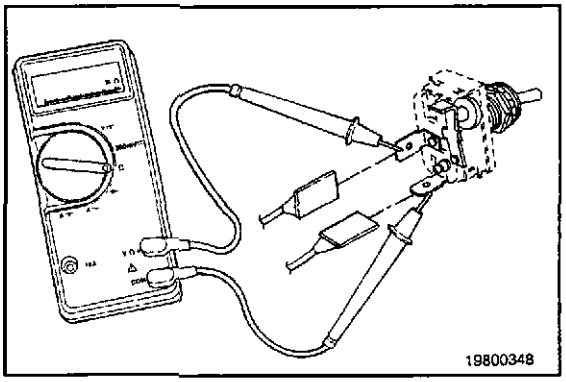


Idle Rated Switch (019-095)

General Information

The Idle/Rated switch is used to switch between Idle speed and Rated speed.



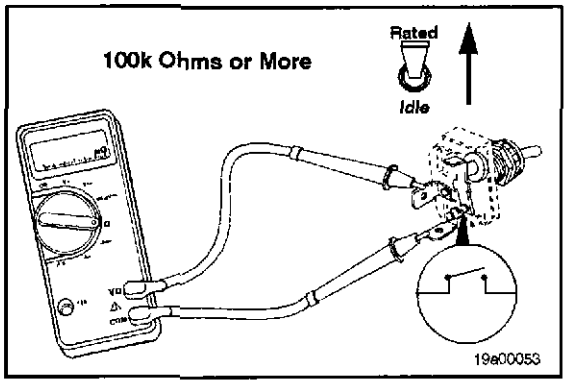


Resistance Check (019-095-038)

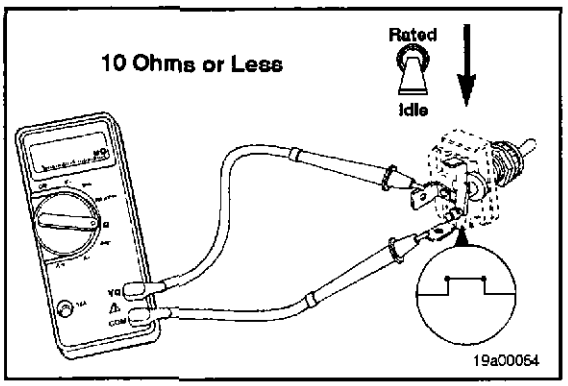
Using INSITE™, Part No. 3825145, in the monitor mode, toggle the Idle/Rated switch between "Idle" and "Rated" checking for proper operation.

If the switch does **not** operate properly or INSITE™ is not available, follow the troubleshooting procedures in this section.

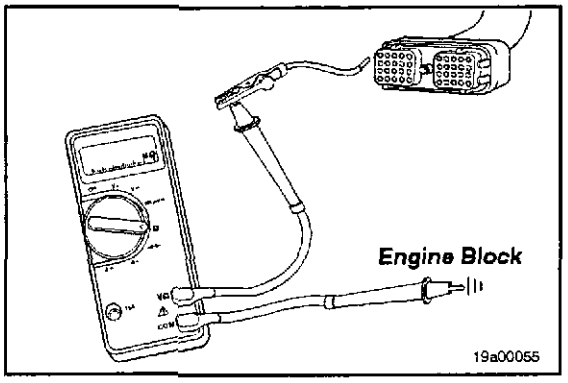
Remove and tag the connectors from the terminals on the switch. Place the multimeter leads on each terminal.



Place the Idle/Rated switch in the "Rated" position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed and must be replaced. Refer to OEM Troubleshooting and Repair Procedures.



Move the switch to the "Idle" position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed and must be replaced. Refer to OEM Troubleshooting and Repair Procedures.



Idle Rated Switch Circuit (019-096)

Resistance Check (019-096-038)

⚠ CAUTION ⚠

Do not use probes or leads other than Part No. 3822758. The connector will be damaged. The leads must fit tight in the connector without expanding the pins in the connector.

Insert the test lead into pin 3 of the OEM harness connector.

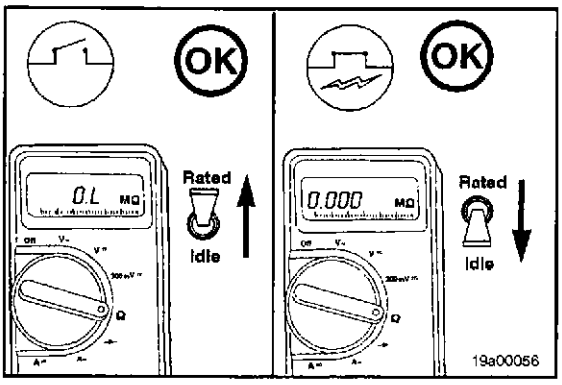
Measure the resistance from pin 3 to engine block ground.

Move the Idle/Rated switch to the "Idle" position. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, check for an open circuit in the Idle/Rated switch wiring.

Move the switch to the "Rated" position. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the OEM harness, provided the switch has previously been checked. Refer to OEM Troubleshooting and Repair Procedures.

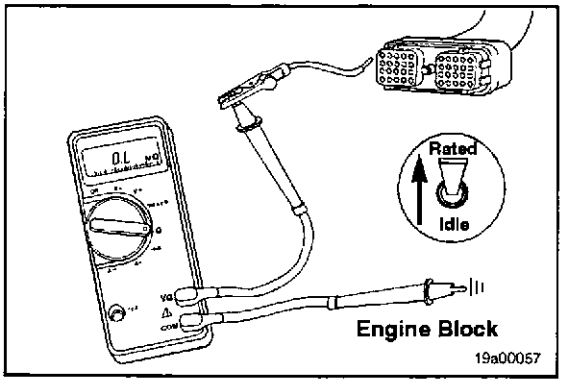


Check for Short Circuit to Ground (019-096-039)

Place the Idle/Rated switch in the "Rated" position.

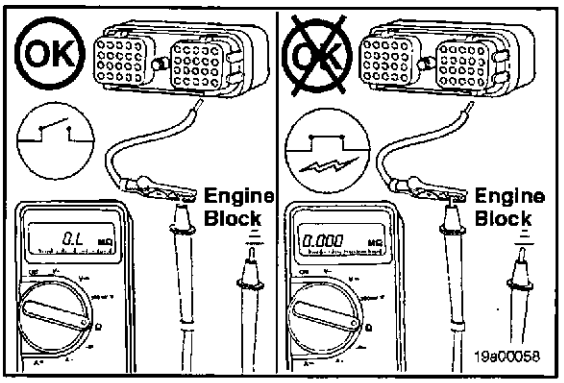
Remove the OEM harness connector from the ECM.

Use test lead, Part No. 3822758, and measure the resistance from pin 3 of the OEM harness connector to ground.



The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit in the Idle/Rated switch circuit, provided the diagnostic Idle/Rated switch has been previously checked.

Repair or replace OEM harness, refer to OEM Troubleshooting and Repair Procedures.



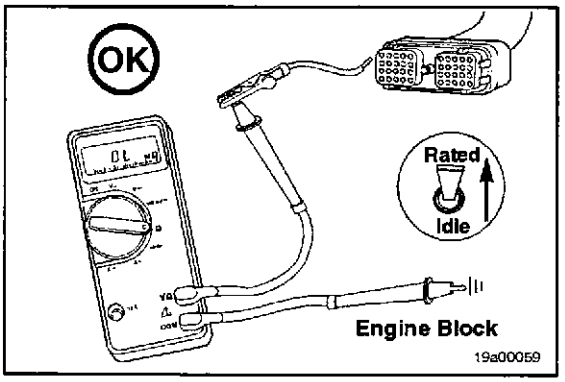
Check for Short Circuit from Pin to Pin (019-096-040)

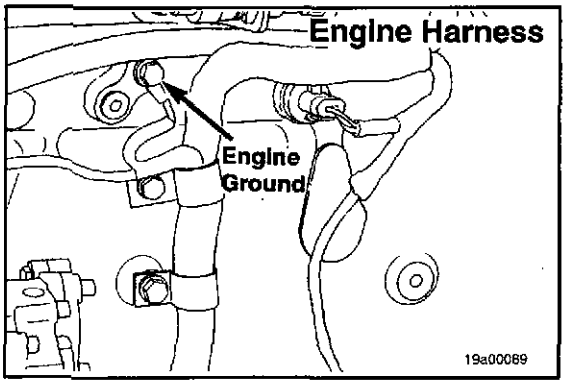
Remove the engine harness connector from the ECM.

Move the Idle/Rated switch to the "Rated" position.

Use test lead, Part No. 3822758, and measure the resistance from pin 3 of the OEM harness connector to every other pin in the connector. The multimeter **must** show an open circuit (100k ohms or more).

If the multimeter does not show an open, a short circuit exists between pin 3 and whichever pin showed less than 100k ohms. Repair or replace the OEM harness, refer to OEM Troubleshooting and Repair Procedures.



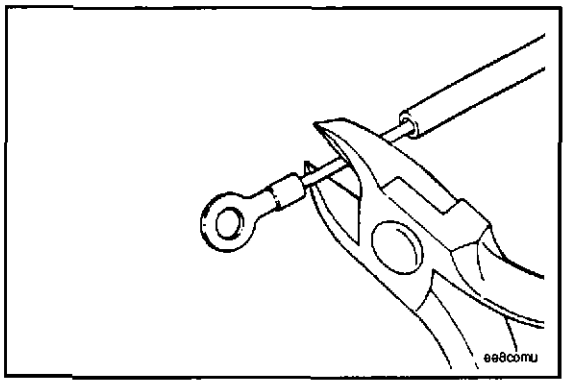


Ring Terminal (019-197)

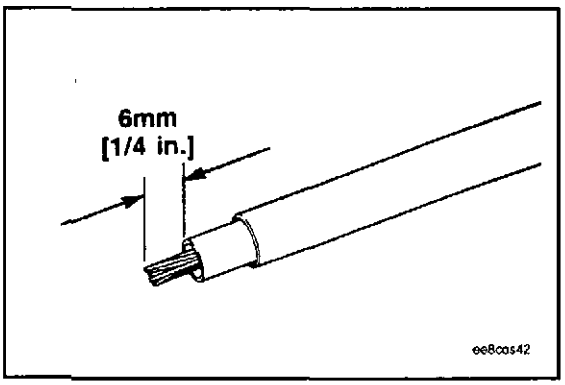
Connector Replacement (019-197-067)

Terminals are used on the engine harness:

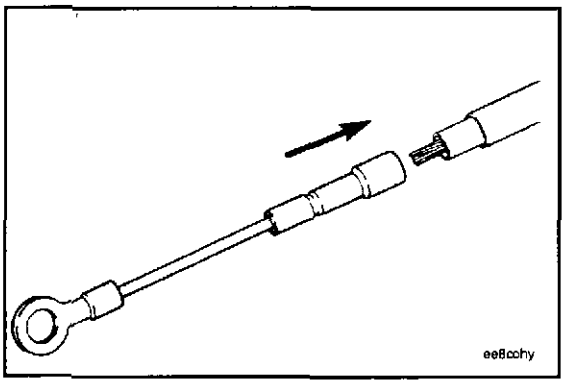
- Fuel shutoff solenoid valve (2)
- engine ground



Use wire crimp tool, Part No. 3822930 to cut and remove the ring terminal connector as shown.



Use wire crimp tool, Part No. 3822930, to remove 6 mm [1/4 inch] of insulation from the harness wire.



Install the proper size ring terminal on the bare wire. The ring terminals that are included in the QST30 G-Drive wiring repair kit, Part No. 3825189, are as follows:

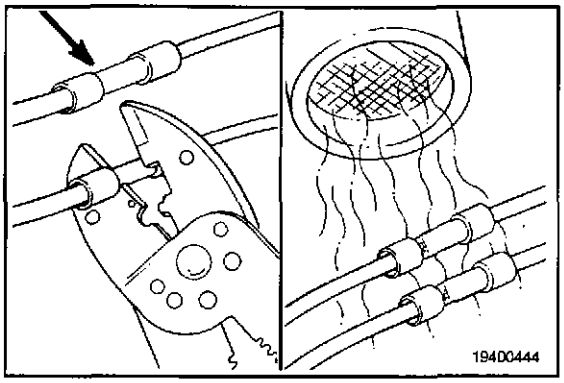
Ring Terminal Size	Part No.
No. 10	3823760
1/2 inch	3823761

⚠ CAUTION ⚠

Only use wire crimping pliers, Part No. 3822930, when repairing electrical terminals.

Crimp the repair wire on the bare wire.

Use a heat gun, Part No. 3822860, or open flame, to heat the shrink tubing. The tubing will shrink and make the connection waterproof.

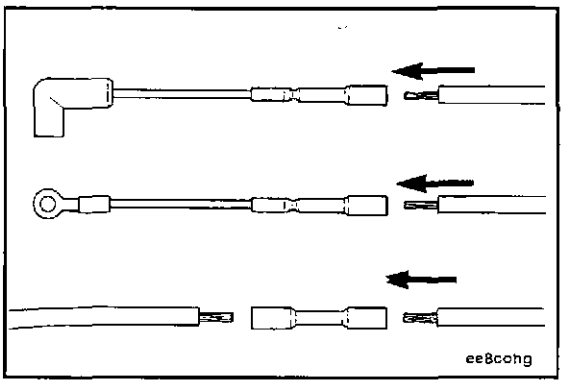


Connector, Butt Splice (019-199)

General Information

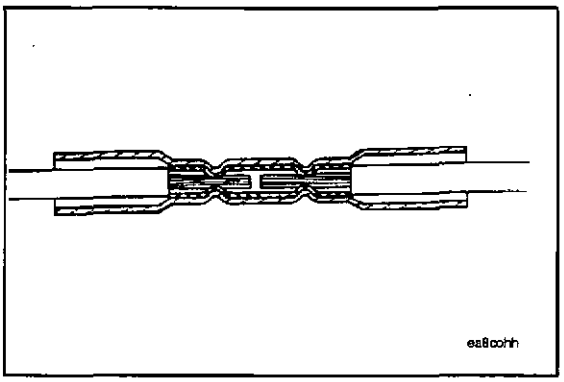
Butt splice connectors are used when repairing harnesses or damaged wires.

NOTE: Only use the butt splices that are supplied with the wiring repair kit, Part No. 3822926, when repairs are necessary.

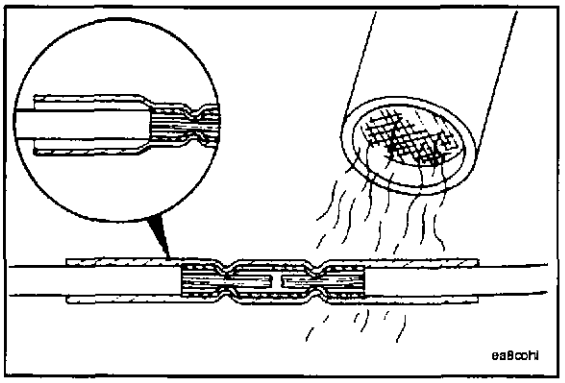


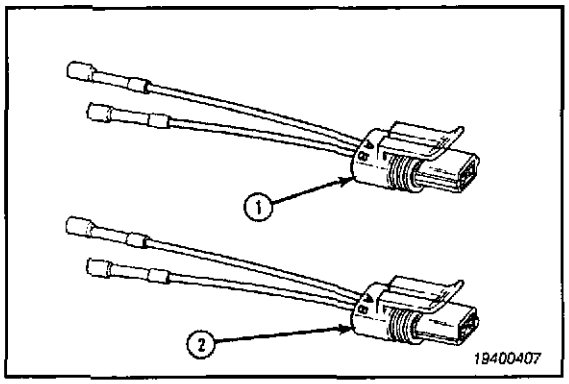
Butt splices are designed to provide the best possible cold joint connection when properly crimped.

NOTE: Use wire crimp tool, Part No. 3822930, supplied with the electrical wiring repair kit.



Butt splices also provide protection against corrosion. After crimping the connection, heat the shrink tube with the heat gun, Part No. 3822860, or an open flame, until the shrink tube has sealed the joint.



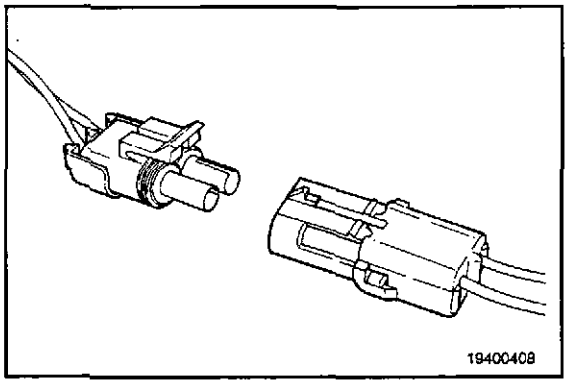


Connector, 2-Pin (019-202)

Pin Replacement (019-202-066)

Metri-Pack

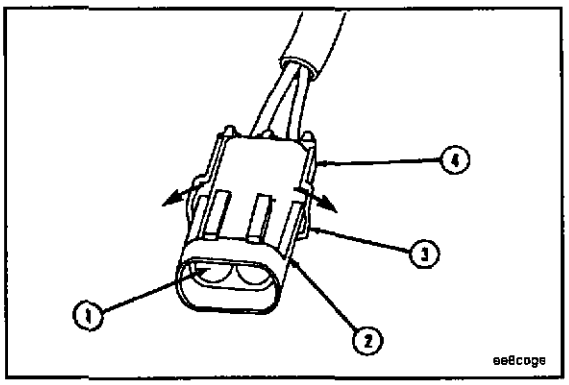
The connector is **not** repairable. If any part of the connector becomes damaged, replace the connector with the repair connector, Part No. 3823256 and Part No. 3824803, that is supplied in the wiring repair kit, Part No. 3825189. Refer to Procedure 019-202-067.



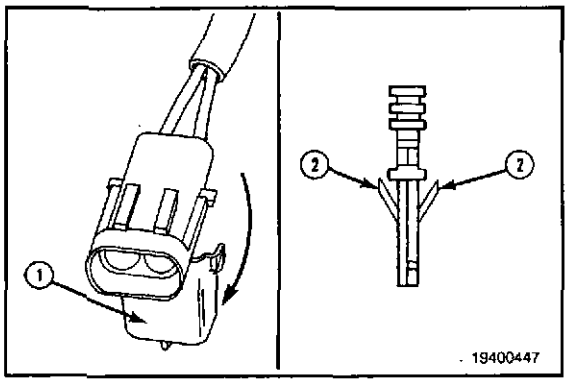
Weather-Pack

The connector is used to connect many different sensors and switches to the engine and OEM harnesses.

NOTE: Make sure the correct wires are connected to the correct connectors. Refer to the wiring diagram in Section E of this manual.



To replace a Weather-Pack terminal (1), pull the locking tabs (3) apart on the wire lock (4).



Open the wire lock.

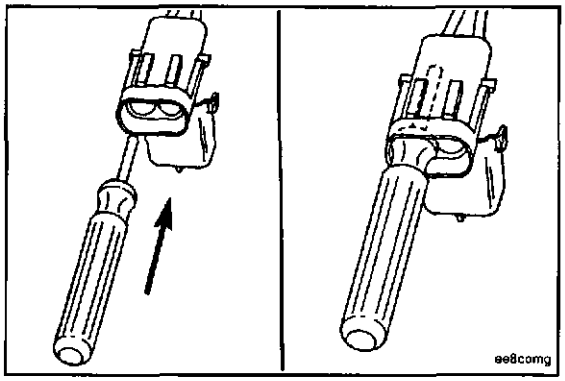
NOTE: The wire is held in the connector body by the wire lock (1) and two locking lances (2) on the terminal.

Insert the Weather-Pack extraction tool, Part No. 3822608, over the terminal.

⚠ CAUTION ⚠

This tool is easily broken. Care must be taken when using this tool. Do not force the tool into place.

Use a twisting motion to push the tool to the bottom of the cavity.



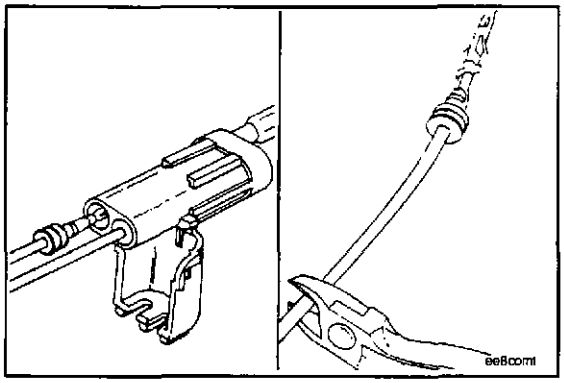
⚠ CAUTION ⚠

If more than on wire is being repaired, tag each wire and install in the original location.

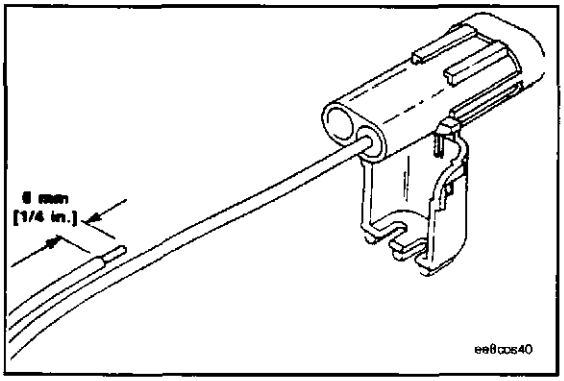
Pull the wire and the terminal out of the connector body.

NOTE: The repair wire and terminal is 127 mm [5 inches] long.

Use wire crimp tool, Part No. 3822930, to cut 127 mm [5 inches] off the terminal and wire.



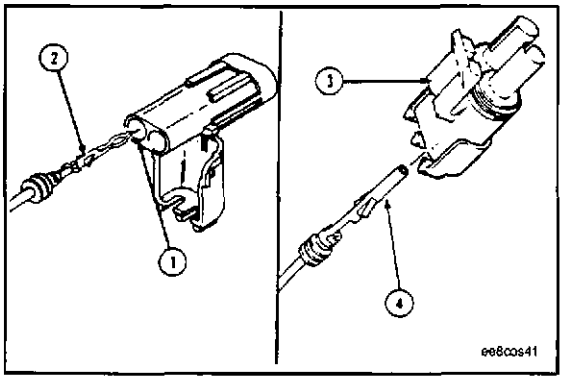
Use wire crimp tool, Part No. 3822930, to remove about 6 mm [1/4 inch] of insulation from the wire.

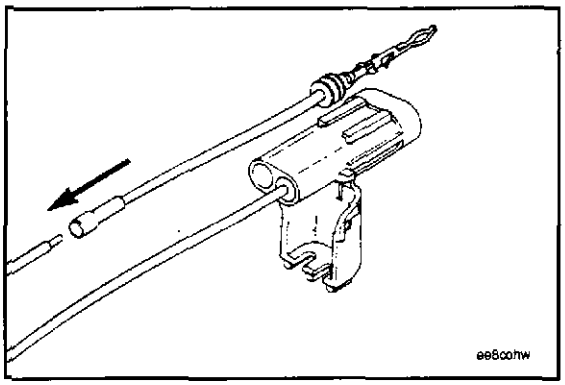


NOTE: The "shroud" connector bodies (1) use "male" terminals (2). The "tower" connector bodies (3) use "female" terminals (4).

The repair wire for the male terminal is Part No. 3822922.

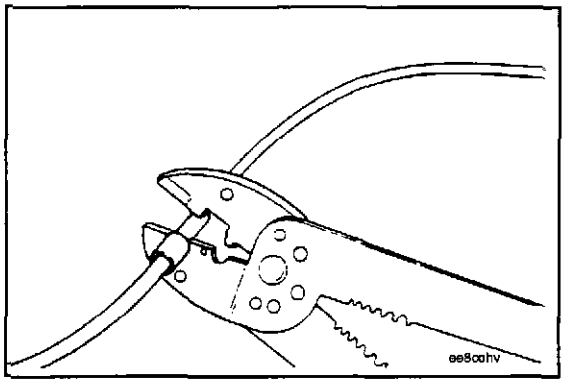
The female terminal is Part No. 3822923.



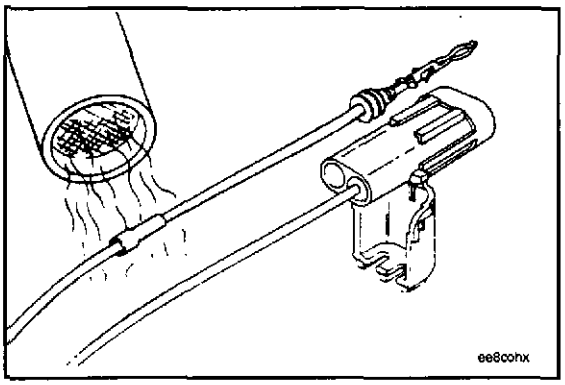


Install the correct repair wire (1) on the bare wire.

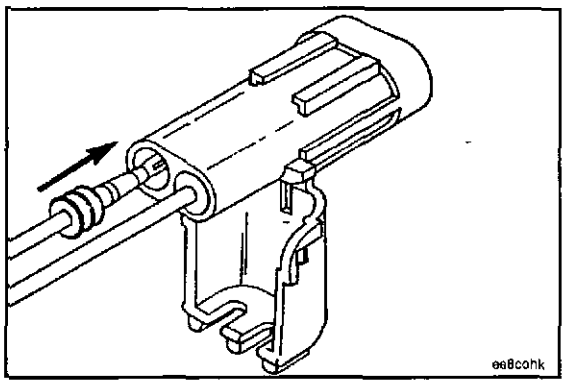
NOTE: Make sure the bare wire extends into the insulated butt splice connector.



Use wire crimp tool, Part No. 3822930, to crimp the repair wire on the bare wire.



Use a heat gun, Part No. 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.

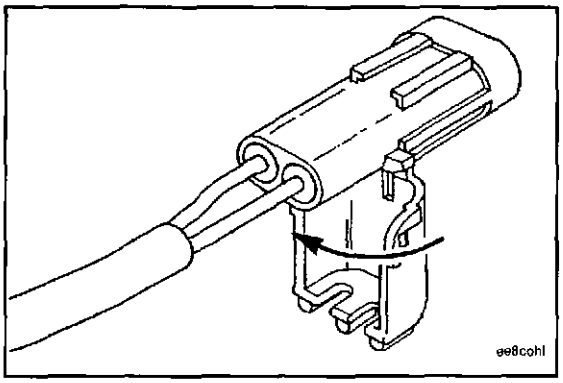


△ CAUTION △

If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same locations as they were in the original connector.

Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.

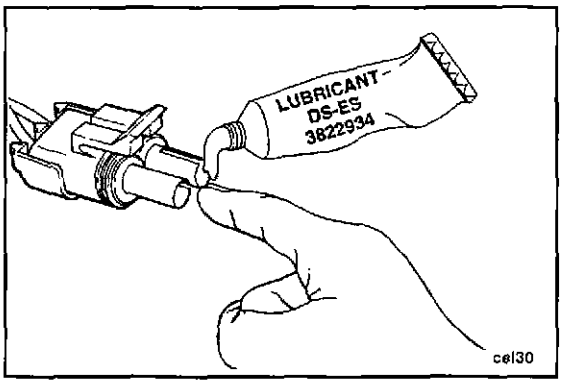
Close and latch the wire lock on the connector body.



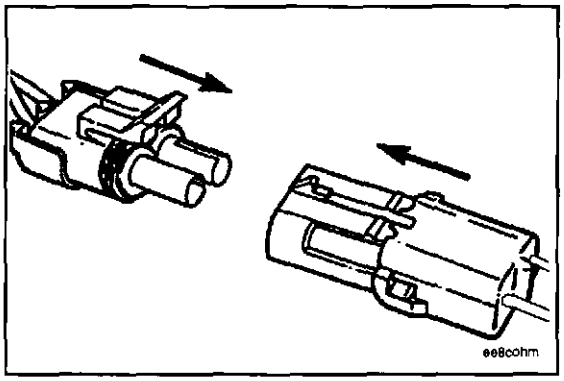
⚠ CAUTION ⚠

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants such as lubricating oil or grease in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.



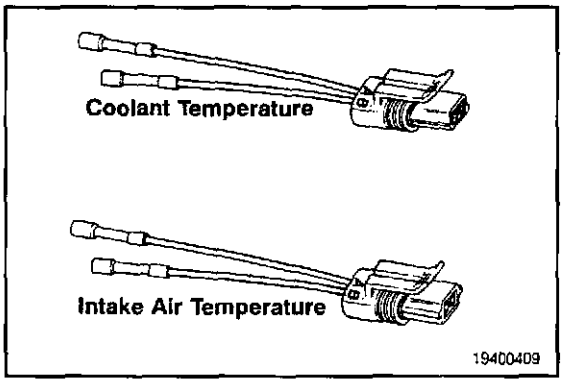
Insert the two connector halves together.

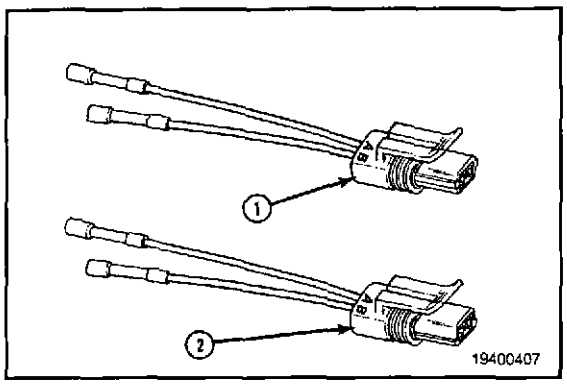


Connector Replacement (019-202-067)

Metri-Pack

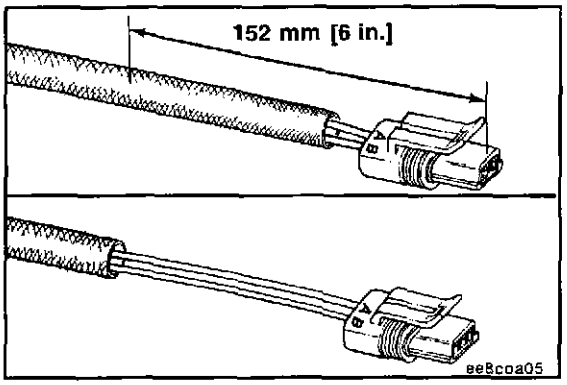
The connector is used to connect the Coolant Temperature sensor.



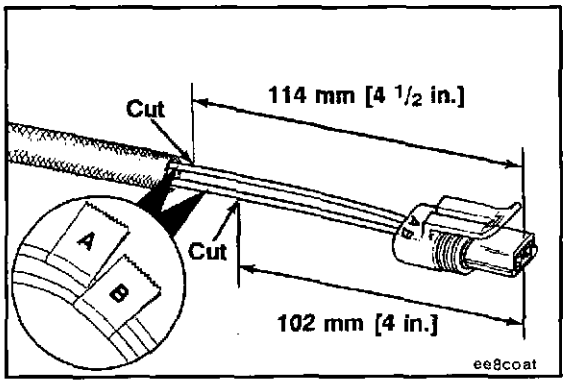


The connector is **not** repairable. If any part of the connector becomes damaged, replace the connector with the repair connector, Part No. 3823256 and Part No. 3824803, that is supplied in the wiring harness repair kit, Part No. 3825189.

NOTE: Make sure the correct wires are connected to pin "A" and pin "B" when replacement is necessary. Refer to the *wiring diagram in Section E in this manual.*



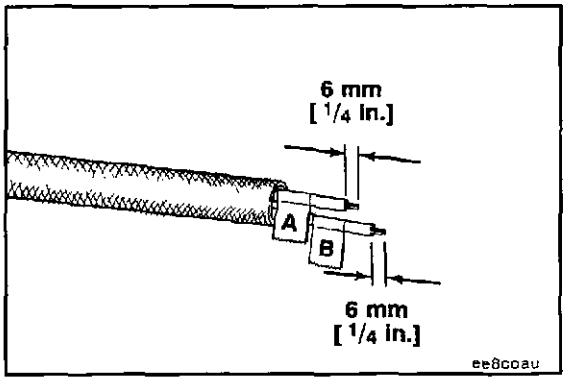
Measure 152 mm [6 inches] back from the face of the connector and remove the wiring harness protective cover.



Before cutting the wires, measure and tag both wires.

Use wire crimp tool, Part No. 3822930, to cut wire "A" 114 mm [4–1/2 inches] from the face of the connector.

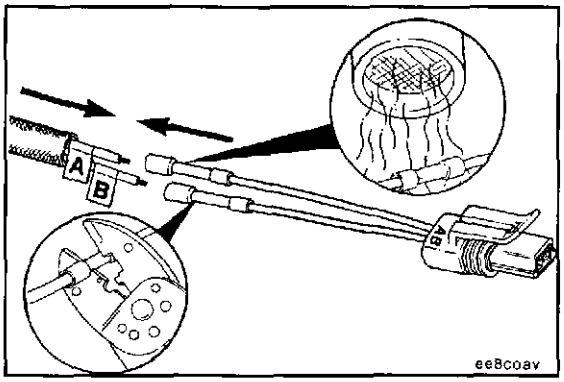
Use crimp tool, Part No. 3822930, to cut wire "B" 102 mm [4 inches] from the face of the connector.



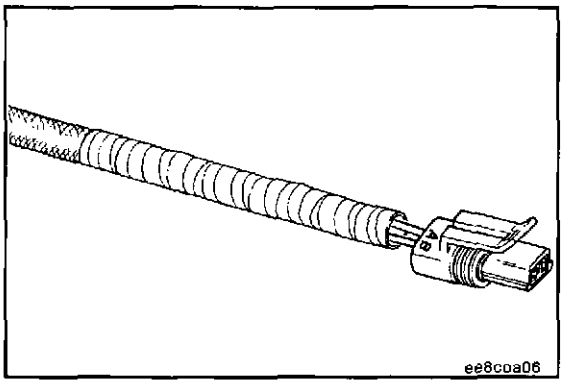
Use wire crimp tool, Part No. 3822930, to remove 6 mm [1/4 inch] of insulation from both electrical wires.

Install the terminal repair wires on the bare wires and use wire crimp tool, Part No. 3822930, to crimp the terminals.

Use heat gun, Part No. 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



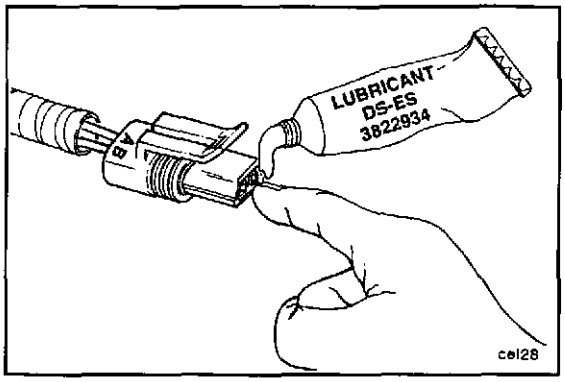
Wrap the wires with tape, for added protection, to complete the repair.



⚠ CAUTION ⚠

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants such as lubricating oil or grease in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

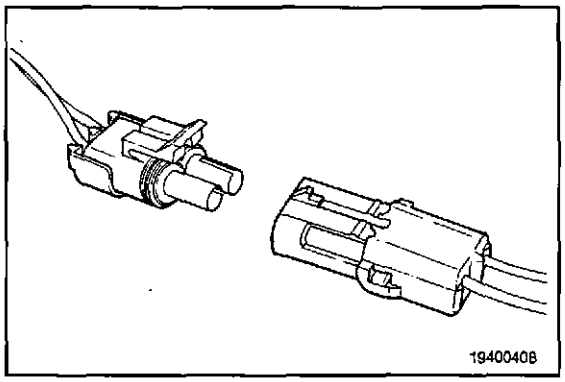
Apply a small amount of lubricant to the connector terminals. Before installing, fill the entire connector cavity with lubricant.

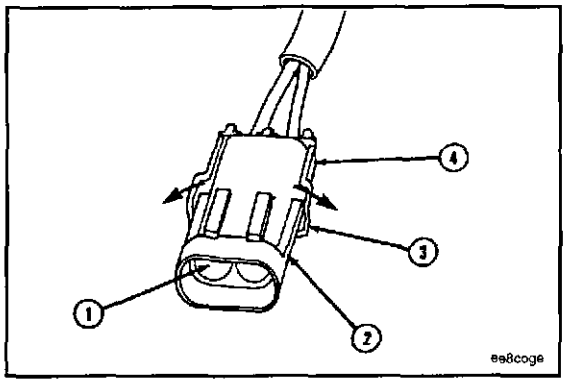


Weather-Pack

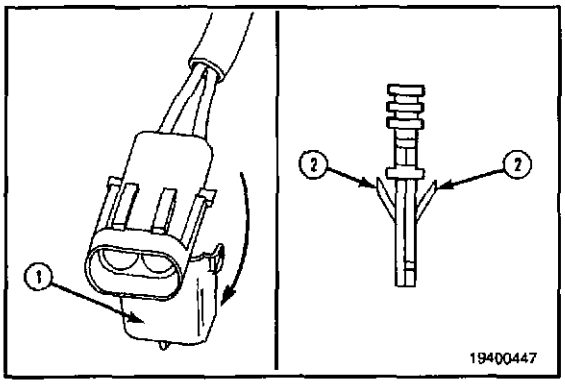
The connector is used to connect many different sensors and switches to the engine and OEM harnesses. The connector can be a 1–way, 2–way, 3–way, or 4–way pin type. All types of connectors are repaired in the same manner.

NOTE: Make sure the correct wires are connected to the correct connectors. Refer to the wiring diagram in Section E of this manual.



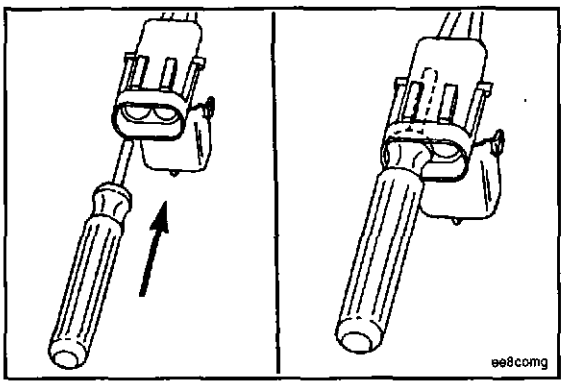


To replace a Weather-Pack connector body (2), pull the locking tabs (3) apart on the wire lock (4).



Open the wire lock.

NOTE: The wire is held in the connector body by the wire lock (1) and two locking lances (2) on the terminal.

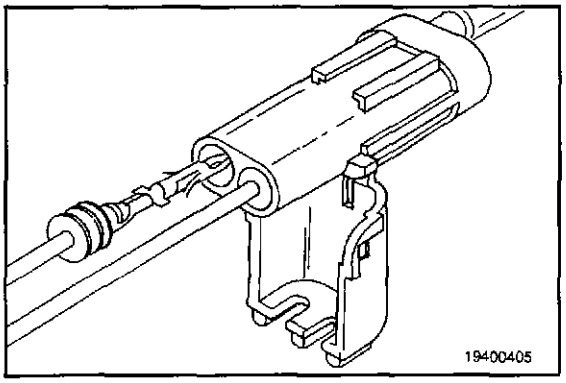


Insert the Weather-Pack extraction tool, Part No. 3822608, over the terminal.

△ CAUTION △

This tool is easily broken. Care must be taken when using this tool. Do not force the tool into place.

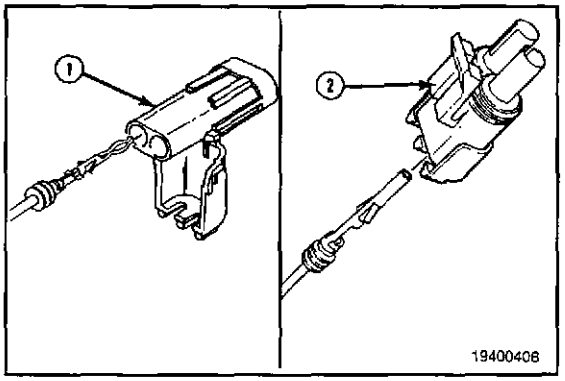
Use a twisting motion to push the tool to the bottom of the cavity.



Pull the wire and the terminal out of the connector body.

Replace the "shroud" connector bodies (1) with Part No. 3823337.

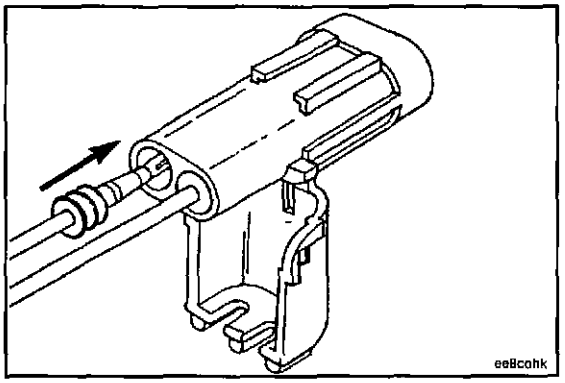
Replace the "tower" connector bodies (2) with Part No. 3823338.



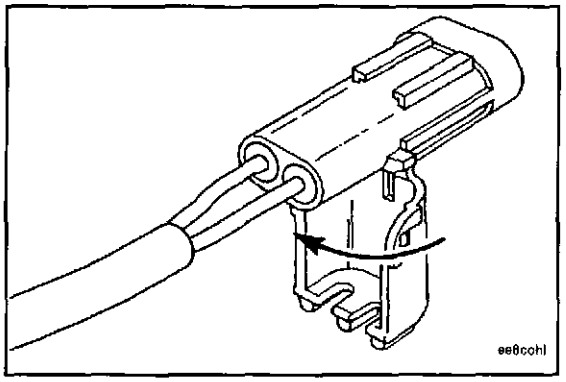
⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaces, be sure to insert the wires into the same locations as they were in the original connector.

Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.



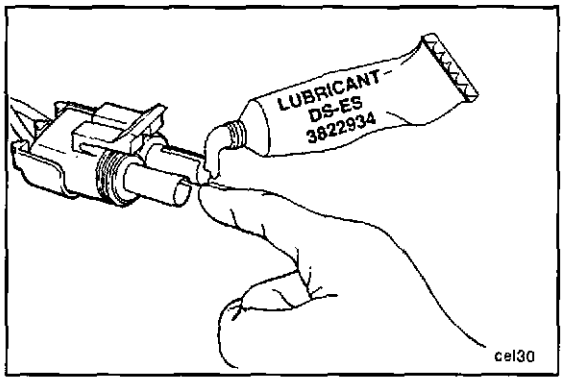
Close and latch the wire lock on the connector body.

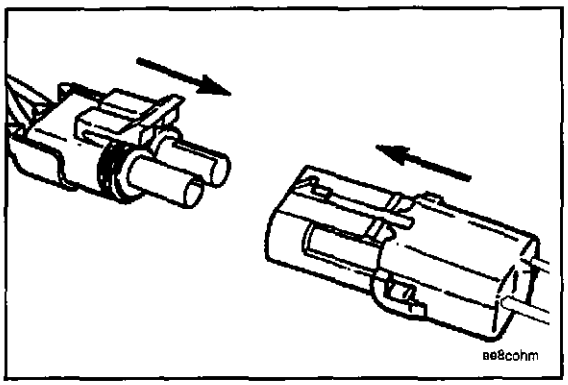


⚠ CAUTION ⚠

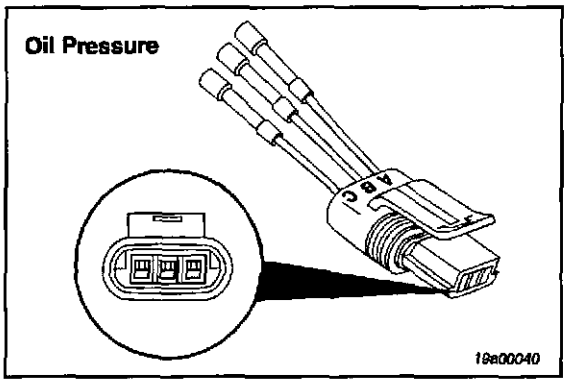
Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants such as lubricating oil or grease in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.





Insert the two connector halves together.



Connector, 3-Pin (019-203)

Pin Replacement (019-203-066)

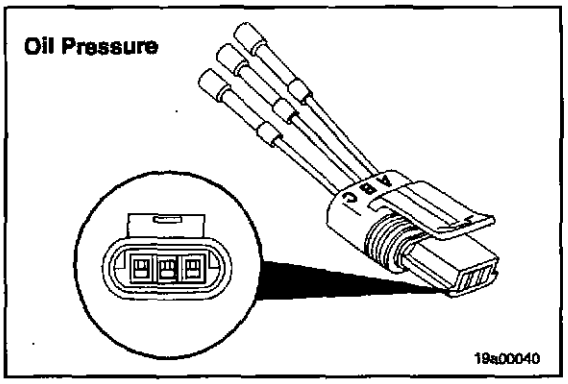
Metri-Pack

The connector is **not** repairable. If any part of the connector *becomes damaged, replace the:*

1. connector with the repair connector, Part No. 3823255
2. connector with the repair connector, Part No. 3823254, *supplied in the wiring harness repair kit, Part No.* 3825189
3. connector with the repair connector, Part No. 3824256

NOTE: These connectors are supplied in the wiring harness repair kit, Part No. 3822926.

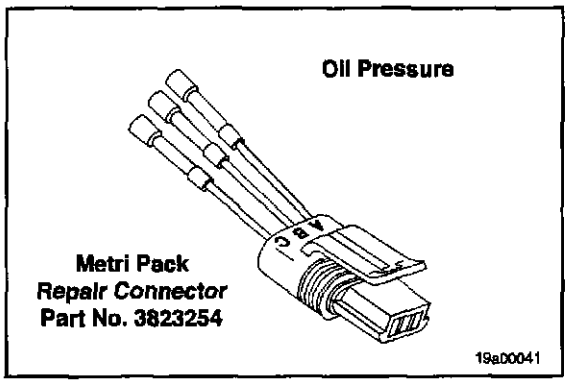
Refer to Procedure 019-203-067.



Connector Replacement (019-203-067)

Metri-Pack

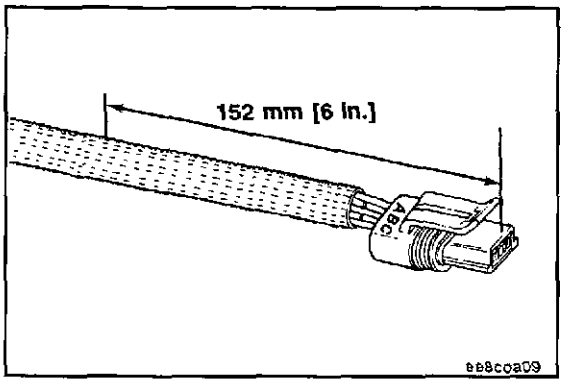
The connector is used to connect the Oil Pressure sensor *to the engine harness.*



The connectors have different "keying" and **cannot be** interchanged with each other.

NOTE: Make sure the correct wires are connected to pins "A", "B", *and "C" when replacement is necessary. Refer to* the wiring diagram in Section E of this manual.

Measure 152 mm [6 inches] back from the face of the connector and remove the wiring harness protective cover.

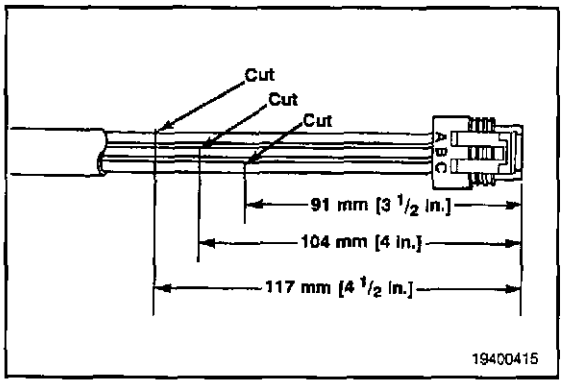


Before cutting the wires, measure and tag the three wires.

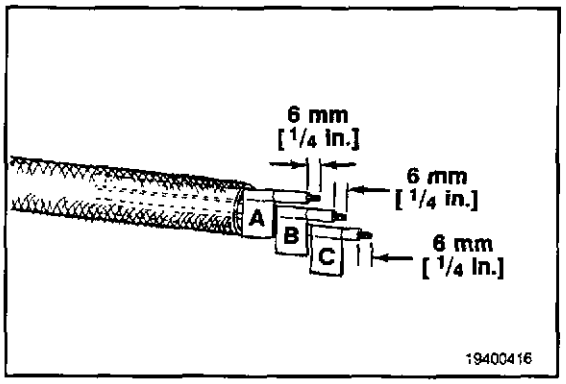
Use wire crimp tool, Part No. 3822930, to cut wire "A" 117 mm [4–1/2 inches] from the face of the connector.

Use the wire crimp tool to cut wire "B" 104 mm [4 inches] from the face of the connector.

Use the wire crimp tool to cut wire "C" 91 mm [3–1/2 inches] from the face of the connector.

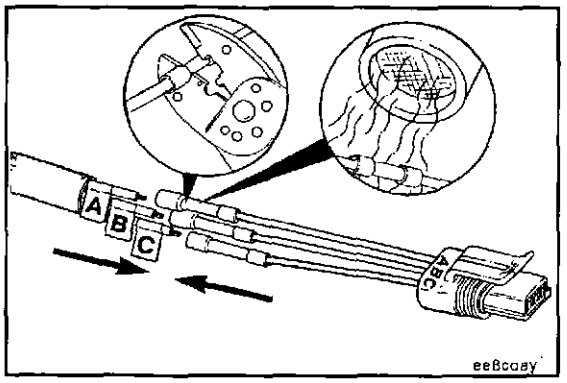


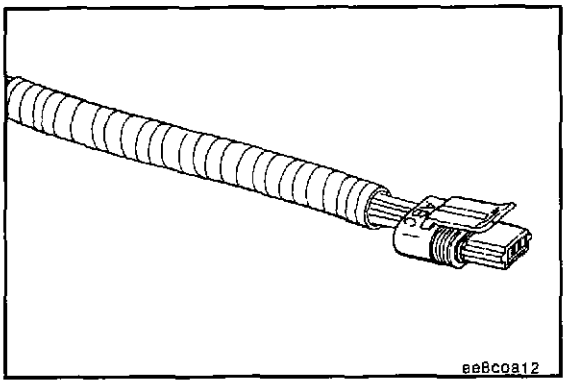
Use the wire crimp tool to remove 6 mm [1/4 inch] of insulation from all three electrical wires.



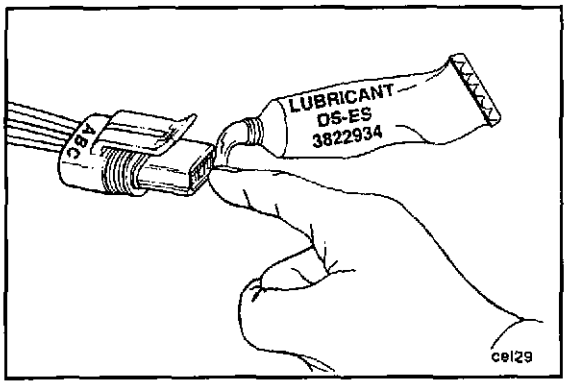
Install the terminal repair wires on the bare wires and use wire crimp tool to crimp the terminal.

Use a heat gun, Part No. 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.





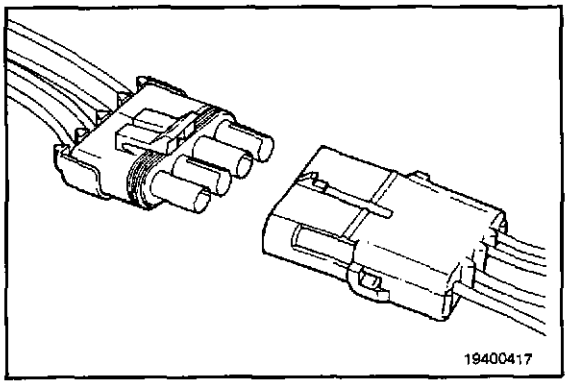
For added protection, wrap the wires with tape to complete the repair.



⚠ CAUTION ⚠

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Before installing, fill the entire connector cavity with lubricant.



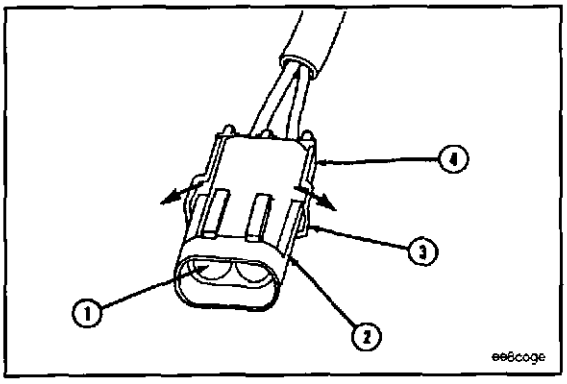
Connector, 4-Pin (019-204)

Pin Replacement (019-204-066)

Weather-Pack

The connector is used to connect many different sensors and switches to the engine and OEM harnesses. The connector can be a 1–way, 2–way, 3–way, or 4–way pin type. All four types of connectors are repaired in the same manner.

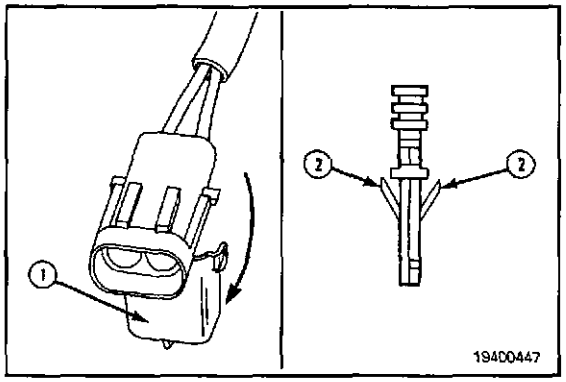
NOTE: Make sure the correct wires are connected to the correct connectors. Refer to the wiring diagram in Section E of this manual.



To replace a Weather-Pack terminal (1), pull the locking tabs (3) apart on the wire lock (4).

Open the wire lock.

NOTE: The wire is held in the connector body by the wire lock (1) and two locking lances (2) on the terminal.

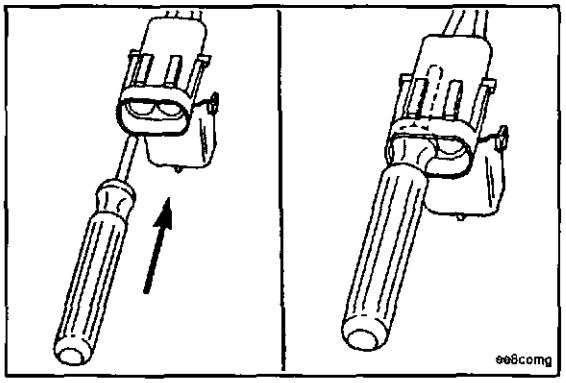


Insert the Weather-Pack extraction tool, Part No. 3822608, over the terminal.

⚠ CAUTION ⚠

This tool is easily broken. Care must be taken when using this tool. Do not force the tool into place.

Use a twisting motion to push the tool to the bottom of the cavity.



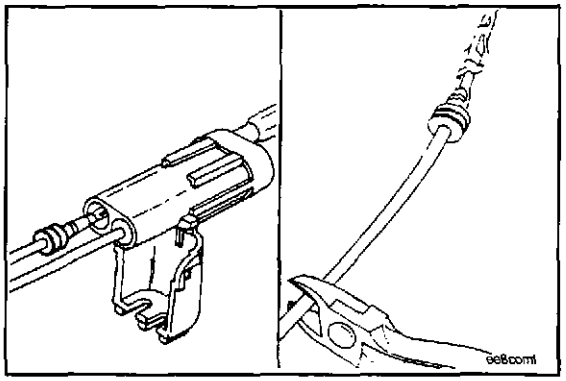
⚠ CAUTION ⚠

If more than one wire is being repaired, tag each wire and install in the original location.

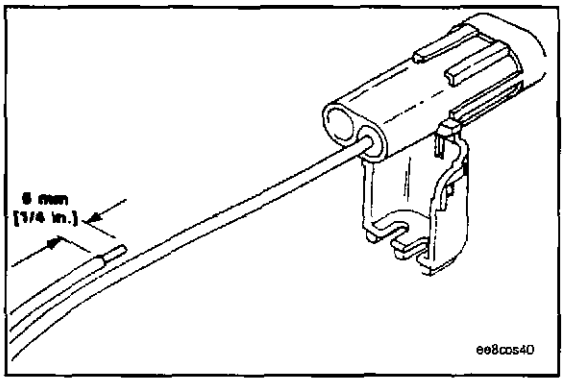
Pull the wire and the terminal out of the connector body.

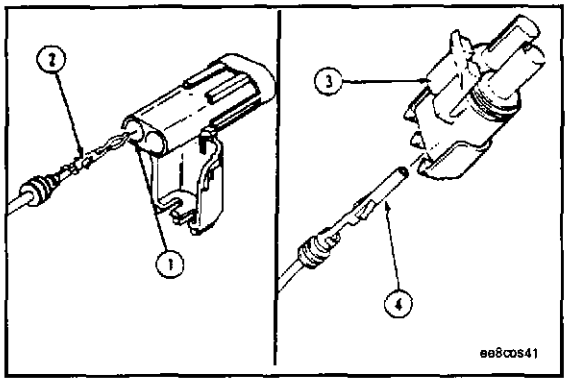
NOTE: The repair wire and terminal is 127 mm [5 inches] long.

Use wire crimp tool, Part No. 3822930, to cut 127 mm [5 inches] off the terminal and wire.



Use the wire crimp tool to remove about 6 mm [1/4 inch] of insulation from the wire.

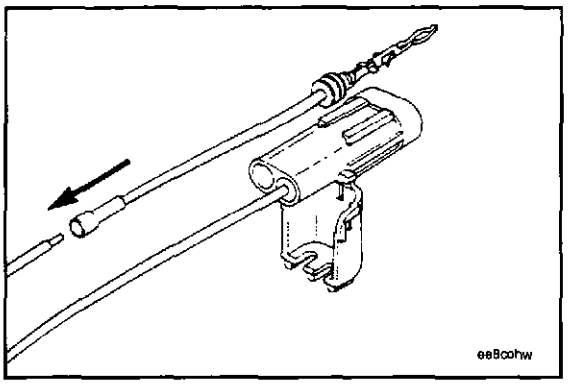




NOTE: The "shroud" connector bodies (1) use male terminals (2). The "tower" connector bodies (3) use female terminals (4).

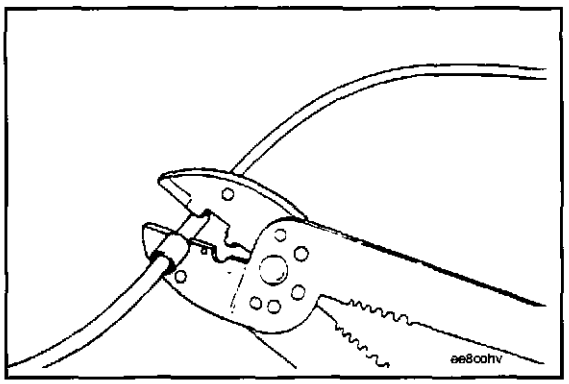
The repair wire for the male terminal is Part No. 3822922.

The female terminal is Part No. 3822923.

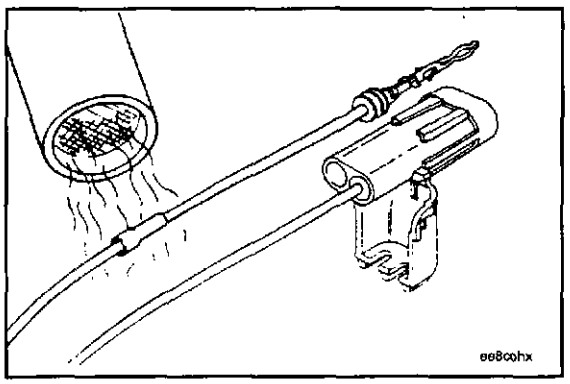


Install the correct repair wire (1) on the bare wire.

NOTE: Make sure the bare wire extends into the insulated butt splice connector.



Use the wire crimp tool to crimp the repair wire on the bare wire.

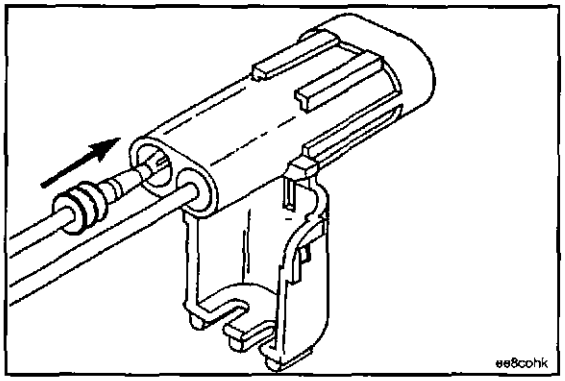


Use a heat gun, Part No. 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.

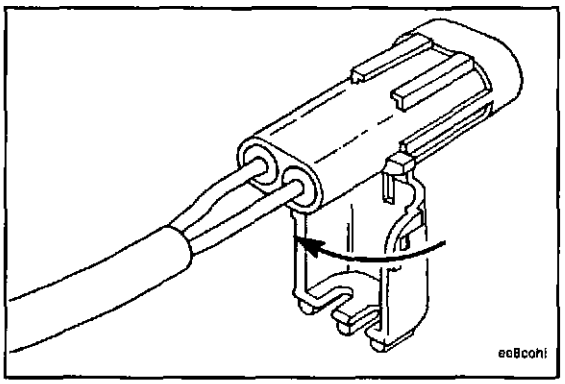
⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same locations as they were in the original connector.

Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.



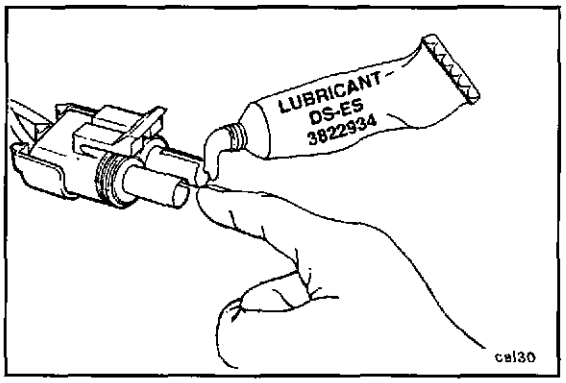
Close and latch the wire lock on the connector body.



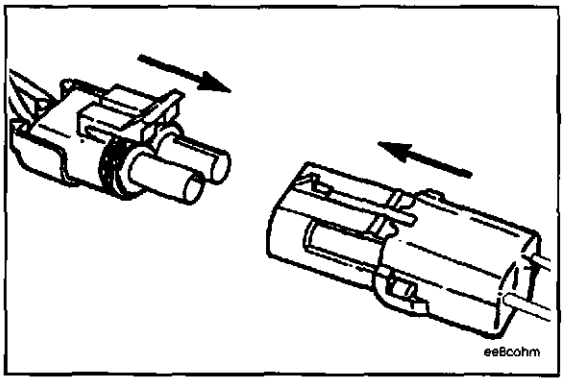
⚠ CAUTION ⚠

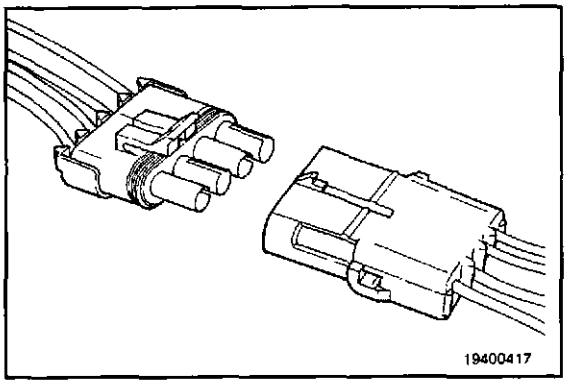
Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.



Insert the two connector halves together.



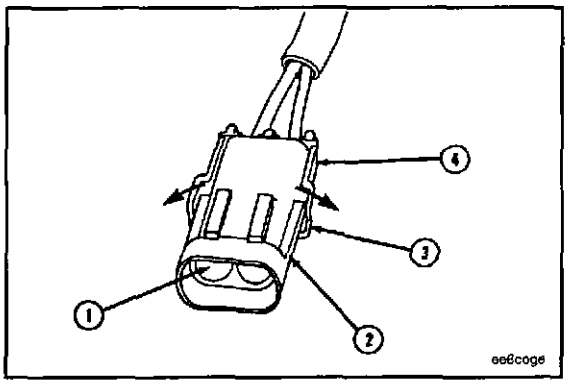


Connector Replacement (019-204-067)

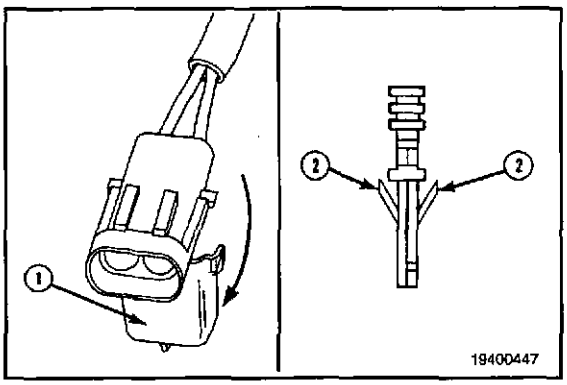
Weather-Pack

The connector is used to connect many different sensors and switches to the engine and OEM harnesses. The connector can be a 1–way, 2-way 3–way, or 4–way pin type. All four types of connectors are repaired in the same manner.

NOTE: Make sure the correct wires are connected to the correct connectors. Refer to the wiring diagram in Section E of this manual.

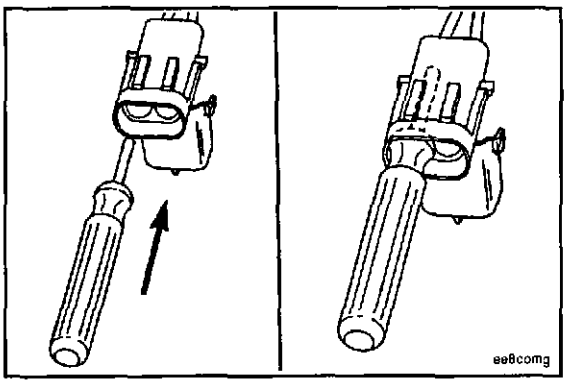


To replace a Weather-Pack connector body (2), pull the locking tabs (3) apart on the wire lock (4).



Open the wire lock.

NOTE: The wire is held in the connector body by the wire lock (1) and two locking lances (2) on the terminal.



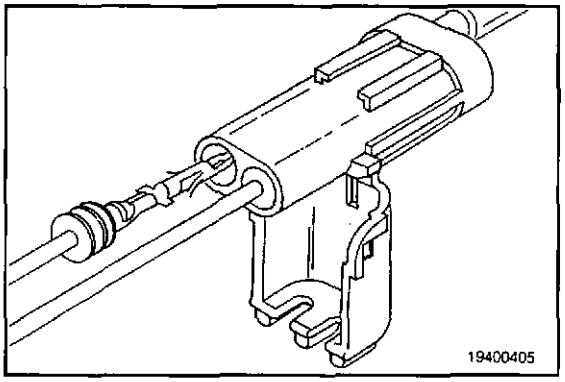
Insert the Weather-Pack extraction tool, Part No. 3822608, over the terminal.

⚠ CAUTION ⚠

This tool is easily broken. Care must be taken when using this tool. Do not force the tool into place.

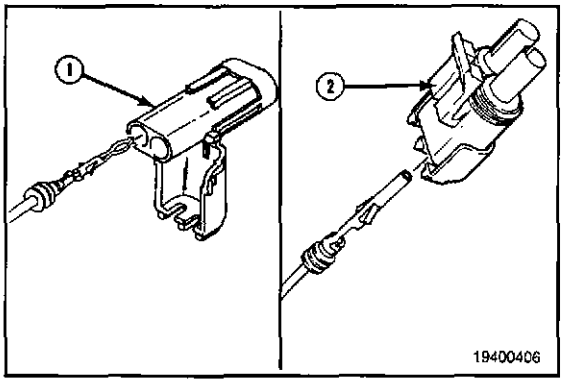
Use a twisting motion to push the tool to the bottom of the cavity.

Pull the wire and the terminal out of the connector body.



Replace the "shroud" connector bodies (1) with Part No. 3823341.

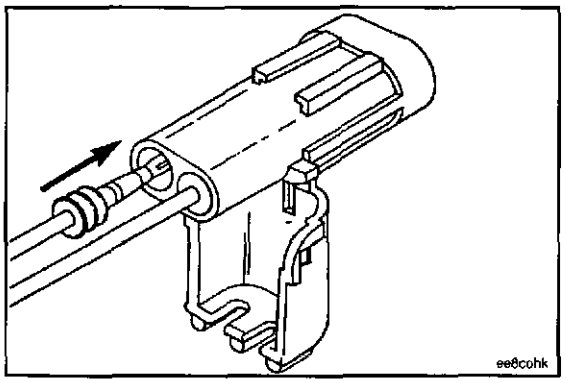
Replace the "tower" connector bodies (2) with Part No. 3823342.



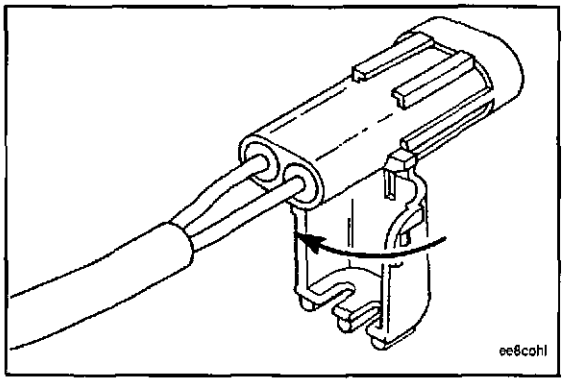
△ CAUTION △

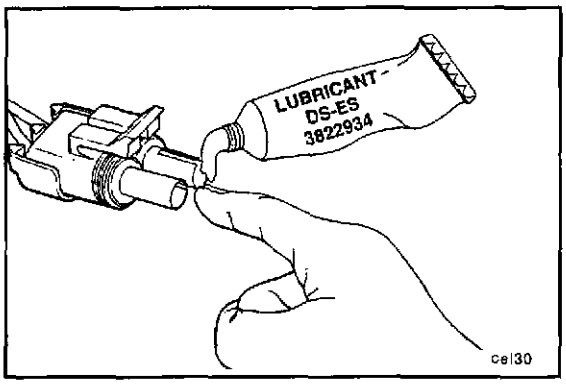
If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same locations as they were in the original connector.

Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.



Close and latch the wire lock on the connector body.

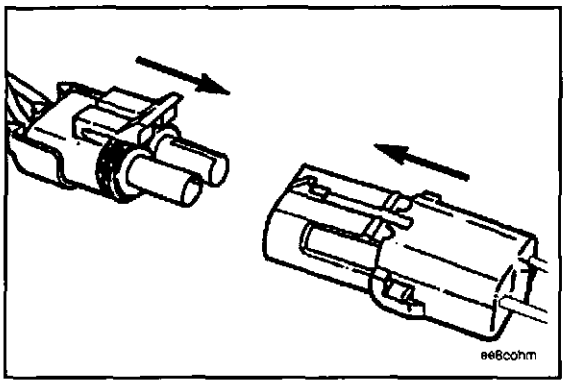




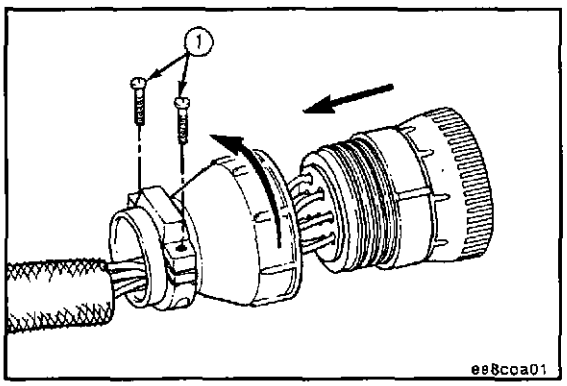
△ CAUTION △

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.



Insert the two connector halves together.

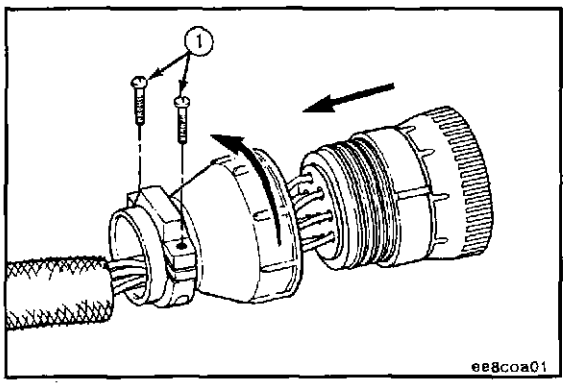


Connector, 9-Pin (019-209)

Pin Replacement (019-209-066)

Deutsch

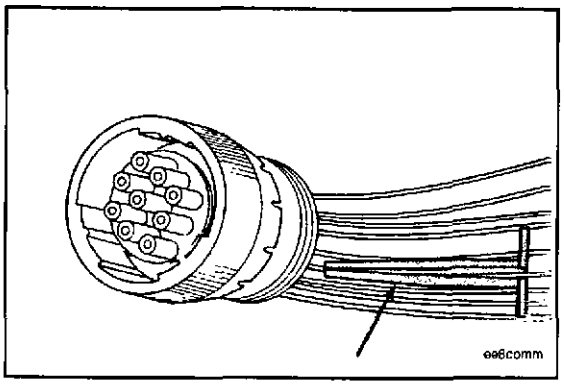
Unlock the connector. Rotate the locking tab counterclockwise by hand. do **not** use pliers which can damage the connector.



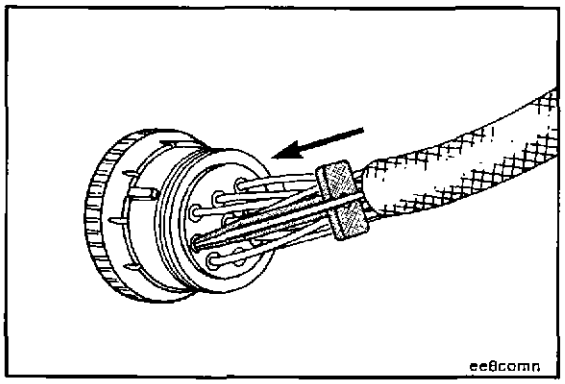
Remove the two clamp capscrews (1) from the rear of the connector. Turn the rear support of the connector counterclockwise until the two pieces are separated.

Install the Deutsch terminal removal tool, Part No. 3822760, over the wire to remove a pin from the connector.

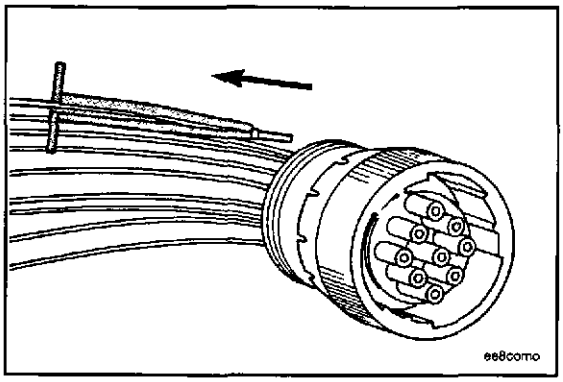
NOTE: Replace one wire at a time. If more than one wire needs replacement, attach a lettered tag to each wire removed. Refer to the wiring diagram in Section E.



Push the tool into the connector about 25 mm [1 in] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the commector. Note and record the hole from which the pin is removed.

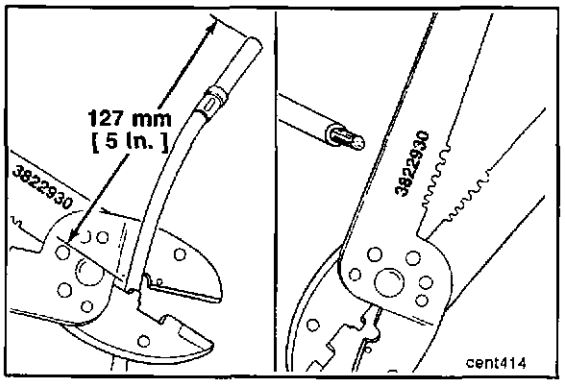


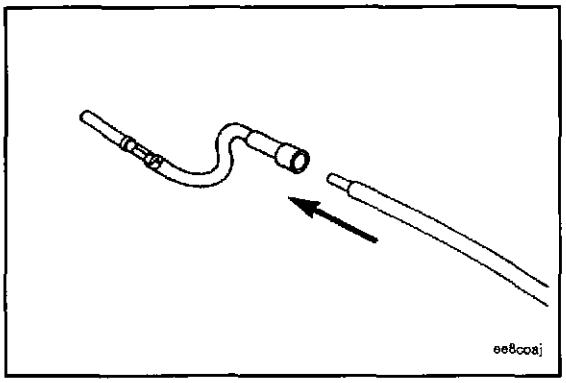
NOTE: The repair wire is 127 mm [5 in] long.

Cut 127 mm [5 in] off of the wire and pin.

The repair wire for the male terminal is Part No. 3822920. The female terminal is Part No. 3822921.

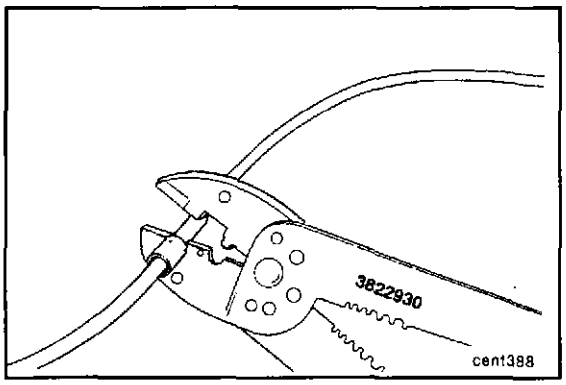
Remove about 6 mm [1/4 in] of insulation from the wire.



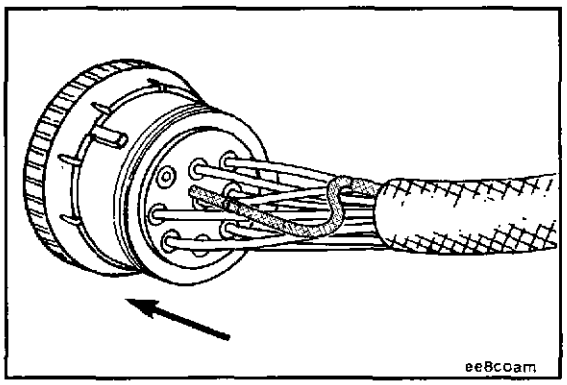


Install a repair wire on the bare wire.

NOTE: Make sure the bare wire extends into the splice connector.



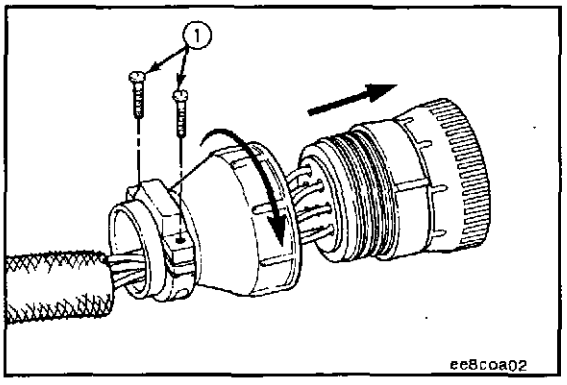
Use wire crimping pliers, Part No. 3822930, to crimp the repair wire onto the bare wire.



Insert the pin into the correct hole of the connector.

The pin **must** lock into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



Install the rear connector support. Tighten the two wire clamp capscrews.

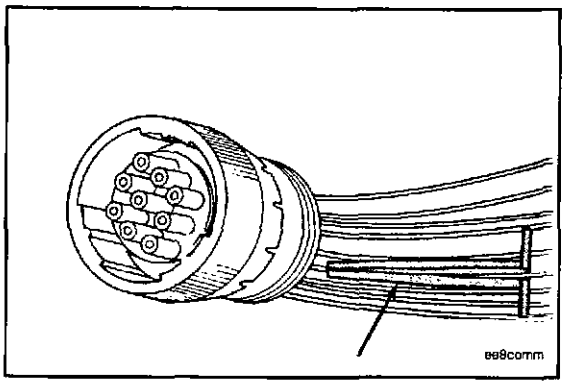
Torque Value: 0.75 N•m [in-lb]

Connector Replacement (019-209-067)

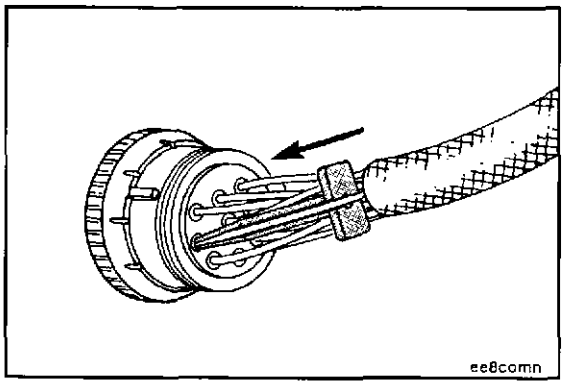
Deutsch

NOTE: Replace one wire at a time. Attach a lettered tag to each wire removed. Refer to the wiring diagram in Section E of this manual.

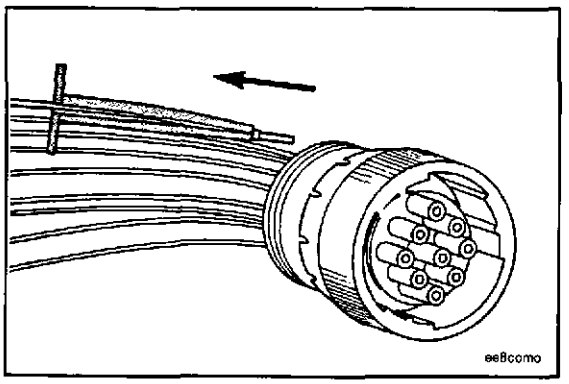
To replace the connector, use Deutsch extraction tool, Part No. 3824816, over each wire to remove all pins from the connector.



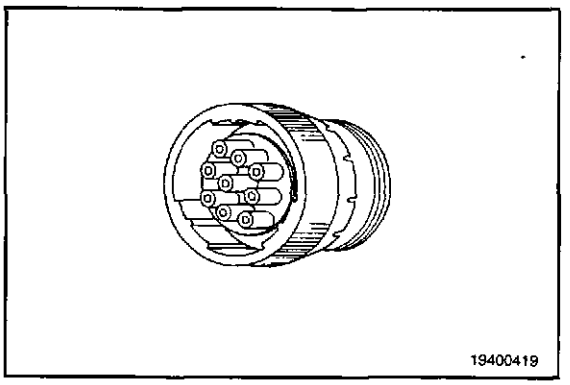
Push the tool into the connector about 25 mm [1 in] until it bottoms on the terminal flange.

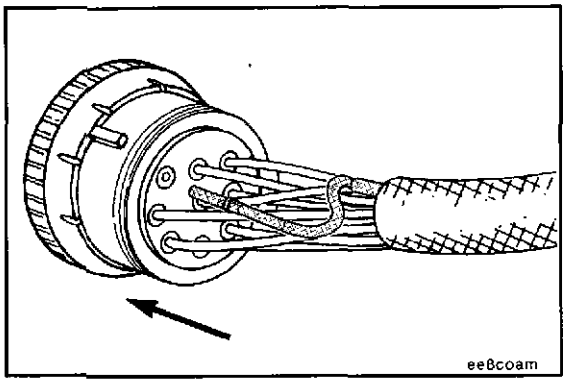


Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



The replacement connector is Part No. 3824016.

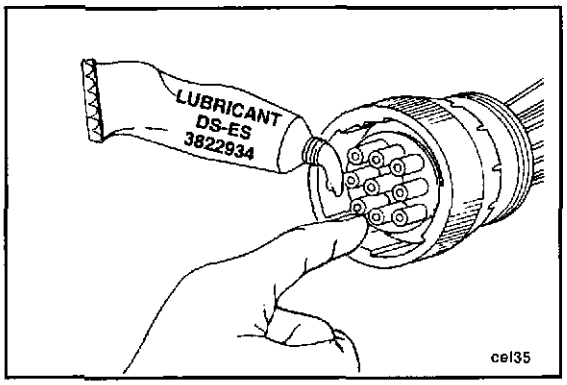




Insert the pins into the correct holes of the replacement connector.

The pin **must** click into place and hold the wire in the connector.

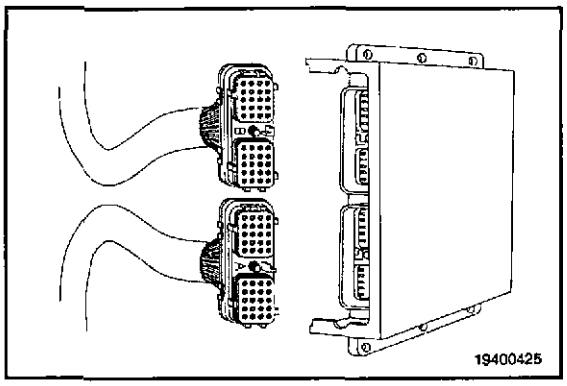
Pull the wire gently to make sure it is seated in the connector.



⚠ CAUTION ⚠

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.



Connector, 40-Pin (019-240)

Pin Replacement (019-240-066)

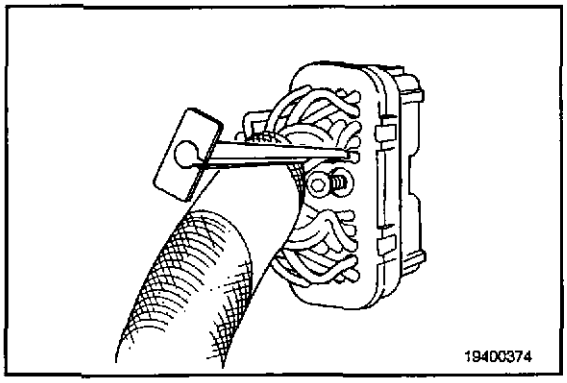
Deutsch

The 40-pin Deutsch connector is used to attach the OEM harness to the ECM and it is also used on the engine harness.

This connector is also used on the engine harness adaptor cable and engine harness extension cables, which allow the ECM and the engine harness to be connected over varying distances.

The engine harness adaptor cable is 5 ft in length.

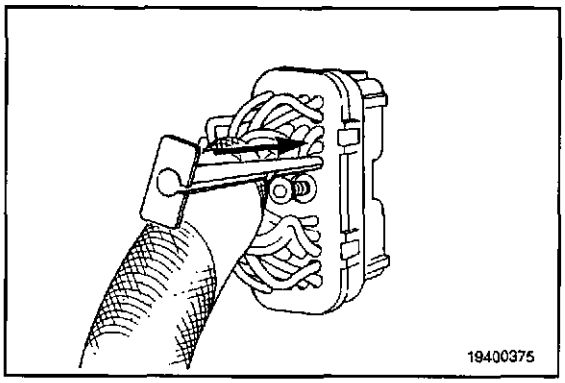
The engine harness extension cables come in length's of 5 ft, 10 ft, and 20 ft.



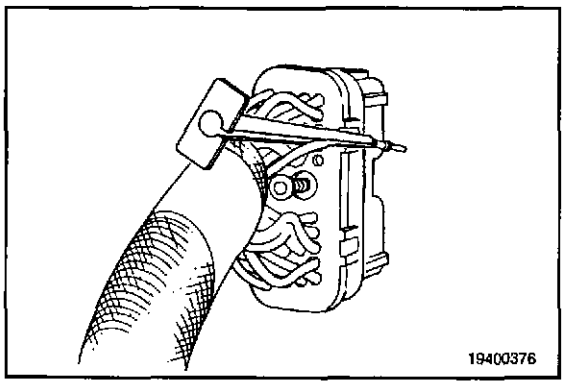
Use Deutsch extraction tool, Part No. 3824815, over the wire to remove a pin from the connector.

NOTE: Replace one wire at a time. If more than one wire needs replacement, attach a lettered tag to each wire removed. Refer to the wiring diagram in Section E of this manual.

Push the tool into the connector about 25 mm [1 inch] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



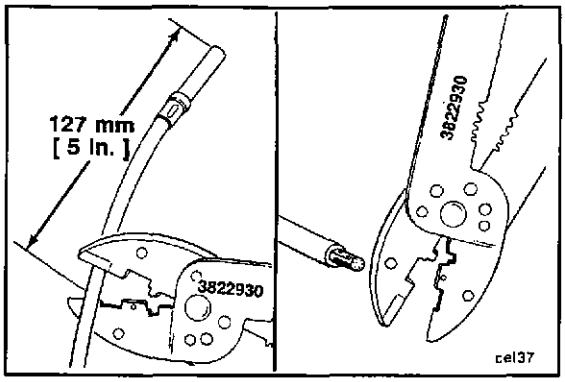
NOTE: The repair wire is 127 mm [5 inches] long.

The female terminal is Part No. 3824810.

The male terminal is Part No. 38224809.

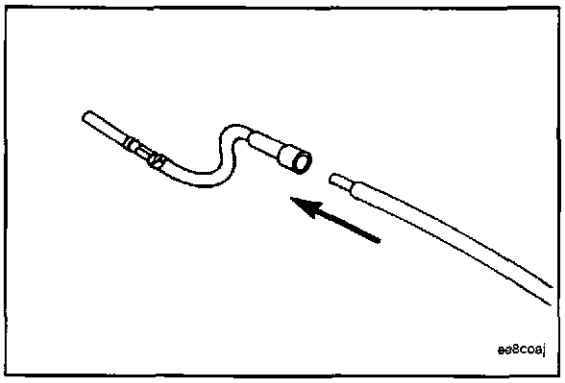
Use wire crimp tool, Part No. 3822930, to cut 127 mm [5 inches] off the wire and pin.

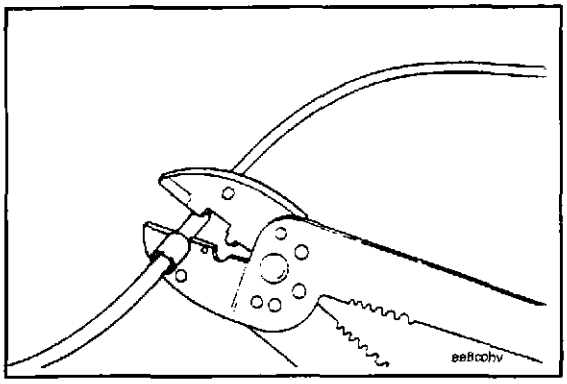
Use the crimp tool to remove 6 mm [1/4 inch] of insulation from the wire.



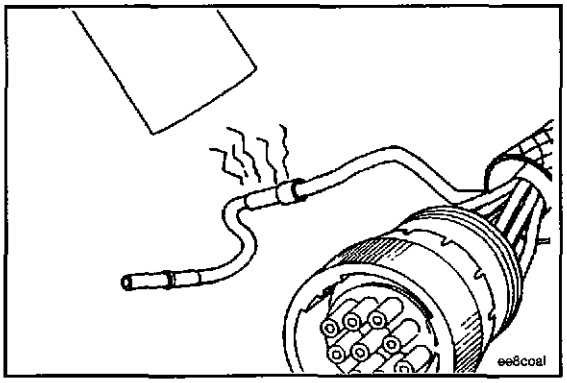
Install the correct repair wire on the bare wire.

NOTE: Make sure the bare wire extends into the splice connector.

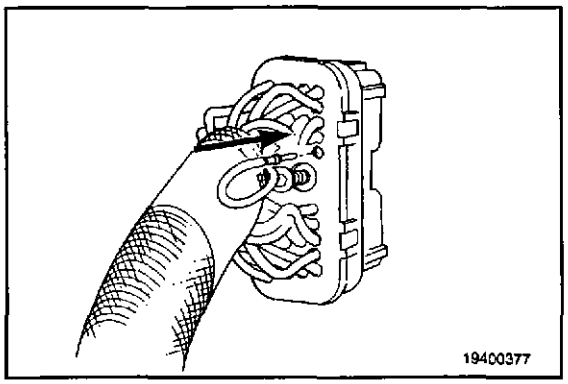




Use the wire crimp tool to crimp the repair wire onto the bare wire.



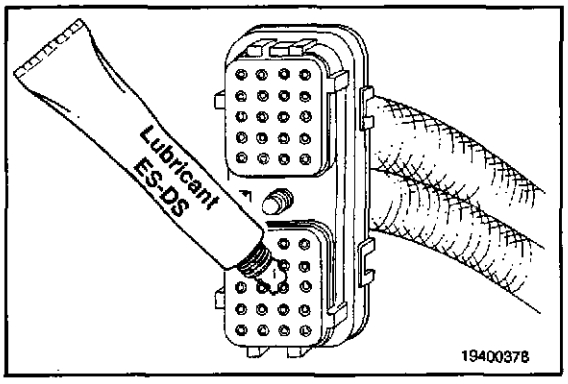
Use a heat gun, Part No. 3822860, or open flame to heat the shrink tubing around the wire. The tubing will shrink and make the connector waterproof.



Insert the pin into the correct hole of the connector.

The pin **must** click into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



△ CAUTION △

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.

Connector Replacement (019-240-067)

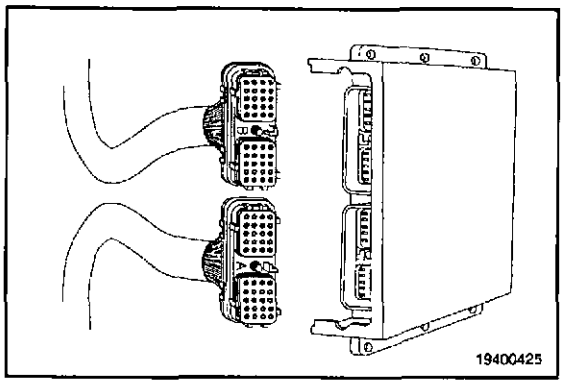
Deutsch

The 40-pin Deutsch connector is used to attach the OEM harness to the ECM and it is used on the engine harness.

This connector is also used on the engine harness adaptor cable and engine harness extension cables, which allow the ECM and the engine harness to be connected over varying distances.

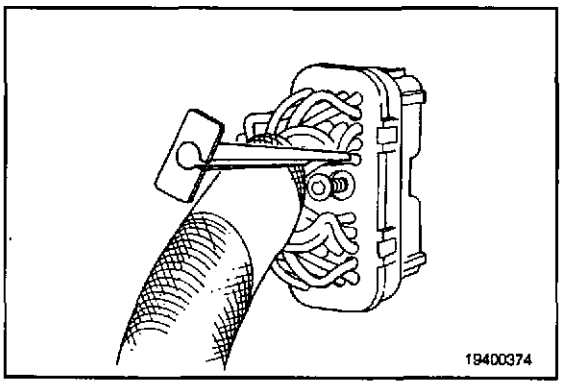
The engine harness adaptor cable is 5 ft in length.

The engine harness extension cables come in length's of 5 ft, 10 ft, and 20 ft.

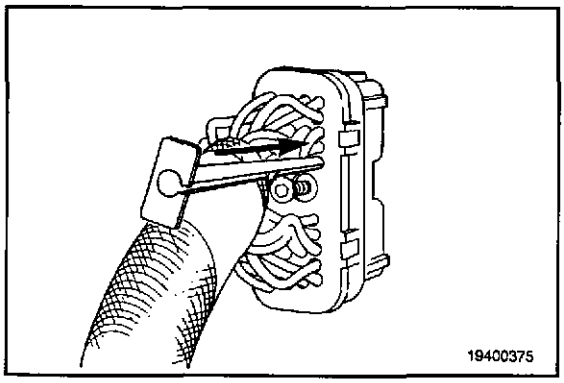


To replace the connector, use Deutsch extraction tool, Part No. 3824815, over each wire to remove all pins from the connector.

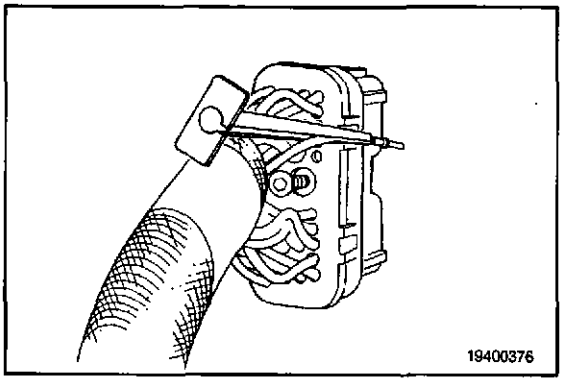
NOTE: Replace one wire at a time. Attach a lettered tag to each wire removed. Refer to the wiring diagram in Section E of this manual.

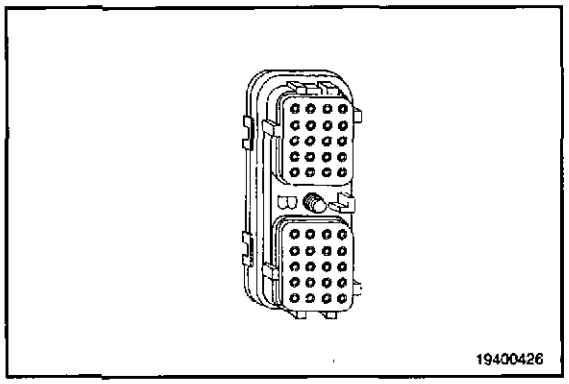


Push the tool into the connector about 25 mm [1 inch] until it bottoms on the terminal flange.



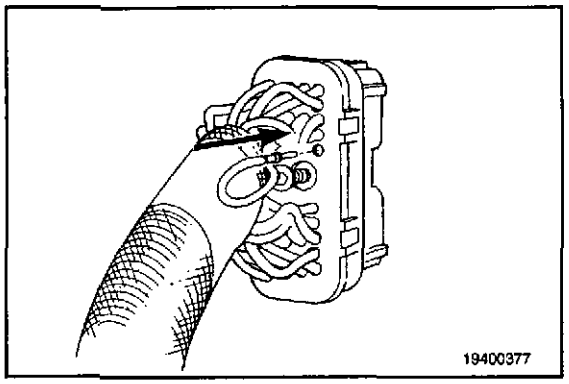
Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.





The replacement OEM harness connector is Part No. 3824818.

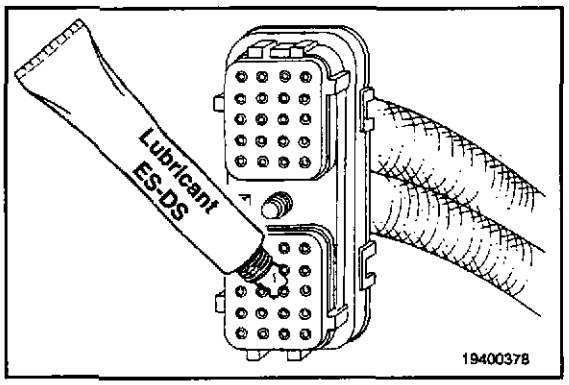
The replacement engine harness connector is Part No. 3824817.



Insert the pins into the correct holes of the replacement connector.

Each pin **must** click into place and hold the wires in the connector.

Pull each wire gently to make sure it is seated in the connector.



△ CAUTION △

Use only Cummins recommended lubricant DS-ES, Part No. 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.

Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.

Section L - Service Literature

Section Contents

Page

Additional Service Literature L-1
Literature Order Form L-3
Service Literature Ordering Location L-2

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Additional Service Literature

The following publications can be purchased by filling in and mailing the Literature Order Form:

Bulletin No.	Title of Publication
3666134	Operation and Maintenance Manual QST30 G-Drive Engines
3666185	QST30 G-Drive Wiring/Fault Code Diagram
3666196	INSITE™ G-Drive User's Manual (QST30)
3672101	QST30-G1/G2/G3 Parts Manual
3884888	QST30 G-Drive Governor Bulletin
AEB 10.52	QST30 (30 Liters) Generator-Drive Technical Package

Service Literature Ordering Location

Region	Ordering Location
United States and Canada	Cummins Distributors or Contact 1-800-DIESELS (1-800-343-7357)
U.K., Europe, Mid-East, Africa, and Eastern European Countries	Cummins Engine Co., Ltd. Royal Oak Way South Daventry Northants, NN11 5NU, England
South and Central America (excluding Brazil and Mexico)	Cummins Americas, Inc. 16085 N.W. 52nd Avenue Hialeah, FL 33104
Brazil and Mexico	Cummins Engine Co., Inc. International Parts Order Dept., MC 40931 Box 3005 Columbus, IN 47202-3005
Far East (excluding Australia and New Zealand)	Cummins Diesel Sales Corp. Literature Center 8 Tanjong Penjuru Jurong Industrial Estate Singapore
Australia and New Zealand	Cummins Diesel Australia Maroondah Highway, P.O.B. 139 Ringwood 3134 Victoria, Australia

Obtain current price information from your local Cummins Distributor.

Literature Order Form

Use this form for prompt handling of your literature order.

Item	Bulletin Number	Title of Publication	Quantity	U.S. Price Each	Amount
1				$	$
2					
3					
4					
5					
6					
				Order Total	$

Contact your Cummins distributor for prices and availability.

For problems with literature orders (for U.S.A. and Canada), contact 1-800-DIESELS (1-800-343-7357). All other locations contact your local Distributor.

Prices subject to change without notice.

Please cut on dotted line

Literature Order Form

Use this form for prompt handling of your literature order.

Item	Bulletin Number	Title of Publication	Quantity	U.S. Price Each	Amount
1				$	$
2					
3					
4					
5					
6					
				Order Total	$

Contact your Cummins distributor for prices and availability.

For problems with literature orders (for U.S.A. and Canada), contact 1-800-DIESELS (1-800-343-7357). All other locations contact your local Distributor.

Prices subject to change without notice.

Mail the Literature Order Form along with your ship-to address to your nearest Cummins distributor.

FROM:		
Name:		
Street Address:		
City:	State/Province:	Zip/Postal Code:
Country:		

SHIP TO: (Name and address where literature is to be shipped)		
Name:		
Street Address:		
City:	State/Province:	Zip/Postal Code:
Country:		

Please cut on dotted line

Mail the Literature Order Form along with your ship-to address to your nearest Cummins distributor.

FROM:		
Name:		
Street Address:		
City:	State/Province:	Zip/Postal Code:
Country:		

SHIP TO: (Name and address where literature is to be shipped)		
Name:		
Street Address:		
City:	State/Province:	Zip/Postal Code:
Country:		

Section V - Specifications

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⚠ WARNING ⚠

This diagram is provided as a diagnostic tool for trained, experienced technicians only. Improper troubleshooting or repair can result in severe personal injury or death or property damage. See important instructions in Service Manual.

ELECTRICAL SPECIFICATIONS

ALL CONTINUITY CHECKS
- OK (no open circuits) if less than 10 Ω

SHORTS TO GROUND

ESS circuits
- OK (no open circuits) if less than 10 MΩ

All other circuits
- OK (no open circuits) if less than 10 KΩ

SHORT CIRCUIT TO EXTERNAL VOLTAGE
- OK if less than 1.5 VDC

5 V POWER SUPPLY (Sensor and Switch)

@ ECM
- 4.75 to 5.25 VDC

@ Harness
- 4.75 to 5.25 VDC

SOLENOIDS

Fuel Shutoff Valve - 24 VDC
- Coil Resistance = 28 to 32 Ω
- Voltage = 24 VDC

ECM CONNECTOR

Cap Screw Torque = 3 N•m [25 in-lb]

FUEL PUMP
- Rack Actuator Coil = 0.55 to 0.90 Ω

SENSOR SPECIFICATIONS

ENGINE SPEED SENSOR

Torque = 34 to 47 N•m [25 to 35 ft-lb]
First Coil Resistance = 750 to 1100 Ω
Second Coil Resistance = 1100 to 1500 Ω

OIL PRESSURE SENSOR

Torque = 14 N•m [10 ft-lb]

Pressure (kPa)	Pressure [psi]	Voltage (V)
0	0	0.42 to 0.58
172	25	1.42 to 1.58
344	50	2.42 to 2.58
517	75	3.42 to 3.58
689	100	4.42 to 4.58

COOLANT TEMPERATURE SENSORS

Torque = 14 N•m [10 ft-lb]

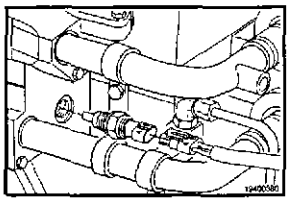
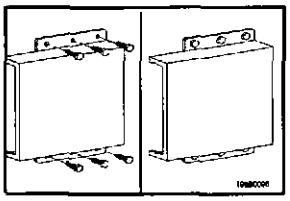
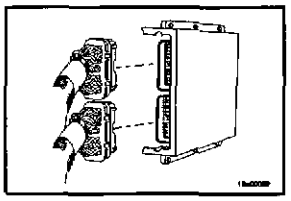
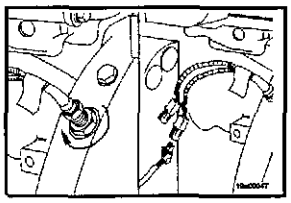
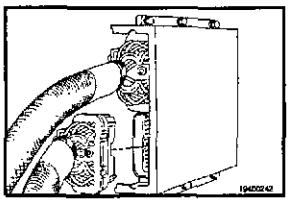
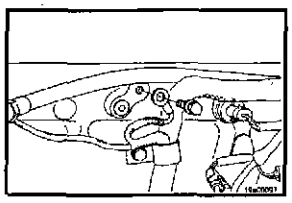
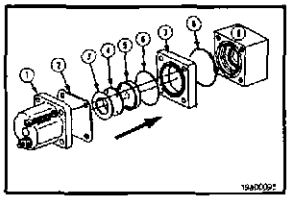
Temperature (C°)	Temperature [F°]	Resistance (Ω)
0	32	30K to 36K
25	77	9K to 11K
50	122	3K to 4K
75	167	1350 to 1500
100	212	600 to 675

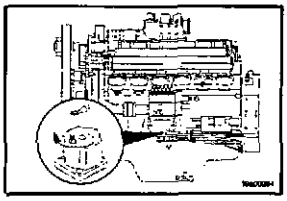
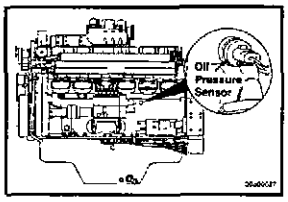
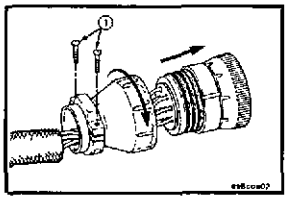
Rack Position Sensor Coil = 17 to 23 Ω

Rack Position Sensor Reference Coil = 17 to 23 Ω

18a00001

Electronic Engine Controls - Torque Values

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.
Coolant Temperature Sensor (019-019)			
			
Coolant Temperature Sensor		14 N•m	10 ft-lb
Electronic Control Module (ECM) (019-031)			
			
ECM Mounting Surface Capscrews		8 N•m	72 in-lb
			
OEM and Engine Harness Connectors		3 N•m	25 in-lb
Engine Speed Sensor (ESS) (019-042)			
			
Engine Speed Sensor Locknut		34 to 47 N•m	25 to 35 ft-lb
Engine Wiring Harness (019-043)			
			
Deutsch Connector Hexhead Capscrew		3 N•m	25 in-lb
			
Engine Block Ground Wire		20 N•m	15 ft-lb
Fuel Shutoff Valve (FSOV) Solenoid (019-050)			
			
Fuel Shutoff Valve Mounting Capscrew		8 N•m	72 in-lb

Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Fuel Shutoff Valve Electrical Connection Nut		2 N•m	15 in-lb	
Lubricating Oil Pressure Sensor (019-066)				
Lubricating Oil Pressure Sensor		14 N•m	10 ft-lb	
Connector, 9-Pin (019-209)				
		0.75 N•m	0.55 in-lb	

Drive Belt Tension

SAE Belt Size	Belt Tension Gauge Part No.		Belt Tension New		Belt Tension Range Used*	
	Click-type	Burroughs	N	lbf	N	lbf
0.380 in	3822524		620	140	270 to 490	60 to 110
0.440 in	3822524		620	140	270 to 490	60 to 110
1/2 in	3822524	ST-1138	620	140	270 to 490	60 to 110
11/16 in	3822524	ST-1138	620	140	270 to 490	60 to 110
3/4 in	3822524	ST-1138	620	140	270 to 490	60 to 110
7/8 in	3822524	ST-1138	620	140	270 to 490	60 to 110
4 rib	3822524	ST-1138	620	140	270 to 490	60 to 110
5 rib	3822524	ST-1138	670	150	270 to 530	60 to 120
6 rib	3822525	ST-1293	710	160	290 to 580	65 to 130
8 rib	3822525	ST-1293	890	200	360 to 710	80 to 160
10 rib	3822525	3823138	1110	250	440 to 890	100 to 200
12 rib	3822525	3823138	1330	300	530 to 1070	120 to 240
12 rib K section	3822525	3823138	1330	300	890 to 1070	200 to 240

Note: This chart does not apply to automatic belt tensioners.

* A belt is considered used if it has been in service for ten minutes or longer.

* If used belt tension is less than the minimum value, tighten the belt to the maximum used belt value.

Fraction, Decimal, Millimeter Conversions

Fraction	inch	mm	Fraction	inch	mm
1/64	0.0156	0.397	33/64	0.5156	13.097
1/32	0.0313	0.794	17/32	0.5313	13.494
3/64	0.0469	1.191	35/64	0.5469	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.0781	1.984	37/64	0.5781	14.684
3/32	0.0938	2.381	19/32	0.5938	15.081
7/64	0.1094	2.778	39/64	0.6094	15.478
1/8	0.1250	3.175	5/8	0.6250	15.875
9/64	0.1406	3.572	41/64	0.6406	16.272
5/32	0.1563	3.969	21/32	0.6563	16.669
11/64	0.1719	4.366	43/64	0.6719	17.066
3/16	0.1875	4.763	11/16	0.6875	17.463
13/64	0.2031	5.159	45/64	0.7031	17.859
7/32	0.2188	5.556	23/32	0.7188	18.256
15/64	0.2344	5.953	47/64	0.7344	18.653
1/4	0.2500	6.350	3/4	0.7500	19.050
17/64	0.2656	6.747	49/64	0.7656	19.447
9/32	0.2813	7.144	25/32	0.7813	19.844
19/64	0.2969	7.541	51/64	0.7969	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.3281	8.334	53/64	0.8281	21.034
11/32	0.3438	8.731	27/32	0.8438	21.431
23/64	0.3594	9.128	55/64	0.8594	21.828
3/8	0.3750	9.525	7/8	0.8750	22.225
25/64	0.3906	9.922	57/64	0.8906	22.622
13/32	0.4063	10.319	29/32	0.9063	23.019
27/64	0.4219	10.716	59/64	0.9219	23.416
7/16	0.4375	11.113	15/16	0.9375	23.813
29/64	0.4531	11.509	61/64	0.9531	24.209
15/32	0.4688	11.906	31/32	0.9688	24.606
31/64	0.4844	12.303	63/64	0.9844	25.003
1/2	0.5000	12.700	1	1.0000	25.400

Conversion Factor: 1 inch = 25.4 mm

Weight and Measures — Conversion Factors

Quantity	U.S. Customary		Metric		From U.S. Customary To Metric Multiply By	From Metric To U.S. Customary Multiply By
	Unit Name	Abbr.	Unit Name	Abbr.		
Area	sq. inch	in^2	sq. millimeters	mm^2	645.16	0.001550
			sq. centimeters	cm^2	6.452	0.155
	sq. foot	ft^2	sq. meter	m^2	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kW-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.352	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kW	0.746	1.341
Pressure	pounds force per sq. inch	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613
	inches of water	in H_2O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H_2O	millimeters of water	mm H_2O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	°F	centigrade	°C	(°F-32) +1.8	(1.8 x °C) +32
Torque	pound force per foot	ft-lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in-lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers/hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in^3	liter	l	0.01639	61.02545
	cubic inch	in^3	cubic centimeter	cm^3	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	J	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kW-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kW-hr	0.746	1.341

Newton-Meter to Foot-Pound Conversion Chart

N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1	8.850756 in-lb	55	41	155	114
5	44 in-lb	60	44	160	118
6	53 in-lb	65	48	165	122
7	62 in-lb	70	52	170	125
8	71 in-lb	75	55	175	129
9	80 in-lb	80	59	180	133
10	89 in-lb	85	63	185	136
1	0.737562 ft-lb	90	66	190	140
12	9	95	70	195	144
14	10	100	74	200	148
15	11	105	77	205	151
16	12	110	81	210	155
18	13	115	85	215	159
20	15	120	89	220	162
25	18	125	92	225	165
30	22	130	96	230	170
35	26	135	100	235	173
40	30	140	103	240	177
45	33	145	107	245	180
50	37	150	111	250	184

NOTE: To convert from Newton-Meters to Kilogram-Meters divide Newton-Meters by 9.803.

Capscrew Markings and Torque Values

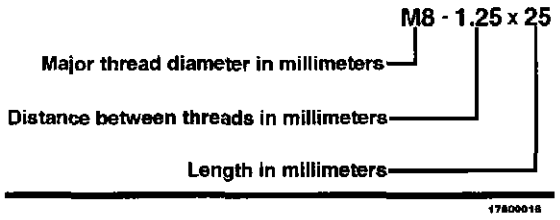
△ CAUTION △

When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

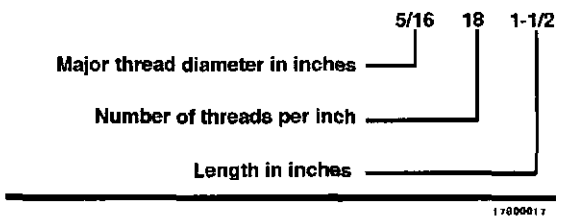
Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U.S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

The following examples indicate how capscrews are identified:

Metric - M8-1.25 X 25



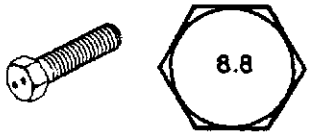
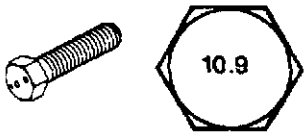
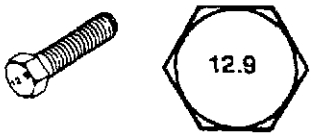
U.S. Customary [5/16 X 18 X 1-1/2]



NOTES:

1. **Always** use the torque values listed in the following tables when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual.
3. The torque values in the table are based on the use of lubricated threads.
4. When the ft-lb value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Capscrew Markings and Torque Values — Metric

Commercial Steel Class	8.8	10.9	12.9
Capscrew Head Markings			

Body Size	Torque				Torque				Torque			
Diam.	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	12	9	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	25	18	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	60	45	30	25	70	50	30	25
12	80	60	55	40	105	75	55	40	125	95	55	40
14	125	90	90	65	165	122	90	65	195	145	90	65
16	180	130	140	100	240	175	140	100	290	210	140	100
18	230	170	180	135	320	240	180	135	400	290	180	135

Capscrew Markings and Torque Values — U.S. Customary

SAE Grade Number	5	8
Capscrew Head Markings *These are all SAE Grade 5 (3) line*		
	Capscrew Torque - Grade 5 Capscrew	Capscrew Torque - Grade 8 Capscrew

Capscrew Body Size	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4 - 20	9	7	8	6	15	11	8	6
- 28	12	9	9	7	18	13	9	7
5/16 - 18	20	15	16	12	30	22	16	12
- 24	23	17	19	14	33	24	19	14
3/8 - 16	40	30	25	20	55	40	25	20
- 24	40	30	35	25	60	45	35	25
7/16 - 14	60	45	45	35	90	65	45	35
- 20	65	50	55	40	95	70	55	40
1/2 - 13	95	70	75	55	130	95	75	55
- 20	100	75	80	60	150	110	80	60
9/16 - 12	135	100	110	80	190	140	110	80
- 18	150	110	115	85	210	155	115	85
5/8 - 11	180	135	150	110	255	190	150	110
- 18	210	155	160	120	290	215	160	120
3/4 - 10	325	240	255	190	460	340	255	190
- 16	365	270	285	210	515	380	285	210
7/8 - 9	490	360	380	280	745	550	380	280
- 14	530	390	420	310	825	610	420	310
1 - 8	720	530	570	420	1100	820	570	420
- 14	800	590	650	480	1200	890	650	480

Pipe Plug Torque Values

Size		Torque		Torque	
Thread	Actual Thread O.D.	In Aluminum Components		In Cast Iron or Steel Components	
in	in	N•m	ft-lb	N•m	ft-lb
1/16	0.32	5	45 in-lb	15	10
1/8	0.41	15	10	20	15
1/4	0.54	20	15	25	20
3/8	0.68	25	20	35	25
1/2	0.85	35	25	55	40
3/4	1.05	45	35	75	55
1	1.32	60	45	95	70
1-1/4	1.66	75	55	115	85
1-1/2	1.90	85	65	135	100

Tap-Drill Chart — U.S. Customary and Metric

NOTE ON SELECTING TAP-DRILL SIZES: The tap drill sizes shown on this card give the theoretical tap drill size for approximately 60% and 75% of full thread depth. Generally, it is recommended that drill sizes be selected in the 60% range as these sizes will provide about 90% of the potential holding power. Drill sizes in the 75% range are recommended for shallow hole tapping (less than 1 1/2 times the hole diameter) in soft metals and mild steel.

Tap Size		Drill Size
60%	75%	
		48
		1.95mm
		5/64
	3-48	47
		2.00mm
	M2.5x.45	2.05mm
		46
3-48	3056	45
		2.10mm
M2.5x.45	M2.6x.45	2.15mm
3-56	4-36	44
		2.20mm
M2.6x.45		2.25mm
4-36	4-40	43
		2.30mm
		2.35mm
4-40	4-48	42
		3/32
	M3x.6	2.40mm
4-48		41
		2.45mm
		40
M3x.6	M3x.5	2.50mm
		39
	5-40	38
M3x.5		2.60mm
5-40	5-44	37
		2.70mm
5-44	6-32	36
		2.75mm
		7/64
		35
		2.80mm
		34
6-32	6-40	33
	M3.5x6	2.90mm
		32
M3.5x6		3.00mm
6-40		31
		3.10mm
		1/8
		3.20mm
	M4x.75	3.25mm
		30
	M4x.7	3.30mm
M4x.75		3.40mm
M4x.7	8-32	29
		3.50mm
	8-36	28
8-32		9/64
		3.60mm
8-36		27
		3.70mm
		26
	M4.5x.75	3.75mm
	10-24	25
		3.80mm
		24
M4.5x.75		3.90mm
		23
		5/32
10-24		22
	M5x1	4.00mm
	10-32	21
		20
	M5x.9	4.10mm
M5x1	M5x.8	4.20mm
10-32		19
M5x.9		4.25mm
M5x.8		4.30mm
		18
		11/64
		17

Tap Size		Drill Size
60%	75%	
		4.40mm
	12-24	16
		4.50mm
		15
	M5.5x.9	4.60mm
12-24	12-28	14
		13
		4.70mm
M5.5x.9		4.75mm
12-28		3/16
		12
		4.80mm
		11
		4.90mm
		10
		9
	M6x1	5.00mm
		8
		5.10mm
	1/4-20	7
		13/64
		6
M6x1		5.20mm
		5
	M6x.75	5.25mm
		5.30mm
1/4-20		4
M6x.75		5.40mm
	1/4-28	3
		5.50mm
		7/32
		5.60mm
1/4-28		2
		5.70mm
		5.75mm
		1
		5.80mm
		5.90mm
		A
		15/64
	M7x1	6.00mm
		B
		6.10mm
		C
M7x1		6.20mm
		D
	M7x.75	6.25mm
		6.30mm
		E
		1/4
M7x.75		6.40mm
		6.50mm
	5/16-18	F
		6.60mm
		G
		6.70mm
		17/64
	M8x1.25	6.75mm
5/16-18		H
		6.80mm
		6.90mm
	5.16-24	I
M8x1.25	M8x1	7.00mm
		J
		7.10mm
5/16-24		K
		9/32
M8x1		7.20mm
		7.25mm
		7.30mm
		L
		7.40mm
		M

Tap Size		Drill Size
60%	75%	
		7.50mm
		19/64
		7.60mm
		N
		7.70mm
	M9x1.25	7.75mm
		7.80mm
		7.90mm
	3/8-16	5/16
M9x1.25	M9x1	8.00mm
		O
		8.10mm
M9x1		8.20mm
		P
		8.25mm
		8.30mm
3/8-16	1/8-27NPT	21/64
		8.40mm
	3/8-24	Q
	M10x1.5	8.50mm
		8.60mm
		R
3/8-24		8.70mm
1/8-27NPT		11/32
	M10x1.25	8.75mm
M10x1.5		8.80mm
		S
		8.90mm
M10x1.25	M10x1	9.00mm
		T
		9.10mm
		23/64
M10x1		9.20mm
		9.30mm
	7/16-14	U
		9.40mm
	M11x1.5	9.50mm
		3/8
		V
		9.60mm
		9.70mm
		9.75mm
M11x1.5		9.80mm
7/16-14		W
		9.90mm
	7/16-20	25/64
		10.00mm
7/16-20		X
	M12x1.75	10.20mm
		Y
		13/32
		Z
M12x1.75	M12x1.5	10.50mm
	1/2-13	27/64
M12x1.5	M12x1.25	10.75mm
M12x1.25		11.00mm
1/2-13		7/16
1/4-18NPT		
		11.25mm
		11.50mm
		29/64
		11.75mm
		11.50mm
	1/2-20	29/64
	9/16-12	15/32
	M14x2	12.00m
		12.25mm
9/16-12		31/64
M14x2	M14x1.5	12.50mm
	9/16-18	1/2
M14x1.5	M14x1.25	12.75mm
M14x1.25		13.00mm
9/16-18		33/64

Tap Size		Drill Size
60%	75%	
		13.25mm
	5/8-11	17/32
	M15x1.5	13.50mm
M15x1.5		13.75mm
5/8-11		35/64
	M16x2	14.00mm
		14.25mm
	5/8-18	9/16
M16x2	M16x1.5	14.50mm
5/8-18		37/64
		14.75mm
M16x1.5		15.00mm
		19.32
		15.25mm
		39/64
	M17x1.5	15.50mm
M17x1.5	M18x2.5	15.75mm
		5/8
M18x2.5	M18x2	16.00mm
M18x2		16.25mm
	3/4-10	41/64
	M18x1.5	16.50mm
3/4-10	M19x2.5	21/32
M18x1.5		16.75mm
M19x2.5		17.00mm
		43/64
		17.25mm
3/4-16	3/4-16	11/16
	M20x2.5	17.50mm
		17.75mm
		45/64
M20x2.5	M20x2	18.00mm
M20x2		18.25mm
		23/32
	M20x1.5	18.50mm
		47/64
M20x1.5		18.75mm
		19.00mm
		3/4
		19.25mm
	7/8-9	49/64
	M22x2.5	19.50mm
7/8-9		25/32
		19.75mm
M22x2.5	M22x2	20.00mm
	7/8-14	51/64
M22x2		20.25mm
	M22x1.5	20.50mm
7/8-14		13/16
		20.75mm
M22x1.5	M24x3	21.00mm
		53/64
		21/25mm
		27/32
M24x3		21.50mm
		21.75mm
		55/64
	M24x2	22.00mm
	1"-8	7/8
M24x2		22.25mm
	M24x1.5	22.50mm
1"-8		57/64
M24x1.5		22.75mm
	M25x2	23.00mm
	1"-12	29/32
M25x2		23.25mm
1"x12	1"-14	59/64
	M25x1.5	23.50mm
M20x1.5		23.75mm
1"-14		15/16

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