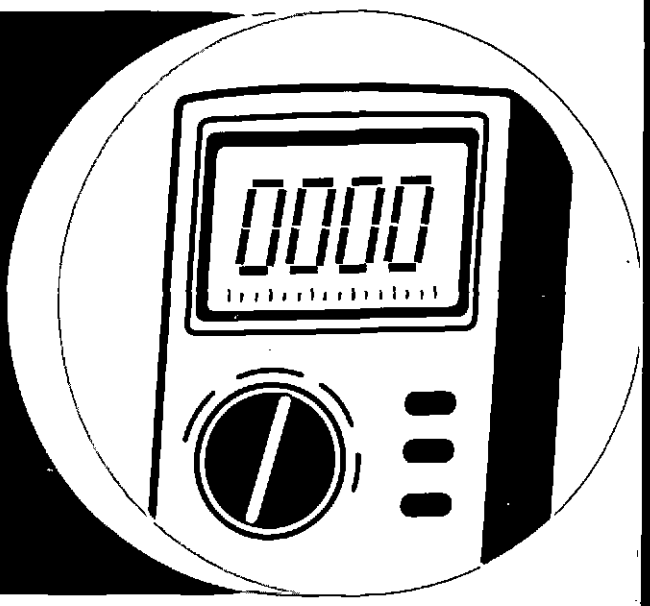
POWERTECH 10.5 L & 12.5 L 6105 and 6125 Diesel Engines

Operation and Diagnostics

COMPONENT TECHNICAL MANUAL



For complete service information also see:

POWERTECH 10.5 L & 12.5 L
6105 & 6125 Diesel Engines Repair . . CTM100

Deere Power Systems Group
CTM115 (30SEP97)
LITHO IN U.S.A.
ENGLISH

JOHN DEERE

DEERE POWER

Introduction

FOREWORD

This manual is written for an experienced technician. Special tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

CAUTION: This is the safety-alert symbol. When you see this symbol in this manual, be alert to the potential for personal injury.

Use this component technical manual in conjunction with the engine repair manual (CTM100) and the respective machine technical manual. See the repair *manual for information on component removal and* installation, and gaining access to the components.

This manual is divided in two parts: theory of operation and diagnostics. The theory of operation section contains information that explains how the engine subsystems operate. The diagnostics section helps identify the cause of engine problems.

Applicable special tools needed to do the job, specifications, and helpful reference materials are covered in separate groups toward end of manual.

Engine Training Guide (DSEGET550A) is available to give the service technician a detailed overview of general engine construction and design features. This manual is recommended prior to performing major service procedures on **POWERTECH** 6105 and 6125 engines.

Fundamental service information is available from other sources covering basic theory of operation, *fundamentals of troubleshooting, general maintenance,* and basic type of failures and their causes.

CALIFORNIA PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

Dealer Presentation Sheet

JOHN DEERE DEALERS

IMPORTANT: The changes listed below make your CTM obsolete. Discard CTM115 dated 01OCT96. Please copy this page and route through your service department.

GROUP 100

- Revised lubrication system flow diagram.
- Revised cooling system flow diagram.
- Revised John Deere applications low pressure fuel system flow diagram.
- Added OEM applications low pressure fuel system flow diagram.
- Updated electronic control system sensor locations.

GROUP 105

- Moved intake manifold pressure (turbocharger boost) specification to Group 199 Specifications.
- Fuel system air bleeding procedure revised.

GROUP 115

- All diagnostic procedures, except procedure for diagnosing engine misfires/runs irregularly, revised such that diagnosis can be made using the Diagnostic Scan Tool or the Break-Out-Box.
- Added instructions for connecting and using the Break-Out-Box.
- Increased awareness (importance) of not forcing meter probes into connector terminals.
- Procedure for locating the cause of intermittent faults revised.
- Added procedure for diagnosing fuel supply system problems.
- Revised engine misfires/runs irregularly diagnostic procedure.
- Revised low power/excessive black smoke diagnostic procedure.
- Revised torque curve selection chart and moved to Group 199 Specifications.
- Procedure for diagnostic fault code 81 revised.

GROUP 198

- Fuel Air Detection Line added to existing Fuel Pressure Test Fitting to make new Fuel Supply System Test Kit.
- 10.5/12.5 ECU Communication Software and Hardware Kits tool numbers changed to reflect that these tools will be distributed through John Deere Distribution Service Center.
- Added new Connector Adapter Test Kit.

GROUP 199

- Revised John Deere applications intake manifold pressure (turbocharger boost) specifications and added OEM applications specifications.
- Revised John Deere applications torque curve selection chart and added OEM applications chart.
- Revised generic electronic control system wiring diagram.
- Added OEM specific electronic control system wiring diagram.

Contents

Continued on next page

CTM115 (30SEP97)

HANDLE FLUIDS SAFELY — AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227

Handle Fluids Safely – Avoid Fires

PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

TS204

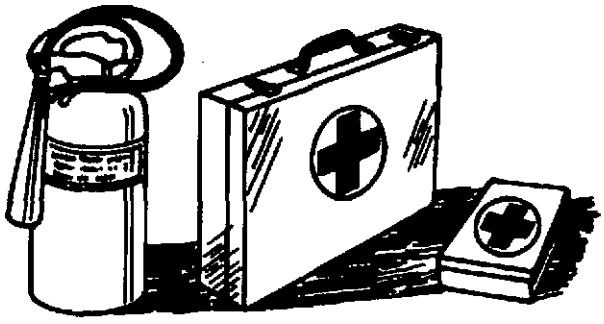
Prevent Battery Explosions

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291

Prepare for Emergencies

PREVENT ACID BURNS

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2

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

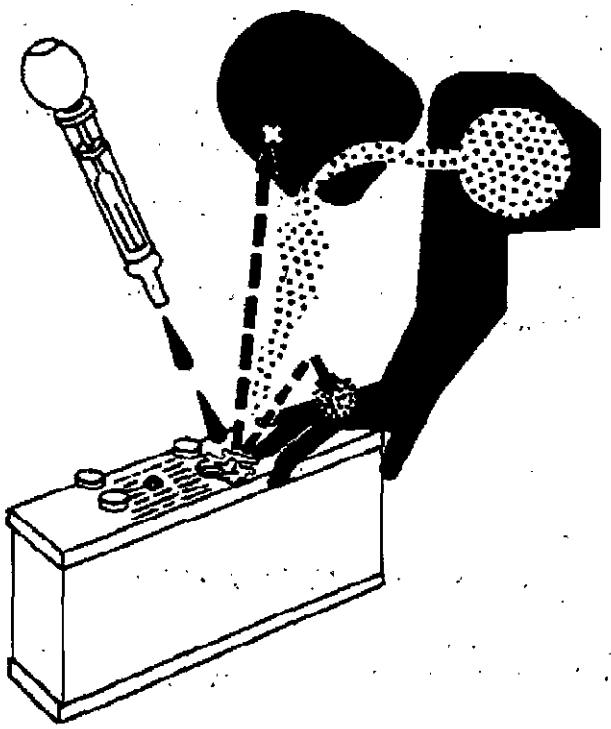
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15 – 30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt).
3. Get medical attention immediately.



TS203

Prevent Acid Burns

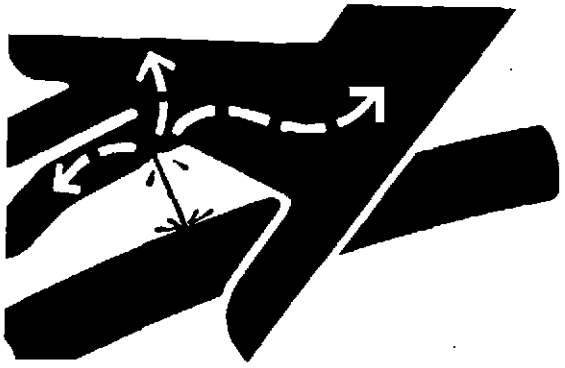
AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere and Company Medical Department in Moline, Illinois, U.S.A.



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Avoid High-Pressure Fluids

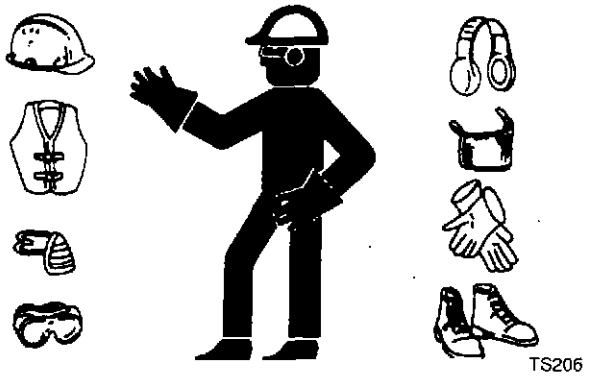
WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



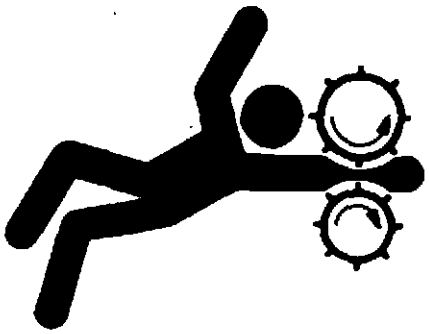
TS206

Wear Protective Clothing

SERVICE MACHINES SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



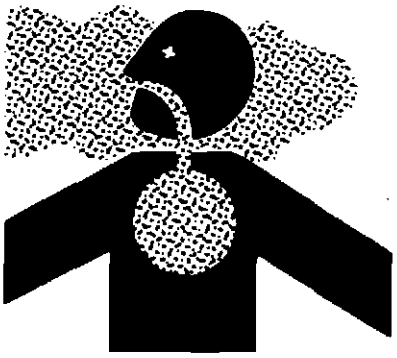
TS228

Service Machines Safely

WORK IN VENTILATED AREA

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.



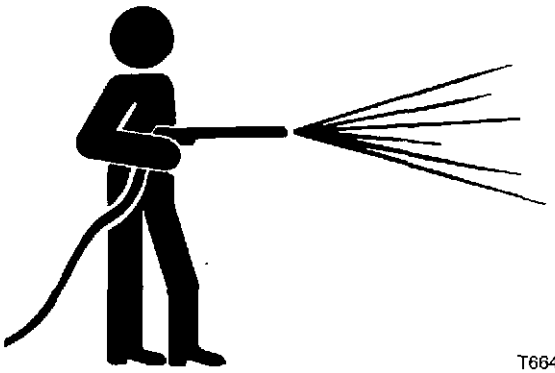
TS220

Work in Ventilated Area

WORK IN CLEAN AREA

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



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Work in Clean Area

REMOVE PAINT BEFORE WELDING OR HEATING

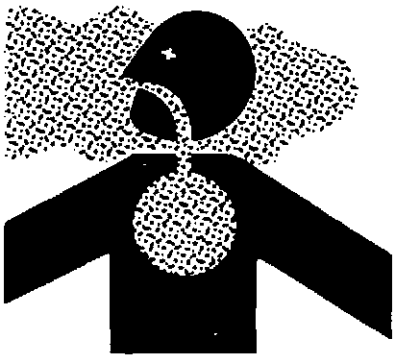
Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



TS220

Avoid Toxic Fumes and Dust

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

TS953

Avoid Heating Near Pressurized Fluid Lines

ILLUMINATE WORK AREA SAFELY

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite fuel or oil.

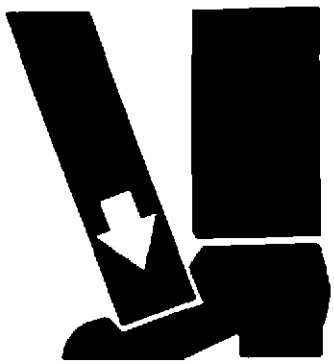
TS223

Illuminate Work Area

USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



TS226

Use Proper Lifting Equipment

PRACTICE SAFE MAINTENANCE

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet, and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

Disconnect battery ground cable (–) before making adjustments on electrical systems or welding on machine.

TS218

Practice Safe Maintenance

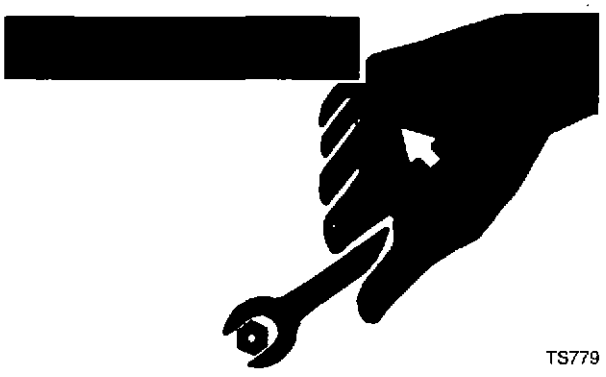
USE PROPER TOOLS

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



TS779

Use Proper Tools

DISPOSE OF WASTE PROPERLY

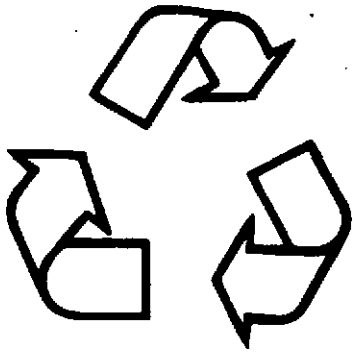
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133

Dispose of Waste Properly

LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231

Live With Safety

GENERAL ENGINE OPERATION

The 6105 and 6125 engines include a cam in head, actuating four valves per cylinder and an electronic unit injector (EUI) fuel system. They are vertical stroke, in-line, valve-in-head, 6-cylinder diesel engines. The firing order is 1-5-3-6-2-4.

The cast block has ribbed walls to add strength and rigidity, and to decrease noise and vibration. The 6105 and 6125 use the same block. The crankshafts and pistons are different to produce a long stroke and short stroke engine.

The engine oil filter mounts to a combination oil filter housing and pressure regulator housing. These items then bolt together with the oil cooler housing (A) located on the right side of the block.

A gear train on the front of the engine consists of four gears connecting the crankshaft with the camshaft. The crankshaft gear drives the oil pump gear (B), which drives the engine coolant pump gear and the idler gear (C). The idler gear then drives the camshaft gear (D). A backlash adjustment is required during assembly. No timing marks are used on the gears.

A timing pin procedure is used to increase the accuracy of the gear train adjustment. To locate top dead center of the crankshaft for number one and number six cylinders, a timing pin is installed through a timing hole on the right side of the block. The pin will engage a slot cut into a counterweight of the crankshaft.

The crankshaft (E) is a heat treated, dynamically balanced steel forging which rotates in replaceable main bearings. Thrust washers are added to the number five main bearing to reduce crankshaft defection and to limit end play during high load operation.

Cylinder liners (F) are wet sleeve, flanged, and centrifugally cast using a strong durable alloy. O-rings (G) are used to seal the connection between the cylinder block and liners. Liners incorporate top liner cooling passages.

6105 engines use an aluminum piston with a 3 ring configuration. The top two rings are compression rings and the lower ring is an oil control ring. Double Ni-Resist ring carriers are cast integrally in the piston to greatly improve the life of the ring grooves.

6125 engines use an articulated or two piece piston (H). The crown of the piston is steel. This adds strength and durability for the higher power output of the 6125 engine. The skirt of the piston is aluminum to reduce the overall weight of the piston.

The 6105 and 6125 pistons have a centered, symmetrical bowl to provide efficient combustion, which allows the engine to produce high power with low exhaust emissions.

The hardened piston pins (I) are highly polished, fully floating, and held in place by snap rings.

Connecting rods (J) are made of forged steel and have replaceable bushing and bearing inserts. They are weight controlled (by machining) on both ends to minimize engine vibration.

WEAR-GARD bearings are used on the connecting rod. These bearing have a lube pocket to provide an extra volume of oil to lubricate and cool the crankshaft.

The engine is equipped with an oil spray jet (K) for each cylinder, installed through the right side of the cylinder block. The spray jets precisely spray a stream of oil directly from the main oil galley onto the bottom of the pistons. This provides piston cooling and lubrication for the piston pin and the connecting rod bushing.

GENERAL ENGINE OPERATION—CONTINUED

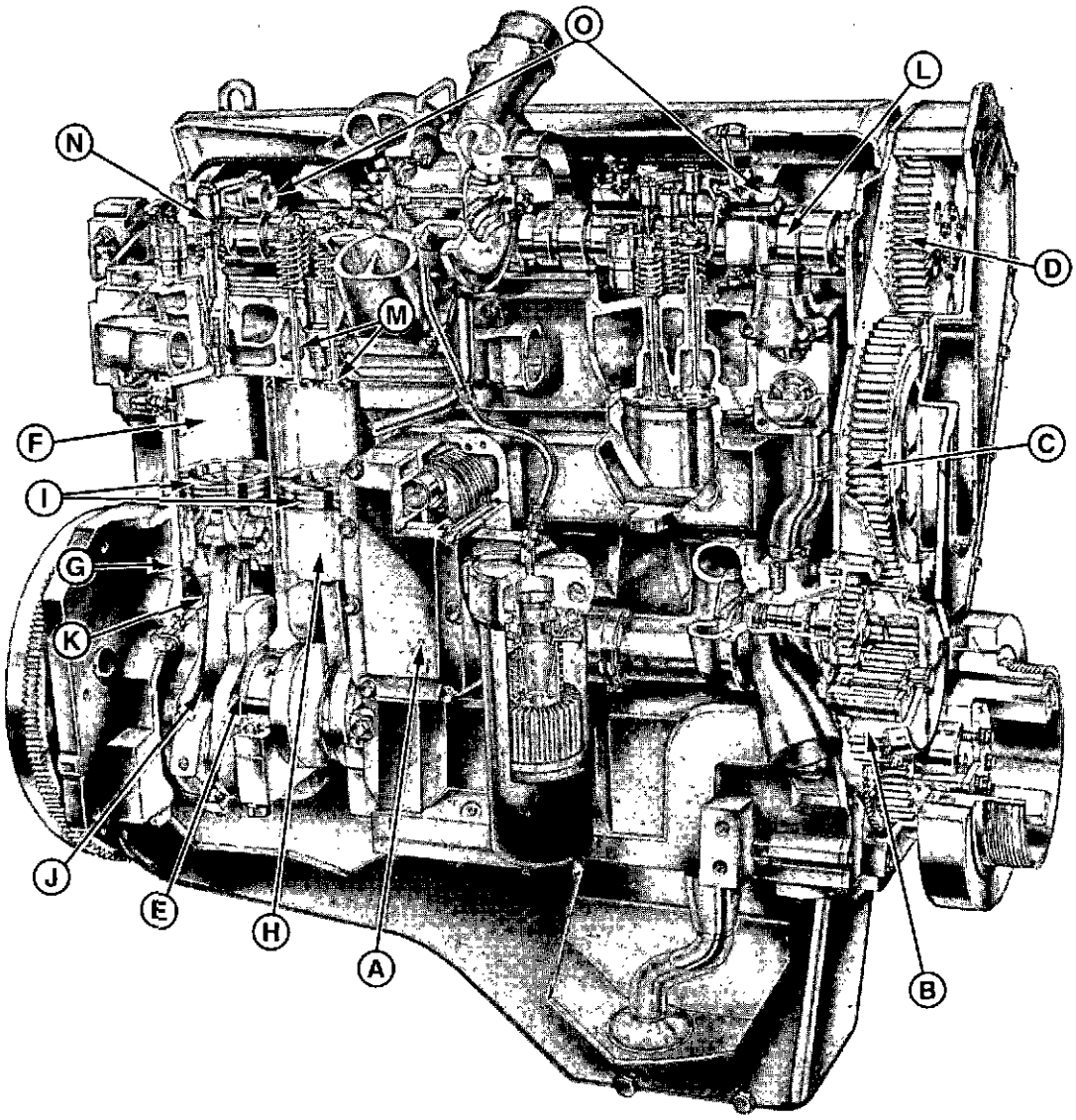
The cylinder head is an air-flow-through design. The exhaust manifold is located on the left side of the head; the intake manifold on the right. Intake and exhaust passages have been optimized for the most efficient air flow, raising the volumetric efficiency of the engine. Intake ports are short to reduce intake air heating. Exhaust ports are short to reduce heat rejection to the head. The head contains the camshaft (L), 4 valves per cylinder (M), the rocker arm assemblies, and the electronic unit injectors (N). The head has replaceable powdered metal valve guides and valve seats.

The camshaft turns in the head on four replaceable bushings. The camshaft directly actuates the rocker arms for the valves and the rocker arm for the electronic unit injectors. Rocker arms rotate on a two-piece rocker arm shaft (O). The rocker arms for cylinders 1, 2, and 3 rotate on one half of the two piece shaft; the rocker arms for cylinders 4, 5, and 6 rotate on the other half. Rollers built in to each rocker arm ride on the camshaft lobes.

The electronic unit injector rocker arm directly actuates an injector for each cylinder. The injectors are located so that they spray fuel directly into the center of the cylinder. The injectors deliver fuel at a much higher pressure (approximately 23,200 psi) than what is achievable with an in-line or rotary injection pump.

The valve rocker arms push on a short push rod. The push rod actuates a bridge that will then operate two valves.

Four valves per cylinder increases engine air flow compared to using one large intake and one large exhaust valve. The intake valves for each cylinder are located towards the front of engine. The exhaust valves are located towards the rear. The intake valves and exhaust valves are the same size. The difference between the two can be determined by the fact that the intake valves are all magnetic. The head of the exhaust valves are a stellite alloy and are not magnetic.



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Engine Components

A—Oil Cooler
B—Oil Pump Drive Gear
C—Idler Gear
D—Camshaft Gear
E—Crankshaft
F—Cylinder Liner
G—Cylinder Liner O-rings
H—Piston
I—Piston Rings
J—Connecting Rod
K—Oil Spray Jet
L—Camshaft
M—Valves
N—Electronic Unit Injector
O—Two-Piece Rocker Arm Shaft

LUBRICATION SYSTEM OPERATION

The lubrication system consists of a crankshaft driven oil pump (A), oil cooler (B), oil filter (C), oil filter bypass valve (D), oil cooler bypass valve (E), and oil pressure regulating valve (F).

Oil is drawn from the sump via a pick-up tube (G) and an internal passage in the cylinder block. The oil pump sends the oil to the pressure regulating valve housing and then to the oil cooler through an internal passage in the cylinder block. An oil cooler relief valve (H) protects the oil cooler during cold oil starting by returning oil to sump. The cooler bypass valve allows oil to bypass the cooler and flow to the filter if the oil cooler is restricted. From the oil cooler oil flows to the oil filter housing and into the filter. If the filter becomes restricted, the oil filter bypass valve will open sending oil to the main oil galley.

Oil flow from the filter is sensed by the oil pressure regulating valve. This valve regulates the pressure in the main oil galley (I). Excess oil is returned to sump.

Clean cool oil is routed directly from the top of the filter base (U) to the turbocharger. Turbocharger return oil is routed through a steel line to the cylinder block and then to sump.

The remaining oil is routed to the main oil galley then distributed to the piston spray jets (J), crankshaft main bearings (K), connecting rod bearings (L), the two rocker arm shaft assemblies (M), upper idler gear bushing (N), and auxiliary drive.

The piston spray jets receive oil directly from the main oil galley. These spray jets allow for precise targeting of the oil spray onto the bottom of the piston.

Drilled passage in the block route oil directly to each crankshaft main journal. The main bearing is slotted to allow oil to flow to the crankshaft cross-drilled passages. The crankshaft cross drilled passages route oil flow from a main journal to each connecting rod bearing.

A drilled passage (O) at the front of the block routes lubrication oil to the oil pump. A cross drilled passage in the pump housing routes this oil to the outside edge of the pump. This oil lubricates the oil pump gear bushing.

A drilled passage from the number one main bearing routes oil to the upper idler gear hub. A drilled passage in the hub routes oil to the outside edge of the hub. This oil lubricates the upper idler gear bushing.

A drilled passage in the cylinder block connects with the upper idler passage. This oil is available to lubricate auxiliary drive components.

Two drilled passages route oil from the main oil galley through the cylinder block towards the head. At the head gasket, oil flows into head bolt holes 19 and 23. Oil flows around these bolts and into a cross-drilled passage at the top of the head. Steel lines (P) connect with the cross drilled passages and routes oil to a rocker arm shaft hold down clamp for each rocker arm shaft.

At the rocker arm hold down clamp, oil flows around a cap screw and enters the rocker arm shaft assemblies (M). The rocker arm shaft is hollow and is sealed on each end. A hollow roll pin connects with each rocker arm shaft drilled passage and routes oil to the two center camshaft bushings.

The front and rear camshaft bushings receive oil from a hole in the respective rocker arm shaft. A drilled passage lines up with a drilled passage in the head to route oil to the bushings.

The rocker arm shaft is cross-drilled to provide lubrication to each rocker arm bushing.

The unit injector rocker arms (Q) are cross-drilled to route oil from the bushing to each end of the rocker arm. At the roller end, oil flows through the roller bushing (R) and out to spray and lubricate the adjacent valve rocker arm rollers (S). Oil then sprays on to the camshaft lobes.

At the front of the unit injector rocker arms, oil sprays out the adjusting screw to lubricate the unit injector (T) and the adjacent valves and adjusting screws.

Some oil is routed from the top of the oil filter base through an external line to the turbocharger and is returned to the cylinder block crankcase through another external line.

LUBRICATION SYSTEM FLOW DIAGRAM

A—Oil Pump
B—Oil Cooler
C—Oil Filter
D—Oil Filter Bypass Valve
E—Oil Cooler Bypass Valve
F—Oil Pressure Regulating Valve
G—Pick-up Tube
H—Oil Cooler Relief Valve
I—Main Oil Galley
J—Piston Spray Jets
K—Crankshaft Main Bearing
L—Connecting Rod Bearing
M—Rocker Arm Shaft Assemblies
N—Idler Gear Bushing
O—Oil Pump Drive Gear Bushing Lube
P—Rocker Arm Shaft Oil Supply
Q—Unit Injector Rocker Arm
R—Unit Injector Rocker Arm Roller Bushing
S—Valve Rocker Arm Rollers
T—Electronic Unit Injector
U—Turbocharger Lube Line
V—Return Oil
W—Pressurized-Nonfiltered Oil
X—Pressurized-Filtered Oil

COOLING SYSTEM OPERATION

The pressurized cooling system consists of a radiator (not shown), coolant pump (A), coolant heater (B), coolant manifold (C), coolant passages in block and the cylinder head, thermostats (D), and thermostat housing (E).

The coolant pump draws coolant from the radiator through the lower radiator hose. Flow then goes past a coolant heater and into the oil cooler housing. Coolant flows around the oil cooler and then flows into one of two circuits.

The main circuit flows coolant from the oil cooler into the coolant manifold. The coolant manifold extends the length of the right side of the block. From the coolant manifold, coolant flows into each liner cavity. From the liners, coolant flows up into the cylinder head.

The coolant flow through the block and cylinder head is optimized to provide ample flow around each liner and to provide more flow to the rear of the cylinder head than into the front. To achieve this, the coolant passages from the block to the cylinder head vary in size and in number.

The holes on the right side of the block are smaller than the holes on the left side. Therefore, as coolant flows out of the coolant manifold on the right side of the block, it is forced to flow around the liners to escape through larger holes on the left of the block. This assures that each liner is surrounded by coolant flow.

In addition, there are more holes and larger holes at the rear of the cylinder head than at the front. Cylinders 1 and 2 have one 6.3 mm (0.25 in.) and one 9 mm (0.35 in.) hole. Cylinders 3 and 4 have two 6.3 mm (0.25 in.) and two 10 mm (0.39 in.) holes. Cylinders 5 and 6 have two 10 mm (0.39 in.) and two 16 mm (0.63 in.) holes.

The larger and higher number of coolant flow holes around cylinders 5 and 6 force more coolant to flow to the back of the cylinder head than to the front.

Once coolant is in the cylinder head, all flow is towards the front. Coolant from cylinder 6 flows forward and accumulates with flow from other cylinders. All coolant flow then exits out the head at number 1 cylinder to the thermostat housing.

The second circuit is called the "directed top liner cooling" system. Two drilled passages (F) at the top of the oil cooler cavity in the cylinder block route coolant to cylinders 3 and 4 liners for top liner cooling.

Coolant will flow around the top of cylinder 3 liner, then flow forward to cylinder 2 liner and then to cylinder 1 liner. Coolant will leave cylinder 1 through a drill passage to the thermostat housing. Coolant entering number 4 cylinder will flow rearward to number 5 and then to number 6. Coolant leaves number 6 cylinder through a drilled passage and flows though an external steel line (G) to the thermostat housing.

When the engine is cold, the thermostats will be closed. Coolant will flow through the bypass tube (H), into the inlet of the coolant pump.

When the engines warms to operating temperature, the thermostats will open and coolant will flow past the open thermostats to the radiator (M).

The thermostat housing contains two thermostats. The bottom thermostat has a blocking poppet. When the engine gets to operating temperature, this thermostat will open and allow flow to the radiator. The blocking will close off the bypass path to the coolant pump inlet.

The top thermostat is a non-blocking type. When it opens, coolant will flow to the radiator. The non-blocking type has a vent notch to provide an air bleed when the cooling system is filled.

On water-to-air aftercooled engines, coolant is routed through an external line (I) to the aftercooler, then back to the oil cooler housing through a second external line (J).

A—Coolant Pump
B—Coolant Heater
C—Coolant Manifold
D—Thermostats
E—Thermostat Housing
F—Directed Top Liner Cooling Passages
G—Directed Top Liner Cooling Return Line
H—Coolant Bypass Tube
I—Water-to-Air Aftercooler Supply
J—Water-to-Air Aftercooler Return
K—Low Temperature Coolant
L—High Temperature Coolant
M—To Radiator Top Tank
N—From Radiator

INTAKE AND EXHAUST SYSTEM OPERATION

Engine suction draws dust-laden outside air through an air inlet stack into the air cleaner. Air is filtered through dry-type primary and final filter elements in the air cleaner canister. Clean air travels through the intake air hose to the turbocharger, through the air-to-air aftercooler, through the air/fuel mixing elbow, and into the intake manifold.

Exhaust, as it is expelled out of the exhaust manifold, drives the turbocharger to deliver a larger quantity of air to meet the engine requirements than what could be delivered under naturally aspirated (non-turbocharged) conditions.

On some engines, an air-to-air aftercooler cools the turbocharger compressor discharge air by routing it through a heat exchanger before it enters the engine. The heat exchanger uses no liquid coolant but relies on air flow to cool the charge air.

On some engines, the aftercooler functions as a heat exchanger. Engine coolant circulates through the aftercooler core and carries heat out of the aftercooler.

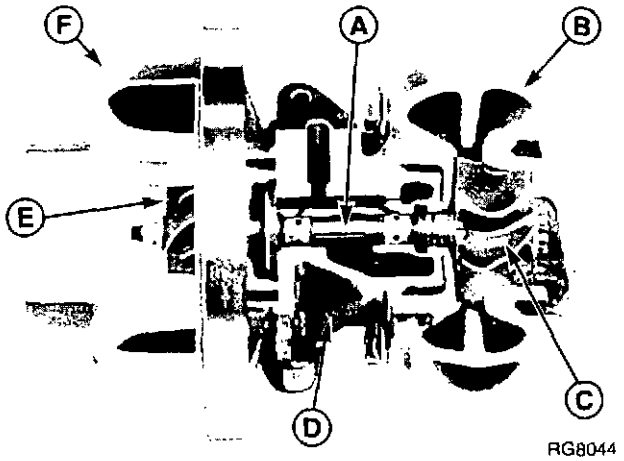
TURBOCHARGER OPERATION

The turbocharger, which is basically an air pump that is driven by exhaust gases, allows the engine to produce added power without increasing displacement. Turbochargers are specially matched for the power ratio requirements of each specific application.

The turbine wheel (C) is driven by the hot engine exhaust gases. These gases flowing through the turbine housing (B) act on the turbine wheel causing shaft (A) to turn.

Compressor wheel (E) brings in filtered air and discharges the compressed air into the intake manifold where it is then delivered to engine cylinders.

Engine oil under pressure from the engine lubrication system is forced through passages in center housing (D) to bearings.



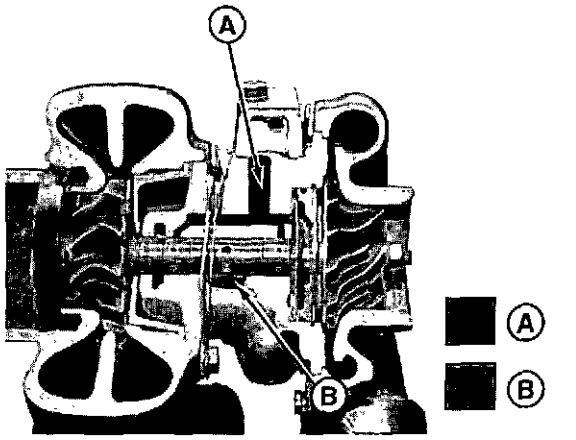
Turbocharger Components

A—Shaft
B—Turbine Housing
C—Turbine Wheel
D—Center Housing
E—Compressor Wheel
F—Compressor Housing

HOW THE TURBOCHARGER IS LUBRICATED

Engine oil under pressure from the engine lubrication system is pumped through a passage in the bearing housing and directed to the bearings, thrust plate, and thrust sleeve. Oil is sealed from the compressor and turbine by a piston ring at both ends of the bearing housing.

The turbocharger contains two floating bearings. These bearings have clearance between the bearing OD and the housing bore as well as clearance between the bearing ID and the shaft OD. These clearances are lubricated by the oil supply (A) and the bearings are protected by a cushion of oil. Discharge oil (B) drains by gravity from the bearing housing to the engine crankcase.



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Turbocharger Lubrication

A—Pressure Oil
B—Discharge Oil

LOW PRESSURE FUEL SUPPLY SYSTEM OPERATION

The fuel transfer pump (A) draws fuel from the fuel tank through an in-line check valve (B) into the primary filter base inlet and the primary filter (C). The primary filter base (D) contains a hand primer pump (E) and three outlet passages (F). The water separator bowl (G) screws on to the bottom of the primary filter. A self venting drain valve is mounted on the bottom of the clear bowl.

Fuel flows from one of the primary filter base outlets to the inlet of the fuel transfer pump mounted on the rear of the head. The fuel transfer pump is a gear type pump. The pump shaft is coupled to the end of the camshaft. The fuel transfer pump contains a pressure regulating valve for system over-pressure protection. A bypass valve in the pump base allows fuel to bypass the gears during hand priming.

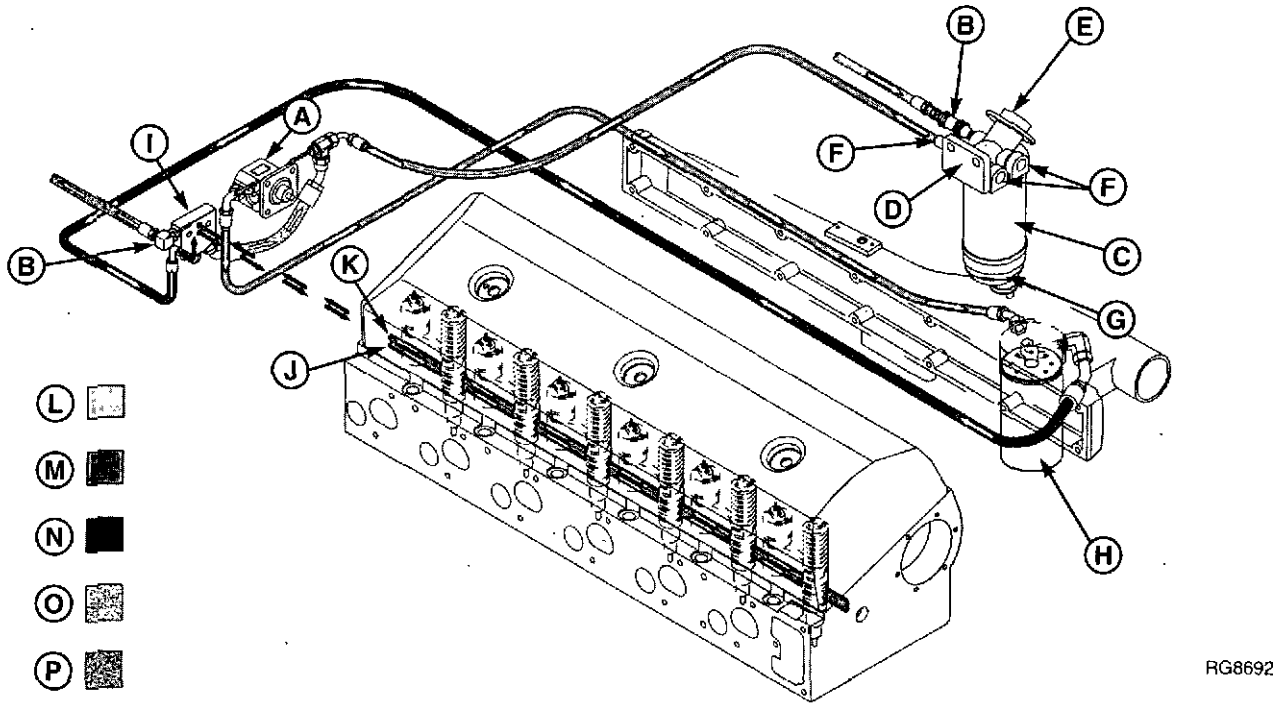
Fuel flows from the outlet of the fuel transfer pump to the inlet of the final fuel filter (H). The spin-on final filter is the last clean-up of the fuel before entering the engine.

Fuel flows from the outlet of the final filter to the fuel manifold (I) mounted on the rear of the cylinder head. The fuel manifold contains a fuel temperature sensor, pressure regulating valve, return to tank orifice, and passages to route fuel into and out of the cylinder head. On some applications, the fuel manifold also contains a fuel pressure sensing switch. The fuel pressure regulator will maintain fuel pressure at 410–480 kPa (4.1–4.8 Bar) (60–70 psi).

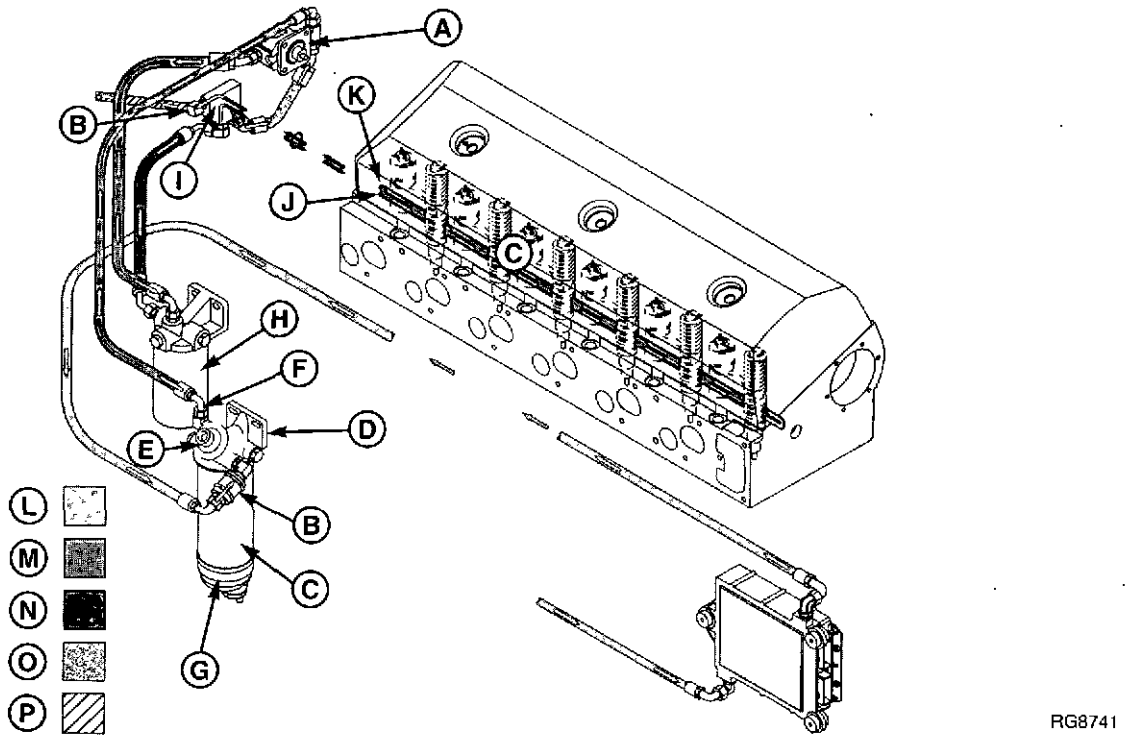
Fuel flows from the fuel manifold into the fuel supply rail in the cylinder head. Fuel rails are drilled passages in the cylinder head that route fuel to each unit injector. The fuel supply rail (J) is the bottom drilled passage; the return fuel rail (K) is the top drilled passage. The two passages are connected at the front of the head.

Excess fuel not needed by the electronic unit injectors flows from the cylinder head into the fuel manifold. The fuel flows past the fuel temperature sensor. At this point the fuel is routed in one of two directions. The return to tank orifice will cause approximately 10% of the fuel to flow back to the fuel tank. The return-to-tank fuel enters the tank at the bottom to prevent fuel drain-back. The remaining 90% of the fuel will flow past the pressure regulating valve and return to the inlet of the fuel transfer pump to be recirculated through the cylinder head.

LOW PRESSURE FUEL SYSTEM FLOW DIAGRAM



John Deere Applications Fuel System



OEM Applications Fuel System

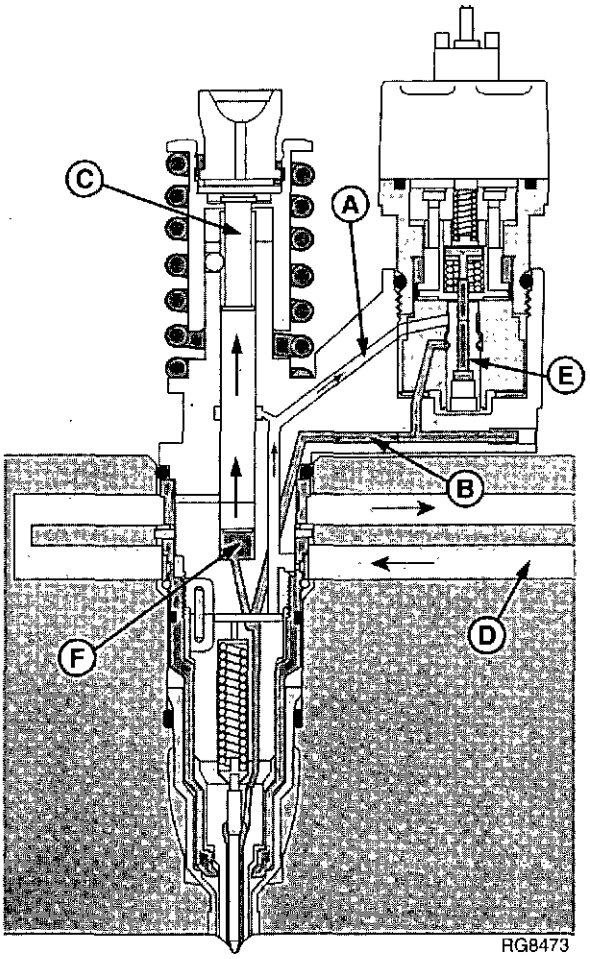
A—Fuel Transfer Pump
B—In-line Check Valves
C—Primary Filter
D—Primary Filter Base
E—Hand Primer Pump
F—Primary Filter Base Outlets
G—Water Separator Bowl
H—Final Filter
I—Fuel Manifold
J—Fuel Supply Rail
K—Fuel Return Rail
L—Suction Fuel from Tank
M—Primary-Filtered Fuel
N—Final-Filtered Fuel
O—Recirculated Fuel
P—Return-to-Tank Fuel

ELECTRONIC UNIT INJECTOR (EUI) OPERATION

The electronic unit injector pumping action is created by the up and down movement of the plunger. The plunger movement is caused by the rotation of the camshaft and the rocking action of the rocker arms. The larger return spring will move the plunger up as the camshaft rotates and relaxes the force on the rocker arm.

- **Fill Cycle**

The electronic unit injector will fill with fuel when the plunger (C) is moving up. Fuel from the fuel supply rail (D) enters fuel passage (A) of the unit injector. Fuel flows past the open spill valve (E) into fuel passage (B). Passage B routes fuel into the plunger cylinder (F), which fills as the plunger moves up.

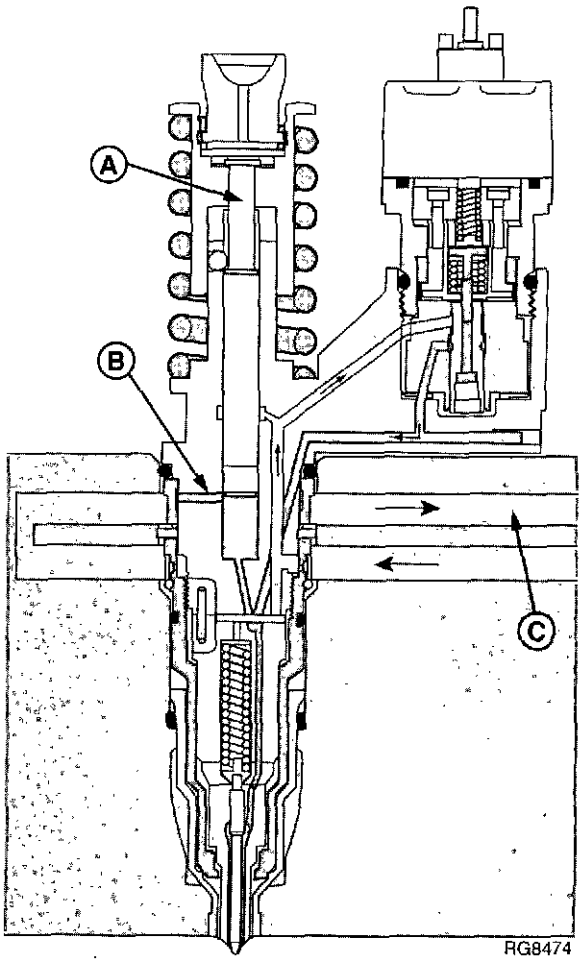


EUI Fill Cycle

ELECTRONIC UNIT INJECTOR OPERATION—CONTINUED

- **Vent Cycle**

The vent cycle begins when the plunger (A) nears the top of the fill cycle stroke. At this point a vent port (B) will be uncovered and fuel and any trapped air can flow to the return fuel rail (C).



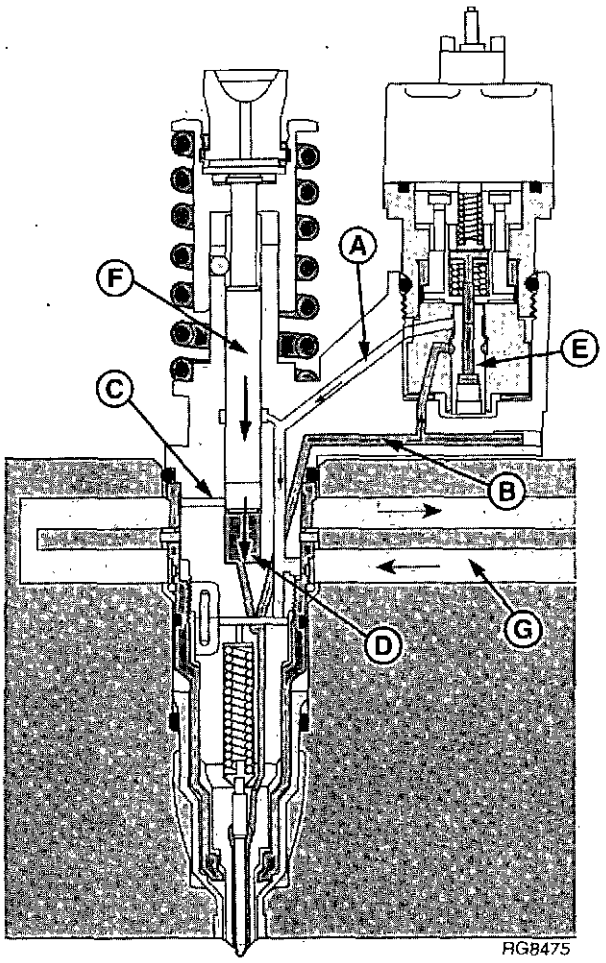
EUI Vent Cycle

ELECTRONIC UNIT INJECTOR OPERATION—CONTINUED

- ***Pumping Cycle***

The pumping cycle begins when the camshaft lobe pushes on the rocker arm to cause the plunger (F) to start moving down. During the first downward movement of the plunger, the vent port (C) will close.

Further downward movement of the plunger will force fuel from the plunger cylinder (D). Fuel will flow out fuel passage (B), through the open spill valve (E), into fuel passage (A) and back to the fuel supply rail (G). This flow will continue until the injection cycle begins.



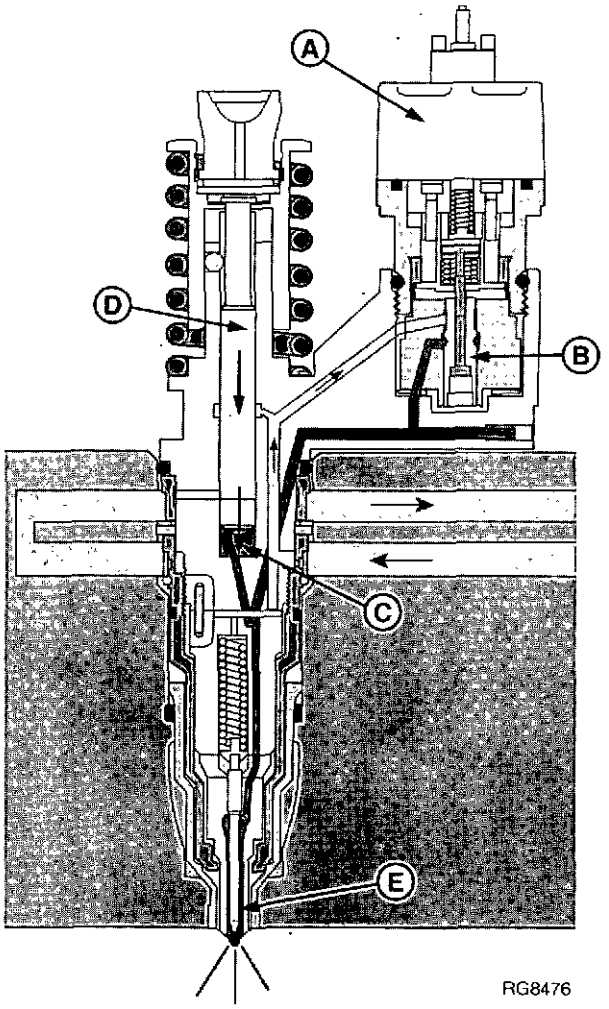
EUI Pumping Cycle

ELECTRONIC UNIT INJECTOR OPERATION—CONTINUED

- **Injection Cycle**

The injection cycle will start when the Engine Control Unit (ECU) energizes the EUI solenoid (A). This will occur during the downward stoke of the plunger.

The energized solenoid will close the spill valve (B). With the spill valve closed, fuel can not escape from the plunger cylinder (C). The downward movement of the plunger (D) will cause the fuel pressure to rise. When the pressure reaches 30,000 kPa (300 bar) (4350 psi), the injector needle (E) will start to move up and injection will begin. As the plunger continues to move down, pressure will rapidly rise to approximately 160,000 kPa (1600 bar) (23,200 psi). Injection will continue until the ECU de-energizes the solenoid. The spill valve will then open allowing fuel pressure to drop rapidly. The injector needle will close and injection will stop.



EUI Injection Cycle

ELECTRONIC CONTROL SYSTEM GLOSSARY OF TERMS

Actuator — A device controlled by the (ECU) to perform a certain function.

Analog — Signal which has a continuous range of possible voltages. Usually 0 to 5 volt or 0 to 12 volt signals.

BOB — Break-Out-Box. A BOB tees into the engine wiring harness, and allows easy voltage checks on control system circuits even while the system is in operation. Voltage, resistance, and ground feed measurements can be made without having to backprobe into connectors. (See USING THE BREAK-OUT-BOX in Group 115 for more information.)

Boost — *Air pressure in the intake manifold.*

DFC — Diagnostic Fault Code. A code which is stored in the ECU's memory when the ECU detects a problem in the electronic control system.

DST — Diagnostic Scan Tool. The tool used to read and clear DFCs, read sensor and actuator data, and perform engine tests. The DST consists of an Windows (3.X or '95) compatible computer and 2 kits available from John Deere Distribution Service Center (DSC): JDIS121 - 10.5/12.5 ECU Communication Hardware Kit, and JDIS122 - 10.5/12.5 ECU Communication Software Kit.

Digital — A signal which consists of only two-volt levels — usually 0 volts and +5 volts.

ECT — Engine Coolant Temperature (sensor). Measures the temperature of the engine coolant. (See MEASURING TEMPERATURE later in this group for details.)

ECU — Engine Control Unit. The computer which controls the fuel, air, and ignition systems on the engine. (See ENGINE CONTROL UNIT (ECU) later in this group for details.)

EUI — Electronic Unit Injector. An EUI is an electronically controlled injection pump and injector combined. The ECU controls the start of injection and the amount of fuel injected by energizing and de-energizing the solenoid in the EUI valve housing. (See ELECTRONIC UNIT INJECTOR (EUI) OPERATION earlier in this group for details.)

J1587/J1708 — The Society of Automotive Engineers (SAE) standard for the electronic components of heavy duty vehicles. J1587 is the software standard. J1708 is the hardware standard.

MAP — Manifold Air Pressure (sensor). Measures the pressure of the air in the intake manifold. (See MEASURING MANIFOLD AIR PRESSURE later in this group for details.)

MAT — Manifold Air Temperature (sensor). Measures the temperature of the air in the intake manifold. (See MEASURING TEMPERATURE later in this group for details.)

PDM — Parallel Data Module. Device used as part of the DST that allows communication with the ECU.

PROM — Programmable, Read-Only Memory. The computer chip which contains the calibration information for the engine control system. (See ENGINE CONTROL UNIT (ECU) later in this group for details.)

ELECTRONIC CONTROL SYSTEM GLOSSARY OF TERMS—CONTINUED

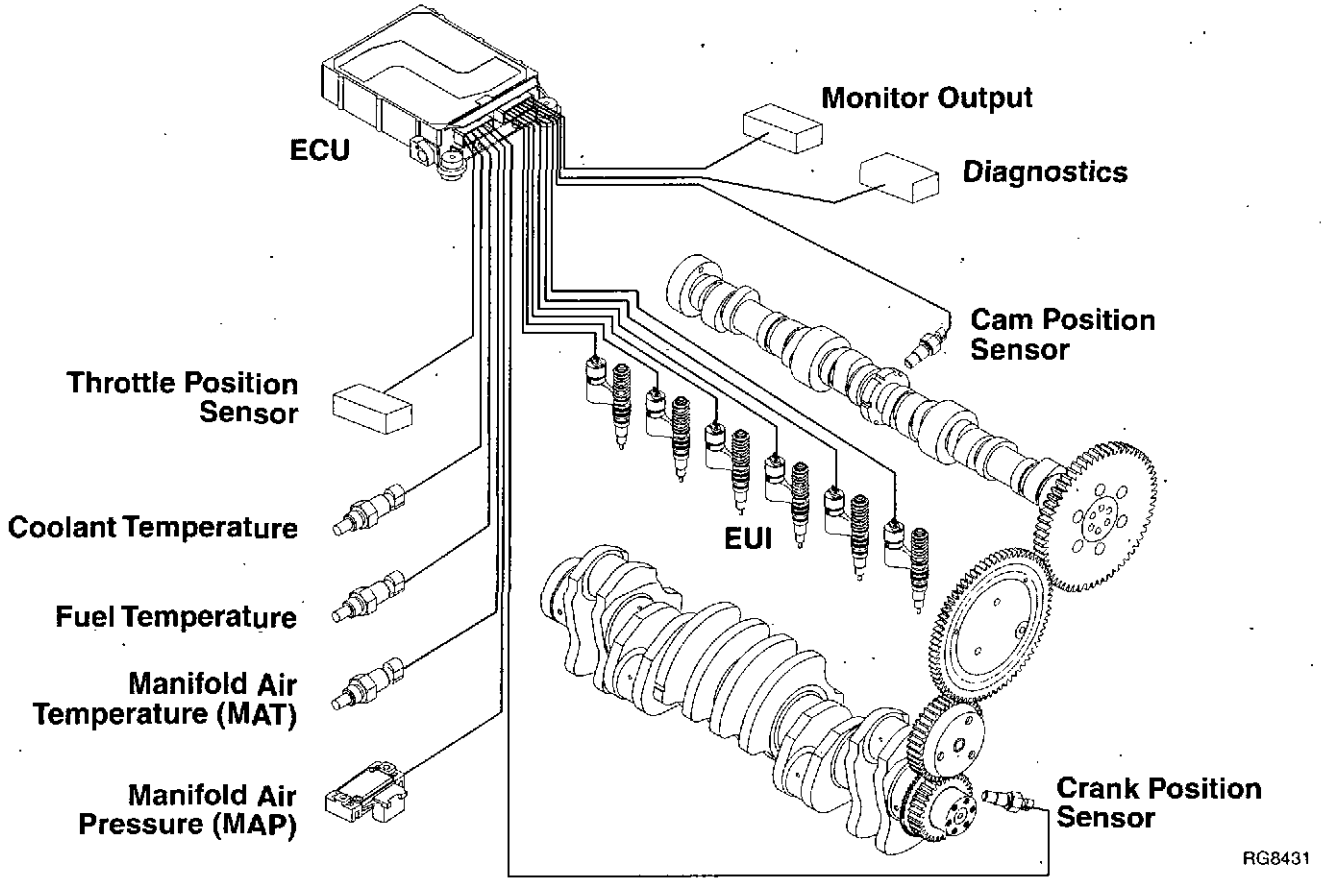
PWM Pulse Width Modulation. A digital signal (not analog) which consists of a pulse generated at a fixed frequency. When an actuator is controlled by a PWM signal, the on time of the signal is increased or decreased (modulated) to increase or decrease the output of the actuator.

RAM Random Access Memory. The portion of computer memory within the ECU which changes as the engine is running and is stored while the engine is off. (See ENGINE CONTROL UNIT [ECU] later in this group for details.)

Sensor Device used by the ECU to monitor various engine parameters.

TPS Throttle Position Sensor. The TPS measures the position of the throttle, which is controlled by the machine operator. (See MEASURING THROTTLE POSITION later in this group for details.)

ELECTRONIC CONTROL SYSTEM OVERVIEW



Electronic Control System

The electronic control system serves as an engine governor by controlling the Electronic Unit Injectors (EUIs) so that fuel is delivered according to a given set of engine conditions, in precise amounts, and at a precise time in relation to piston position. In order to achieve this, the control system performs the following functions:

- Constantly monitor engine operating conditions
- Precisely determines piston position
- Deliver optimum amount of fuel for a given set of operating conditions
- Deliver fuel at optimum piston position
- Provide multiple control modes
- Perform self-diagnosis

ELECTRONIC CONTROL SYSTEM OPERATION

- **Engine Starting Mode**

When the key is turned to the "ON" position, a switched power voltage signal is sent to the ECU. This key ON signal causes the ECU to energize the ECU power relay, allowing battery voltage to be available at ECU/cab connector terminals 11 and 12; this causes the ECU to "boot-up" and ready itself for engine start.

NOTE: If a wiring problem prevents the key ON signal from getting to the ECU, the engine will not start.

As soon as the ECU determines using the crankshaft position sensor input that the engine is cranking, it will determine using the camshaft position sensor input when cylinder number 1 is coming to top-dead-center at the end of the compression stroke. It will then start injecting fuel when the next cylinder in the firing order (cylinder number 5) is at the correct position before top-dead-center at the end of compression. To provide cold temperature enrichment, the amount of fuel injected is based on the temperature measured by the Engine Coolant Temperature (ECT) sensor. At this point, the engine will start and the ECU will go into the running mode.

- **Engine Running Mode**

In the running mode, the ECU monitors information from the various sensors, then determines the optimum amount of fuel to inject and the optimum injection timing in order to allow the engine to develop high power while maintaining low exhaust emission output. The camshaft and crankshaft position sensors allow the ECU to precisely determine piston position in relation to top-dead-center so that the ECU can command the correct Electronic Unit Injector (EUI) solenoid at the correct time. The ECU controls fuel delivery by energizing and de-energizing the individual solenoids that open and close the EUI spill valves. When the ECU energizes the EUI solenoid, the spill valve closes and injection begins. When the correct amount of fuel has been injected, the ECU de-energizes the solenoid, causing the spill valve to open, and fuel injection to stop.

MONITORING ENGINE PARAMETERS

In order for the electronic control system to deliver fuel according to a given set of operating conditions, the following parameters are monitored by the ECU:

- Engine Coolant Temperature (ECT)
- Manifold Air Temperature (MAT)
- Fuel Temperature
- Manifold Air Pressure (MAP)
- Throttle Position
- Engine Speed

MEASURING TEMPERATURE

The Engine Coolant Temperature (ECT) sensor, the Manifold Air Temperature (MAT) sensor, and the fuel temperature sensor are all temperature sensitive variable resistors. The sensors' resistance goes down as the temperature it is exposed to goes up (negative temperature coefficient). The Engine Control Unit (ECU) sends 5 volts to the sensor, monitors the voltage drop across the sensor, then compares the voltage drop to preprogrammed values in the ECU's memory to determine temperature.

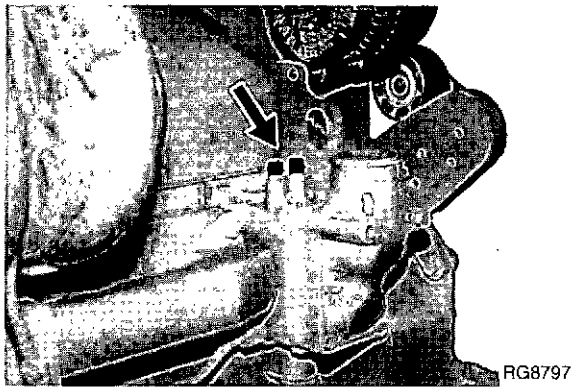
- **ECT (Engine Coolant Temperature) Sensor**

The ECT sensor *(arrow)* is located on top of the thermostat housing. The ECU monitors coolant temperature for:

- Engine protection purposes – If coolant temperatures become excessive, the ECU will derate power to protect the engine.
  - — At a coolant temperature of 100°C (212°F) power will be derated 1.5%
  - — At a coolant temperature of 105°C (220°F) power will be derated 4%
  - — At a coolant temperature of 113°C (235°F) power will be derated 14%

The above derates will stay in effect until the coolant temperature drops below the derate threshold. If the coolant temperature again goes above a derate threshold, engine power will again be derated.

- Starting fuel quantity determination – The ECU will adjust the amount of fuel delivered during start-up based on initial ECT readings.
- Idle speed determination – In order to speed engine warm-up, the ECU will increase idle speed after start-up if a low coolant temp is measured.

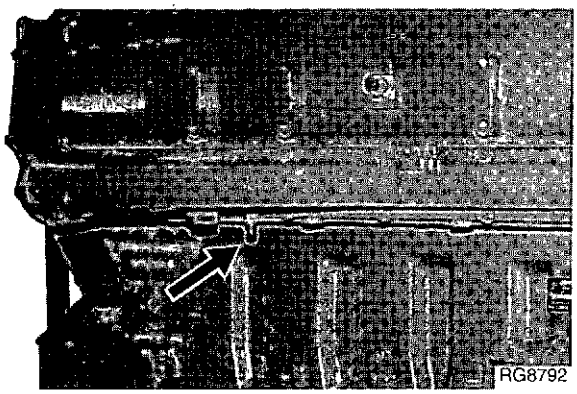


ECT Sensor Location

MEASURING TEMPERATURE—CONTINUED

- **MAT (Manifold Air Temperature) Sensor**

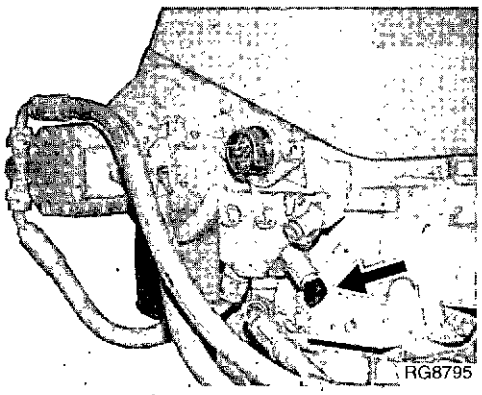
The MAT sensor *(arrow)* is located on the underside of the intake manifold. The ECU uses the manifold air temperature measurement in engine airflow calculations.



MAT Sensor Location

- **Fuel Temperature Sensor**

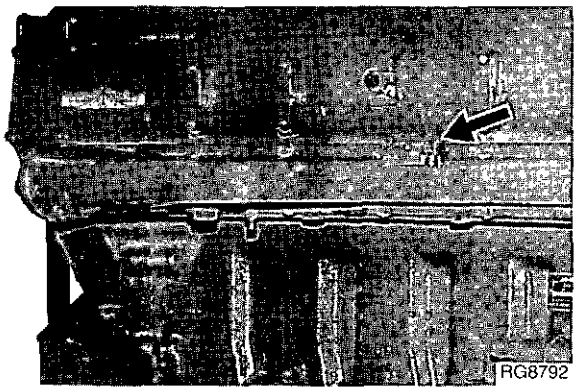
The fuel temperature sensor *(arrow)* is located on the fuel manifold. Using the fuel temperature measurement, the ECU will determine fuel density, and adjust fuel delivery accordingly.



Fuel Temperature Sensor Location

MEASURING MANIFOLD AIR PRESSURE

The Manifold Air Pressure (MAP) sensor is a pressure sensitive variable resistor; as the air pressure that the sensor is exposed to changes, sensor resistance changes. The ECU sends a 5 volt reference to the sensor, then monitors the voltage on the sensor signal wire. The voltage is then compared to preprogrammed values in the ECU's memory to determine manifold air pressure. The MAP sensor measures gauge pressure; therefore to determine absolute pressure, atmospheric pressure must be added to the MAP sensor pressure reading. The MAP sensor *(arrow)* is located on top of the intake manifold.



MAP Sensor Location

MEASURING THROTTLE POSITION

The 10.5 and 12.5 L engines have the option of operating with a pulse-width-modulated (PWM) throttle signal, an analog throttle position sensor output signal, or both. If the system is equipped with both throttle options, the PWM signal will be the primary throttle signal and the analog throttle signal will be secondary.

- **Pulse-width-modulated (PWM) throttle**

The PWM throttle signal is sent to the ECU by another controller. The PWM signal is a square wave signal with a constant frequency. The pulse width of the signal varies and indicates the desired throttle opening.

- **Analog throttle**

An analog throttle signal comes from a poteniometer-type sensor. The ECU converts the voltage returning from the poteniometer into a percent of full throttle signal.

DETERMINING ENGINE AIRFLOW

Engine airflow is calculated by the ECU using the MAP sensor and the MAT sensor. Information from these sensors is effectively used to calculate intake manifold air density, which at a given engine speed gives an approximation of mass air flow.

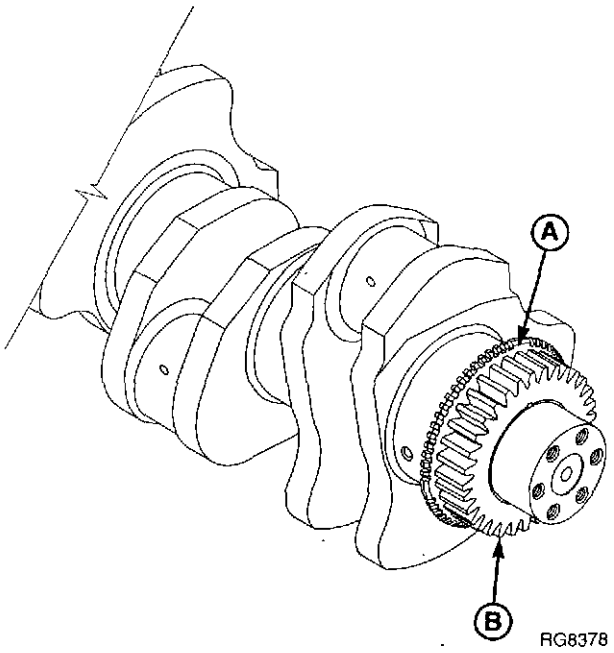
DETERMINING ENGINE SPEED AND PISTON POSITION

Engine speed and precise piston position in relation to Top-Dead-Center (TDC) is determined by the ECU using the crankshaft position sensor and the crankshaft timing wheel. Cylinder identification in relation to the engine firing order is determined by the ECU using the camshaft position sensor, and the camshaft timing wheel. Both sensors operate by detecting notches on a timing wheel. When a notch on the timing wheel is directly under the sensor, a voltage is induced. The ECU monitors this voltage to determine timing wheel position.

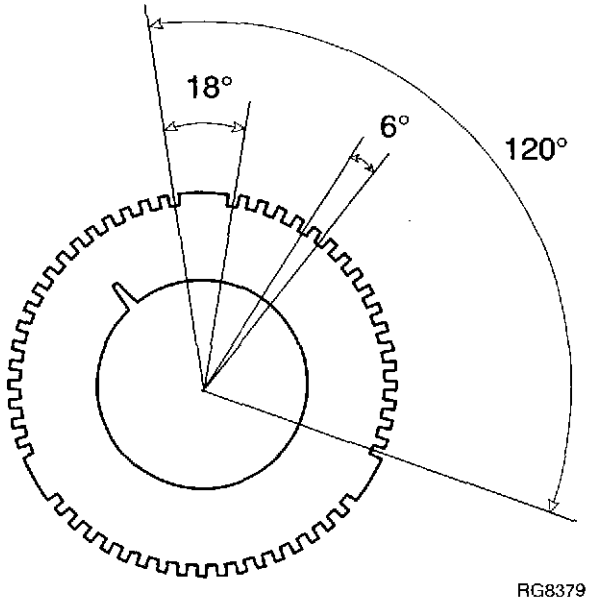
DETERMINING ENGINE SPEED AND PISTON POSITION—CONTINUED

- **Crankshaft Position**

The crank timing wheel (A) is located on the front of the crankshaft, behind the pressed-on crank gear (B). The timing wheel is composed of 54 notches, divided into 3 groups of 18 notches. Before the first notch in each group is a flat area equal to 18° of crankshaft rotation, the following 17 notches are separated by 6° of crankshaft rotation. Each group of 18 notches and a flat area is equal to 120°, or a third of a full turn.



Crankshaft Timing Wheel

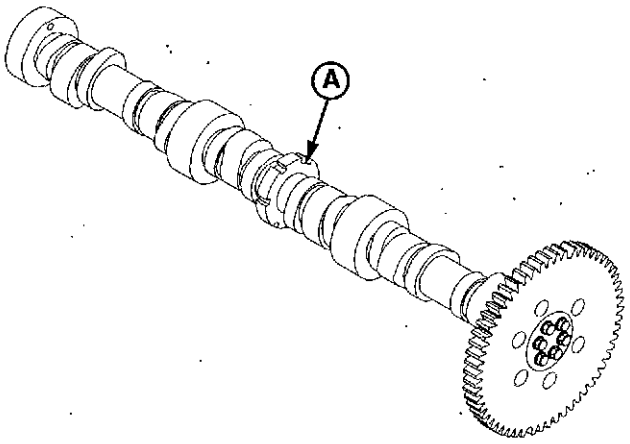


Crankshaft Timing Wheel Notches

DETERMINING ENGINE SPEED AND PISTON POSITION—CONTINUED

- **Camshaft Position**

The camshaft timing wheel (A) consists of 7 notches cut into the center journal of the camshaft. Six of the 7 notches are evenly spaced at 60° center-to-center. Each of the 6 notches correspond to a cylinder; the 7th notch is located 15° center-to-center before the notch that identifies cylinder number 1. The ECU has the engine firing order stored in memory, therefore it knows that following the notch identifying cylinder 1 will be the notch identifying cylinder 5 etc. The camshaft timing wheel turns at one half the speed of the crankshaft timing wheel.



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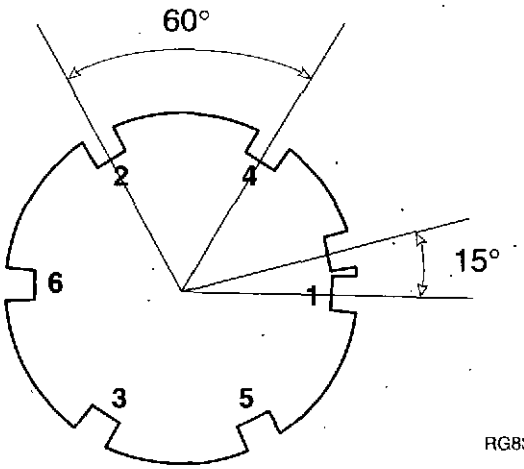
Camshaft Timing Wheel



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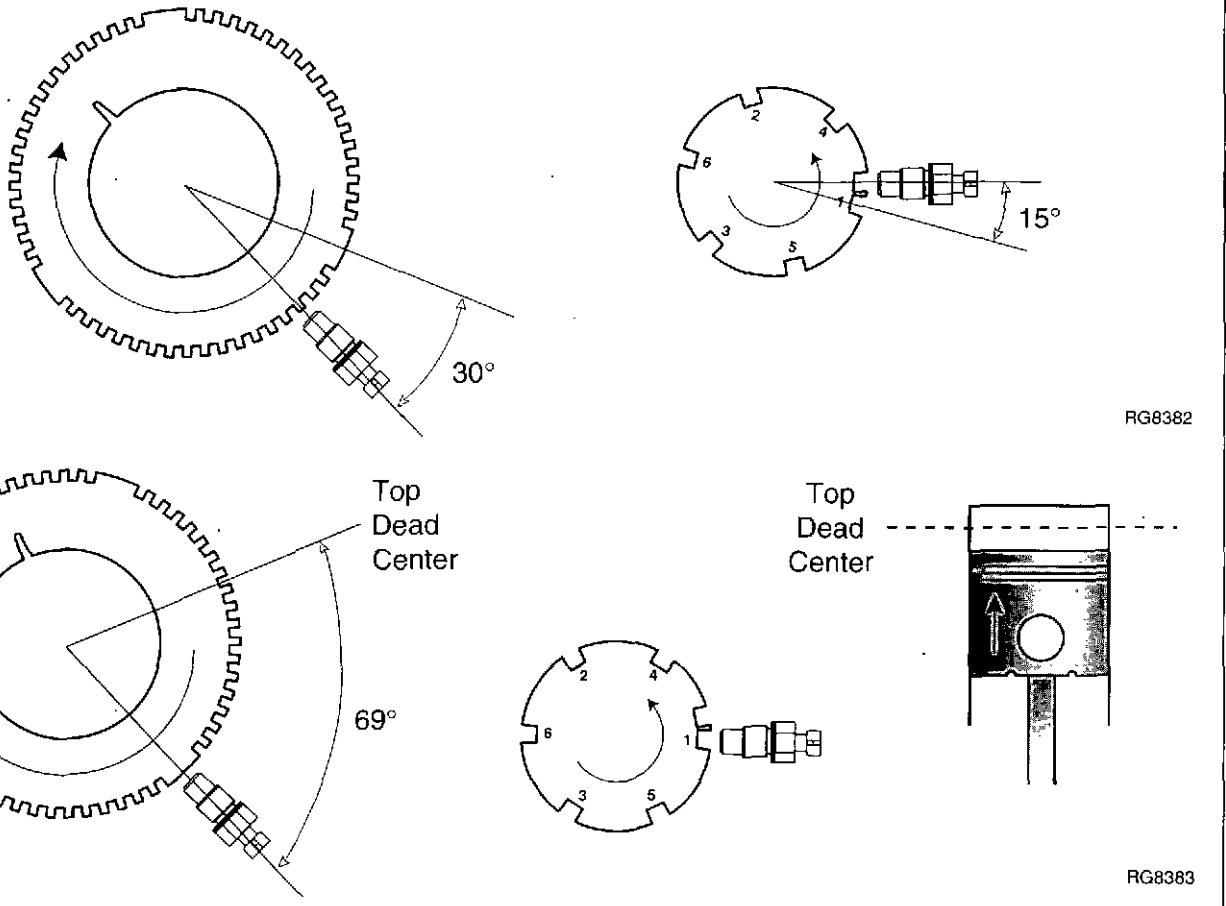
Camshaft Timing Wheel Notches

DETERMINING ENGINE SPEED AND PISTON POSITION—CONTINUED



Crankshaft/Camshaft Timing Wheels Relationship

- **Crankshaft/Camshaft Position Relationship**

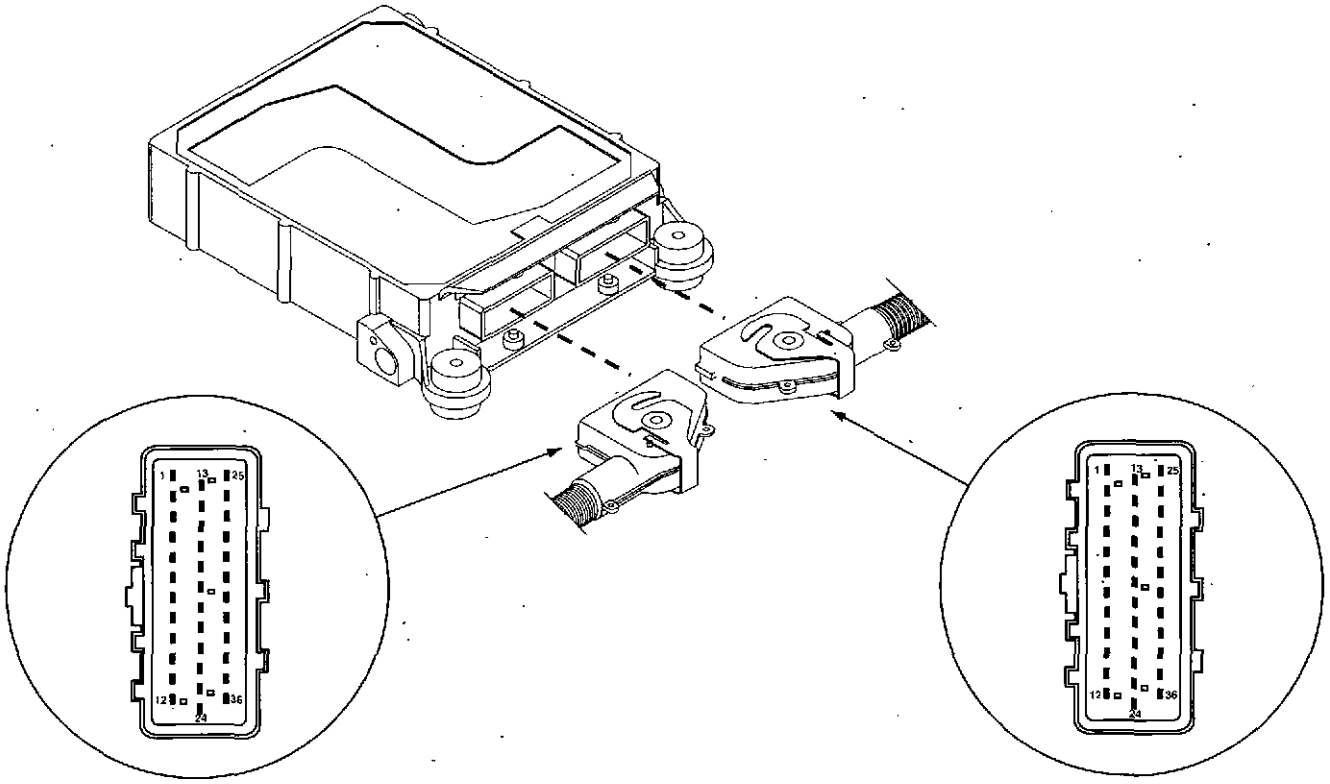
When the cam position sensor detects the extra notch on the cam timing wheel, the ECU is informed that the notch identifying cylinder 1 is 15° of crank rotation away from the cam position sensor, and the center of the flat area on the crank timing wheel is 30° of crank rotation away from the crank position sensor. One timing cycle will then begin when the cam position sensor is directly in the center of a notch on the cam timing wheel. At this time, the crank position sensor is directly in the center of a flat area on the crank timing wheel, and piston number 1 is 69° of crankshaft rotation away from TDC on the compression stroke. During the previous 120°, the ECU calculated engine speed and determined the optimum time to start injecting fuel and the optimum time to stop injecting (determines fuel amount).

It then monitors each crank timing notch until the time to start injection occurs, at which time it energizes the Electronic Unit Injector (EUI) solenoid to start fuel delivery.

It continues to monitor each crank timing notch until the time to end injection occurs, at which time it will denergize the EUI solenoid to stop fuel delivery.

In the event of a crank or cam position sensor failure, a "limp-home" mode will allow the ECU to operate with only one position sensor input. If the crank position sensor fails, engine power will be low. If the cam position sensor fails, long cranking times will be required to start the engine. If both sensors fail, the engine will die and won't restart.

ENGINE CONTROL UNIT (ECU)



ECU and Connectors

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The Engine Control Unit (ECU) is the "brains" of the Electronic Control System. The ECU is a self-contained unit containing electronic circuitry and computer software which together perform the following functions:

- Convert the electrical signals from the various sensors into digital signals
- Make decisions of optimum fuel quantity and injection timing based on information from various sensors
- Control fuel delivery
- Limit maximum fuel for operation on multiple power curves
- Provide min-max or all-speed governing
- Perform self diagnosis on the control system
- Store fault codes in memory

The ECU connects to the wiring harness through an ECU/engine connector and an ECU/cab connector. Each connector can be identified by its color and key configuration. The ECU/engine connector is black; the ECU/cab connector is red. Both connectors contain 36 terminals, individually identified by numbers 1 through 36.

ENGINE CONTROL UNIT (ECU)—CONTINUED

The ECU is composed of the following subsystems:

- **Analog/digital converters**

This portion of the ECU converts the analog voltage signals from the various sensors into digital signals that the central processing unit can "understand".

- **Central Processing Unit (CPU)**

The central processing unit performs the mathematical computations and logical functions that are necessary in controlling injection fuel quantity and injection timing. The CPU commands the Electronic Unit Injectors (EUIs) and controls the self diagnostic system.

- **Memory**

The ECU contains 3 different types of memory:

— Random Access Memory - RAM -

The RAM is like the working desk top of the ECU. Data from the various sensors and the results of various calculations are temporarily stored in RAM. Information in RAM is lost when battery voltage to the ECU is removed.

— Read Only Memory - ROM -

The ROM contains programmed information. Information in ROM can only be read, not changed. ROM information is retained when battery voltage is removed.

— Electrical Erasable Programmable Read Only Memory - EEPROM -

The EEPROM contains information programmed in at the factory including engine specific data, and application data. Information in the EEPROM is retained when battery voltage is removed.

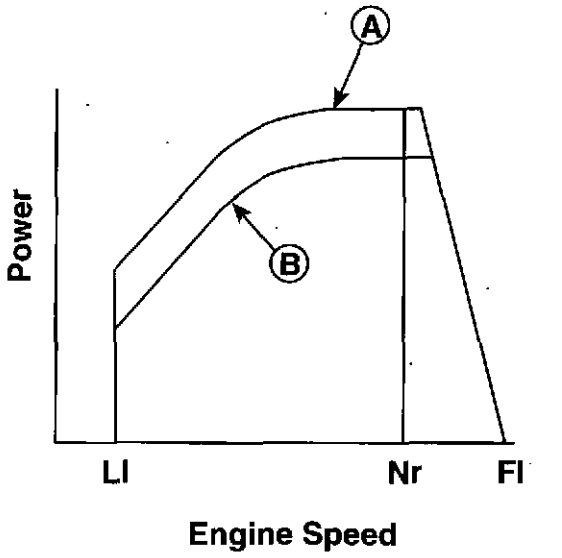
GOVERNOR MODES

The electronic control system has the ability to provide two types of governing; all-speed governing and min-max speed governing. When operating in the all-speed governor mode, the Engine Control Unit (ECU) controls the engine speed based on the analog throttle input or the PWM throttle input. When operating in the min-max speed governor mode, the ECU provides the same minimum (low idle) and maximum (fast idle) speed governing as with the all-speed governor. However, in between the minimum and maximum speeds, the analog throttle input or PWM throttle input is used by the ECU to select a fuel quantity. Thus, the throttle commands fuel quantity rather than engine speed in the min-max governor mode.

The electronic control system also has the ability to provide two types of droop; normal droop and isochronous (0% droop). The normal droop characteristic is a linear increase of engine speed with decreasing load. The 0% droop will only be selected by a switch input, without a switch signal present, the normal droop will be used.

MAXIMUM FUEL QUANTITY CONTROL

The Engine Control Unit (ECU) has the ability to limit the maximum fuel quantity such that multiple torque curves can individually be selected while the engine is running. The selection of a torque curve is determined by switch inputs. In most applications, one torque curve is used for "normal" operation. Several other derated torque curves will be used to protect vehicle axles, hitches, and transmissions under certain operating conditions.



A–Normal Power Curve
B–Derated Power Curve
LI–Low (slow) Idle
Nr–Normal Rated
FI–Fast Idle

Torque Curves

ENGINE CONTROL UNIT (ECU) SELF-DIAGNOSIS

The Engine Control Unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any of the sensor input voltages are too high or too low, if the camshaft and crankshaft position sensor inputs are valid, and if the unit injector solenoids are responding properly. If the ECU detects a problem with the electronic control system a Diagnostic Fault Code (DFC) specific to the failed system will be stored in the ECU's memory.

There are two types of DFCs:

— Active

— Inactive

Active DFCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures.

Inactive DFCs indicate that a failure has occurred in the past, but is not currently occurring. This type of DFC can be caused by an "intermittent" failure. These could be problems such as a bad connection or a wire intermittently shorting to ground.

If a sensor or wiring fails and a DFC is active for that sensor, the ECU will use a substitute "limp home" value in it's calculations to continue engine operation.

NOTE: If the Diagnostic Scan Tool (DST) is used to read a sensor voltage and calculated value, and there is a current DFC for that sensor, the calculated value for that sensor will be the "limp home" value and the voltage will be the actual sensor voltage. Use the voltage during diagnostics unless otherwise directed by a diagnostic chart.

DIAGNOSING ENGINE MALFUNCTIONS

Symptom	Problem	Solution
Engine Will Not Crank	Weak battery	Replace battery.
	Corroded or loose battery connections	Clean battery terminals and connections.
	Defective main switch or start safety switch	Repair switch as required.
	Starter solenoid defective	Replace solenoid.
	Starter defective	Replace starter.
Hard to Start or Will Not Start	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Slow cranking speed	Check for problem in the charging/starting system.
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic Control System problem or basic engine problem	See Diagnostic Chart B2 - ENGINE CRANKS/NO START OR STARTS HARD in Group 115.
Engine Misfiring or Runs Irregularly	Electronic Control System problem or basic engine problem	See Diagnostic Chart B4 - ENGINE MISFIRES/ RUNS IRREGULARLY in Group 115.
Lack of Engine Power	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Improper crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic Control System problem or basic engine problem	See Diagnostic Chart B5 - LOW POWER/ EXCESSIVE BLACK SMOKE in Group 115.

DIAGNOSING ENGINE MALFUNCTIONS—CONTINUED

Symptom	Problem	Solution
Black or Gray Exhaust Smoke	Engine overloaded	Reduce engine load.
	Engine burning oil	See DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS, later in this group.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Defective muffler/exhaust piping (causing back pressure)	Replace muffler or defective piping.
	Electronic Control System problem or basic engine problem	See Diagnostic Chart B5 - LOW POWER/ EXCESSIVE BLACK SMOKE in Group 115.
White Exhaust Smoke	Engine compression too low	Determine cause of low compression and repair as required.
	Defective thermostat(s) (does not close)	Test thermostats; replace thermostats as required. [See Group 25 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Coolant entering combustion chamber (failed cylinder head gasket or cracked cylinder head)	See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).
	Failed water-to-air aftercooler— if equipped	Remove and inspect water-to-air aftercooler. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
Engine Idles Poorly	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Air leak on suction side of air intake system	Check hose and pipe connections for tightness; repair as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Electronic control system problem or basic engine problem	See Diagnostic Chart B4 - ENGINE MISFIRES/ RUNS IRREGULARLY in Group 115.

DIAGNOSING ENGINE MALFUNCTIONS—CONTINUED

Symptom	Problem	Solution
Excessive Fuel Consumption	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Compression too low	Determine cause of low compression and repair as required.
	Leaks in fuel supply system	Locate source of leak and repair as required.
Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. [See Groups 10 and 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Excessive crankshaft end play	Check crankshaft end play. [See Group 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. [See Group 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Scored pistons	Inspect pistons. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Worn timing gears or excess back lash	Check timing gear back lash. [See Group 16 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Excessive valve clearance	Check and adjust valve clearance. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING ENGINE MALFUNCTIONS—CONTINUED

Symptom	Problem	Solution
Abnormal Engine Noise	Worn camshaft	Inspect camshaft. [See Group 16 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Insufficient engine lubrication	See DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS, later in this group.
	Turbocharger noise	See DIAGNOSING AIR INTAKE MALFUNCTIONS, later in this group.

DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS

Symptom	Problem	Solution
Low Oil Pressure	Low crankcase oil level	Fill crankcase to proper oil level.
	Clogged oil cooler or filter	Remove and inspect oil cooler. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).] Replace oil filter.
	Excessive oil temperature	Remove and inspect oil cooler. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Defective oil pump	Remove and inspect oil pump. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Incorrect oil	Drain crankcase and refill with correct oil.
	Oil pressure regulating valve failure	Remove and inspect oil pressure regulating valve. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Broken piston spray jet	Replace piston spray jet. [See Groups 10 and 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Clogged oil pump screen or cracked pick-up tube	Remove oil pan and clean screen. Replace pick-up tube.
	Excessive main or connecting rod bearing clearance	Determine bearing clearance. [See Groups 10 and 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS–CONTINUED

Symptom	Problem	Solution
High Oil Pressure	Improper oil classification	Drain crankcase and refill with correct oil.
	Oil pressure regulating valve bushing loose (wanders)	Remove and inspect oil pressure regulating valve. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Improperly operating regulating valve	Remove and inspect oil pressure regulating valve. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Plugged piston spray jet	Replace piston spray jet. [See Groups 10 and 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Stuck or damaged filter bypass valve	Remove and inspect filter bypass valve. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Stuck or damaged oil cooler bypass valve	Remove and inspect oil cooler bypass valve. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS–CONTINUED

Symptom	Problem	Solution
Excessive Oil Consumption	Too low viscosity crankcase oil	Drain crankcase and refill with correct viscosity oil.
	Crankcase oil level too high	Drain oil until oil level is correct.
	External oil leak(s)	Determine source of oil leak(s) and repair as required.
	Oil control rings worn or broken	Replace piston rings. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Scored cylinder liners or pistons	Remove and inspect cylinders and liners; replace as required. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Worn valve guides or stems	Measure valve stems and valve guides; repair as required. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Excessive oil pressure	See High Oil Pressure above.
	Piston ring grooves excessively worn	Remove and inspect pistons. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Piston rings sticking in ring grooves	Remove and inspect pistons. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Insufficient piston ring tension	Remove and inspect pistons. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Piston ring gaps not staggered	Remove and inspect pistons. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Front and/or rear crankshaft oil seal faulty	Replace oil seals. [See Group 15 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
Fuel in Oil	See DIAGNOSING LOW PRESSURE FUEL SYSTEM MALFUNCTIONS later in this group.	
Coolant in Oil	See DIAGNOSING COOLING SYSTEM MALFUNCTIONS later in this group.	

DIAGNOSING COOLING SYSTEM MALFUNCTIONS

Symptom	Problem	Solution
Engine Overheats	Lack of coolant in cooling system	Fill cooling system to proper level.
	Radiator core and/or side screens dirty	Clean radiator as required.
	Engine overloaded	Reduce engine load.
	Too low crankcase oil level	Fill crankcase to proper oil level.
	Loose or defective fan belt	Replace/tighten fan belt as required.
	Defective thermostat(s)	Test thermostat opening temperature; replace thermostats as required. [See Group 25 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Damaged cylinder head gasket	Replace cylinder head gasket. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Defective water pump	Replace water pump. [See Group 25 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Defective radiator cap	Replace radiator cap as required.

DIAGNOSING COOLING SYSTEM MALFUNCTIONS–CONTINUED

Symptom	Problem	Solution
Coolant in Crankcase	Cylinder head gasket defective	Replace cylinder head gasket. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Cylinder head or block cracked	Locate crack, repair/replace components as required.
	Cylinder liner seals leaking	Remove and inspect cylinder liners. [See Group 10 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Leaking oil cooler	Pressure test oil cooler; repair/replace as required. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Defective oil cooler O-rings	Remove and inspect oil cooler O-rings; replace as required. [See Group 20 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Faulty water pump seal; weep hole plugged; coolant leaking through bearing	Replace water pump seals. [See Group 25 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Inadequate swage on injector sleeve	Replace injector sleeve. [See Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Faulty injector sleeve O-ring AND all EUI O-rings faulty	Remove suspected EUI, replace O-rings as required. [See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
Coolant Temperature Below Normal	Defective thermostat(s)	Test thermostats; replace thermostats as required. [See Group 25 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING AIR INTAKE MALFUNCTIONS

If turbocharger requires replacement, determine what caused the failure of the defective unit, and correct the condition. This will prevent an immediate repeat failure of the replacement unit.

Symptom	Problem	Solution
Hard to Start or Will Not Start	See DIAGNOSING ENGINE MALFUNCTIONS earlier in this group.	
Engine Misfiring or Runs Irregularly	See DIAGNOSING ENGINE MALFUNCTIONS earlier in this group.	
Black or Grey Exhaust Smoke	See DIAGNOSING ENGINE MALFUNCTIONS earlier in this group.	
Lack of Engine Power	See DIAGNOSING ENGINE MALFUNCTIONS earlier in this group.	
Turbocharger "Screams"	Air leak in intake manifold.	Check intake manifold gasket and manifold; repair as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
Turbocharger Noise or Vibration		
NOTE: Do not confuse the whine heard during run down with noise which indicates a bearing failure.		
	Bearings not lubricated (insufficient oil pressure)	Determine cause of lack of lubrication; repair as required.
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Improper clearance between turbine wheel and turbine housing	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Broken blades (or other wheel failures)	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING AIR INTAKE MALFUNCTIONS–CONTINUED

Symptom	Problem	Solution
Oil on Turbocharger Compressor Wheel or in Compressor Housing (Oil Being Pushed or Pulled Through Center Housing)	Excessive crankcase pressure.	Determine cause of excessive crankcase pressure; repair as required.
	Air intake restriction	Determine cause of intake restriction; repair as required.
	Drain tube restriction	Determine cause of drain tube restriction; repair as required.
Oil in Intake Manifold or Dripping From Turbocharger Housing	Excessive crankcase pressure	Determine cause of excessive crankcase pressure; repair as required.
	Air intake restriction	Determine cause of intake restriction; repair as required.
	Drain tube restriction	Determine cause of drain tube restriction; repair as required.
	Damaged or worn journal bearings	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Unbalance of rotating assembly	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Damage to turbine or compressor wheel or blade	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Dirt or carbon build-up on wheel or blade	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Bearing wear	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Oil starvation or insufficient lubrication	Determine cause of lack of lubrication; repair as required.
	Shaft seals worn	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING AIR INTAKE MALFUNCTIONS–CONTINUED

Symptom	Problem	Solution
Turbocharger Turbine Wheel Drag	Carbon build-up behind turbine wheel caused by coked oil or combustion deposits	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Dirt build-up behind compressor wheel caused by air intake leaks	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Bearing seizure or dirty, worn bearings	Inspect turbocharger; repair/replace as required. [See Group 30 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

DIAGNOSING LOW PRESSURE FUEL SYSTEM MALFUNCTIONS

Symptom	Problem	Solution
Fuel in Oil	Cracked or worn Electronic Unit Injector (EUI) O-ring	Remove suspected EUI, replace EUI O-ring as required. [See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Cracked cylinder head	Locate crack, repair / replace components as required.
Fuel Aeration	EUI hold-down clamp loose	Tighten hold-down clamp cap screw to proper torque. [See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
	Cracked or worn Electronic Unit Injector (EUI) O-ring	Remove suspected EUI, replace EUI O-ring as required. [See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100).]
Fuel Pressure Low	Plugged primary and final fuel filters	Replace fuel filters.
	Restricted fuel line	Locate restriction, repair as required.
	Faulty fuel transfer pump	Remove fuel transfer pump, repair/ replace pump as required. [See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100).]

CHECK ENGINE OIL PRESSURE

1. Remove pipe plug from main oil galley using JDG782 Oil Galley Plug Tool.
2. Attach pressure gauge to oil galley.

IMPORTANT: To achieve an accurate oil pressure reading, warm engine oil to 105°C (220°F).

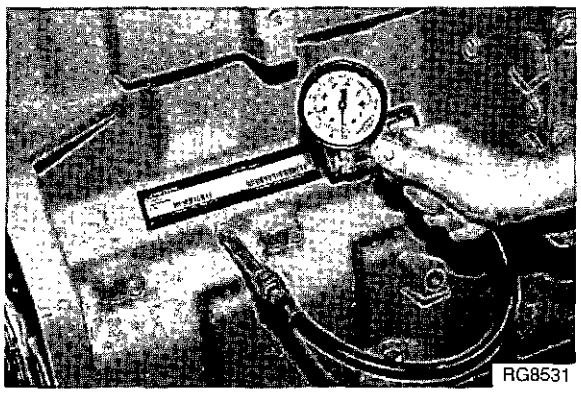
3. Start engine, run at speeds given below, measure oil pressure, and compare readings.

OIL PRESSURE SPECIFICATIONS

Minimum No Load
(Idle) . . . . . 100 kPa (1.0 bar) (15 psi)

Maximum Full Load
(Rated Speed) . . . . . 450 kPa (4.5 bar) (65 psi)

NOTE: The oil pressure regulating valve is designed so that adjustment of oil pressure should not be required.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Oil Pressure Gauge

INSPECT THERMOSTAT AND TEST OPENING TEMPERATURE

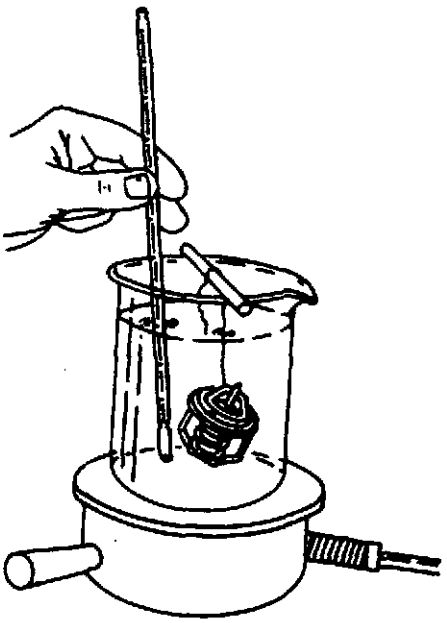
Visually inspect thermostat for corrosion or damage. Replace as necessary.

- Test thermostat as follows:

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

1. Remove thermostats. (See REMOVE THERMOSTATS in Group 25 of CTM100.)
2. Suspend thermostat and a thermometer in a container of water.
3. Stir the water as it heats. Observe opening action of thermometer and compare temperatures with specification given in chart below.

NOTE: Due to varying tolerances of different suppliers, initial opening and full open temperatures may vary slightly from specified temperatures.



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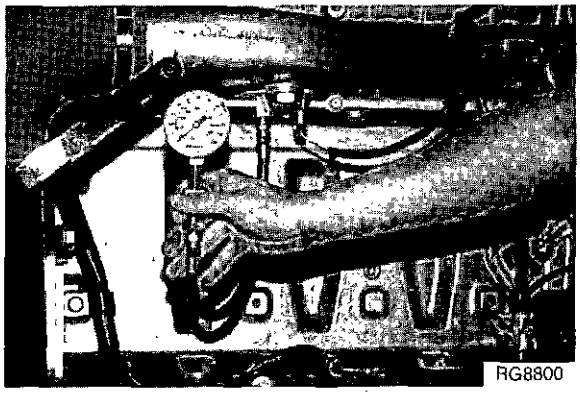
Testing Thermostat Opening Temperature

THERMOSTAT TEST SPECIFICATIONS

Rating	Initial Opening (Range)	Full Open (Nominal)
71°C (160°F)	69–72°C (156–162°F)	84°C (182°F)
77°C (170°F)	74–78°C (166–172°F)	89°C (192°F)
82°C (180°F)	80–84°C (175–182°F)	94°C (202°F)
89°C (192°F)	86–90°C (187–194°F)	101°C (214°F)
90°C (195°F)	89–93°C (192–199°F)	103°C (218°F)
92°C (197°F)	89–93°C (193–200°F)	105°C (221°F)
96°C (205°F)	94–97°C (201–207°F)	100°C (213°F)
99°C (210°F)	96–100°C (205–212°F)	111°C (232°F)

4. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.
5. If any thermostat is defective on a multiple thermostat engine, replace all thermostats.

CHECK INTAKE MANIFOLD PRESSURE (TURBO BOOST)



Measuring Intake Manifold Pressure (Turbo Boost)

The preferred method of measuring intake manifold pressure (turbo boost) is to use the Diagnostic Scan Tool (DST) and read the Manifold Air Pressure (MAP) parameter when engine is developing rated power at full load rated speed. If the DST is not available, use the procedure below to manually test intake manifold pressure.

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1. Remove ether starting aid assembly adapter or plug from intake manifold cover, as equipped. Connect pressure gauge to intake manifold using JT05412 Universal Pressure Test Kit. Be sure all connections are tight.

2. Before checking boost pressure, warm up engine to allow the lubricating oil to reach operating temperature.

IMPORTANT: Engine speed and load should be stabilized before taking a gauge reading. Be sure that gauge works properly and familiarize yourself with the use of the gauge.

3. Observe pressure reading on gauge. Compare reading to the specification below when engine is developing rated power at full load rated speed.

- If boost pressure is too low, check for the following:
  - — Restricted air filter elements.
  - — Incorrect fast idle adjustment.
  - — Exhaust manifold leaks.
  - — Intake manifold leaks.
  - — Low compression pressure.
  - — Carbon build-up in turbocharger.
  - — Turbocharger compressor or turbine wheel rubbing housing.
  - — Restricted exhaust.

4. After completing test, remove test equipment and reinstall plug. Tighten securely.

NOTE: See Group 199 SPECIFICATIONS for Intake Manifold Pressure (Turbocharger Boost) specifications.

CHECK FUEL SUPPLY PRESSURE

1. Disconnect final filter-to-fuel manifold fuel line at the final filter.

IMPORTANT: Before disconnecting any fuel line, completely clean any debris from around the fitting. Do not allow debris to enter the fuel line.

If a fuel line is going to be left disconnected any longer than it takes to install the test fitting, cap line with JDG998 Fuel System Cap Plug Kit to ensure that debris does not enter the fuel system.

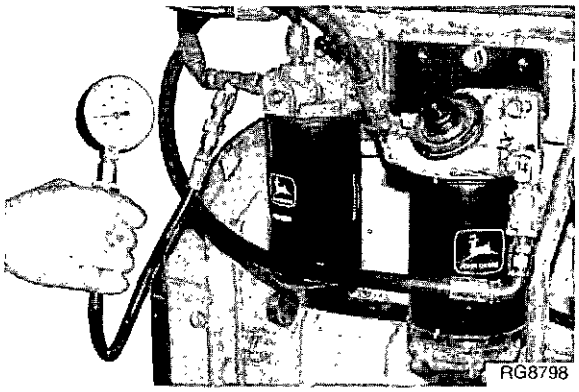
2. Install Pressure Test Fitting from JT03513 Fuel Supply System Test Kit and pressure gauge as shown. Torque fitting connections to 24 N·m (18 lb-ft).

3. Start/crank engine. Fuel transfer pump should maintain minimum pressure shown in specification at right. If pressure is low, check strainer (in fuel line before primary filter) replace if necessary; replace primary and final filter elements and recheck pressure.

4. If pressure is still low, look for a possible restriction in one of the fuel lines; check pressure regulator. Make sure the gauge/hose assembly is not at fault. If none of the above problems are found, repair/replace fuel transfer pump.

IMPORTANT: Before connecting ORFS fuel line fittings, be sure O-ring is correctly positioned in the groove of fitting. Tighten fitting ONLY to specified torque. DO NOT OVERTIGHTEN.

5. After completing test, remove test equipment and reinstall fuel line. Torque fuel line connections to 25 N·m (18 lb-ft).



Measuring Fuel Pressure

FUEL TRANSFER PUMP PRESSURE SPECIFICATIONS

Normal (Idle)	410–480 kPa (4.1–4.8 bar) (60–70 psi)
Cranking (Minimum 200 RPM)	70–170 kPa (0.7–1.7 bar) (15–25 psi)

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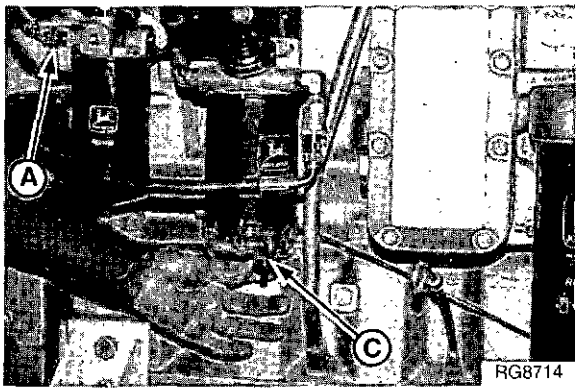
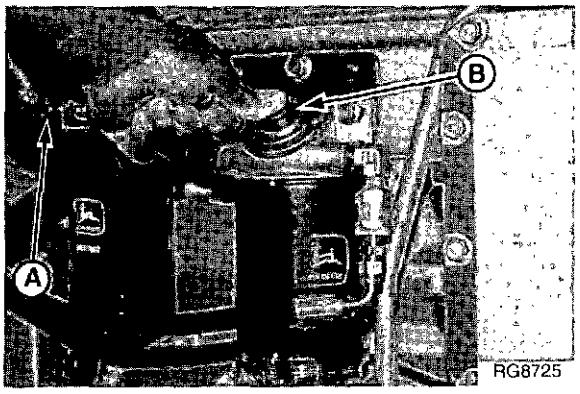
BLEED THE FUEL SYSTEM

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

1. Drain water and contaminants from clear water separator sediment bowl (C).
2. Loosen secondary (final) fuel outlet line (A).
3. Pump hand primer (B) on primary filter until a steady flow of fuel (without bubbles) comes out of connection.
4. Continue pumping hand primer and simultaneously tighten outlet line connection to 24 N·m (18 lb-ft). DO NOT overtighten.
5. Start engine and run at high idle for 3–5 minutes.



Draining Sediment Bowl



Primary Filter Hand Primer

ABOUT THIS SECTION OF THE MANUAL

This section of the manual contains necessary information to diagnose the electronic control system. Use this information in conjunction with the 6105 and 6125 DIESEL ENGINES REPAIR (CTM100).

See the 6105 and 6125 ENGINE REPAIR manual for:

- Removal of components
- Repair procedures
- Disassembly
- Inspection
- Assembly

Parts such as sensors, actuators, connectors, and wiring harnesses are serviceable and available.

To help diagnose electronic control system problems, Group 199 SPECIFICATIONS contains useful information, such as ECU terminal identification, system wiring schematic, and component location.

IMPORTANT: Not under any circumstances, should the Engine Control Unit (ECU) be opened.

NOTE: Instruction is given throughout the diagnostic charts to make resistance and voltage measurements in the ECU/Cab connector and the ECU/Engine connector. Note that these measurements are always made in the harness end of the connector. Measurements should never be made in the ECU end of the connection.

ELECTRICAL CONCEPTS

Tests will include making measurements of voltage and resistance and making checks for open circuits and short circuits. An understanding of the following concepts is required to use the diagnostic procedures:

- Voltage (volts)
- Current (amps)
- Resistance (ohms)
- Open Circuit
- Short Circuit

USING A DIGITAL MULTIMETER

It is recommended that a digital multimeter (JT05791 or equivalent with an analog display) be used to make the required measurements in the diagnostic procedures. A knowledge of the operation of the particular meter used is assumed.

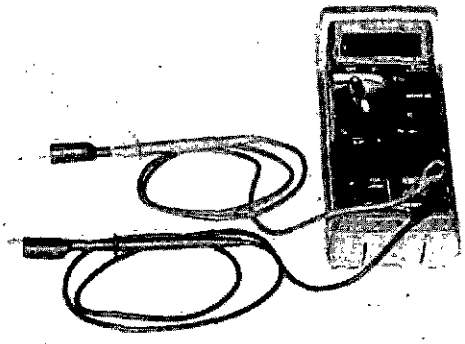
Instructions for measuring voltages take the following form:

Measure voltage from Point A (+) to Point (B) (-)

In this example, the positive test lead from the volt-ohm input of the meter should be connected to Point A and the negative test lead from the common input of the meter should be connected to Point B.

Unless otherwise stated, all voltage measurements are direct current (D.C.).

In making a resistance measurement, be careful to use the correct resistance range on the meter. Disconnect appropriate connectors or turn off key switch, as directed by diagnostic procedures later in this group.



RW11274

Digital Multimeter

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- **Operation Of JT05791 Digital Multimeter**

Digital Display—The digital display reads values of variables measured. It is updated 2-1/2 times a second. In normal operation the meter selects the range which will show the most accurate reading. When the value being measured is too large for the meter to display, an "OL" (overload) will be shown. Position of decimal point will change, depending upon range in use. The display also verifies the type and size of measurement being made.

Analog Display—This is a bar graph located below the digital display. The analog display is updated 25 times per second. It is more responsive to help see trends developing in variable readings. The polarity indicator is also part of this display. The full bar graph indicates the maximum reading for a scale. The arrowhead indicates OL.

Selector—The selector is the rotary switch which allows the operator to select the type of variable to be measured. For amperage readings, the red (+) contact must also be moved to the desired terminal.

Diode Test—The "diode test" position can be used to test diodes. A single tone will sound in the forward bias direction along with a display of forward voltage drop. The meter also can be used to test continuity. If the circuit is open, there will be no tone. if the circuit made has continuity (less than 150 ohms) a continuous tone will sound.

Autoranging—The meter powers up in the autorange mode. Range is selected automatically. The digital display indicates the range.

Manual Ranging—When the violet button in the middle of the selector knob is pressed with the meter on, the range is selected manually. You can "dial" through ranges by repeatedly depressing the button. As in the autorange mode, range in use will be shown in the digital display. To return to autorange mode, press range button for 1 second. Meter will "chirp" once and return to autorange mode.

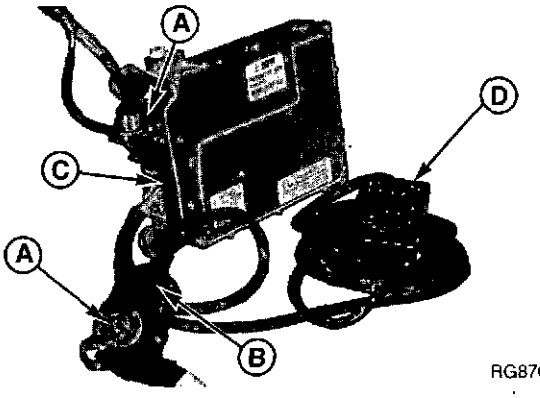
Touch Hold—If the violet button in the selector us depressed and held down while the meter is being turned on, and held until the display reaches full brightness the meter is in the "touch hold" mode. In touch hold, any reading which is constant for a minimum of 1/2 second and differs from the previous reading by at least one bar of the analog display will be "captured" by the meter. A tone (beep) will sound when the reading has been held. The operator can then remove the probes and the reading will be retained. Touch hold is always in autorange mode. Turn the selector switch to "OFF" to deactivate touch hold.

USING THE BREAK-OUT-BOX (BOB)

IMPORTANT: Make sure that probes are inserted into the BOB sockets that the diagnostic procedures instruct or engine control system circuitry may be damaged. Never install jumper wires between BOB sockets.

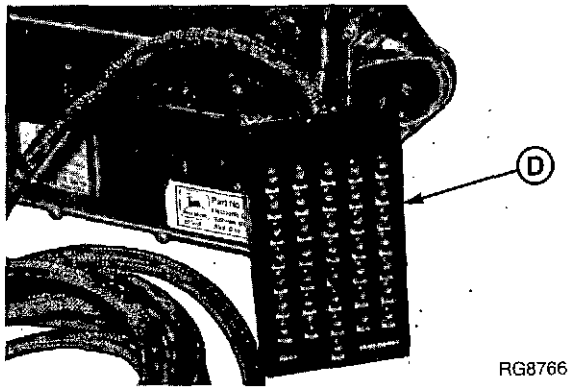
The diagnostic procedures on the following pages are written such that diagnosis can be made using the Diagnostic Scan Tool (DST) or JT02171 10.5/12.5 L Engine Control Unit Break-Out-Box. To use the Break-Out-Box (BOB), first determine using the wiring schematic on the left-hand page of the diagnostic procedure if the BOB will be connected to the ECU/Engine connector (inside of connector is black) or the ECU/Cab connector (inside of the connector is red). With the ignition OFF, disconnect the appropriate ECU connector (A), connect the male end of the BOB connector to the wiring harness (B); connect the female end of the BOB connector to the ECU (C). The BOB is now teed into the ECU wiring. The numbers on the face of the BOB (D) correspond to the individual ECU connector terminals. The diagnostic procedures will instruct voltage measurements be made from certain positive (+) BOB sockets to certain negative (-) BOB sockets.

NOTE: If resistance measurements are made at the BOB, disconnect the BOB from the ECU or faulty readings may result.



RG8765

ECU Connected to BOB



RG8766

Break-Out-Box Display

ELECTRICAL CIRCUIT MALFUNCTIONS

- **MALFUNCTIONS**

1. There are only four circuit malfunctions:

   — High-Resistance Circuit
   — Open Circuit
   — Grounded Circuit
   — Shorted Circuit

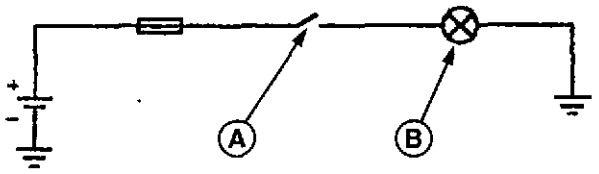
2. There are only three sections in a simple circuit where these malfunctions can occur:

   — Before the controlling switch (A)
   — Between the controlling switch (A) and the load (B)
   — After load (B)

Component malfunctions can easily be confused with circuit malfunctions. Therefore, care must be exercised when isolating the cause of the problem.

Example: A component may not operate before disconnecting an electrical connection, but it operates after reconnecting the connector.

Reason: High resistance created a voltage drop at the connector terminals which prevented the proper amount of current from flowing to the component.



RW45155

Simple Circuit

HIGH RESISTANCE OR OPEN CIRCUIT

A High Resistance Circuit can result in slow, dim, or no component operation.

Examples: Loose, corroded, dirty or oily terminals. Wire size too small. Strands broken inside the wire.

An Open Circuit results in no component operation because the circuit is incomplete.

Examples: Broken wire, terminals disconnected, and open protective device on switch.

To isolate the location of a "high resistance" or "open circuit":

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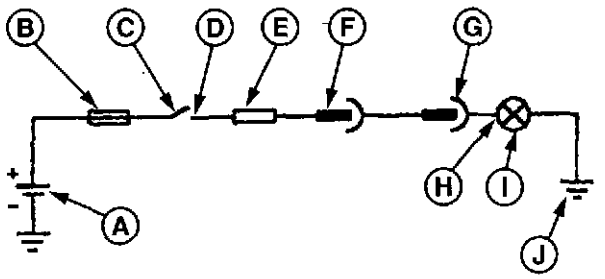
1. With the controlling switch (C) ON and the load (I) connected into the circuit, check for proper voltage at a location easily accessible between (D) and (H).

If voltage is low, move toward voltage source (A) to locate point of voltage drop.

NOTE: The illustration shows high resistance between (D) and (F) and open circuit between (F) and (G).

If voltage is correct, move toward load (I) and ground terminal (J) to locate voltage drop.

2. Repair circuit as required.
3. Repeat check-out procedure after repair.



RW45156

High Resistance Circuit

A—Battery
B—Fuse
C—Switch
D—Component Terminal
E—Circuit Resistance
F—Circuit Connector
G—Circuit Connector
H—Component Terminal
I—Lamp
J—Ground

GROUNDED CIRCUIT

A grounded circuit results in no component operation and the fuse or circuit breaker open.

Example: Power wire contacting ground.

To isolate the location of a grounded circuit:

1. With controlling switch (D) OFF, check for continuity to ground between (C) and (D).

If there is continuity, there is a grounded circuit between (C) and (D). Repair circuit.

If no continuity, go to Step 2.

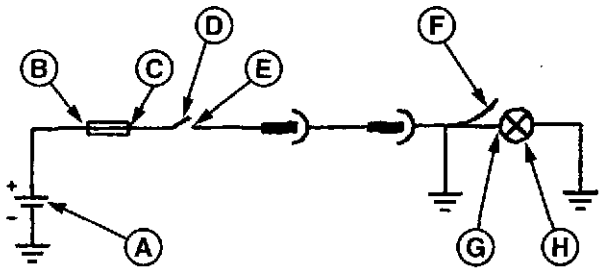
2. Disconnect load (H) at (G).

3. With controlling switch (D) OFF, check continuity to ground between (D) and (F).

If there is continuity, there is a grounded circuit between (E) and (F). Repair circuit.

NOTE: The illustration is grounded between (E) and (F).

4. Repeat check-out procedure after repair.



RW45157

Grounded Circuit

A—Battery
B—Fuse Terminal
C—Fuse Terminal
D—Switch
E—Component Terminal
F—Grounded Circuit
G—Component Terminal
H—Lamp

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SHORTED CIRCUIT

A shorted circuit usually results in two components operating when one of two switches is turned on.

Example: Improper wire-to-wire contact.

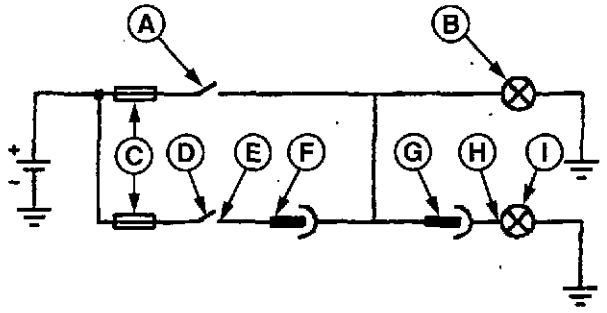
Components can also become shorted. However, shorted components will usually open the circuit protection device.

To isolate the location of a shorted circuit:

1. Turn switch (A) ON for correct lamp (B) to operate.
2. Start at controlling switch (D) of lamp (I) that should not be operating and disconnect the wire at terminal (E).
3. Follow circuit and disconnect wire at connectors (F), (G), or (H) until the extra lamp (I) stops operating.
4. The short or improper connection will be between the last two locations where the wire was disconnected.

NOTE: In illustration, it is between (F) and (G).

5. Repair circuit as follows:
   - — Wires not in a loom: Wrap individual wire with electrical tape or replace the damaged wire and band as required.
   - — Wires in a loom: If hot spots exist in shorted area of harness, replace harness. If hot spots are not noticeable, install a new wire of proper gauge between the last two connections. Band wire to outside of harness.
6. Repeat check-out procedure after repair.



RW45158

Shorted Circuit

A—Switch
B—Lamp
C—Fuse
D—Switch
E—Component Terminal
F—Circuit Connector
G—Circuit Connector
H—Component Terminal
I—Lamp

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DATA PARAMETER DESCRIPTION

Following is a list of the data parameters that can be read on the Diagnostic Scan Tool (DST). The DST consists of a Windows (3.X or '95) compatible computer, JDIS121 - 10.5/12.5 ECU Communication Hardware Kit, and JDIS122 - 10.5/12.5 ECU Communication Software Kit, available from John Deere. Included in the list below is a brief description of each parameter, the range of possible readings, and each parameter's unit of measurement.

Parameter	Range	Units	Description
PWM % Throttle	0–100	%	Optional component, not included on all applications.The position of the PWM throttle expressed as a percentage. Low idle should read 0%, wide open throttle should read 100%.
Analog % Throttle	0–100	%	Optional component, not included on all applications. The position of the analog throttle expressed as a percentage. Low idle should read 0%, wide open throttle should read 100%.
Analog Throttle Volts	0–5	volts	Optional component, not included on all applications. The voltage from the analog throttle position sensor (potentiometer).
Throttle Type	PWM or Analog	N/A*	If the application uses an analog throttle and a PWM throttle, this will display the type of throttle the ECU is using as an input to govern the engine. The PWM throttle is the primary throttle and will be used if there are no faults associated with it. If the application only uses a PWM throttle, PWM will always be displayed.
Engine Speed	0–6000	rpm	The engine speed measured by the crankshaft position sensor.
% Of Max Allowed Fuel	0–100	%	The amount of fuel the ECU is requesting, expressed as a percent of maximum fuel allowed at a given engine speed; representative of engine load.

** N/A = Not Applicable*

DATA PARAMETER DESCRIPTION—CONTINUED

Parameter	Range	Units	Description
Boost Pressure (MAP)	0–400 (0–58)	kPa (psi)	Manifold Air Pressure value (boost pressure). *NOTE: If there is an active fault for the MAP circuit, the MAP value displayed will be the "limp-home" value.*
MAP Volts	0–5	volts	Manifold Air Pressure sensor input voltage to the ECU.
Intake Air Temperature (MAT)	-184–+149 (-300–+300)	°C (°F)	Manifold Air Temperature value. *NOTE: If there is an active fault for the MAT circuit, the MAT value displayed will be the "limp-home" value.*
MAT Sensor Volts	0–5	volts	Manifold Air Temperature sensor input voltage to the ECU.
Engine Coolant Temperature (ECT)	-184–+149 (-300–+300)	°C (°F)	Engine Coolant Temperature value. *NOTE: If there is an active fault for the ECT circuit, the ECT value displayed will be the "limp-home" value.*
ECT Sensor Volts	0–5	volts	Engine Coolant Temperature sensor input voltage to the ECU.
Fuel Pressure	Low or Normal	N/A*	On some applications, the ECU monitors fuel pressure using a pressure switch. This parameter displays normal when fuel pressure is greater than 296 kPa (43 psi); low when fuel pressure is less than 296 kPa (43 psi).
Fuel Temperature	-184–+149 (-300–+300)	°C (°F)	Fuel temperature value. *NOTE: If there is an active fault for the fuel temperature circuit, the fuel temperature value displayed will be the "limp-home" value.*

** N/A = Not Applicable*

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DATA PARAMETER DESCRIPTION—CONTINUED

Parameter	Range	Units	Description
Fuel Temperature Sensor Volts	0–5	volts	Fuel Temperature sensor input voltage to the ECU.
Governor Type	Normal or Isochronous	N/A*	On some applications, the ECU will govern the engine in either normal droop (standard operation) or isochronous (0% droop; field cruise) mode. This displays the ECU governor mode.
Pilot Injection	ON or OFF or N/A	N/A*	On some applications, a pilot injection feature aids engine starting. On applications with the pilot injection feature, this parameter displays ON when pilot injection is on; OFF when pilot injection is off. On applications that don't have pilot injection, this parameter will read N/A.
Torque Curve Number	1–8	N/A*	On some applications, the ECU limits the max fuel on multiple torque curves. This displays the torque curve the ECU is currently using to limit maximum fuel. Definition of the possible torque curves is found in Group 199 Specifications.
Fuel Used	N/A*	L (gal)	Total amount of fuel the ECU has commanded the EUIs to deliver during the total hours shown by the Engine Hour Meter parameter.
Engine Hour Meter	N/A*	hr -min- sec	Total hours the ECU has run on an engine.

** N/A = Not Applicable*

DIAGNOSTIC SCAN TOOL (DST) ENGINE TEST INSTRUCTIONS—CYLINDER MISFIRE TEST

The Diagnostic Scan Tool (DST) consists of a Windows (3.X or '95) compatible computer, JDIS121 - 10.5/12.5 ECU Communication Hardware Kit, and JDIS122 - 10.5/12.5 ECU Communication Software Kit, available from John Deere.

The Cylinder Misfire Test is used to compare the output of each cylinder relative to each of the other cylinders. The test will help identify problems such as an engine misfire or irregularly running engine. During the test, the Engine Control Unit (ECU) will disable a cylinder, then accelerate the engine with a fixed amount of fuel and measure the time taken to accelerate the engine from one speed to the next with that cylinder disabled. The ECU will then repeat the procedure for the remaining 5 cylinders.

The Cylinder Misfire Test cannot determine if an engine is delivering low power. The test results are only a guide to help determine if there is a problem in a cylinder. The results alone should not be used as a conclusive reason for replacing an Electronic Unit Injector (EUI). Other information such as the results of a Relative Compression test and other engine diagnostic procedures should be used to accurately determine the source of an engine problem.

- **Before executing the Cylinder Misfire Test**

  — Warm engine to normal operating temperature
  — Repair the cause of any Diagnostic Fault Codes (DFCs)

NOTE: The ECU will not allow the test to run if there are any active DFCs.

  — Remove any load to the engine that may change during the test. For example, turn the air conditioner off.

- **Performing the Cylinder Misfire Test**

1. Engine idling.
2. Select Cylinder Misfire Test on the DST.
3. Follow instruction given by the DST. The DST will instruct that the throttle lever be moved from low idle position to wide open throttle position, then back to low idle position 6 times.

The DST will inform the test operator if the test was not successfully completed. If the test was successfully completed, the results will be displayed on the screen.

Results shown will represent each cylinders' performance as a percentage in relation to the average of all cylinders. If any cylinder is above or below the average by more than 10%, that indicates the cylinder is contributing too much (above average) or not contributing enough (below average).

NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.

The Relative Compression Test should be performed to help determine the cause of the problem in the cylinder(s) that was above or below average.

DIAGNOSTIC SCAN TOOL (DST) ENGINE TEST INSTRUCTIONS—RELATIVE COMPRESSION TEST

The Diagnostic Scan Tool (DST) consists of a Windows (3.X or '95) compatible computer, JDIS121 - 10.5/12.5 ECU Communication Hardware Kit, and JDIS122 - 10.5/12.5 ECU Communication Software Kit, available from John Deere.

The Relative Compression Test is used to compare the compression of each cylinder to the average compression of all cylinders. The test will help determine if a cylinder has low compression compared to all other cylinders. During the test, the Engine Control Unit (ECU) will disable the engine from starting (by not pulsing the unit injectors), then measure the time it takes the piston of each cylinder to accelerate through and past TDC. A piston that accelerated faster than the rest would indicate that cylinder has lower compression than the other cylinders.

The Relative Compression Test cannot determine the true compression pressure of any cylinder, it can only compare each cylinder to the average. The test results are only a guide to help determine if a cylinder has lower compression. The results alone should not be used as a conclusive reason for performing any major engine work. Other information such as the results of the Cylinder Misfire Test and other engine diagnostic procedures should be used to accurately determine the source of an engine problem.

- **Before executing the Relative Compression Test**

  — Warm engine to normal operating temperature
  — Repair the cause of any Diagnostic Fault Codes (DFCs)

NOTE: The ECU will not allow the test to run if there are any active DFCs.

  — Ensure that the battery and starter are in good working condition

- **Performing the Relative Compression Test**

1. Engine OFF.
2. Select Relative Compression Test on the DST.
3. Follow instruction given by the DST. The DST will instruct that the engine be cranked for up to 15 seconds. Typically, it should take less than 5 seconds. The DST should be observed carefully for instructions during the test.

The DST will inform the test operator if the test was not successfully completed. If the test was successfully completed, the results will be displayed on the screen.

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Results shown will represent each cylinders' compression as a percentage in relation to the average of all cylinders. If any cylinder is more than 10% below the rest, that indicates the cylinder's compression is lower than the rest.

NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.

Further engine diagnostics should be performed to determine the cause of low compression.

After performing the test, it will be necessary to completely power-down the ECU before the engine will start. On 9000 series 4-WD tractor applications, this will involve turning the key to the "OFF" position and getting off the operator's seat. On other applications it will involve turning the key to the "OFF" position.

LISTING OF DIAGNOSTIC FAULT CODES (DFCs)

Following is a list of Diagnostic Fault Codes (DFCs) that can occur in the electronic control system.

NOTE: Not all of these codes are used in all engine applications.

Code	Description
11	Analog Throttle input voltage too high
12	Analog Throttle input voltage too low
13	Pulse-Width-Modulated (PWM) Throttle input voltage too high
14	Pulse-Width-Modulated (PWM) Throttle input voltage too low
21	Manifold Air Pressure (MAP) input voltage too high
22	Manifold Air Pressure (MAP) input voltage too low
23	Manifold Air Temperature (MAT) input voltage too high
24	Manifold Air Temperature (MAT) input voltage too low
25	Engine Coolant Temperature (ECT) input voltage too high
26	Engine Coolant Temperature (ECT) input voltage too low
27	Fuel Rail Pressure periodically low
28	Fuel Rail Pressure continuously low
31	Cylinder 1 Electronic Unit Injector (EUI) fault
32	Cylinder 2 Electronic Unit Injector (EUI) fault
33	Cylinder 3 Electronic Unit Injector (EUI) fault
34	Cylinder 4 Electronic Unit Injector (EUI) fault
35	Cylinder 5 Electronic Unit Injector (EUI) fault
36	Cylinder 6 Electronic Unit Injector (EUI) fault
37	Fuel Temperature input voltage too high
38	Fuel Temperature input voltage too low
41	Crankshaft Position input missing
42	Crankshaft Position input out of sync
43	Camshaft Position input missing

LISTING OF DIAGNOSTIC FAULT CODES (DFCS)—CONTINUED

Code	Description
44	Camshaft Position input out of sync
45	Camshaft/Crankshaft Position inputs out of sync
50	Fuel Pressure Switch fault
52	Manifold Air Pressure (MAP) input voltage erratic
53	Manifold Air Temperature (MAT) input voltage erratic
54	Engine Coolant Temperature (ECT) input voltage erratic
55	Fuel Temperature input voltage erratic
81	Engine Control Unit (ECU) error
84	Power Down error

DIAGNOSTIC PROCEDURE

Diagnosis of the electronic control system should be performed according to the following procedure:

1. Make sure all engine mechanical and other systems not related to the electronic control system are operating properly.
2. Read and record DFC(s).
3. Go to the diagnostic chart that corresponds to the DFC(s) present.

NOTE: If more than one DFC is present, go to the chart corresponding to the lowest number DFC and diagnose that problem to correction unless directed to do otherwise.

4. If no DFC(s) are present, proceed to the B1–B7 symptom diagnostic chart, later in this group, that is appropriate.
5. After any repairs are made, recheck to make sure all DFCs have been eliminated.

NOTE: After using the DST, always replace the dust cover on the diagnostic connector.

IMPORTANT: Care should be used during diagnostic procedures to avoid damaging the terminals of connectors, sensors, and actuators. Probes should not be poked into or around the terminals or damage will result. Probes should only be touched against the terminals to make measurements. It is recommended that JT07328 Connector Adapter Test Kit be used to make measurements in connectors, sensors, and actuators. These adapters will ensure that terminal damage does not occur.

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INTERMITTENT FAULT DIAGNOSTICS

Intermittent faults are problems that periodically "go away". A problem such as a loose terminal that intermittently doesn't make contact is a likely cause of an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors since a high percentage of intermittent problems originate here. Check for loose, dirty, or disconnected connectors. Inspect the wiring routing looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity looking for wires that have pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged terminals. Look for broken wires, damaged splices, and wire-to-wire shorts. Use good judgement if component replacement is thought to be required.

NOTE: The ECU is the component LEAST likely to fail.

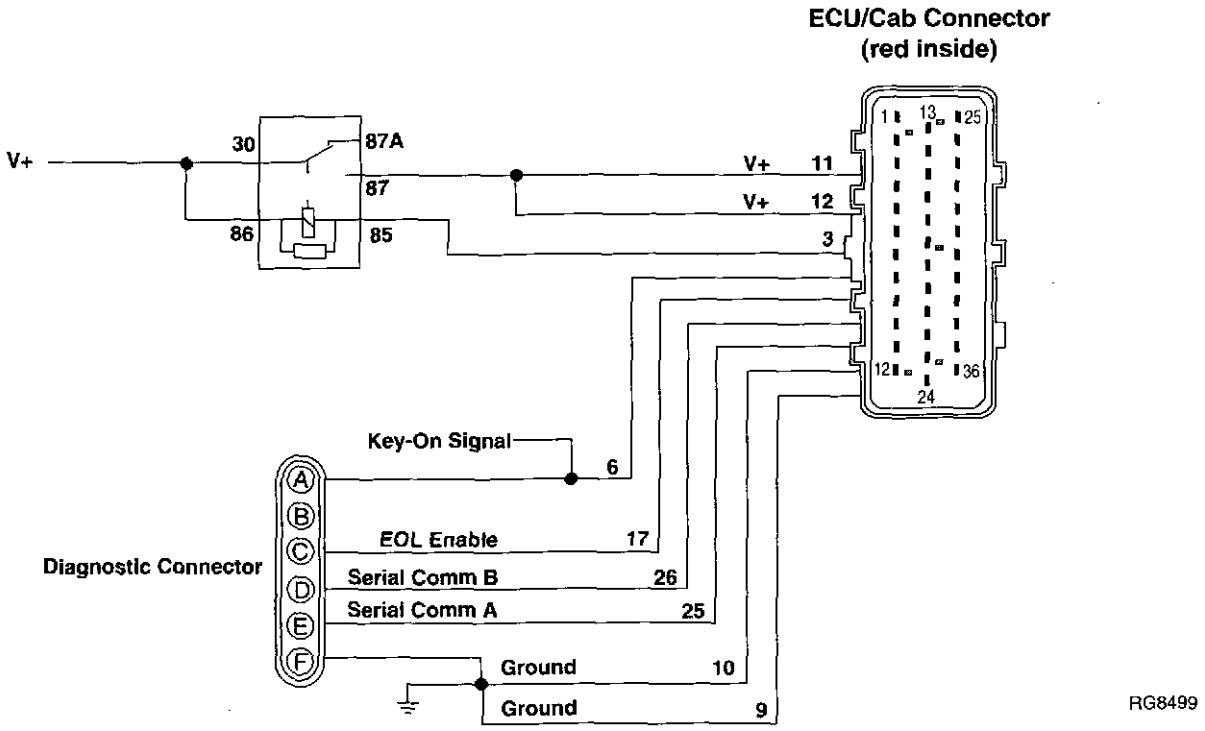
Suggestions for diagnosing intermittent faults:

- If diagnostic chart indicates that the problem is intermittent, try to reproduce the operating conditions that were present when the DFC set. The Diagnostic Scan Tool (DST) can be used to help locate intermittent problems, as it includes a function called Snap Shot. The Snap Shot function permits the recording of data parameter values during a diagnostic session. If a DFC sets during a certain diagnostic session, the parameters can be played back and observed to see what each parameters' value was when the DFC occurred.
- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DFCs, then check the connection or wire by wiggling it while watching the DST to see if the fault resets.
- To check the connection between the harness and a sensor or the harness and the ECU, use JT07328 Connector Adapter Test Kit. Insert the male end of the appropriate test adapter into the female end of the ECU or sensor connector terminal. There should be moderate resistance when the test adapter is inserted into the terminal. If the connection is loose, replace the female terminal.

Possible Causes of Intermittent Faults:

- Faulty connection between sensor or actuator and harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc. can cause faulty signals to be sent to the ECU.

B1 - ECU DOES NOT COMMUNICATE WITH DST

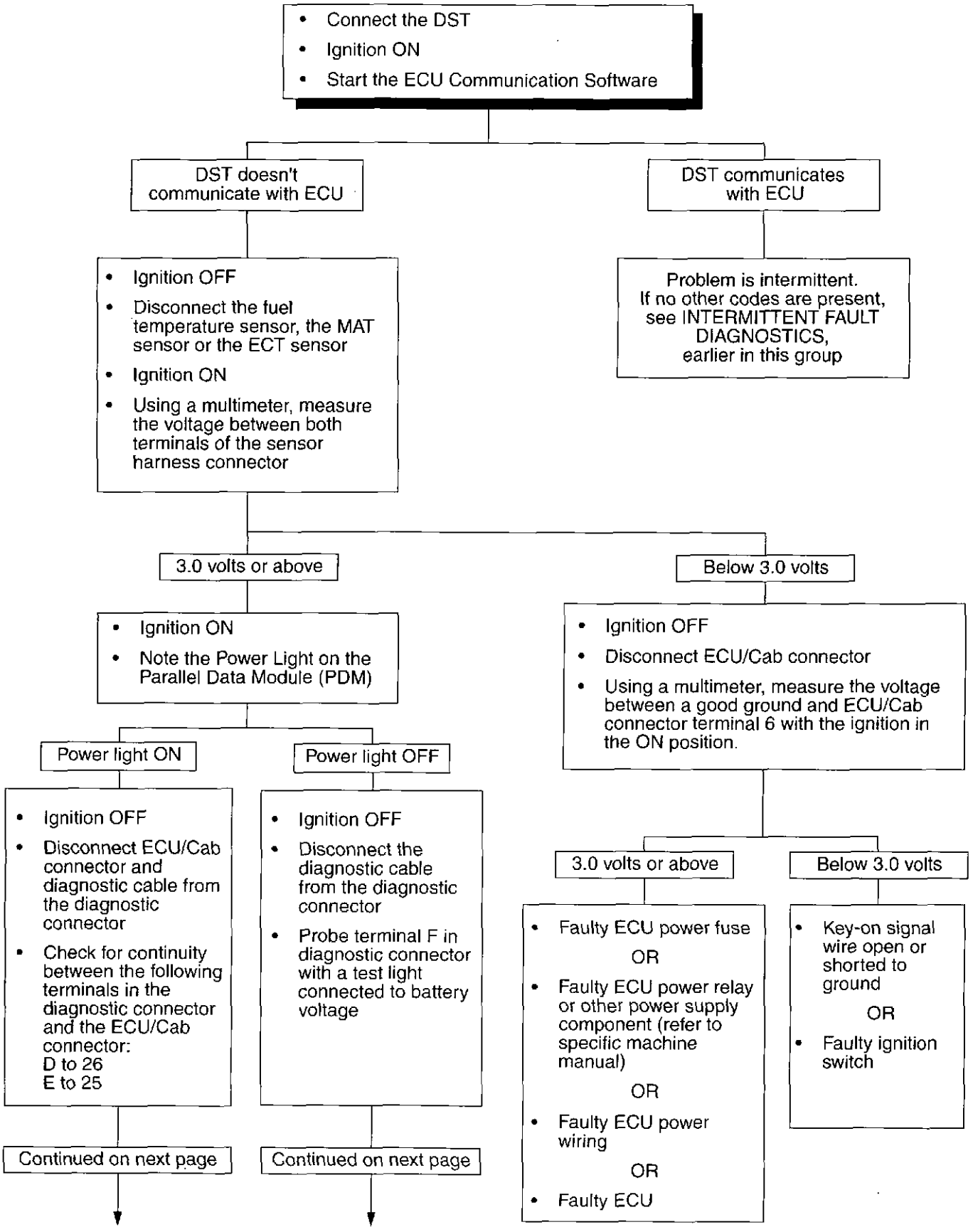


Simplified ECU Power and Communication Wiring

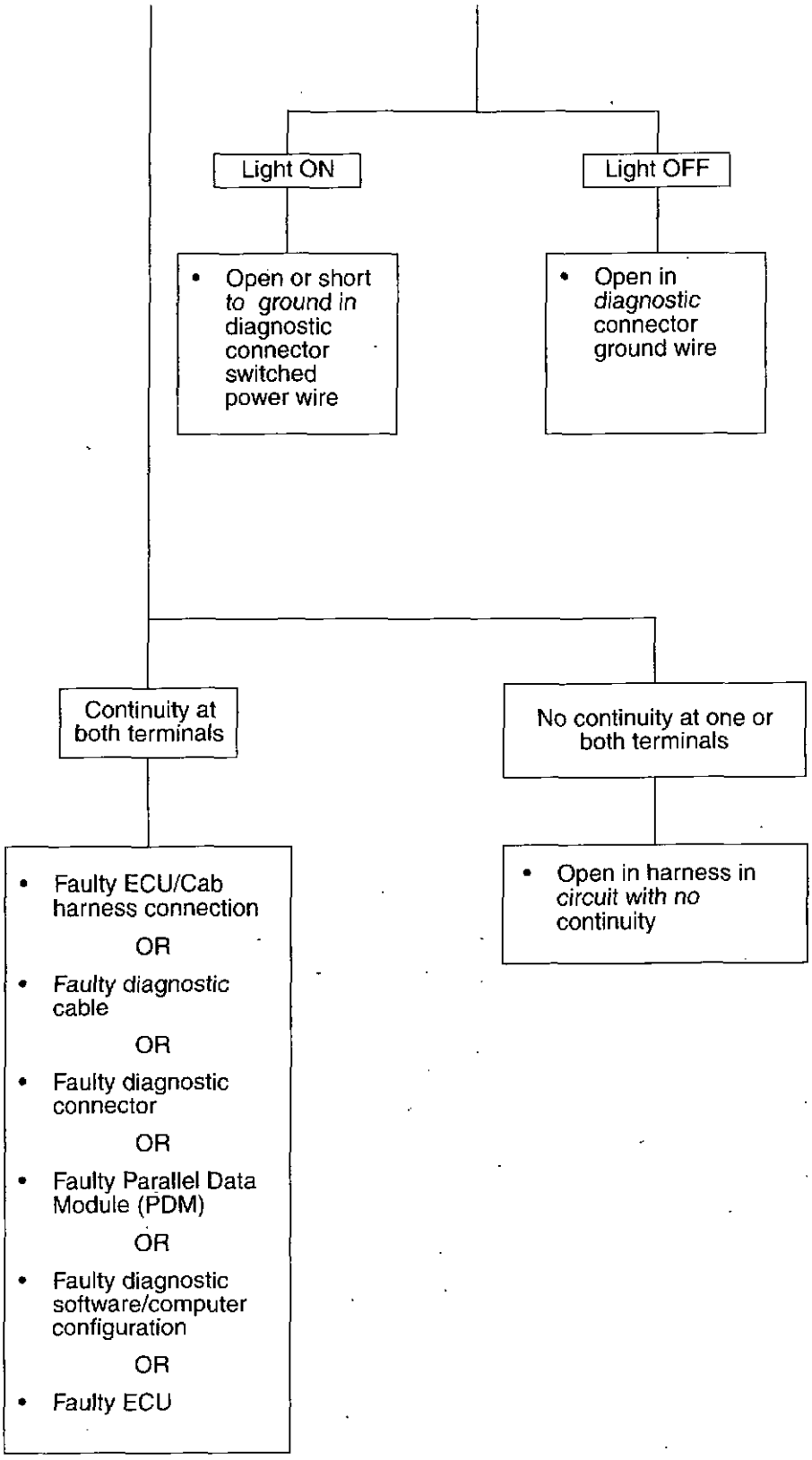
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

This diagnostic chart should be used if communication between the Diagnostic Scan Tool (DST) and the Engine Control Unit (ECU) cannot be established.

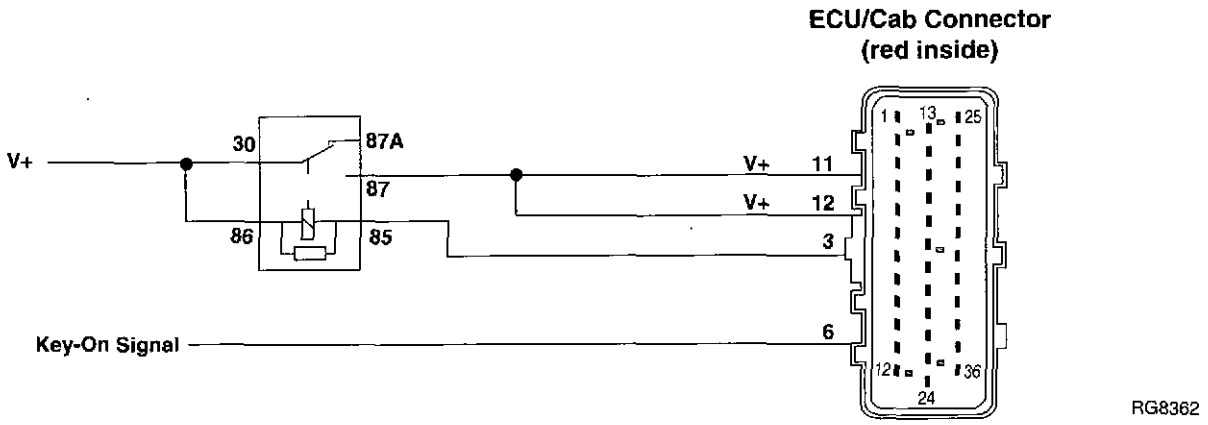
B1 - ECU DOES NOT COMMUNICATE WITH DST—CONTINUED



B1 - ECU DOES NOT COMMUNICATE WITH DST—CONTINUED



B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE)



Simplified ECU Power Wiring

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This diagnostic chart should be used if the engine cranks OK, but will not start or starts only after prolonged cranking. If the engine will not crank, determine problem in the starting/charging system. See DIAGNOSING ENGINE MALFUNCTIONS in Group 105.

B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE)—CONTINUED

NOTE: This diagnostic chart should be used along with the Diagnostic Scan Tool (DST). If the DST is not available, but JT02171 Break-Out-Box (BOB) is, use chart B3.

Before using this diagnostic chart:

- Ensure fuel quantity and quality are OK
- Ensure engine mechanical condition is OK
- Ensure engine cranking speed is OK

- Connect the DST
- Crank engine for 10 seconds
- Using the DST, check for diagnostic fault codes (DFCs)

No DFCs present

- Ignition OFF
- Operate the hand primer pump located on the primary fuel filter base until moderate resistance is felt
- Retry engine start

Engine doesn't start

- While cranking the engine, use the DST and read the Pilot Injection parameter

Pilot Injection reads ON or N/A

- Check the fuel supply system by referring to chart B7 - FUEL SUPPLY SYSTEM CHECK

Continued on next page

Pilot Injection reads OFF

- Pilot Injection should be ON if the engine coolant temperature is below 35°C (95°F). If Pilot Injection is OFF under this condition, determine problem in the Engine Coolant Temperature (ECT) sensor circuitry.

Engine starts

- If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM in Group 105 and retest.
- Inspect check valves and primary filter base flapper valve for proper operation
- Check to see that all fuel fittings are tightened to the correct torque
- Check the weep hole on the under side of the fuel transfer pump, if weep hole is wet with fuel, replace pump and retest
- Check that the hold down clamp cap screw on all EUIs is tightened to spec. See Group 35 of 6015 and 6125 Diesel Engines Repair (CTM 100)
- If torques are correct, remove EUIs and inspect seats for combustion gas leaks. See Group 35 of 6015 and 6125 Diesel Engines Repair (CTM 100)

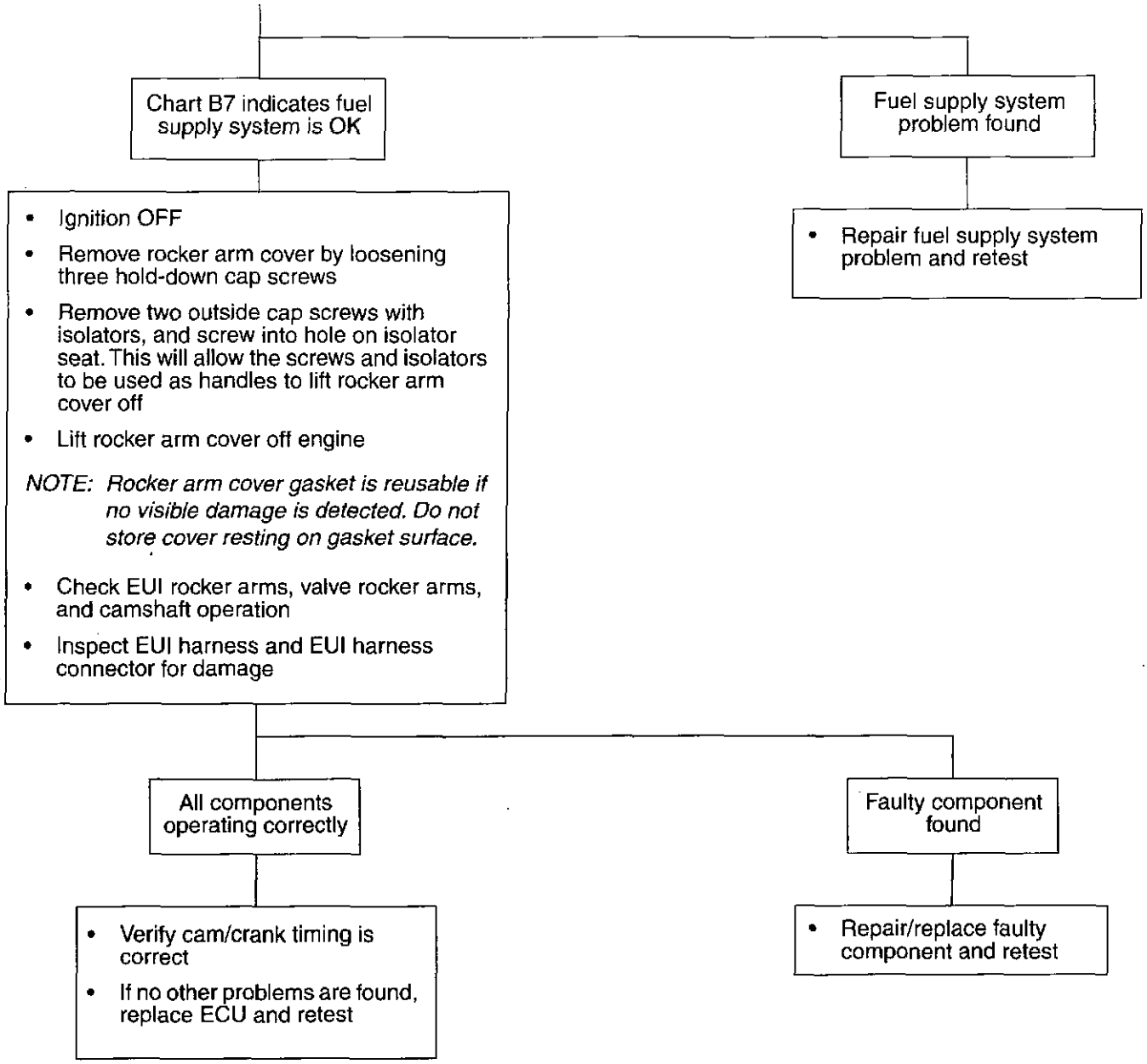
DFC(s) present

- Go to the appropriate diagnostic chart
- If more than 1 DFC is present, go to the chart corresponding to the lowest number DFC

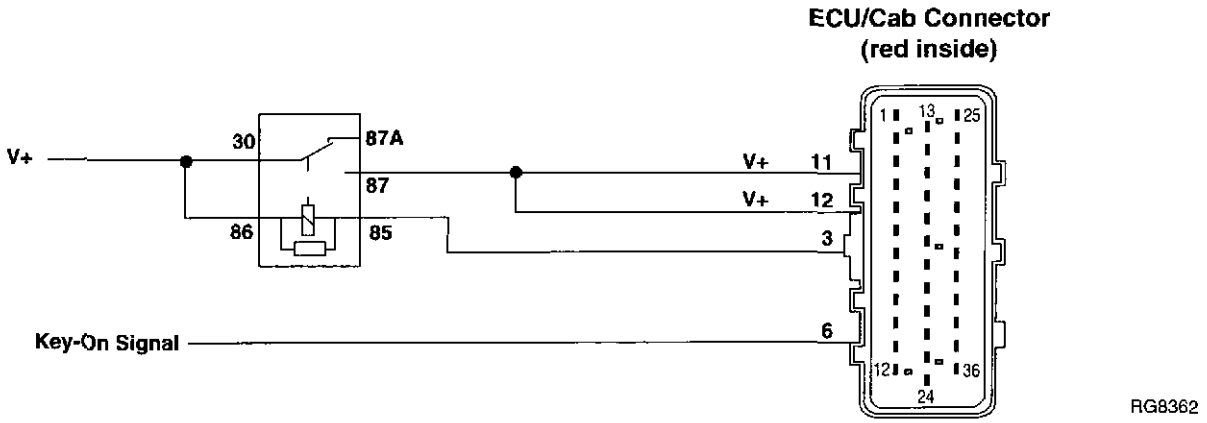
ECU will not communicate with DST

- See diagnostic chart B1-ECU DOES NOT COMMUNICATE WITH DST, earlier in this group

B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE)—CONTINUED



B3 - ENGINE CRANKS/NO START OR STARTS HARD (DST NOT AVAILABLE)



Simplified ECU Power Wiring

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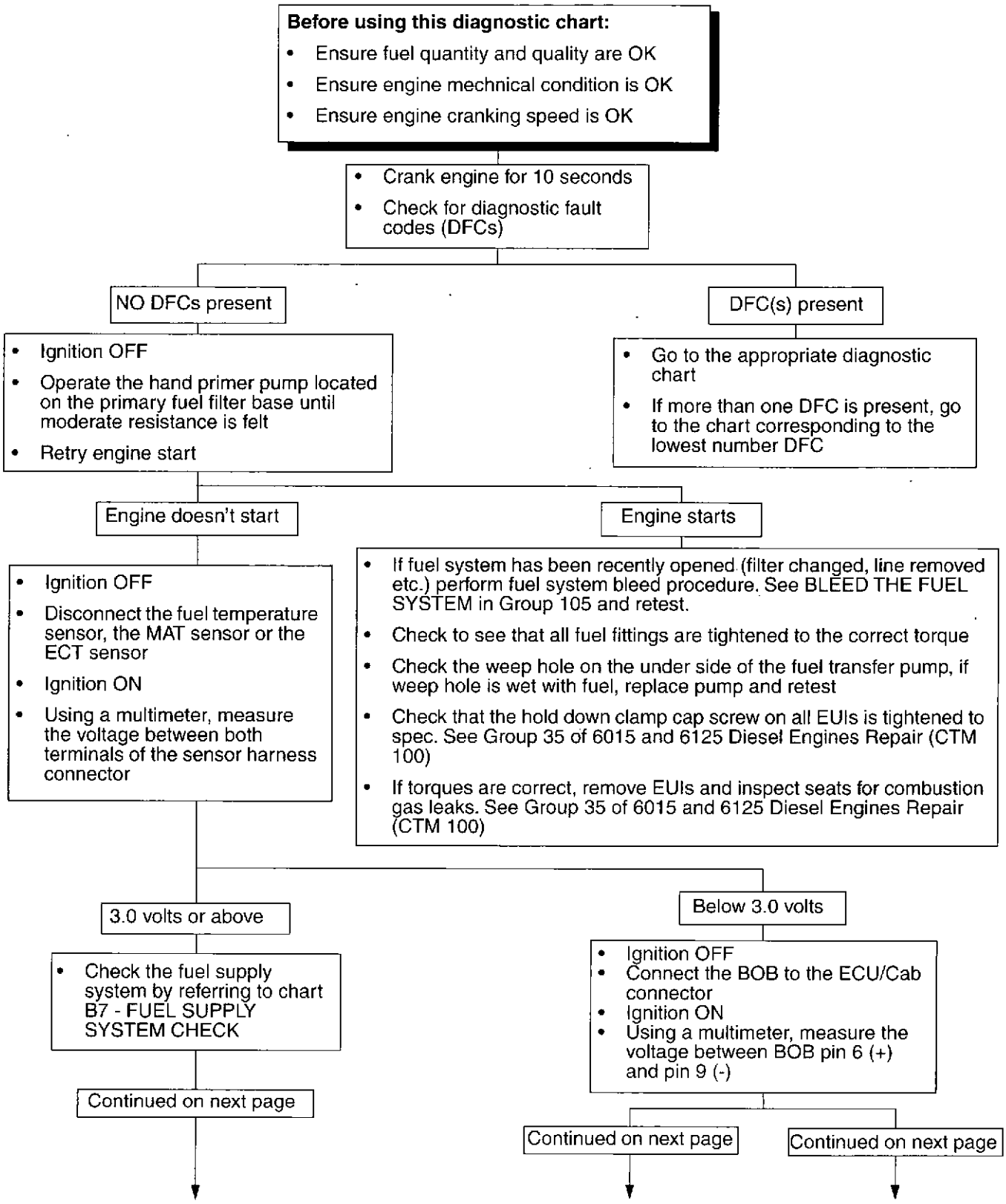
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

This diagnostic chart should be used if the engine cranks OK, but will not start or starts only after prolonged cranking. If the engine will not crank, determine problem in the starting/charging system. See DIAGNOSING ENGINE MALFUNCTIONS in Group 105.

B3 - ENGINE CRANKS/NO START OR STARTS HARD (DST NOT AVAILABLE)—CONT.

NOTE: This diagnostic chart should be used along with JT02171 Break-Out-Box (BOB). If the Diagnostic Scan Tool (DST) is available, use chart B2.



B3 - ENGINE CRANKS/NO START OR STARTS HARD (DST NOT AVAILABLE)—CONT.

3.0 volts or above

- Faulty ECU power fuse

OR

- Faulty ECU power relay or other power supply component (refer to specific machine manual)

OR

- Faulty ECU power wiring

OR

- Faulty ECU

Below 3.0 volts

- Key-on signal open or shorted to ground

OR

- Faulty ignition switch

Chart B7 indicates fuel supply system is OK

- Ignition OFF
- Remove rocker arm cover by loosening three hold-down cap screws
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine

NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.

- Check EUI rocker arms, valve rocker arms, and camshaft operation
- Inspect EUI harness and EUI harness connector for damage

Fuel supply system problem found

- Repair fuel supply system problem and retest

All components operating correctly

- Verify cam/crank timing is correct
- If no other problems are found, replace ECU and retest

Faulty component found

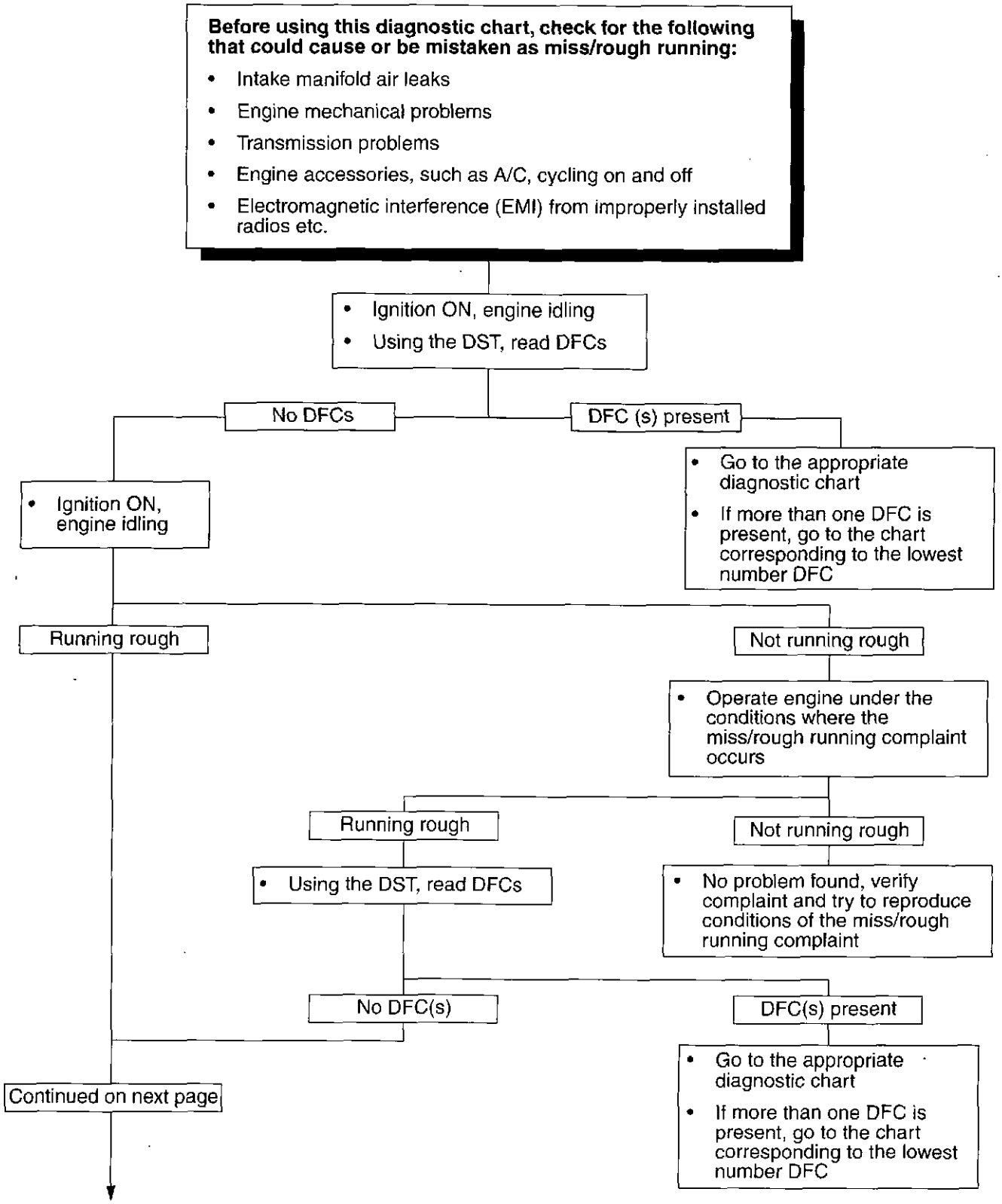
- Repair/replace faulty component and retest

B4 - ENGINE MISFIRES/RUNS IRREGULARLY

This diagnostic chart should be used if the engine does not seem to be running on all cylinders either intermittently or all of the time. If the engine is delivering lower than expected power, see diagnostic chart B5 or B6 - LOW POWER/EXCESSIVE BLACK SMOKE.

B4 - ENGINE MISFIRES/RUNS IRREGULARLY—CONTINUED

NOTE: This diagnostic chart can only be used along with the Diagnostic Scan Tool (DST).



B4 -ENGINE MISFIRES/RUNS IRREGULARLY—CONTINUED

- *Using the DST, perform the Relative* Compression Test. For instructions, see DST ENGINE TEST INSTRUCTIONS earlier in *this group. Make note of the results.*
- Using the DST, perform the Engine Misfire Test. For instructions, see DST ENGINE TEST INSTRUCTIONS earlier in this group. Make note of the results.

All cylinders scored within 10% of each other *on both tests*

One or more cylinders scored 10% or more lower than the *rest on the compression test* and the SAME cylinder(s) scored 10% or more lower on *the misfire test*

- Determine cause of low compression pressure on the low scoring cylinders, repair and retest

One or more cylinders scored 10% or more lower than the rest on the compression test and DIFFERENT cylinder(s) scored 10% or more lower on the misfire test

- These type of results indicate that either the misfire test or the compression test could not operate correctly. Further engine diagnostics should be performed to determine if the engine misfire is caused by a faulty EUI or by a compression problem.

All cylinders scored within 10% of each other on the compression test and one or more cylinders scored 10% or more lower than the rest on the misfire test

- Check EUI pre-load adjustment on the EUI(s) of the cylinder(s) that tested low on the misfire test. Refer to Group 05 of 6105 and *6125 Diesel Engines Repair* (CTM 100)
- If EUI pre-load is adjusted properly, replace the EUI(s) of the cylinder(s) that tested low on the misfire test, and retest

- Check the fuel supply system by *referring* to chart B7 - FUEL SUPPLY SYSTEM CHECK

Chart B7 indicates fuel supply system is OK

Fuel supply system problem found

Continued on next page

- Repair fuel supply system problem and retest

B4 - ENGINE MISFIRES/RUNS IRREGULARLY—CONTINUED

- Check EUI pre-load adjustment and check valve adjustment. Refer to Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100)

EUIs and valves properly adjusted

- Ensure there are no engine mechanical problems
- Ensure there isn't something drawing excessive engine power
- If none of the above problems are found, continue diagnostics by going to diagnostic chart B5 - LOW POWER/ EXCESSIVE BLACK SMOKE.

EUIs and valves NOT properly adjusted

- Adjust EUIs and valves to spec and retest. Refer to Group 05 of 6105 and 6125 Diesel Engines Repair (CTM 100)

B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE)

This diagnostic chart should be used if the engine delivers less power than expected or emits excessive black exhaust smoke. If the engine seems to be misfiring on one or more cylinders or running irregularly, use diagnostic chart B4 - ENGINE MISFIRES/RUNS IRREGULARLY.

B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE)—CONTINUED

NOTE: This diagnostic chart should be used along with the Diagnostic Scan Tool (DST). If the DST is not available, but JT02171 Break-Out-Box (BOB) is, use chart B6.

Before using this diagnostic chart, ensure that:

- There are no problems with the transmission
- There are no engine mechanical problems
- There is not an excessive load on the engine
- Fuel quality is OK

- Operate engine and attempt to recreate the conditions of the low power/excessive black smoke complaint
- Using the DST, check for diagnostic fault codes (DFCs)

No DFCs

NOTE: 6750/6850 Self-Propelled Forage Harvester applications only use one torque curve; therefore this check is not required.

- The ECU on 10.5/12.5 engines has the ability to operate on multiple torque curves. To check that the engine is operating on the correct torque curve under the operating conditions where there is a low power/excessive black smoke complaint:
  - — Recreate the conditions of the low power/excessive black smoke complaint
  - — Using the DST, read the torque curve number
  - — Compare the torque curve number to the appropriate torque curve chart in Group 199 Specifications

The torque curve number displayed IS correct for the operating conditions of the low power complaint

Continued on next page

DFC (s) present

- Go to the appropriate diagnostic chart
- If more than one DFC is present, go to the chart corresponding to the lowest number DFC

The torque curve number displayed ISN'T correct for the operating conditions of the low power complaint

Continued on next page

B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE)—CONTINUED

- Warm engine
- Recreate the conditions of the low power/excessive black smoke complaint
- *Using the DST, read the ECT* sensor temperature

- Refer to machine manual to *determine components that if* faulty could prevent the correct torque curve from being selected

OR

- Faulty torque curve select wiring

Below 100°C (212°F)

Above 100°C (212°F)

- Operate engine at full load and *rated speed*
- At these operating conditions, using the DST, read the % Throttle data parameter

- Engine Coolant Temperature is too high. ECU derates engine power when coolant temperature exceeds 100°C (212°F) to protect the engine from overheating.
- See DIAGNOSING COOLING SYSTEM MALFUNCTION in Group 105.

97% or above

Below 97%

- Operate engine at full load and at rated speed
- Use the DST to read the MAP pressure value
- Compare value to turbocharger boost spec chart in Group 199

- Refer to machine manual and perform the throttle calibration procedure; then retest

MAP in range or above compared to boost spec

MAP below range compared to boost spec

Continued on next page

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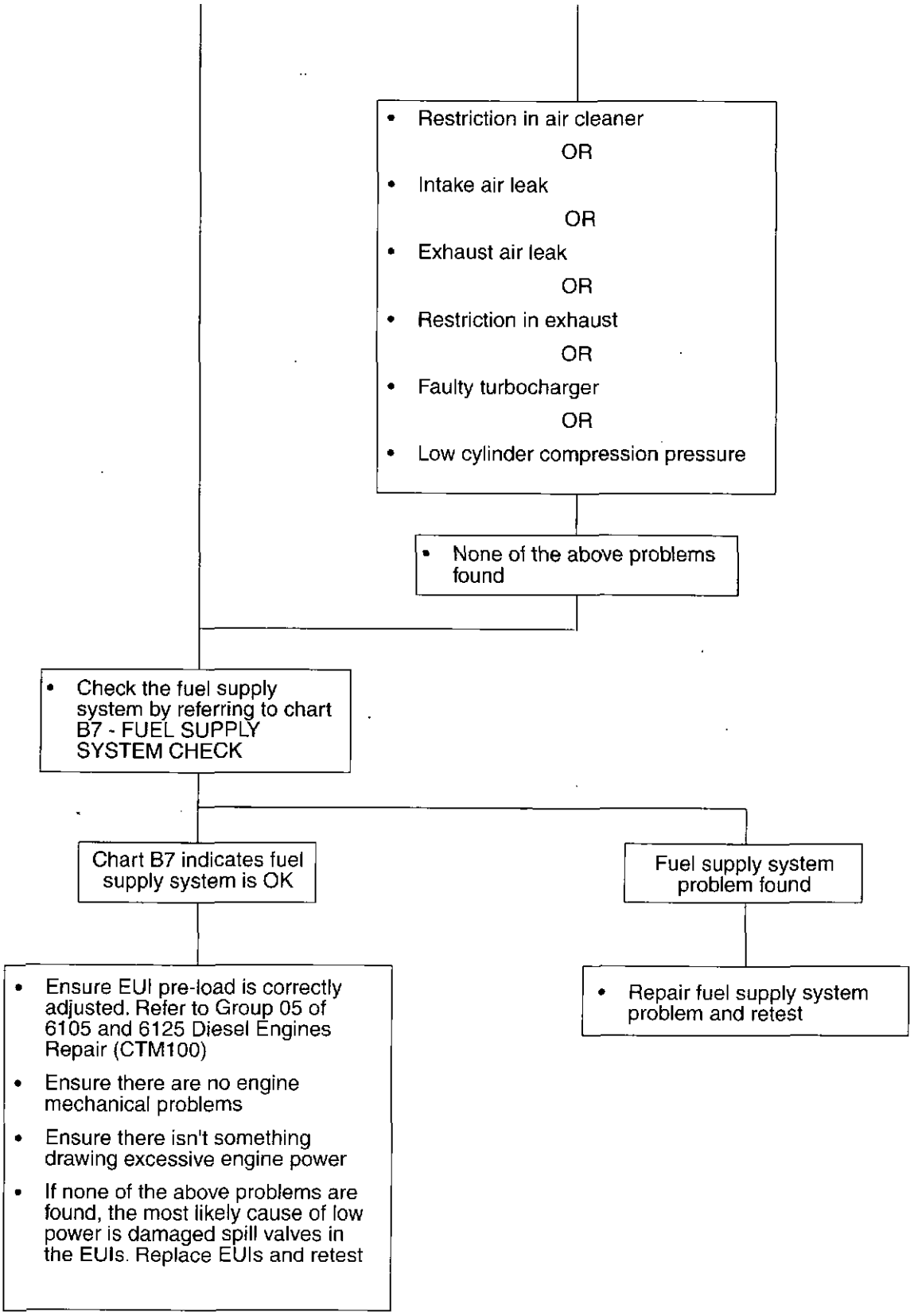
B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE)—CONTINUED



B6 - LOW POWER/EXCESSIVE BLACK SMOKE (DST NOT AVAILABLE)

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

This diagnostic chart should be used if the engine delivers less power than expected or emits excessive black exhaust smoke. If the engine seems to be misfiring on one or more cylinders or running irregularly, use diagnostic chart B4 - ENGINE MISFIRES/RUNS IRREGULARLY.

- **DETERMINING TORQUE CURVE USING BOB**

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NOTE: Not all applications use all eight torque curves.

	Voltage between BOB pin 15 and ground	Voltage between BOB pin 31 and ground	Voltage between BOB pin 21 and ground
Torque Curve 1	0 volts	0 volts	0 volts
Torque Curve 2	0 volts	0 volts	5 volts
Torque Curve 3	0 volts	5 volts	0 volts
Torque Curve 4	0 volts	5 volts	5 volts
Torque Curve 5	5 volts	0 volts	0 volts
Torque Curve 6	5 volts	0 volts	5 volts
Torque Curve 7	5 volts	5 volts	0 volts
Torque Curve 8	5 volts	5 volts	5 volts

B6 -LOW POWER/EXCESSIVE BLACK SMOKE (DST NOT AVAILABLE)—CONTINUED

NOTE: This diagnostic chart should be used along with JT02171 Break-Out-Box (BOB). If the Diagnostic Scan Tool (DST) is available, use chart B5.

Before using this diagnostic chart, ensure that:
- — There are no problems with the transmission
- — There are no engine mechanical problems
- — There is not an excessive load on the engine
- — Fuel quality is OK

- Operate engine and attempt to recreate the conditions of the low power/excessive black smoke complaint
- Check for diagnostic fault codes (DFCs)

No DFC(s) | DFC(s) present

- Warm engine.
- Recreate the conditions of the low power/ excessive black smoke complaint
- Observe the engine coolant temperature

- Go to the appropriate diagnostic chart
- If more than 1 DFC is present, go to the chart corresponding to the lowest number DFC

Below 100°C (212°F) | Above 100°C (212°F)

NOTE: 6750/6850 Self-Propelled Forage Harvester applications only use one torque curve; therefore this check is not required.

- The ECU on 10.5/12.5 engines has the ability to operate on multiple torque curves. To check that the engine is operating on the correct torque curve under the operating conditions where there is a low power/excessive black smoke complaint:
  - — Connect the BOB to the EUC/Cab connector (connector inside is red)
  - — Recreate the conditions of the low power/excessive black smoke complaint
  - — Under these conditions, measure voltage between the following BOB pins and pin 9 (-):
    - pin 15 (+)
    - pin 31 (+)
    - pin 21 (+)
  - — Compare the voltage readings observed to the chart on the preceding page to determine the torque curve number
  - — Compare the torque curve number to the appropriate torque curve chart in Group 199 Specifications

- Engine Coolant Temp is too high. ECU derates engine power when coolant temp exceeds 100°C (212°F) to protect the engine from overheating.
- See DIAGNOSING COOLANT SYSTEM MALFUNCTIONS in Group 105

Continued on next page

B6 -LOW POWER/EXCESSIVE BLACK SMOKE (DST NOT AVAILABLE)—CONTINUED

The torque curve number IS correct for the operating conditions of the low power complaint

- Ignition ON, engine OFF
- BOB still connected to the EUC/Cab connector
- Move the throttle to the high idle position
- On 9000 series 4WD tractor and 744H loader applications, using a multimeter measure the duty cycle of the signal on BOB pin 16

  On OEM and 6750/6850 Self-Propelled Forage Harvester applications, using a multimeter measure the voltage between pin 35 (+) and pin 22 (-)

Tractor and loader applications - duty cycle reads 90-95%

OEM and forage harvester applications - voltage reads 4.0 V or greater

- *Measure turbo boost.* See CHECK INTAKE MANIFOLD PRESSURE (TURBOBOOST) in Group 105.

Boost in range or above compared to spec in Group 199

Continued on next page

The torque curve number ISN'T correct for the operating conditions of low power complaint

- Refer to machine manual to determine components that if faulty could prevent the correct torque curve from being selected

  OR

- Faulty torque curve select wiring

Tractor and loader applications - duty cycle reads below 90%

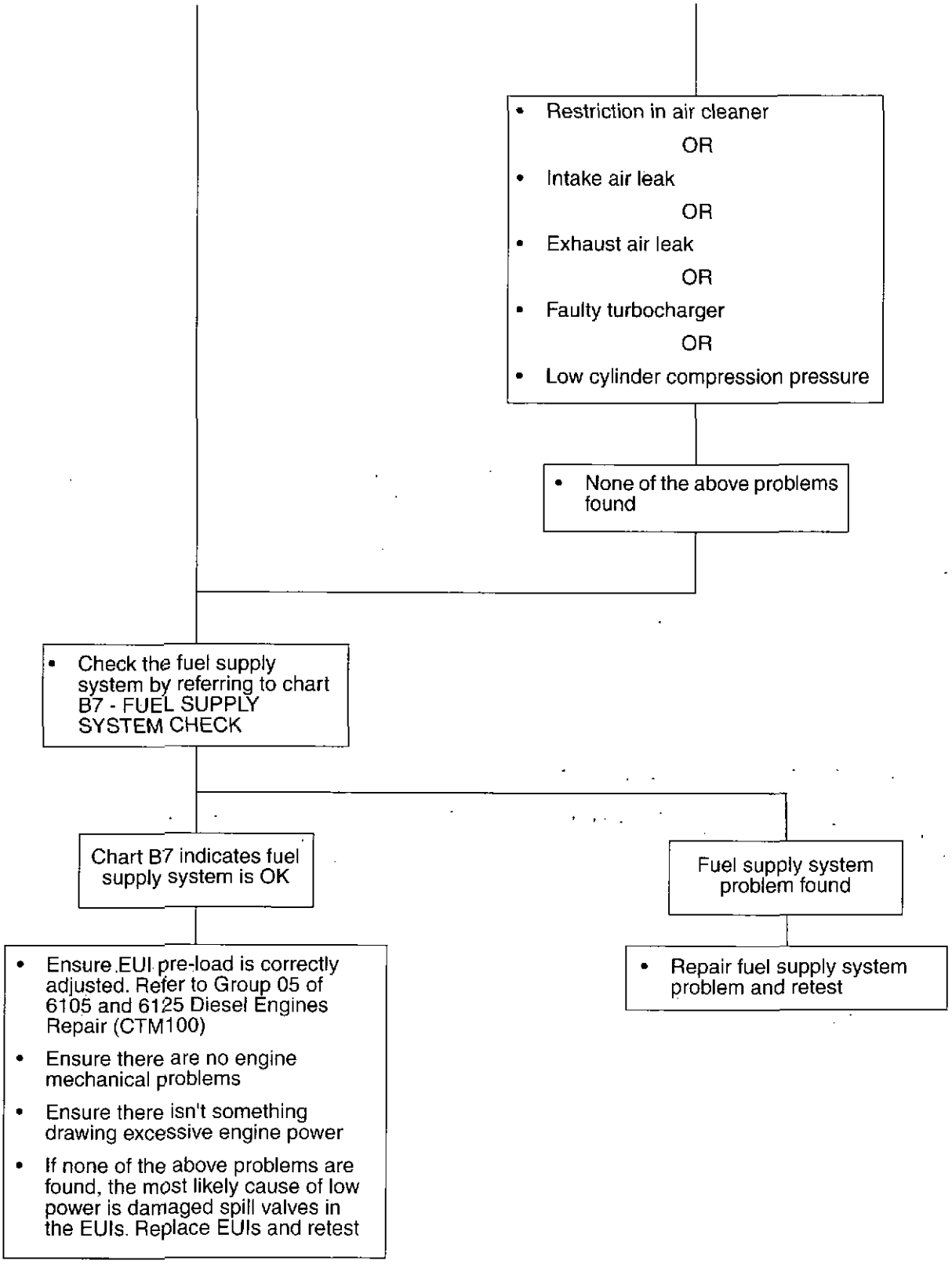
OEM and forage harvester applications - voltage reads below 4.0 V

- Determine why throttle isn't going to full throttle position. Refer to application specific manual if necessary

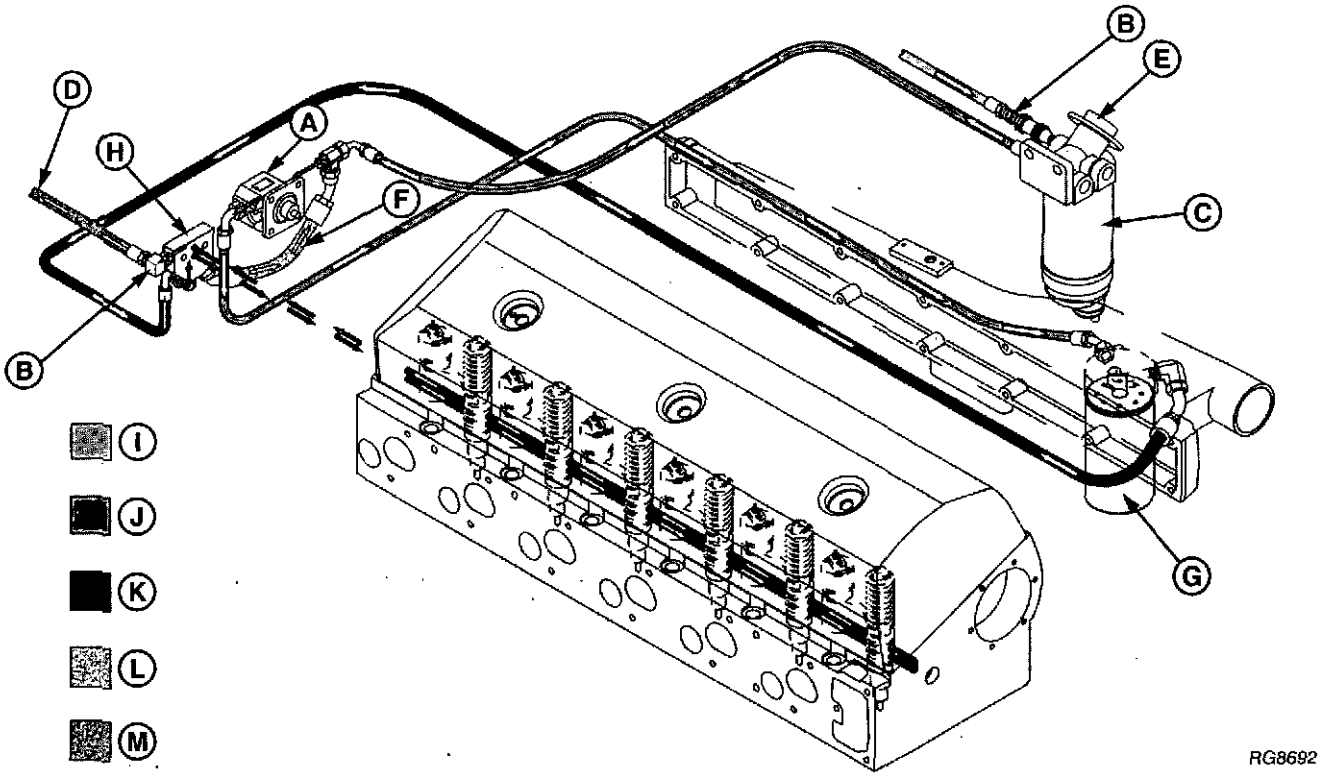
Boost below range compared to spec in Group 199

Continued on next page

B6 -LOW POWER/EXCESSIVE BLACK SMOKE (DST NOT AVAILABLE)—CONTINUED



B7 - FUEL SUPPLY SYSTEM CHECK



Fuel Supply System Components

NOTE: Diagram shows John Deere application, other applications similar.

A—Fuel Transfer Pump
B—In-line Check Valves
C—Primary Filter
D—Return-to-Tank Fuel Line
E—Hand Primer Pump
F—Recirculation Fuel Line
G—Final Filter
H—Fuel Manifold
I—Suction Fuel from Tank
J—Primary-Filtered Fuel
K—Final-Filtered Fuel
L—Recirculated Fuel
M—Return-to-Tank Fuel

This diagnostic chart should be used if referred by another diagnostic chart or if a fuel supply system problem is suspected.

NOTE: Some, but NOT ALL, applications have a fuel pressure switch to detect low fuel pressure. On those applications, even though there may not be a low fuel pressure DFC (DFCs 27 and 28), there could be air in the system causing fuel supply problems.

B7 - FUEL SUPPLY SYSTEM CHECK—CONTINUED

- Fit Clear Line from JT03513 Fuel Supply System Test Kit after the check valve on the return-to-tank fuel line (D)
- Start/crank engine and watch clear line for bubbles

Small amount of small bubbles are observed

Large quantity of bubbles are observed

IMPORTANT: Before disconnecting any fuel line, completely clean any debris from around the fitting. Do not allow debris to enter the fuel line.

- Connect Pressure Test Fitting from JT03513 Fuel Supply System Test Kit and a 0–1000 kPa (0–150 psi) gauge to the outlet of the final fuel filter (G)
- Start engine and check pressure at idle and at rated speed
- If engine won't start, check pressure while cranking

- If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM in Group 105 and retest.
- Check to see that all fuel fittings are tightened to the correct torque
- Check the weep hole on the under side of the fuel transfer pump, if weep hole is wet with fuel, replace pump and retest
- Check that the hold down clamp cap screw on all EUIs is tightened to spec. See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100)
- If torques are correct, remove EUIs and inspect seats for combustion gas leaks. See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM100)

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410–480 kPa (60–70 psi) @ idle, 620–690 kPa (90–100 psi) @ rated speed

- Check the weep hole on the under side of the fuel transfer pump (A). If weep hole is wet with fuel, replace pump and retest
- Test the check valve on the return-to-tank fuel line (D) for leakage
- If both of the items above check OK, the fuel supply system appears to be operating correctly

410–480 kPa (60–70 psi) @ idle, Below 620 kPa (90 psi) @ rated speed

- Check fuel strainer (in fuel line before primary filter). Replace if necessary.
- Change primary (C) and final fuel (G) filters and retest. See Group 35 of 6105 and 6125 Diesel Engines Repair (CTM 100)

Low pressure all conditions; below 100 kPa (15 psi) cranking

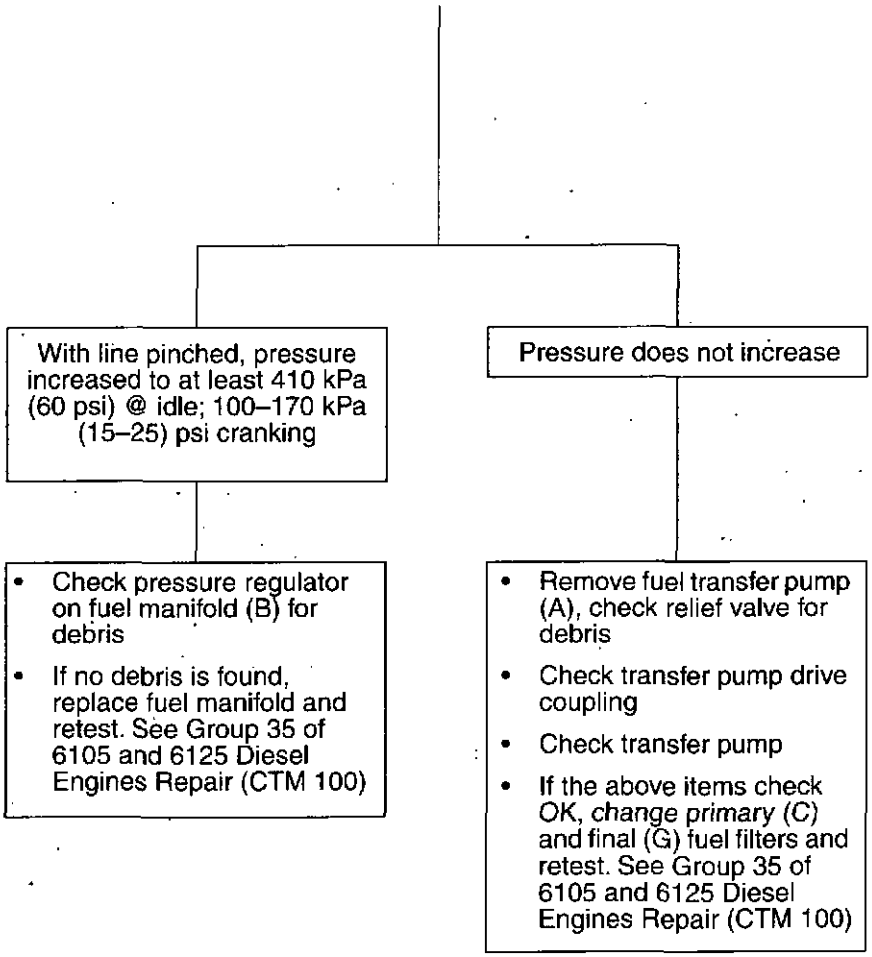
- Pinch-off the recirculation fuel line (F)
- Start/crank engine and check pressure

Continued on next page

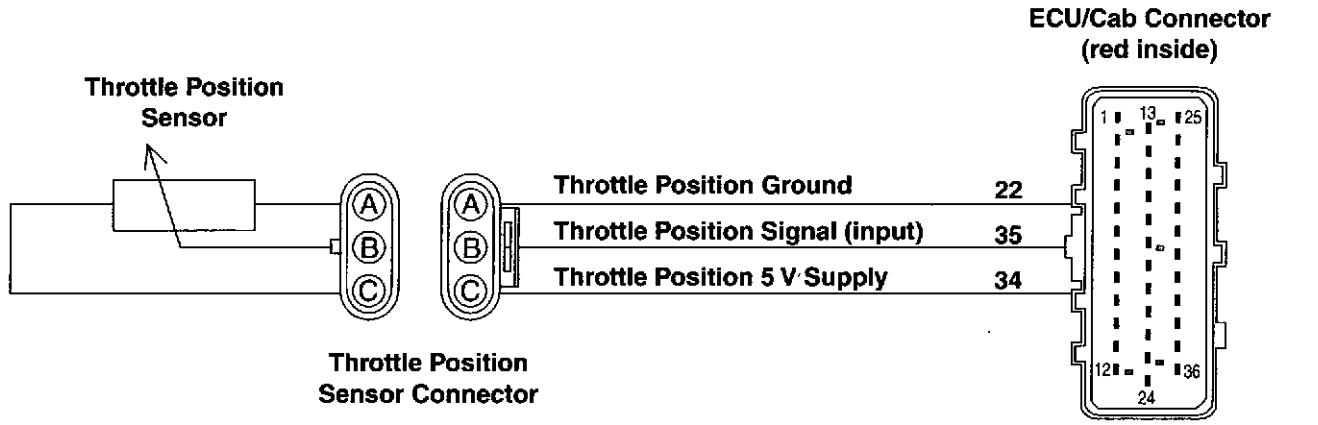
Engine won't start; 100–170 kPa (15–25 psi) cranking

- Return to diagnostic chart B2 - ENGINE CRANKS/NO START OR HARD TO START

B7 - FUEL SUPPLY SYSTEM CHECK—CONTINUED



DFC 11 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH



Analog Throttle Wiring

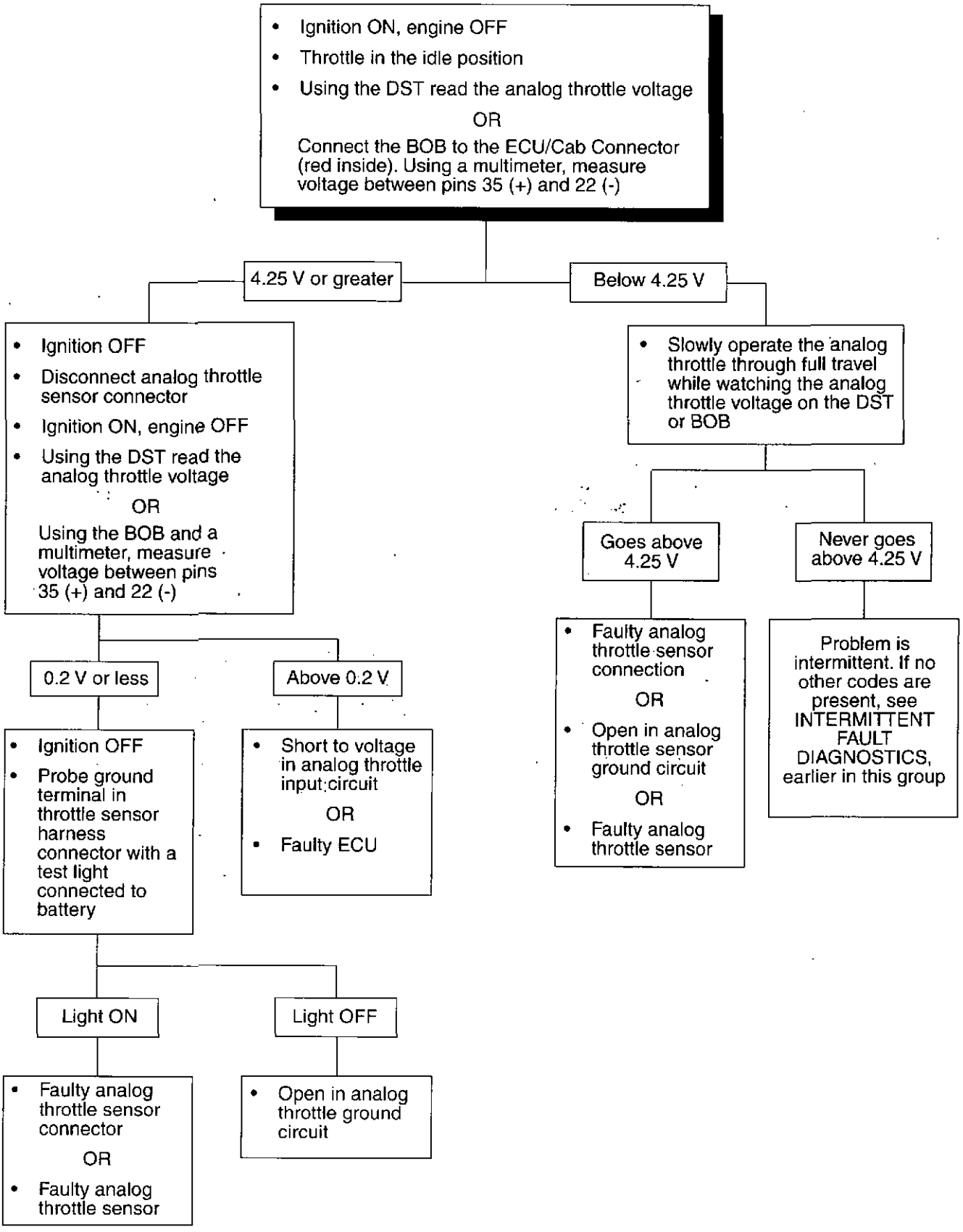
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Analog Throttle Position Sensor**
  - — The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 0.5 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 0.5 volts and 4.0 volts at high idle.

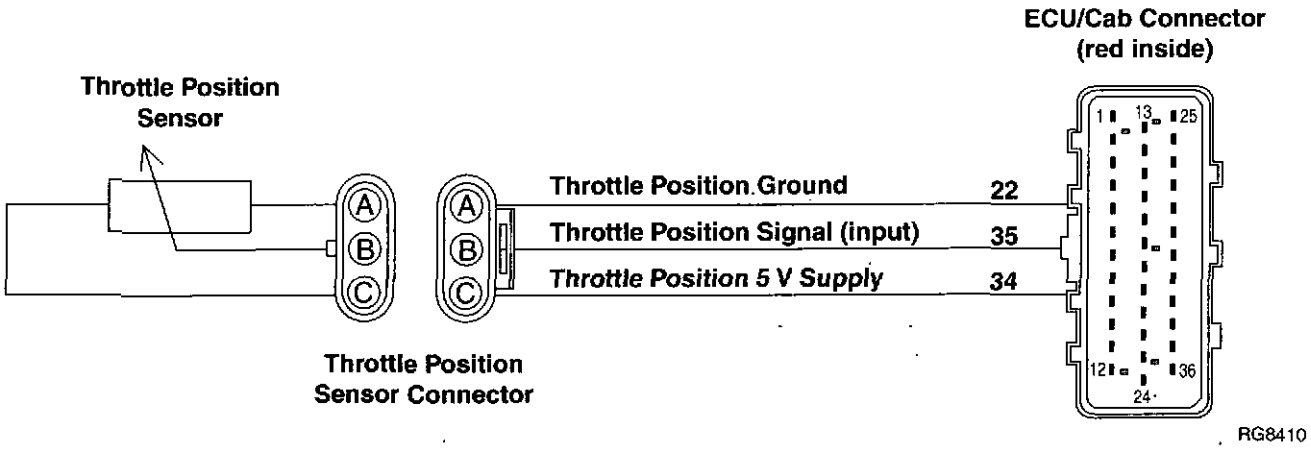
- **Fault code 11 will set if:**
  - — The analog throttle input voltage exceeds 4.25 volts.

- **If fault code 11 sets, the following will occur:**
  - — The ECU will ignore the analog throttle input, and only use the PWM throttle input (if used) if it is a valid signal.
  - — If codes 13 or 14 (indicating a faulty PWM throttle input) are also set with code 11, the ECU will use a default "limp-home" throttle value that will only allow low idle engine speed.
  - — If application uses only an analog throttle, the ECU will use a default "limp-home" throttle value that will only allow low idle engine speed.

DFC 11 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH—CONTINUED



DFC 12 ANALOG THROTTLE INPUT VOLTAGE TOO LOW

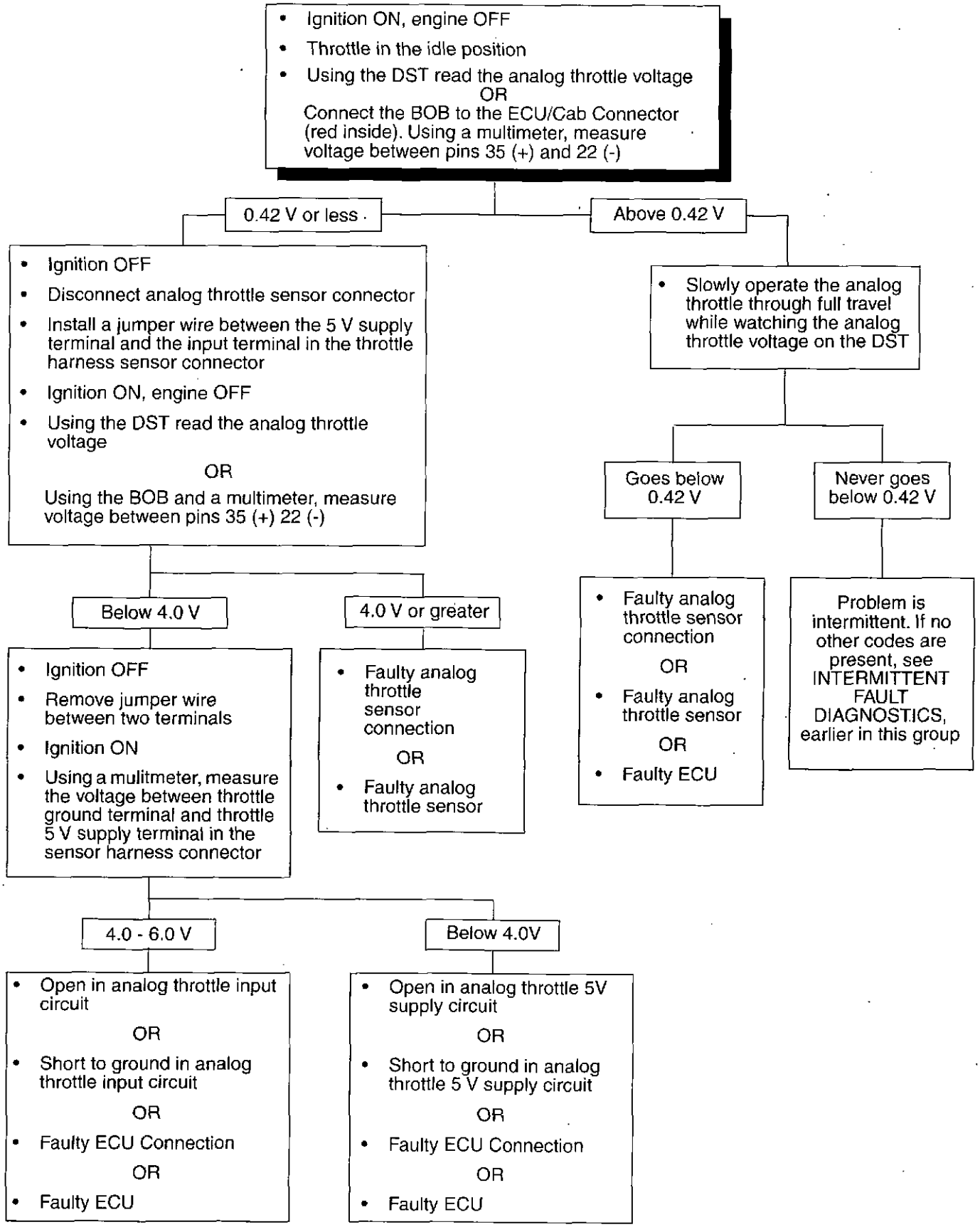


Analog Throttle Wiring

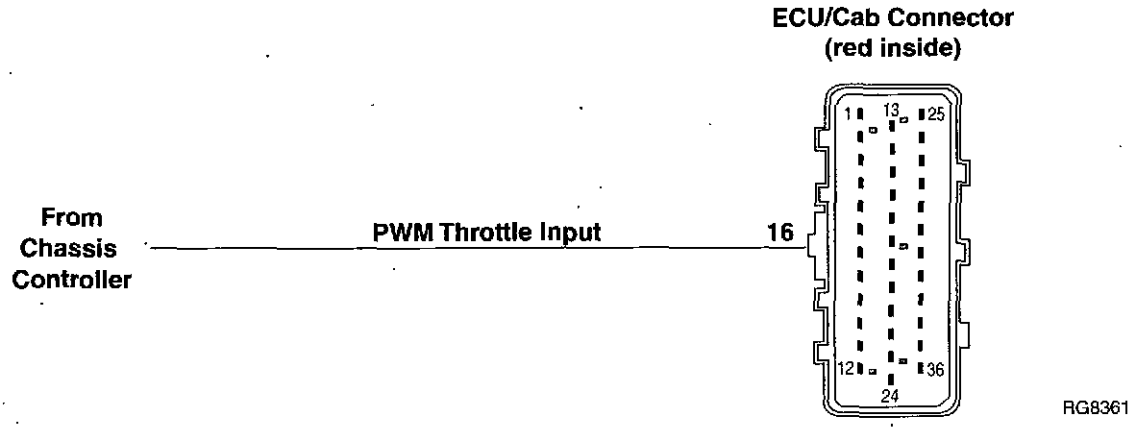
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Analog Throttle Position Sensor**
  - — The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 0.5 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 0.5 volts and 4.0 volts at high idle.
- **Fault code 12 will set if:**
  - — The analog throttle input voltage drops below 0.42 volts.
- **If fault code 12 sets, the following will occur:**
  - — The ECU will ignore the analog throttle input, and only use the PWM throttle input (if used) if it is a valid signal.
  - — If codes 13 or 14 (indicating a faulty PWM throttle input) are also set with code 12, the ECU will use a default "limp-home" throttle value that will only allow low idle engine speed.
  - — If application uses only an analog throttle, the ECU will use a default "limp-home" throttle value that will only allow low idle engine speed.

DFC 12 ANALOG THROTTLE INPUT VOLTAGE TOO LOW—CONTINUED



DFC 13 PWM THROTTLE INPUT TOO HIGH

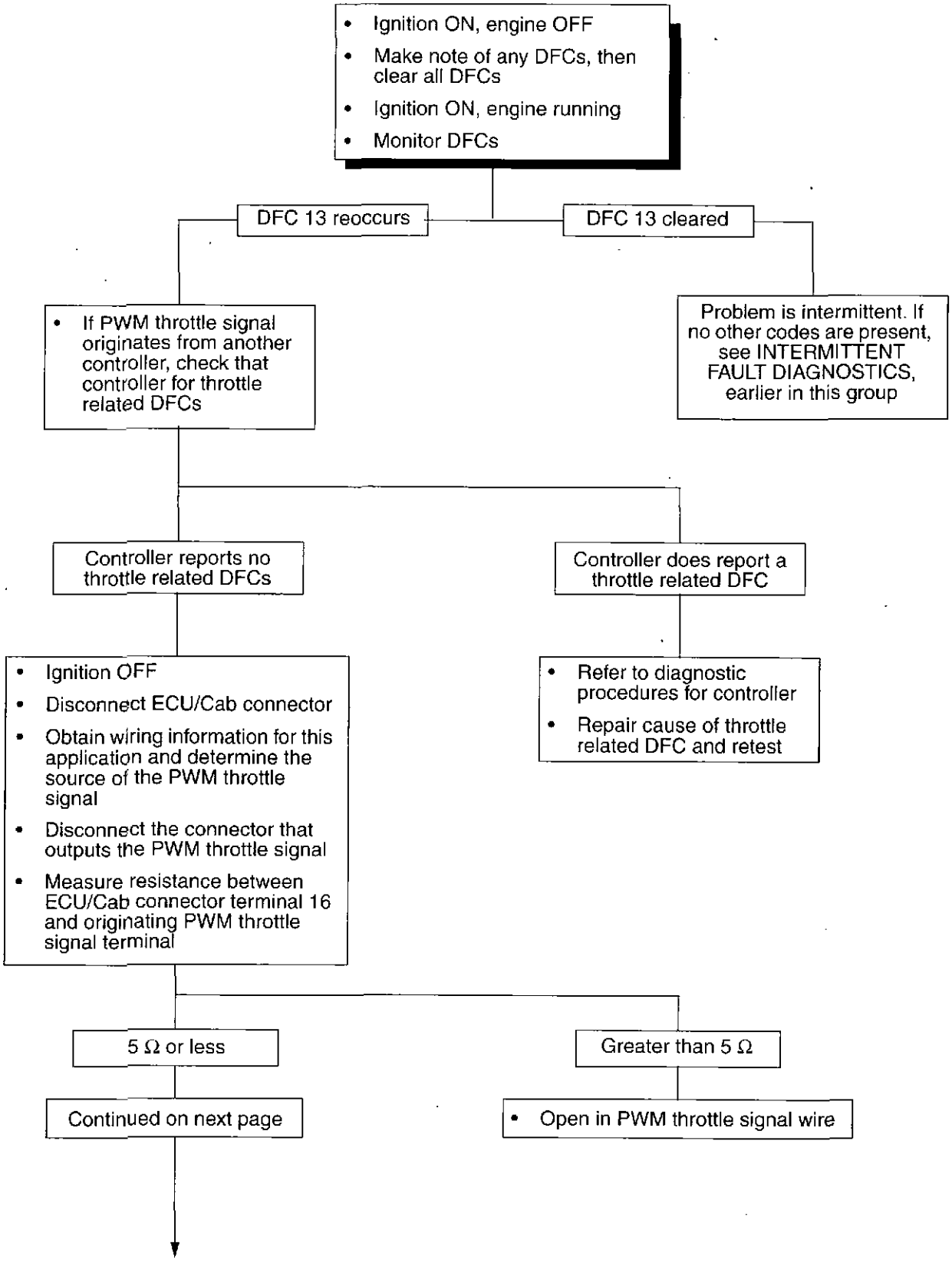


PWM Throttle Wiring

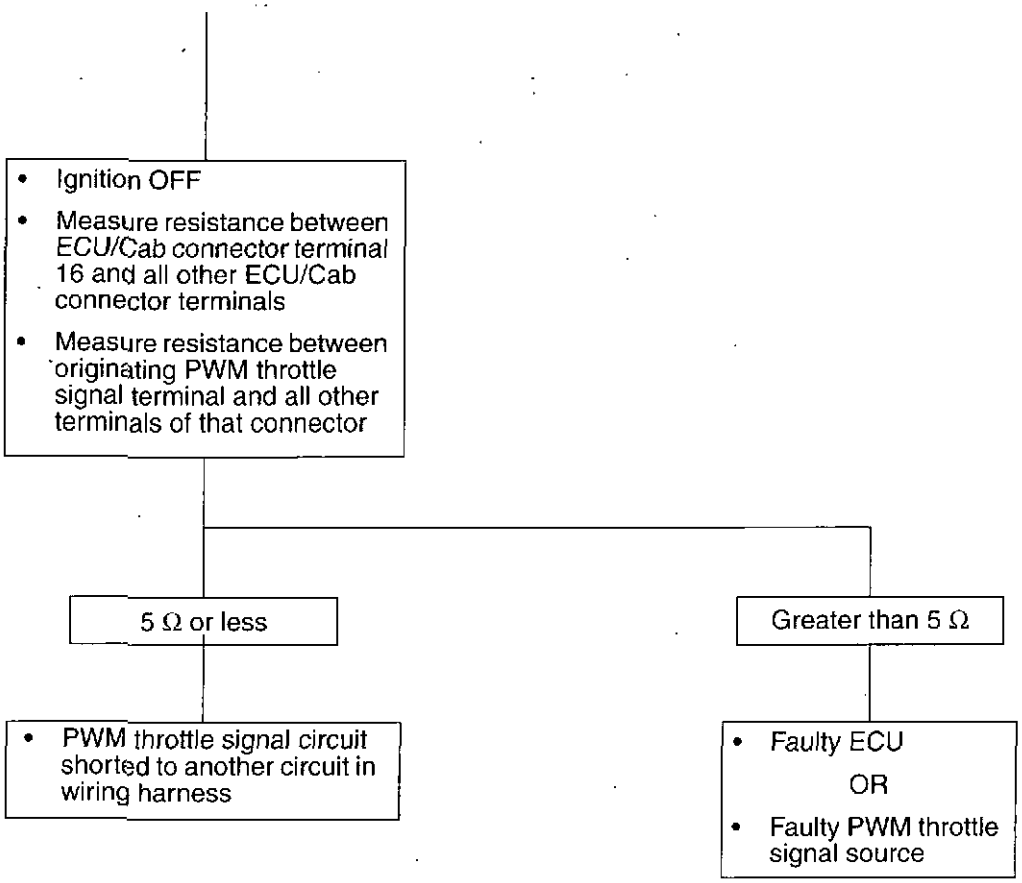
IMPORTANT: Do not force probes into connector *terminals or damage will result. Use* JT07328 Connector Adapter Test Kit to make measurements in *connectors. This will ensure that* terminal damage does not occur.

- **PWM (Pulse Width Modulated) Throttle Position Input**
  - — The PWM throttle signal is sent to the ECU by the Chassis Computer. The PWM signal is a square wave signal with a constant frequency. The pulse-width of the signal (amount of time the signal is high) varies as throttle input from the Chassis Computer varies.
- **Fault code 13 will set if:**
  - — The pulse-width of the PWM signal is higher than the normal operating range of the signal.
- ***If fault code* 13 sets, *the following will occur*:**
  - — If the only throttle input to the ECU is the PWM throttle, the ECU will only allow low idle engine speed.
  - — If the ECU has an analog throttle in addition to the PWM throttle, the ECU will ignore the PWM input, and use the analog throttle input to control the engine.

DFC 13 PWM THROTTLE INPUT TOO HIGH—CONTINUED



DFC 13 PWM THROTTLE INPUT TOO HIGH—CONTINUED



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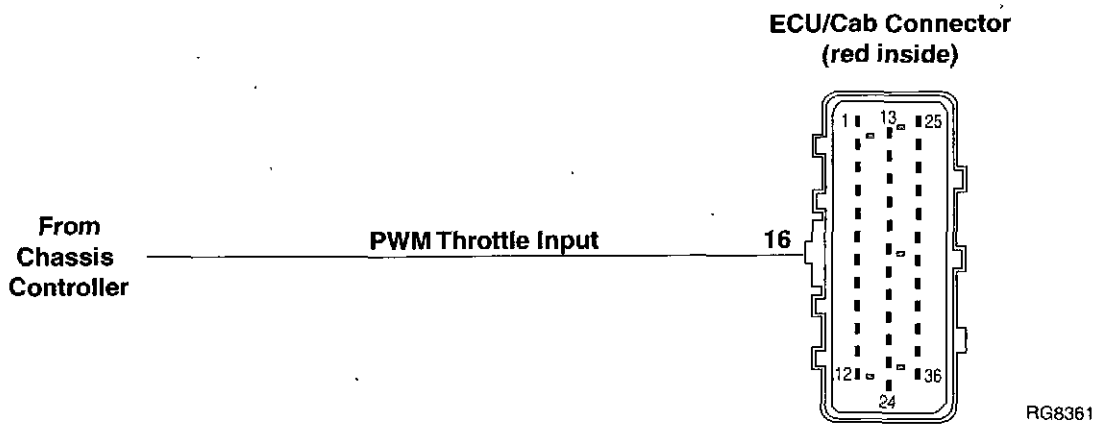
DFC 14 PWM THROTTLE INPUT TOO LOW



PWM Throttle Wiring

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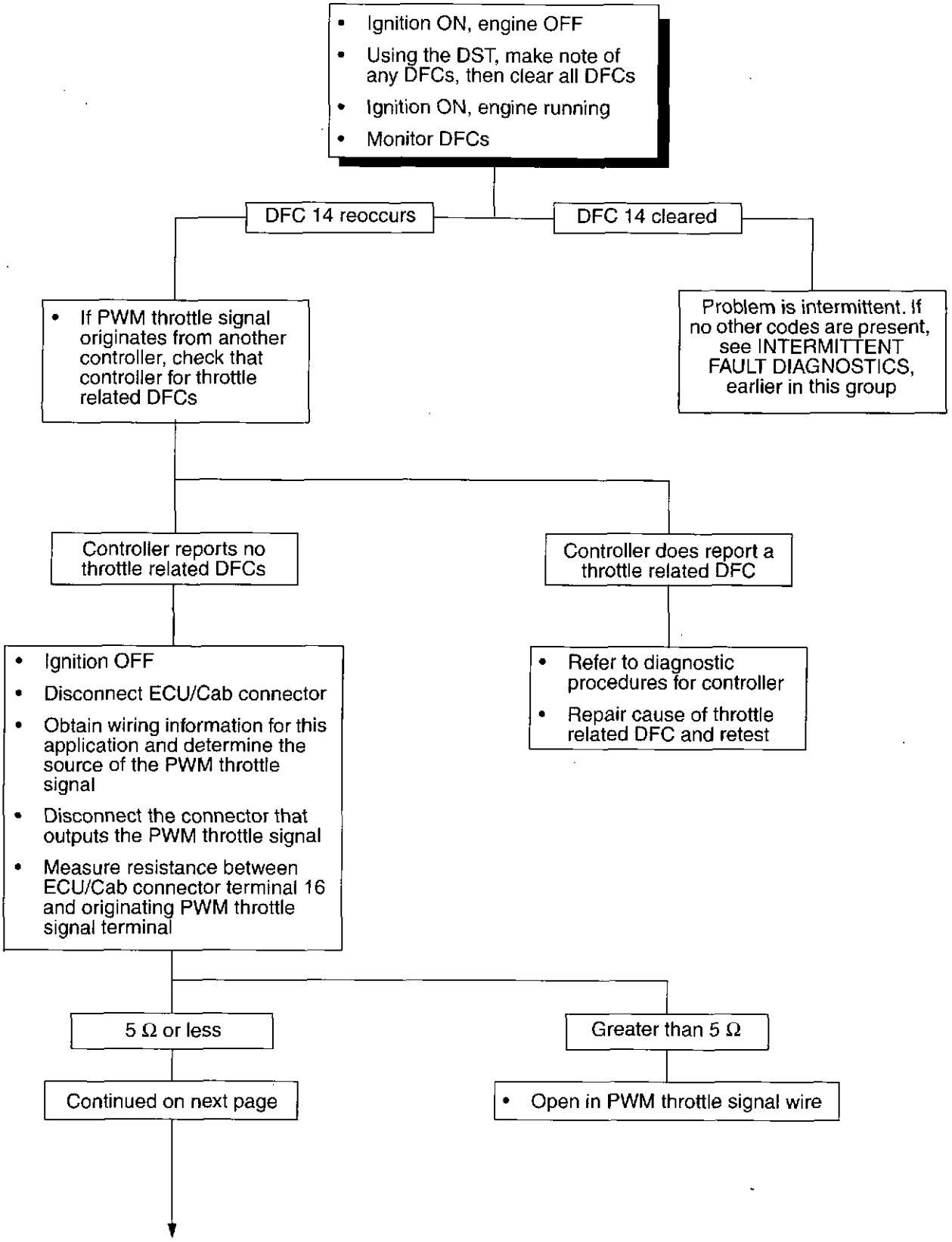
IMPORTANT: ***Do not force probes into connector*** **terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.**

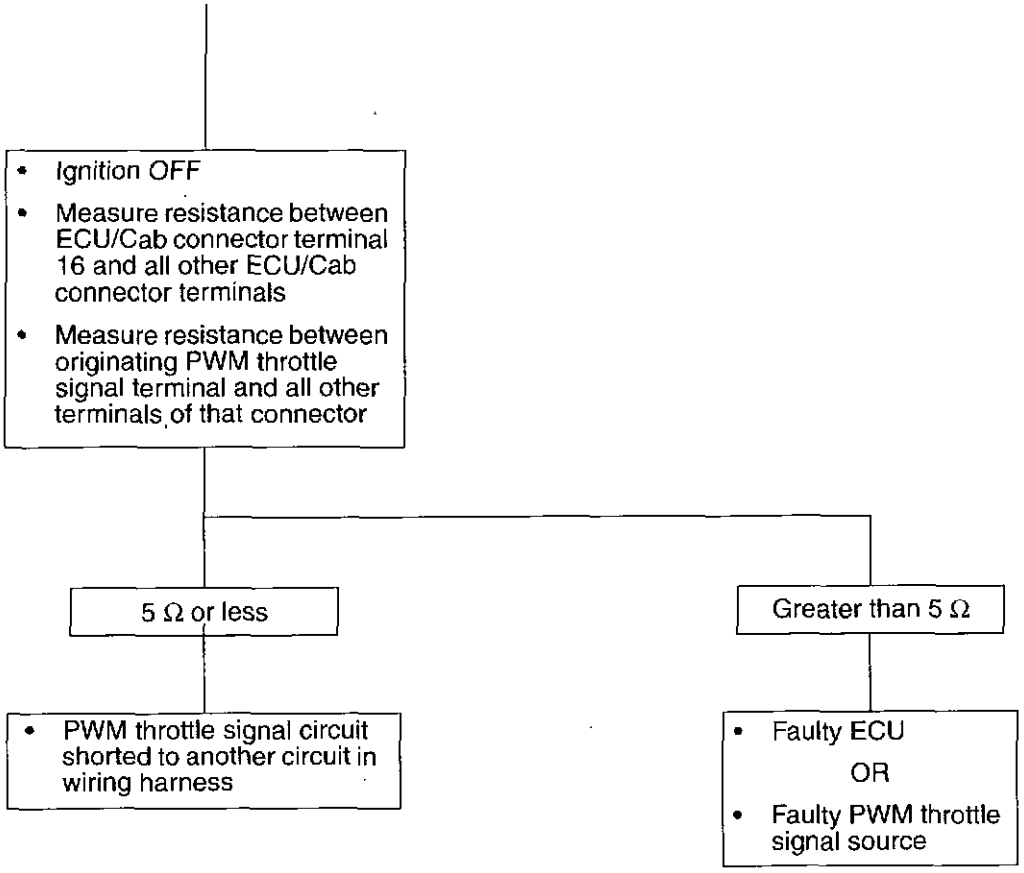
- **PWM (Pulse Width Modulated) Throttle Position Input**
  - — The PWM throttle signal is sent to the ECU by the Chassis Computer. The PWM signal is a square wave signal with a constant frequency. The pulse-width of the signal (amount of time the signal is high) varies as throttle input from the Chassis Computer varies.

- **Fault code 14 will set if:**
  - — The pulse-width of the PWM signal is lower than the normal operating range of the signal.
- **If fault code 14 sets, the following will occur:**
  - — If the only throttle input to the ECU is the PWM throttle, the ECU will only allow low idle engine speed.
  - — If the ECU has an analog throttle in addition to the PWM throttle, the ECU will ignore the PWM input, and use the analog throttle input to control the engine.

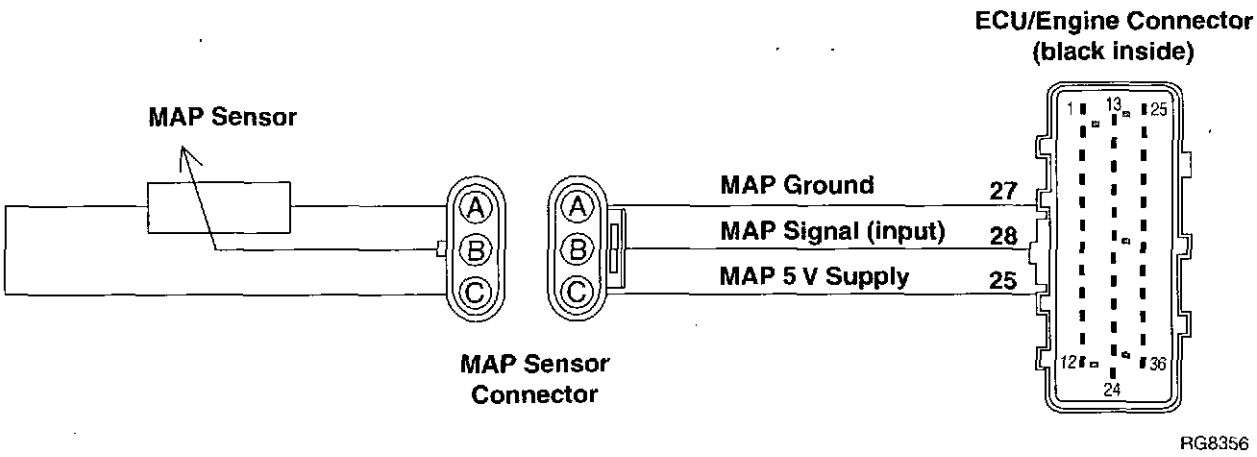
DFC 14 PWM THROTTLE INPUT TOO LOW—CONTINUED



DFC 14 PWM THROTTLE INPUT TOO LOW—CONTINUED



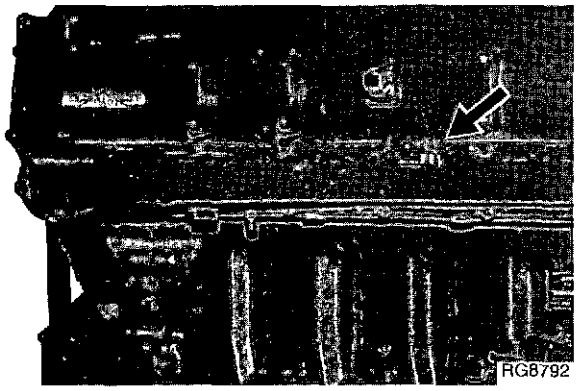
DFC 21 MAP INPUT VOLTAGE TOO HIGH



MAP Sensor Wiring

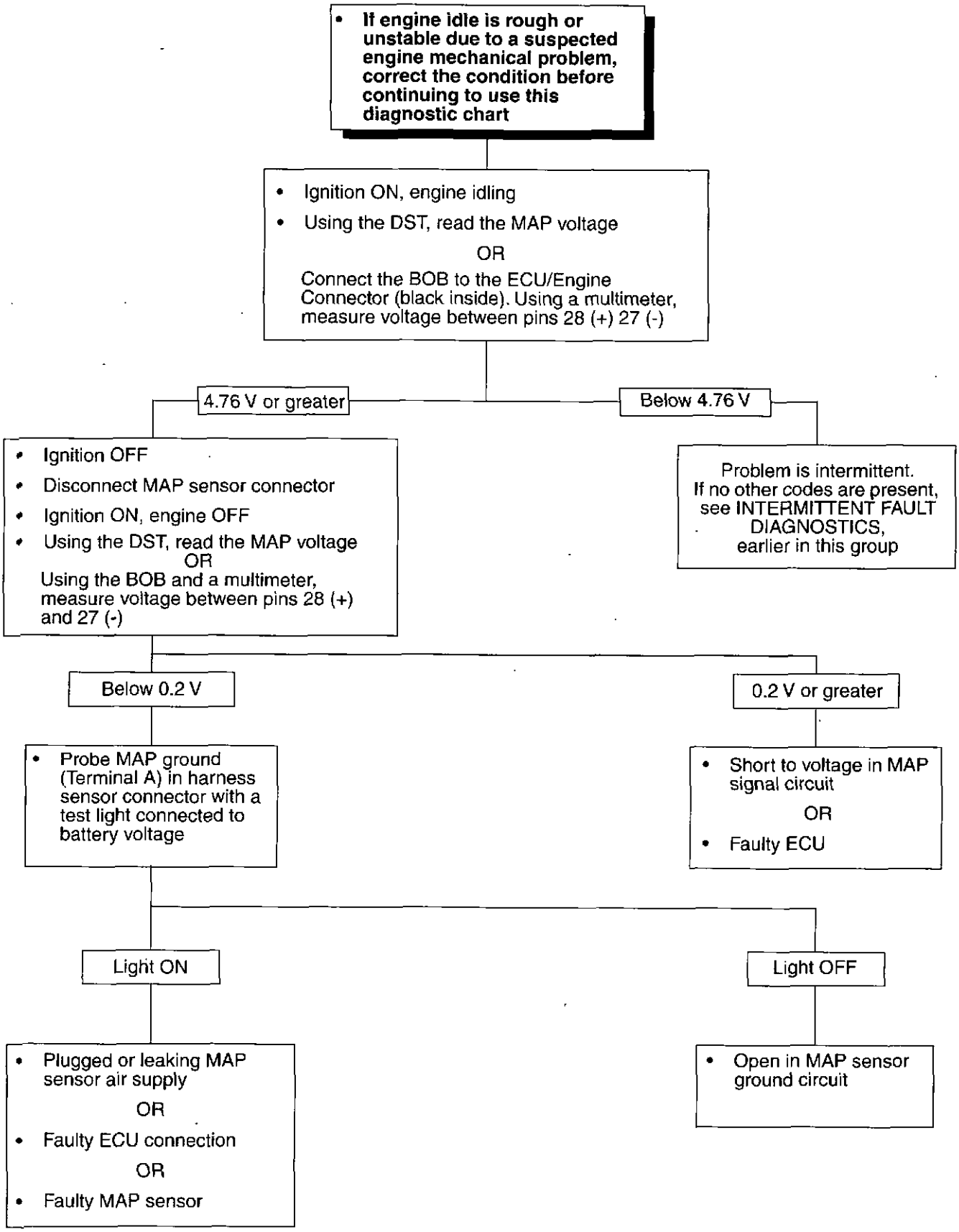
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **MAP (Manifold Air Pressure) Sensor** *(arrow)*
  - — The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, *input voltage to the ECU increases. The ECU* uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow.
- **Fault code 21 will set if:**
  - — The MAP input voltage exceeds 4.76 volts
- **If fault code 21 sets, the following will occur:**
  - — The ECU will use "limp-home" MAP values
  - — *Engine power will be slightly derated*

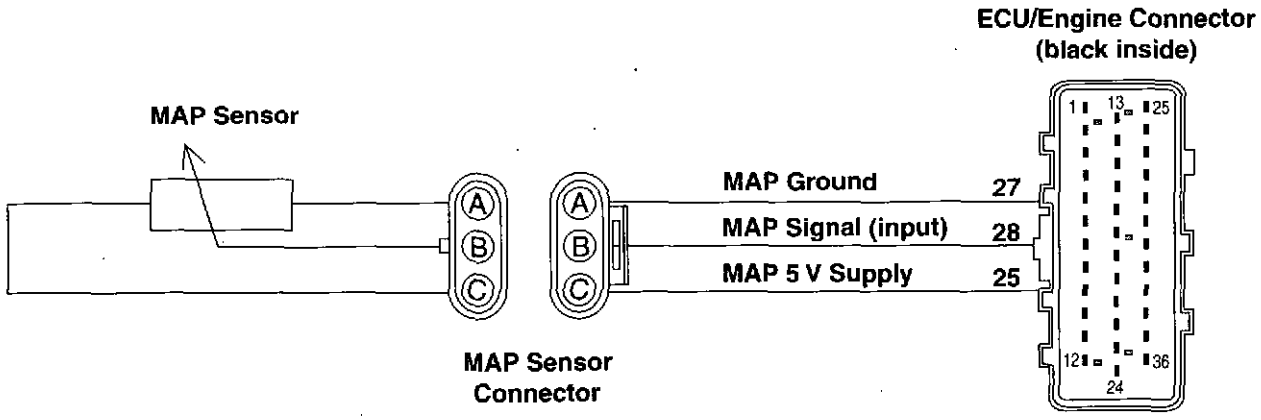


MAP Sensor Location

DFC 21 MAP INPUT VOLTAGE TOO HIGH—CONTINUED

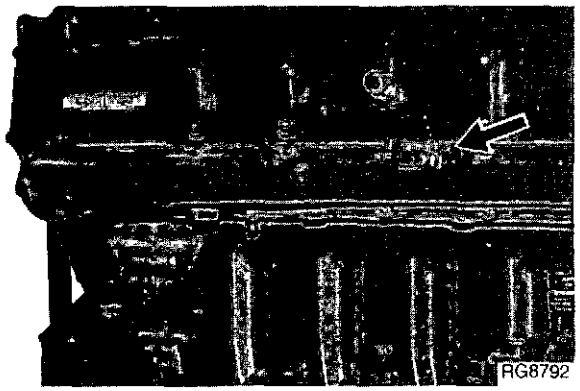


DFC 22 MAP INPUT VOLTAGE TOO LOW



MAP Sensor Wiring

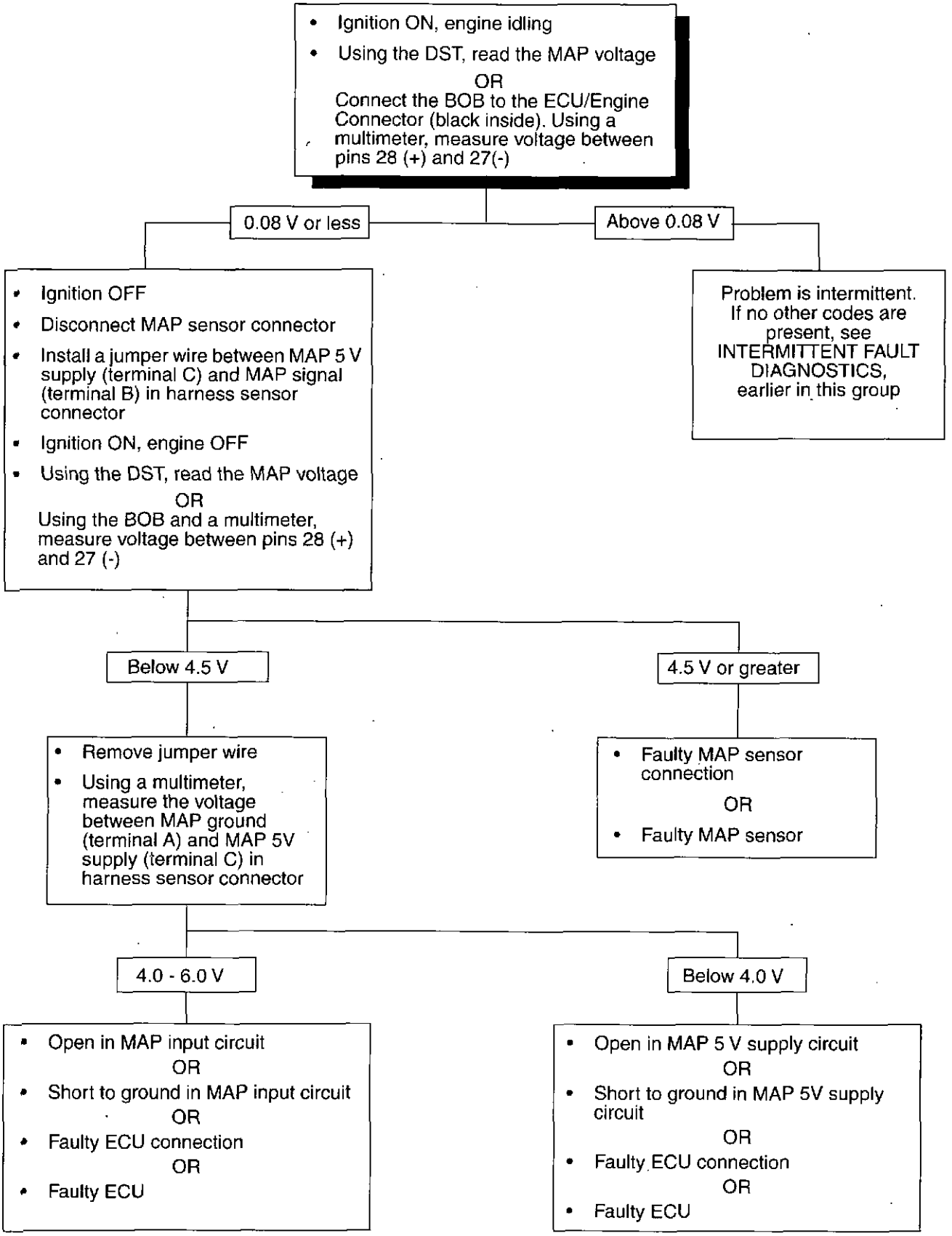
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.



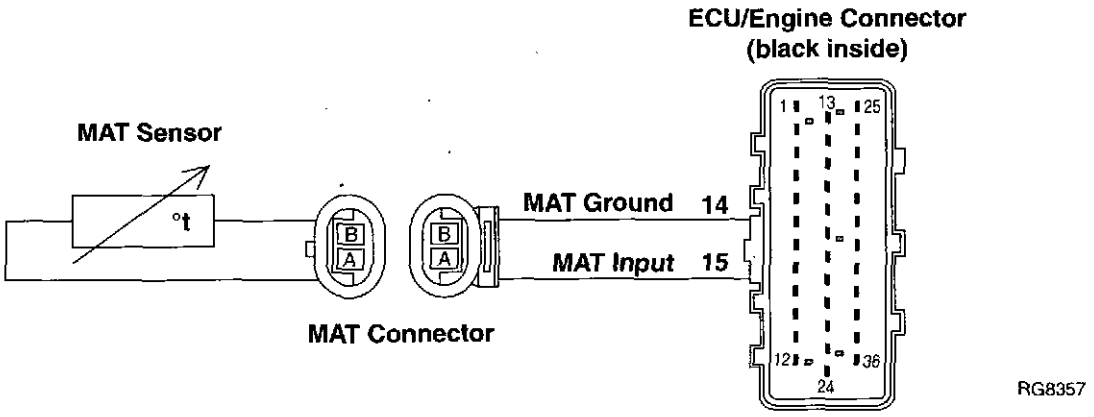
MAP Sensor Location

- **MAP (Manifold Air Pressure) Sensor** *(arrow)*
  - — The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, input voltage to the ECU increases. The ECU uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow.
- **Fault code 22 will set if:**
  - — The MAP input voltage drops below 0.08 volts
- **If fault code 22 sets the following will occur:**
  - — The ECU will use "limp-home" MAP values
  - — Engine power will be slightly derated

DFC 22 MAP INPUT VOLTAGE TOO LOW—CONTINUED



DFC 23 MAT INPUT VOLTAGE TOO HIGH



MAT Sensor Wiring

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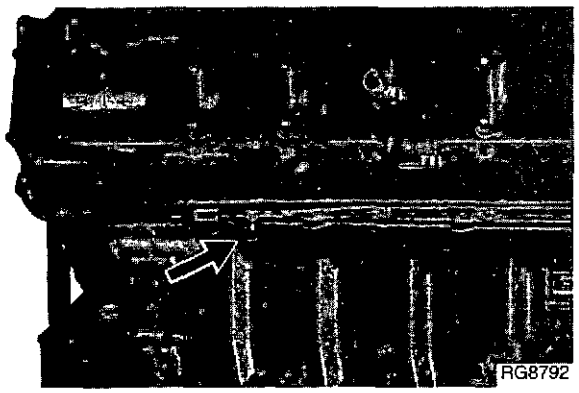
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **MAT (Manifold Air Temperature) Sensor** *(arrow)*
  - — The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow.
- **Fault code 23 will set if:**
  - — The MAT input voltage exceeds 4.93 volts
- **If fault code 23 sets the following will occur:**
  - — The ECU will use a default "limp-home" MAT value of 20°C (68°F)
  - — Cold temperature starting may be slightly harder than normal

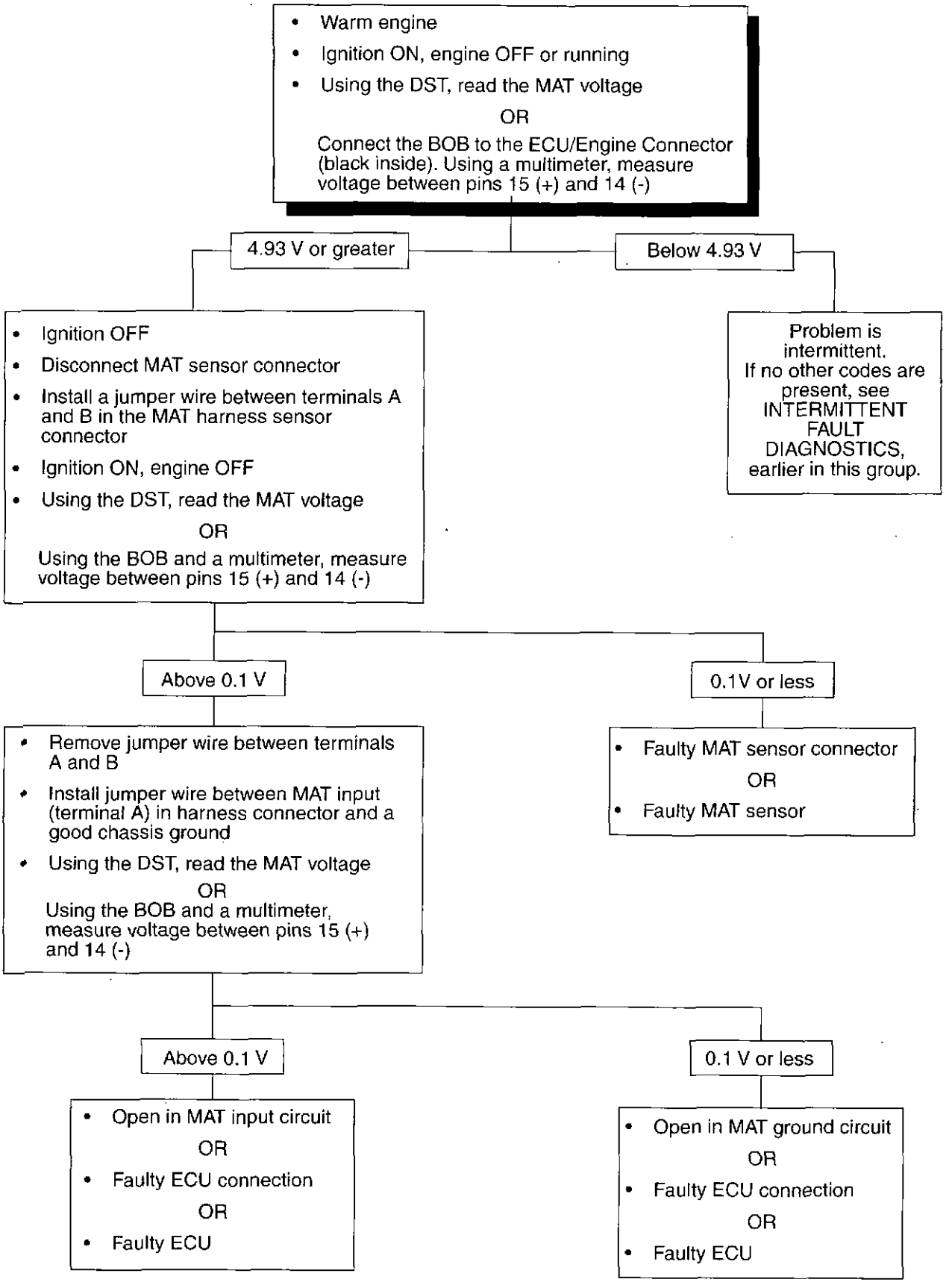


MAT Sensor Location

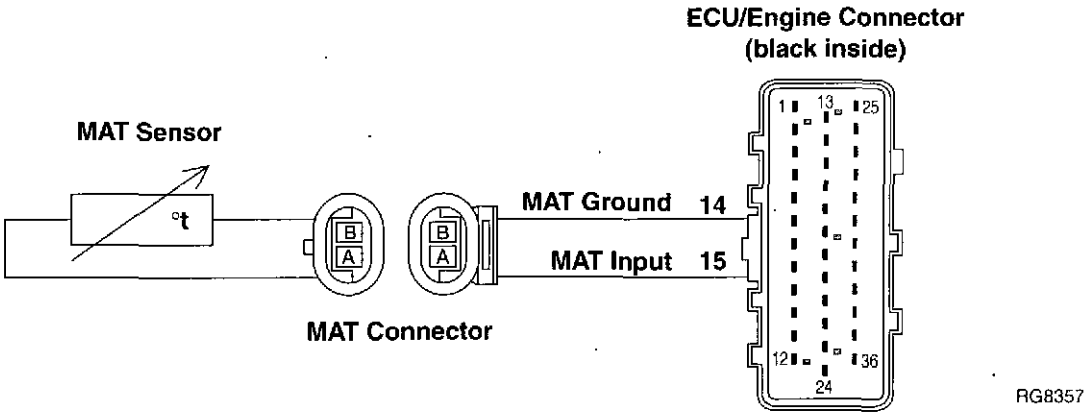
MAT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	12,540
-10 (14)	8,290
0 (32)	5,490
10 (50)	3,630
20 (68)	2,400
30 (86)	1,590
40 (104)	1,050
50 (122)	700
60 (140)	460
70 (158)	300
80 (176)	200

DFC 23 MAT INPUT VOLTAGE TOO HIGH—CONTINUED



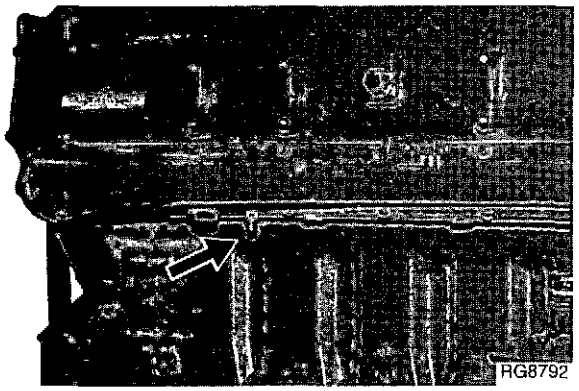
DFC 24 MAT INPUT VOLTAGE TOO LOW



MAT Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **MAT (Manifold Air Temperature) Sensor** *(arrow)*
  - — The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow.
- **Fault code 24 will set if:**
  - — The MAT input voltage drops below 0.08 volts
- **If fault code 24 sets, the following will occur:**
  - — The ECU will use a default "limp-home" MAT value of 20°C (68°F)
  - — Cold temperature starting may be slightly harder than normal

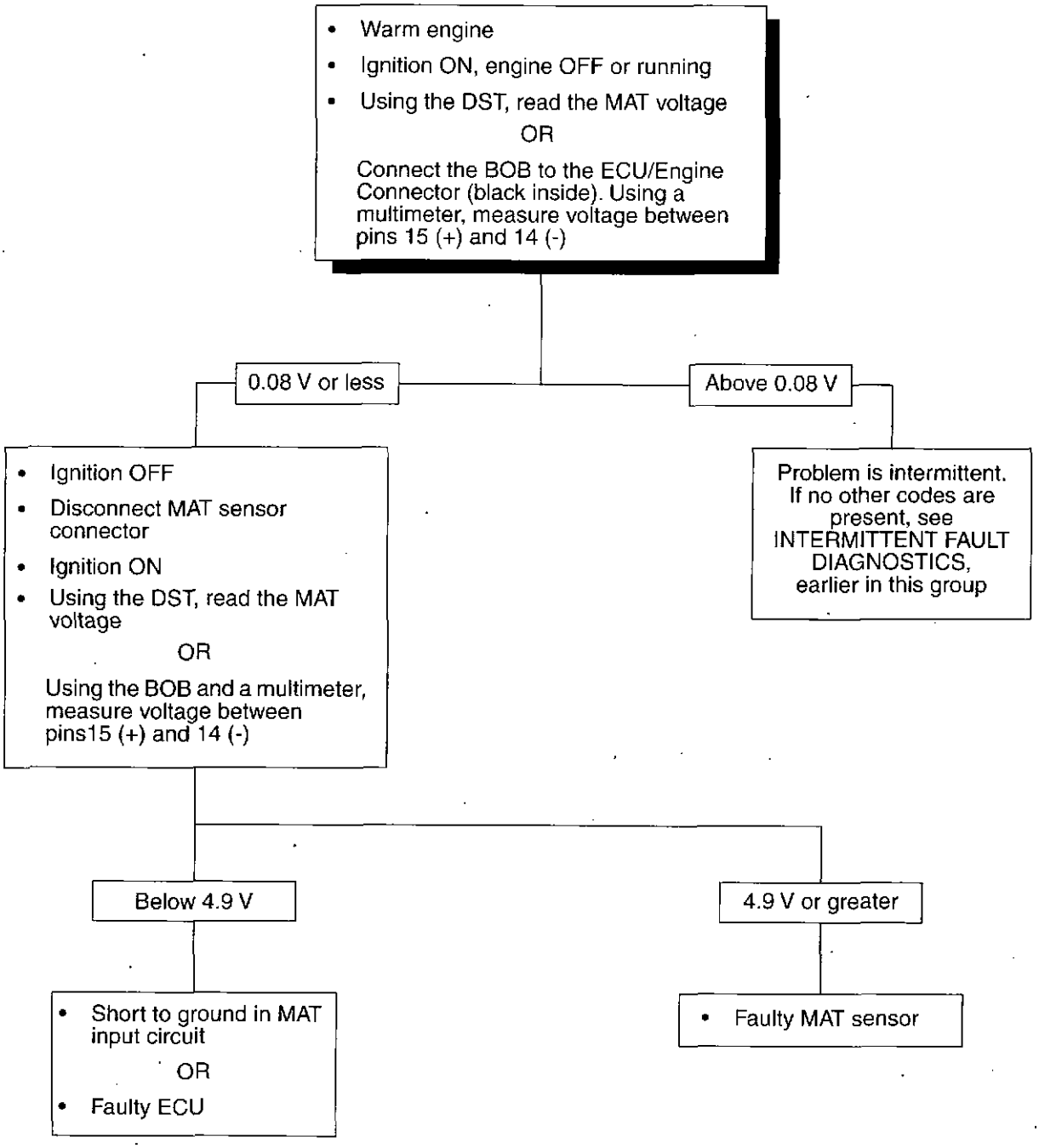


MAT Sensor Location

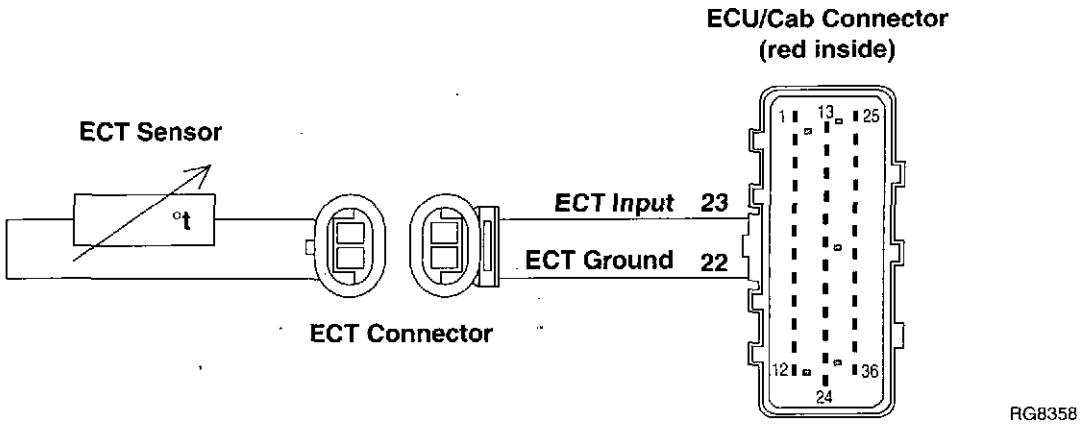
MAT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	12,540
-10 (14)	8,290
0 (32)	5,490
10 (50)	3,630
20 (68)	2,400
30 (86)	1,590
40 (104)	1,050
50 (122)	700
60 (140)	460
70 (158)	300
80 (176)	200

DFC 24 MAT INPUT VOLTAGE TOO LOW—CONTINUED



DFC 25 ECT INPUT VOLTAGE TOO HIGH



ECT Sensor Wiring

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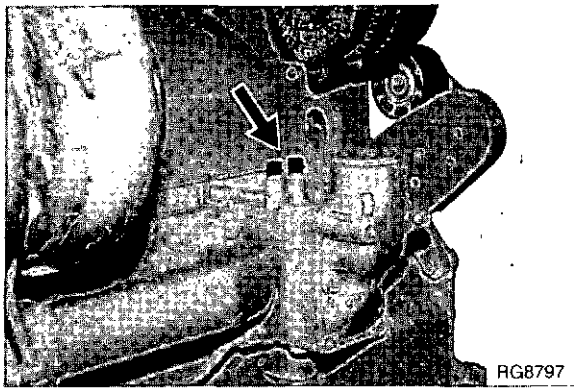
IMPORTANT: Do not force probes into connector terminals or damage will result. Use *JT07328 Connector Adapter Test Kit* to make measurements in connectors. This will ensure that terminal damage does not occur.

- **ECT (Engine Coolant Temperature) Sensor** *(arrow)*
  - — The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages.
- **Fault code 25 will set if:**
  - — The ECT input voltage exceeds 4.93 volts
- **If fault code 25 sets, the following will occur**
  - — The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated



ECT Sensor Location

ECT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 25 ECT INPUT VOLTAGE TOO HIGH—CONTINUED

- Warm engine
- Ignition ON, engine OFF or running
- Using the DST, read the ECT voltage

OR

Connect the BOB to the ECU/Cab Connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (-)

4.9 V or greater

- Ignition OFF
- Disconnect ECT sensor connector
- Install a jumper wire between terminals A and B in the ECT harness sensor connector
- Ignition ON, engine OFF
- Using the DST, read the ECT voltage

OR

Using the BOB and a multimeter, measure voltage between pins 23 (+) and 22 (-)

Above 0.1 V

- Remove jumper wire between terminals A and B
- Install jumper wire between ECT input (refer to machine manual to determine which terminal is input) in harness sensor connector and a good chassis ground
- Using the DST, read the ECT voltage

OR

Using the BOB and a multimeter, measure voltage between pins 23 (+) and 22 (-)

Above 0.1 V

- Open in ECT input circuit

OR

- Faulty ECU connection

OR

- Faulty ECU

0.1 V or less

- Open in ECT ground circuit

OR

- Faulty ECU connection

OR

- Faulty ECU

0.1 V or less

- Faulty ECT sensor connector

OR

- Faulty ECT sensor

Below 4.9 V

Problem is intermittent. If no other fault codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

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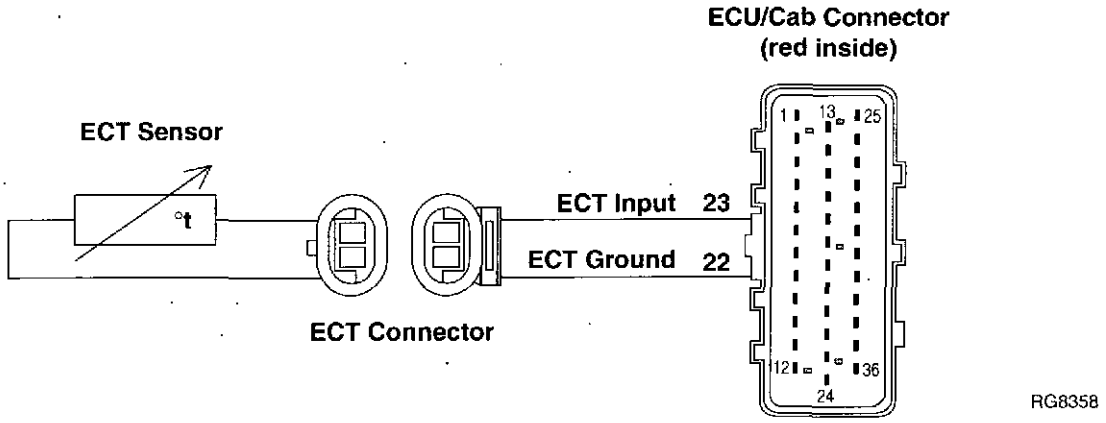
DFC 26 ECT INPUT VOLTAGE TOO LOW



ECT Sensor Wiring

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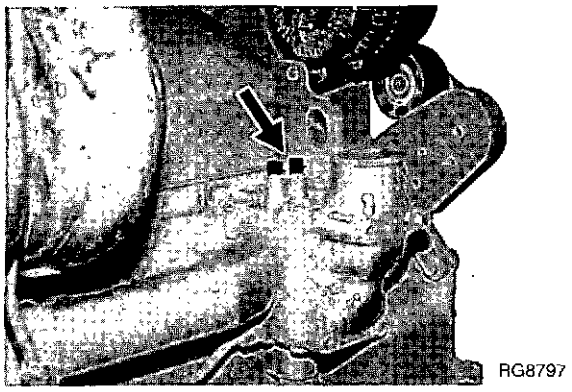
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **ECT (Engine Coolant Temperature) Sensor** *(arrow)*
  - — The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages.
- **Fault code 26 will set if:**
  - — The ECT input voltage drops below 0.08 volts.
- **If fault code 26 sets, the following will occur**
  - — The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated.

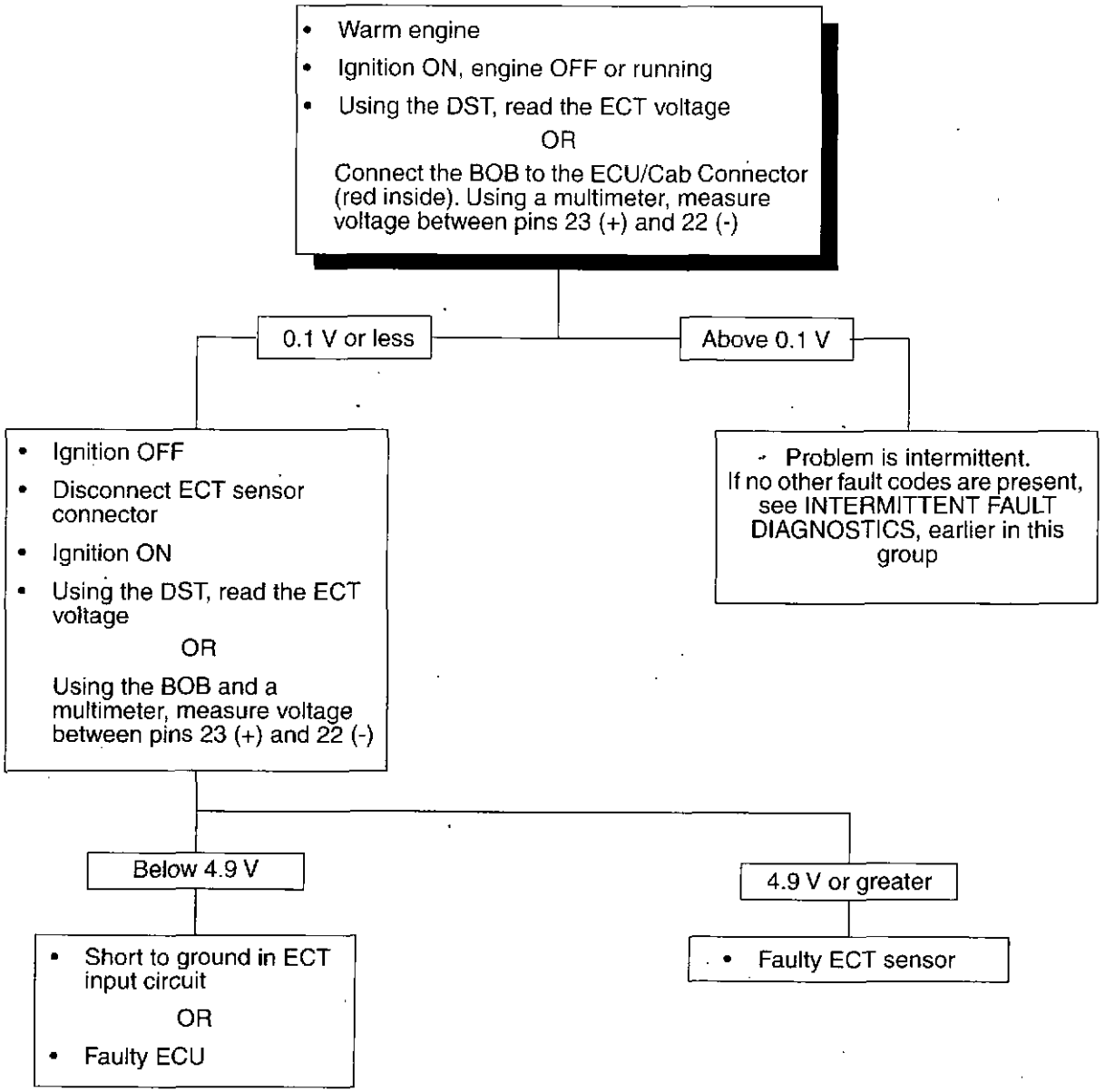


ECT Sensor Location

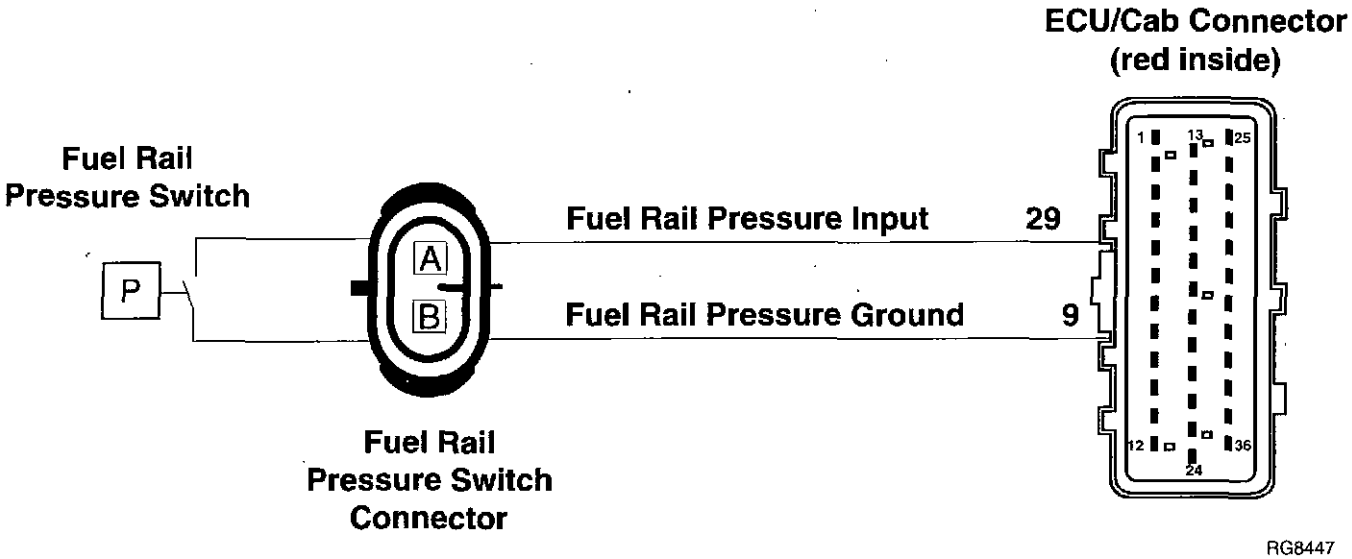
ECT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 26 ECT INPUT VOLTAGE TOO LOW—CONTINUED



DFC 27 FUEL RAIL PRESSURE PERIODICALLY LOW



Fuel Rail Pressure Switch Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Pressure Switch**
  - — The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi) the switch will open.
- **Fault code 27 will set if:**
  - — Fuel rail pressure is below 296 kPa (43 psi) for 40 seconds.
- **If fault code 27 sets, the following will occur:**
  - — Engine operation will not be affected.

DFC 27 FUEL RAIL PRESSURE PERIODICALLY LOW—CONTINUED

- Warm engine to normal operating temperature
- Using a pressure gauge, measure fuel pressure. See MEASURE FUEL SUPPLY PUMP PRESSURE in Group 105.

Fuel pressure OK

- Ignition ON, engine OFF
- Clear DFC 27
- Ignition ON, engine idling for at least one minute

DFC 27 reoccurs

- Ignition ON, engine OFF
- Clear DFC 27
- Ignition OFF
- Disconnect fuel pressure switch harness connector
- Install jumper wire between both terminals in fuel pressure switch harness connector
- Ignition ON, engine idling for at least one minute

DFC 27 reoccurs

- Ignition OFF
- Remove jumper wire
- Probe ground terminal in fuel pressure switch harness connector with a test light connected to battery voltage

Light ON

- Open in fuel pressure switch signal (input) circuit

OR

- Faulty fuel pressure switch connection

OR

- Faulty ECU

Light OFF

- Open in fuel pressure switch ground circuit

DFC 27 cleared

- Faulty fuel pressure switch

DFC 27 cleared

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

Fuel pressure low

- Determine cause of low fuel pressure, repair problem and retest

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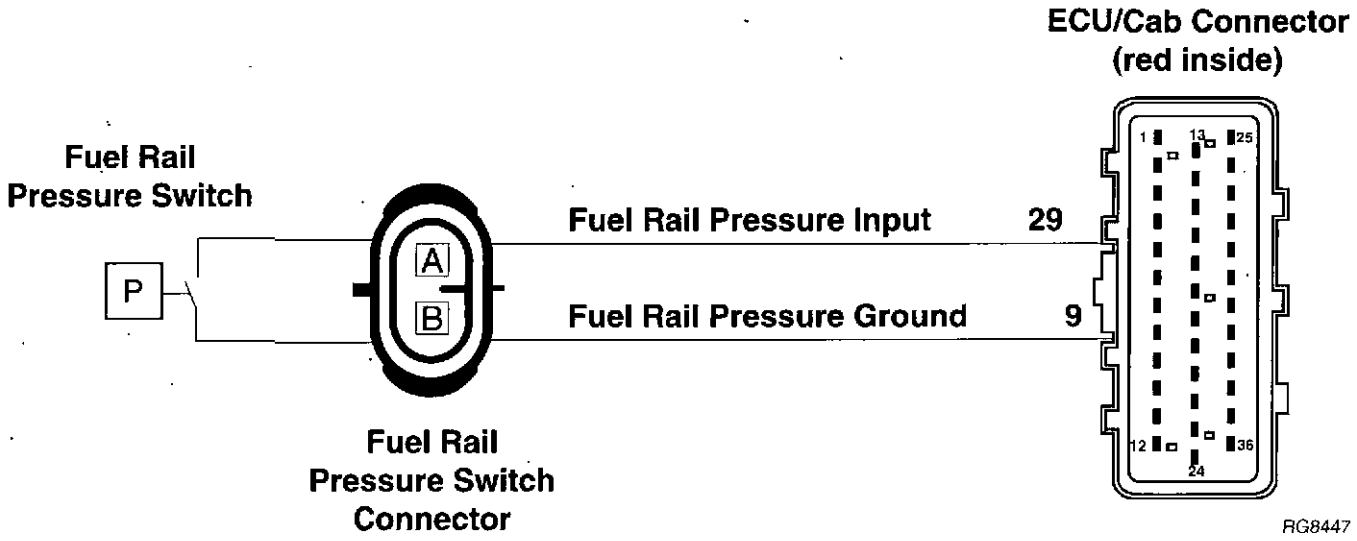
DFC 28 FUEL RAIL PRESSURE CONTINUOUSLY LOW



Fuel Rail Pressure Switch Wiring

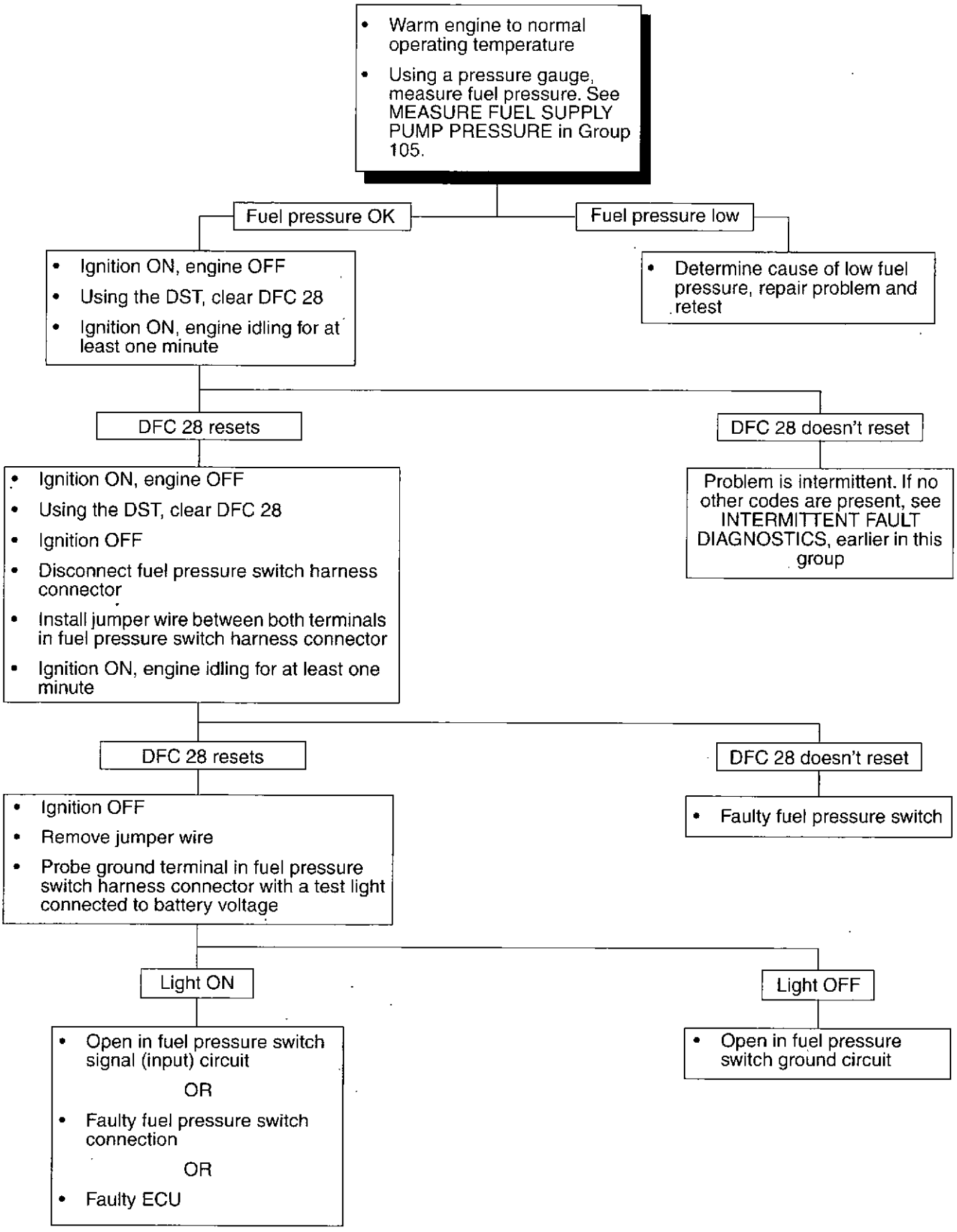
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Pressure Switch**
  - — The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi) the switch will open.

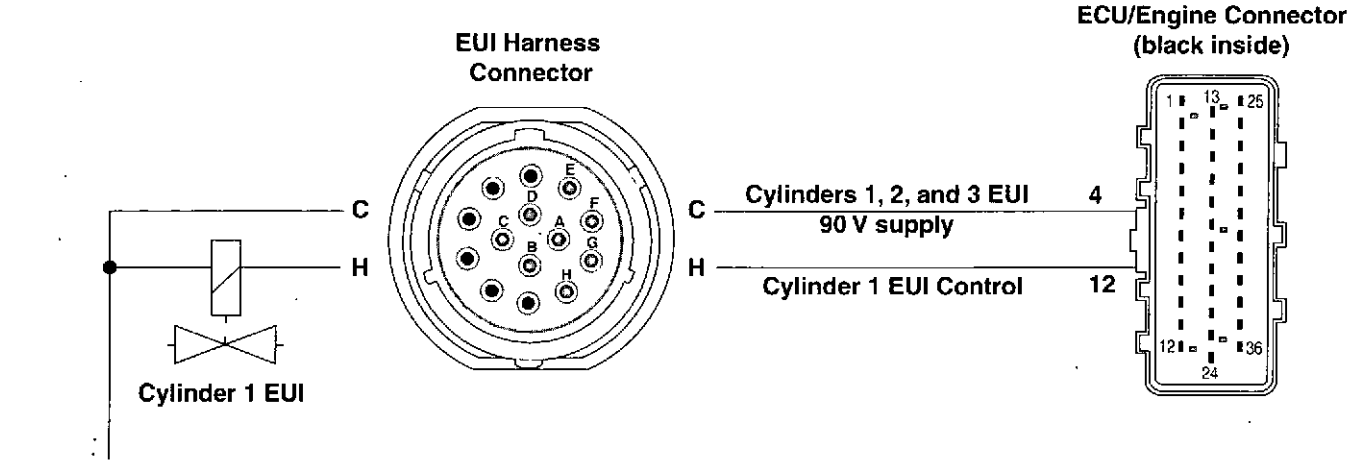
- **Fault code 28 will set if:**
  - — Fuel rail pressure is below 296 kPa (43 psi) continuously for 14 minutes.

- **If fault code 28 sets, the following will occur:**
  - — Immediately after fault code 28 sets, engine power will be derated 10%.
  - — If fault code 28 stays active for 20 minutes, engine power will be derated 30%.

DFC 28 FUEL RAIL PRESSURE CONTINUOUSLY LOW—CONTINUED



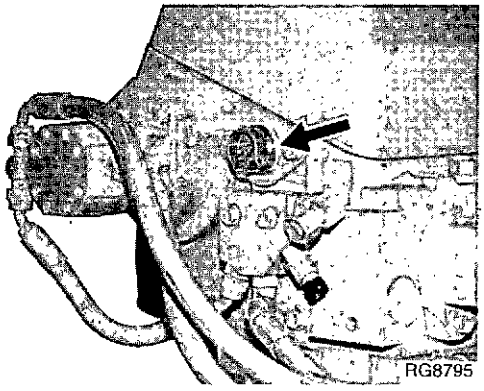
DFC 31 CYLINDER 1 EUI FAULT



Cylinder 1 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

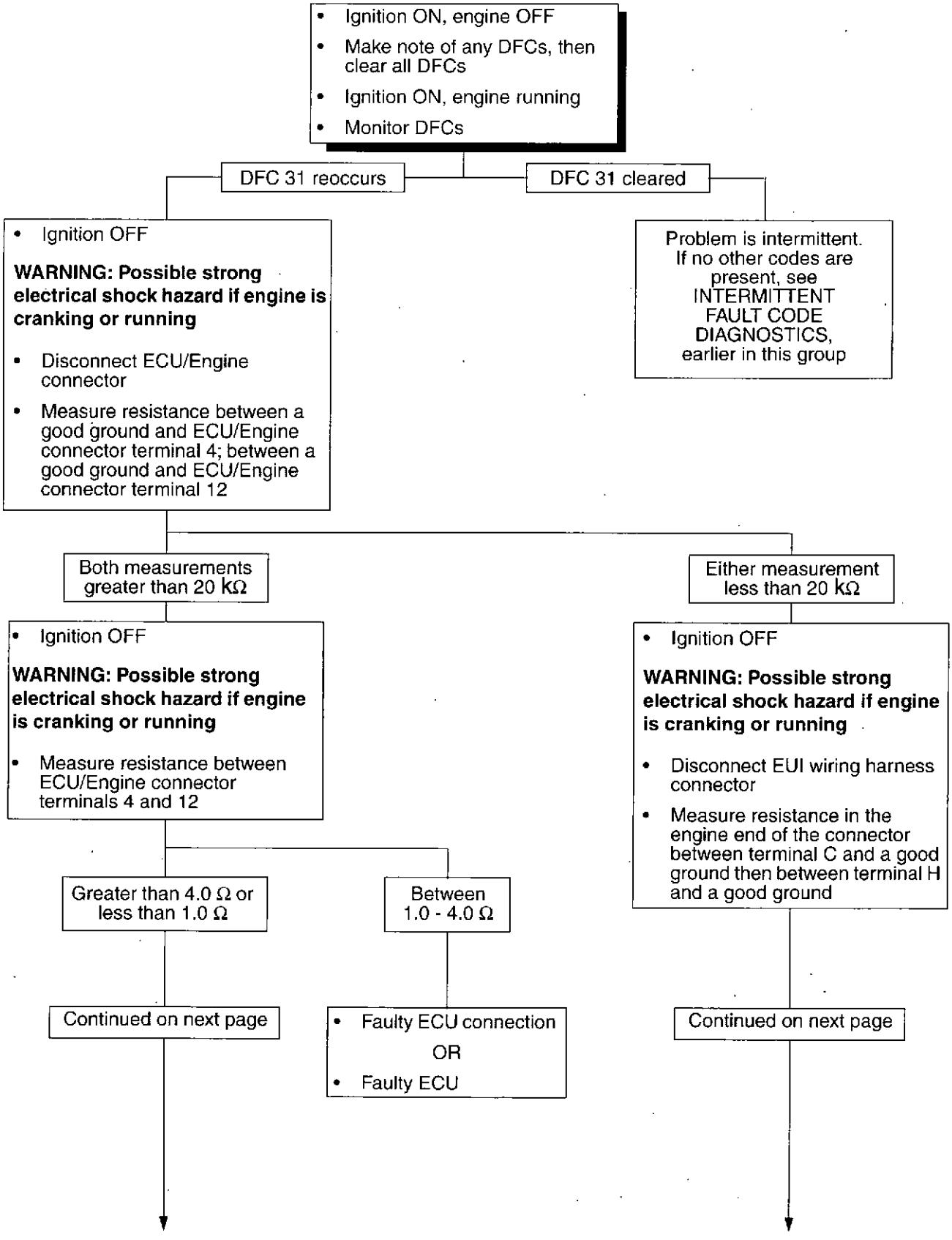
- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 32 and 33 are set along with 31, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.



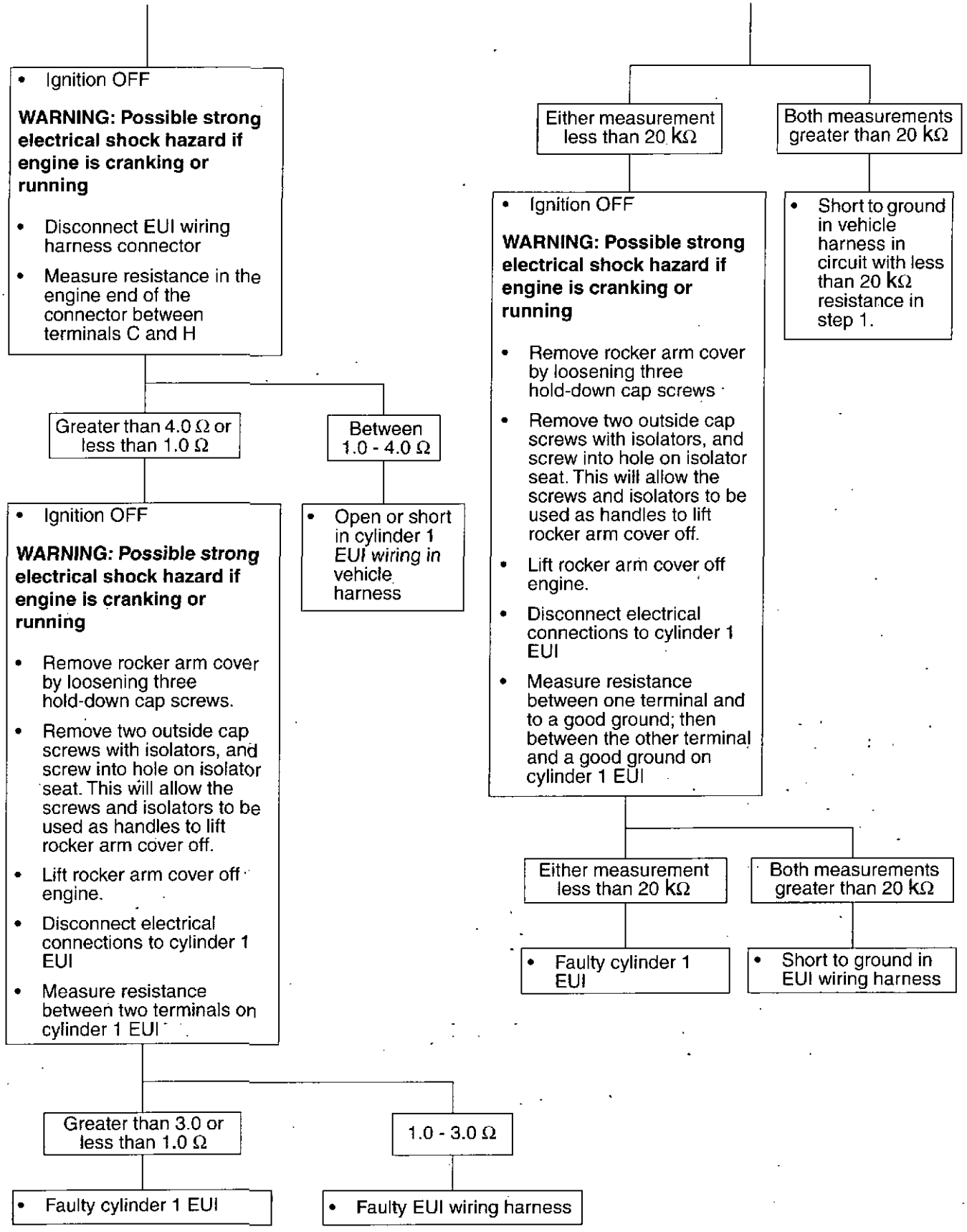
EUI Harness Connector Location

- **Fault code 31 will set if:**
  - — The ECU detects an open or a short in the cylinder number 1 EUI circuitry.
- **If fault code 31 sets, the following will occur:**
  - — With fault code 31 active, the ECU doesn't control the system any differently. Depending on the cause of code 31, cylinder number 1 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 32 and 33 are set along with code 31, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

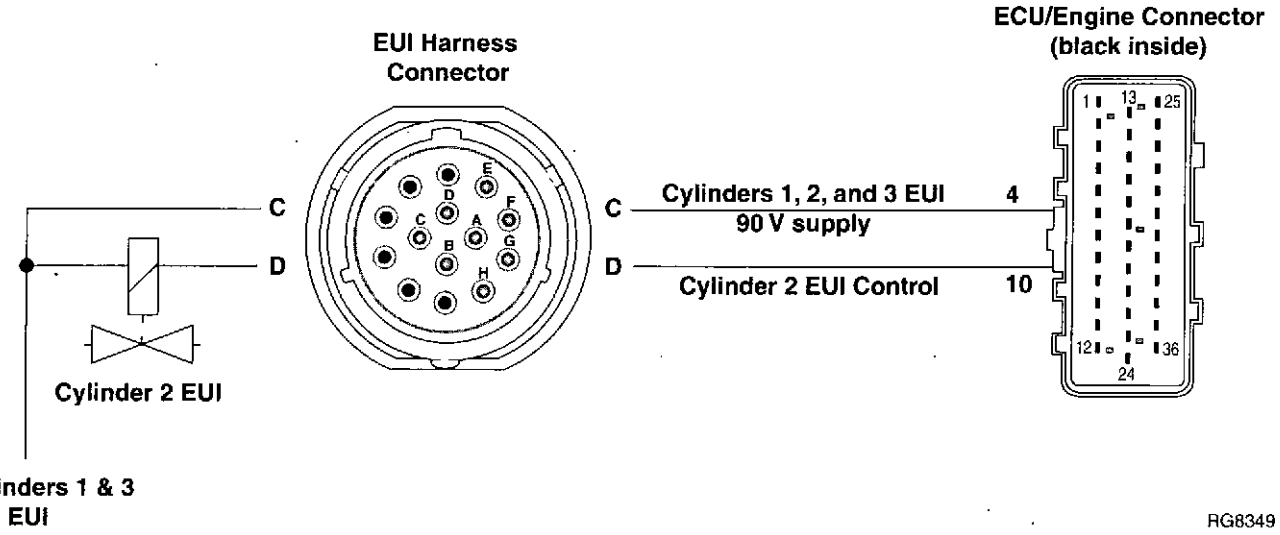
DFC 31 CYLINDER 1 EUI FAULT—CONTINUED



DFC 31 CYLINDER 1 EUI FAULT—CONTINUED



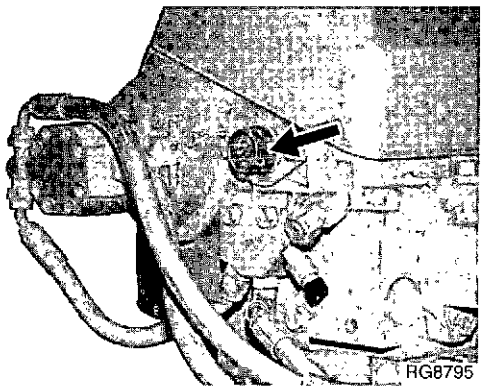
DFC 32 CYLINDER 2 EUI FAULT



Cylinder 2 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

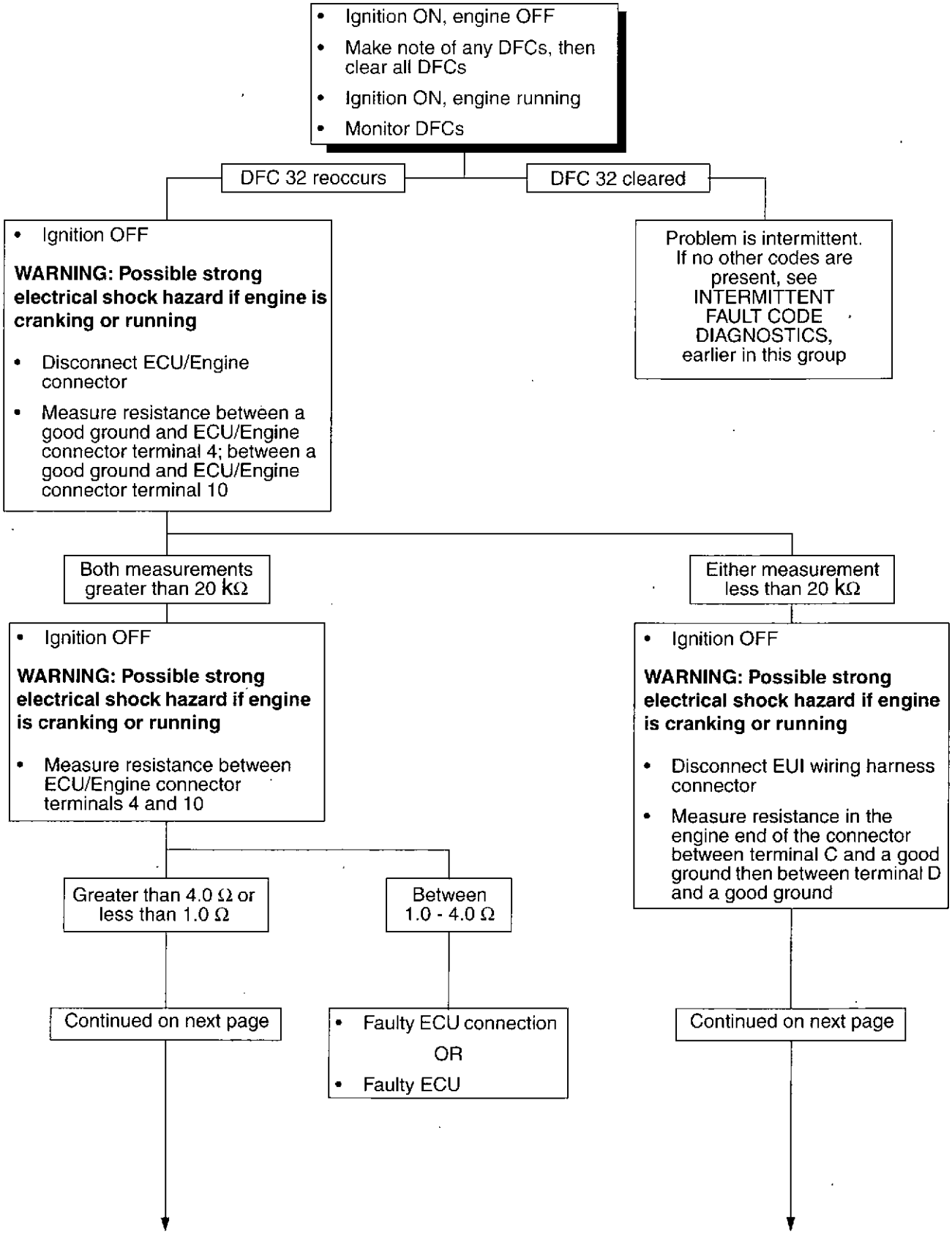
- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 31 and 33 are set along with 32, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.



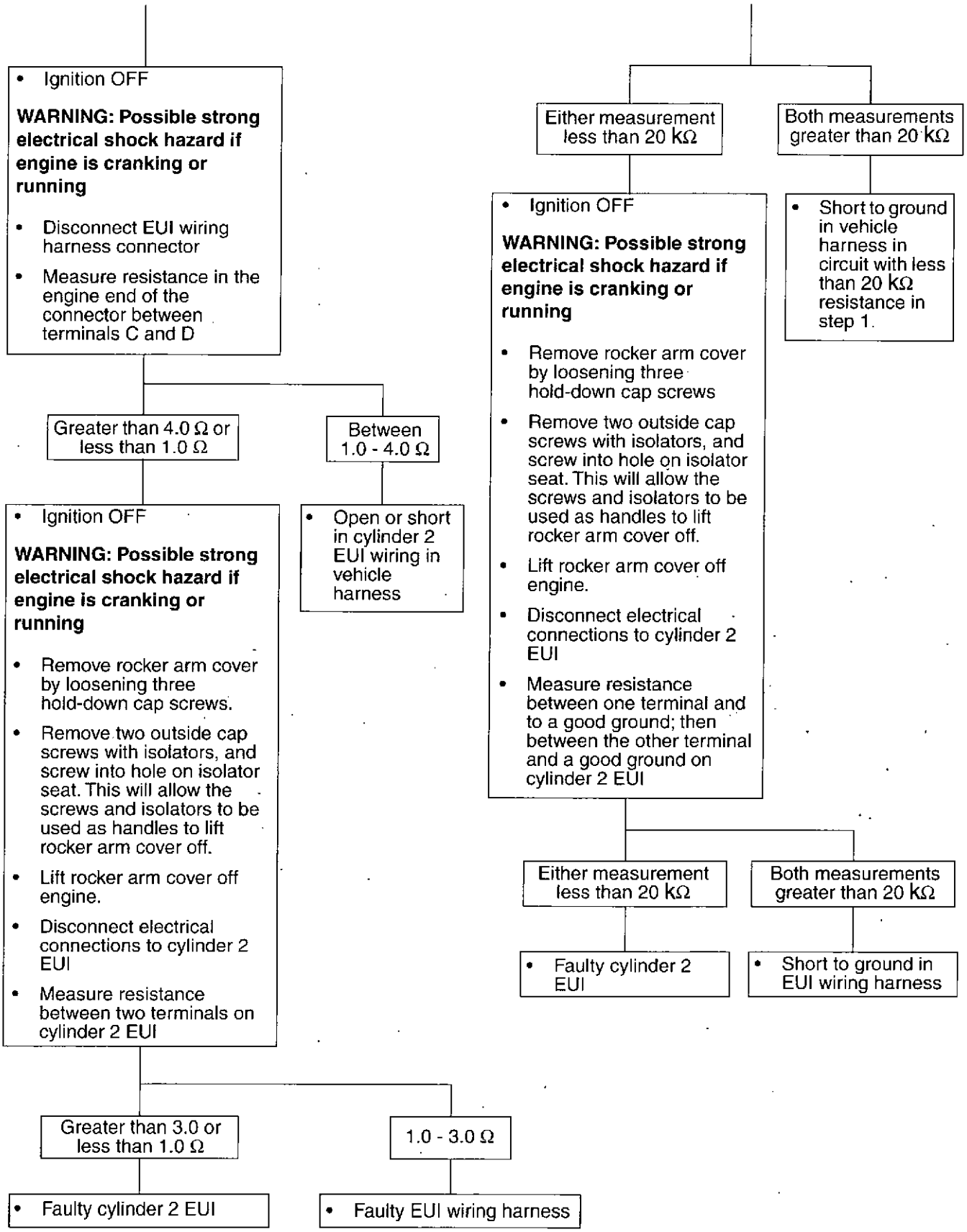
EUI Harness Connector Location

- **Fault code 32 will set if:**
  - — The ECU detects an open or a short in the cylinder number 2 EUI circuitry.
- **If fault code 32 sets, the following will occur:**
  - — With fault code 32 active, the ECU doesn't control the system any differently. Depending on the cause of code 32, cylinder number 2 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 31 and 33 are set along with code 32, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

DFC 32 CYLINDER 2 EUI FAULT—CONTINUED



DFC 32 CYLINDER 2 EUI FAULT—CONTINUED



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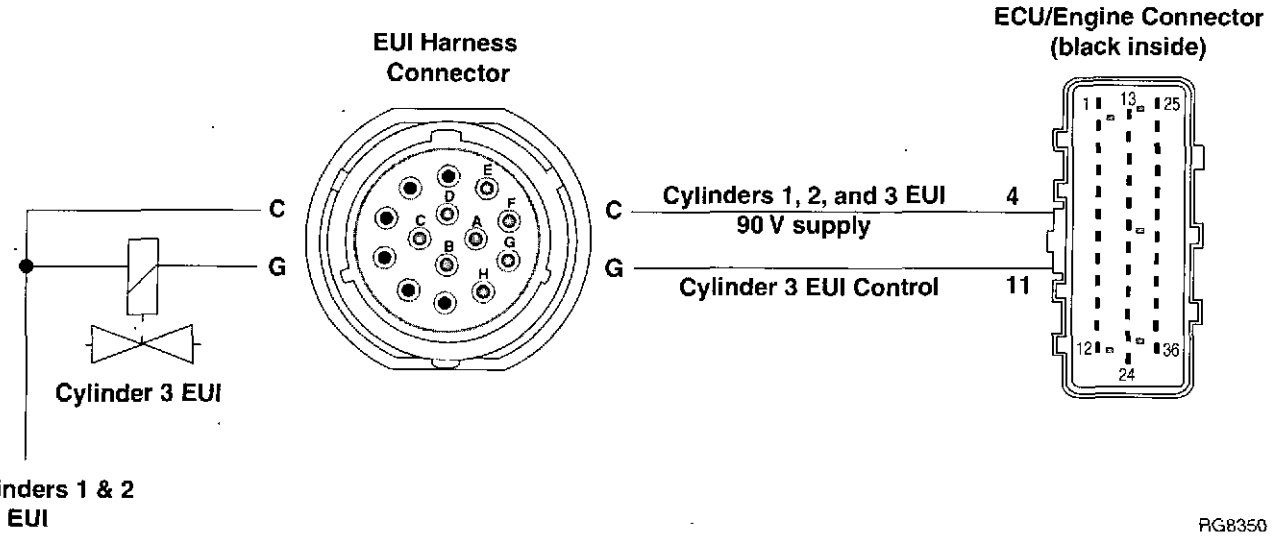
80

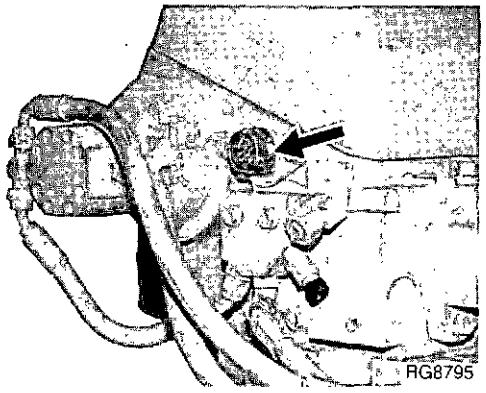
DFC 33 CYLINDER 3 EUI FAULT



Cylinder 3 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 31 and 32 are set along with 33, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.

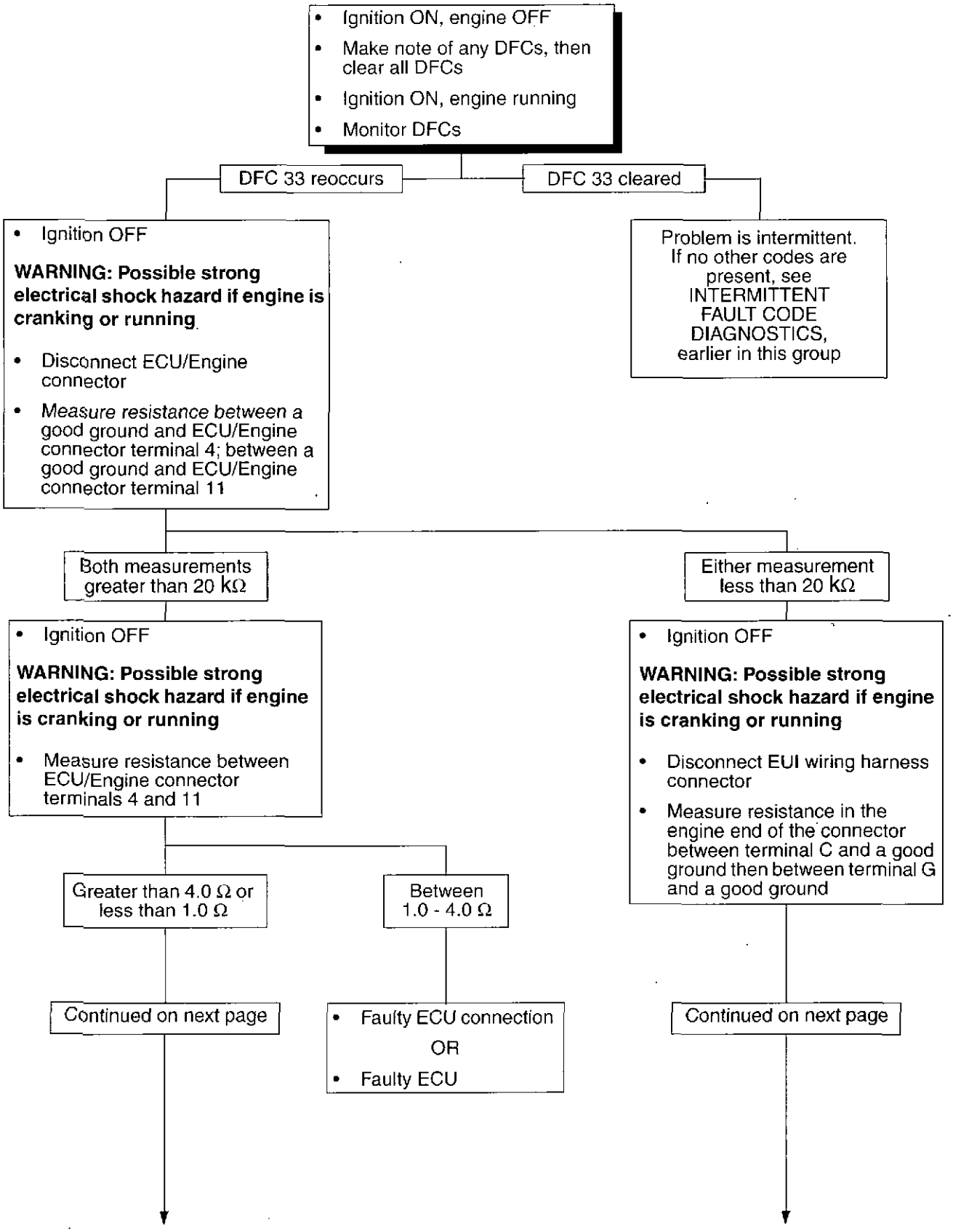


EUI Harness Connector Location

- **Fault code 33 will set if:**
  - — The ECU detects an open or a short in the cylinder number 3 EUI circuitry.
- **If fault code 33 sets, the following will occur:**
  - — With fault code 33 active, the ECU doesn't control the system any differently. Depending on the cause of code 33, cylinder number 3 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 31 and 32 are set along with code 33, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

115
82

DFC 33 CYLINDER 3 EUI FAULT—CONTINUED



DFC 33 CYLINDER 3 EUI FAULT—CONTINUED

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Disconnect EUI wiring harness connector
- Measure resistance in the engine end of the connector between terminals C and G

Greater than 4.0 Ω or less than 1.0 Ω

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Remove rocker arm cover by loosening three hold-down cap screws.
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.
- Disconnect electrical connections to cylinder 3 EUI
- Measure resistance between two terminals on cylinder 3 EUI

Greater than 3.0 or less than 1.0 Ω

- Faulty cylinder 3 EUI

1.0 - 3.0 Ω

- Faulty EUI wiring harness

Between 1.0 - 4.0 Ω

- Open or short in cylinder 3 EUI wiring in vehicle harness

Either measurement less than 20 kΩ

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Remove rocker arm cover by loosening three hold-down cap screws
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.
- Disconnect electrical connections to cylinder 3 EUI
- Measure resistance between one terminal and to a good ground; then between the other terminal and a good ground on cylinder 3 EUI

Either measurement less than 20 kΩ

- Faulty cylinder 3 EUI

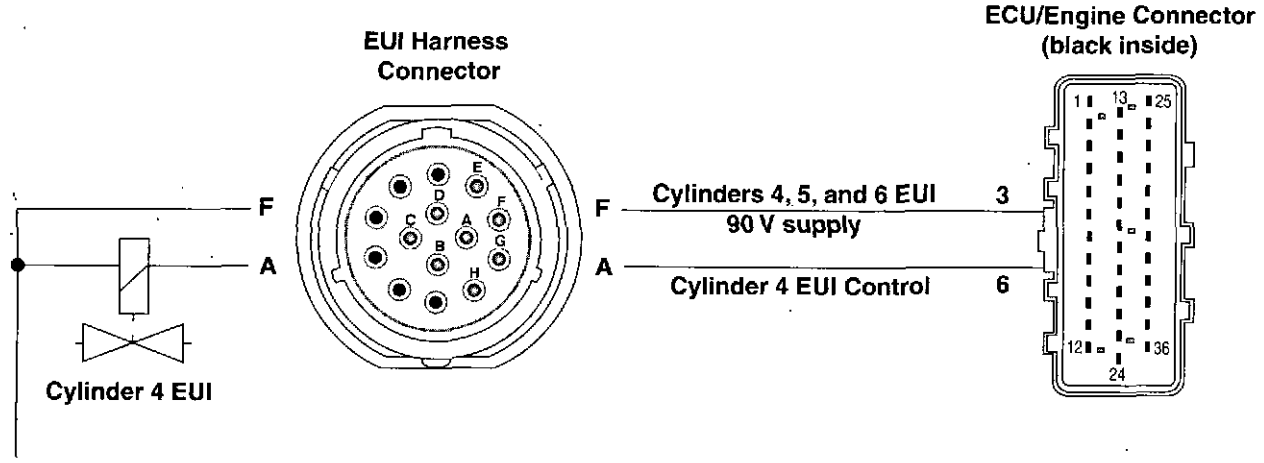
Both measurements greater than 20 kΩ

- Short to ground in EUI wiring harness

Both measurements greater than 20 kΩ

- Short to ground in vehicle harness in circuit with less than 20 kΩ resistance in step 1.

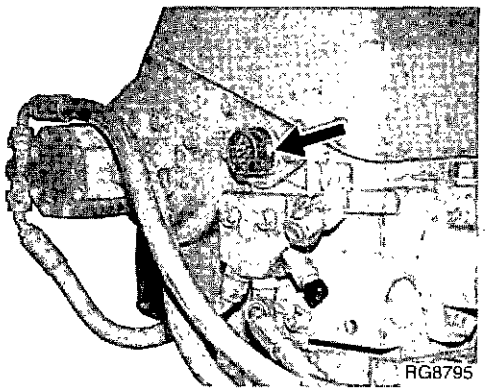
DFC 34 CYLINDER 4 EUI FAULT



Cylinder 4 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

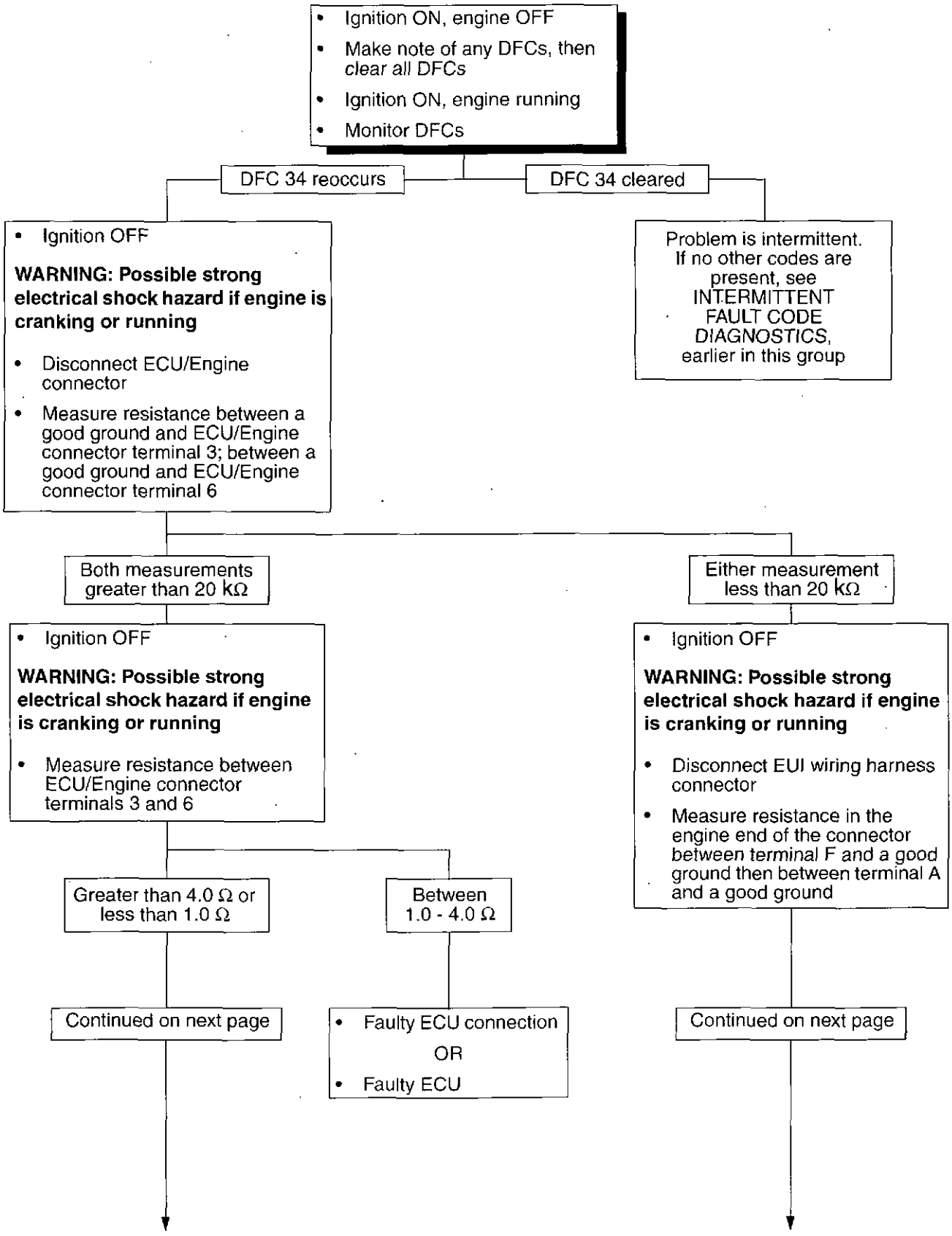
- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 35 and 36 are set along with 34, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.



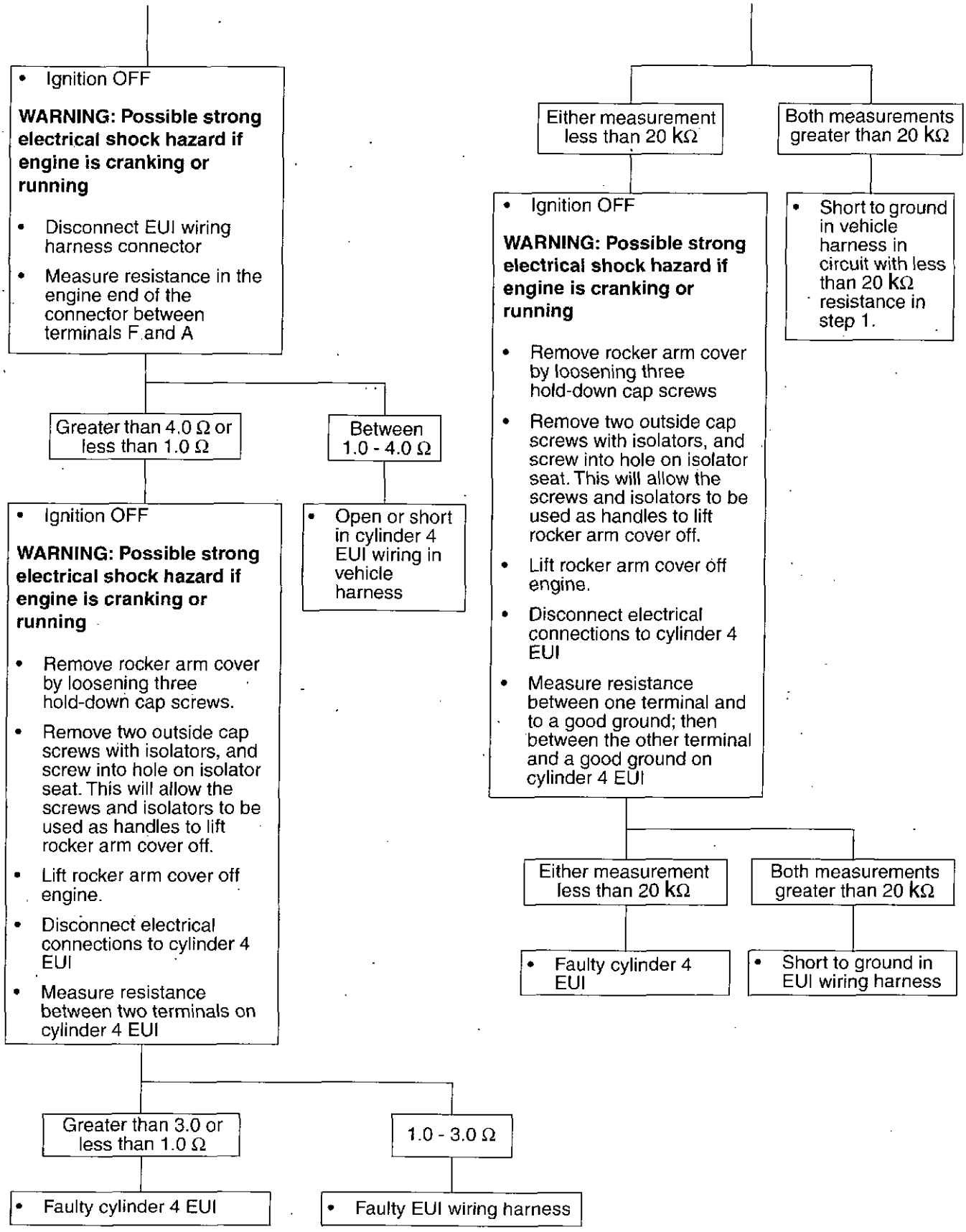
EUI Harness Connector Location

- **Fault code 34 will set if:**
  - — The ECU detects an open or a short in the cylinder number 4 EUI circuitry.
- **If fault code 34 sets, the following will occur:**
  - — With fault code 34 active, the ECU doesn't control the system any differently. Depending on the cause of code 34, cylinder number 4 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 35 and 36 are set along with code 34, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

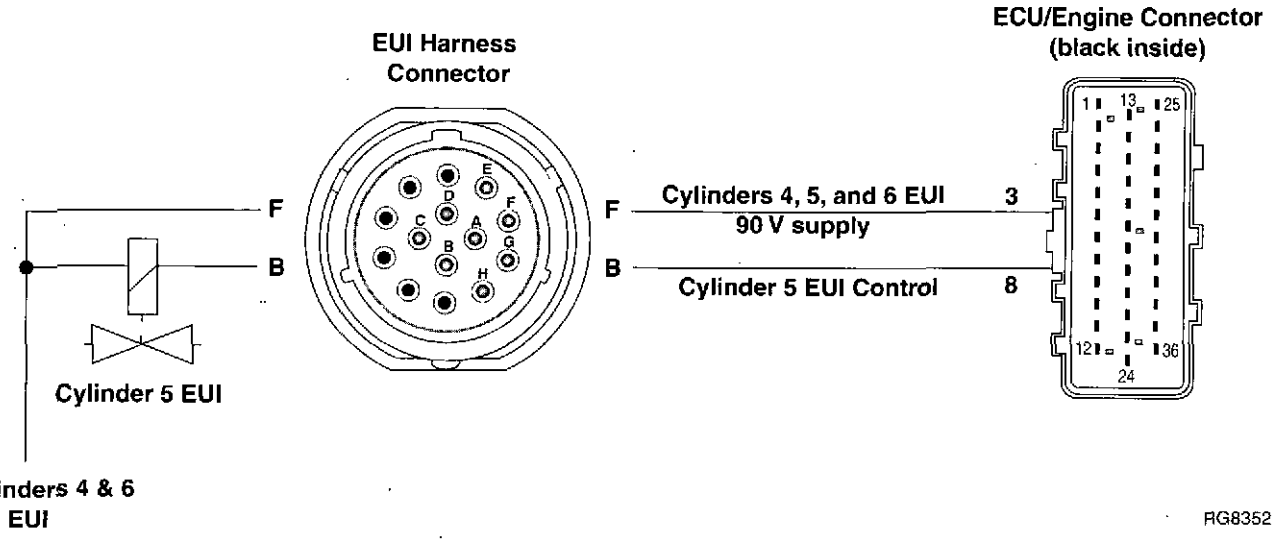
DFC 34 CYLINDER 4 EUI FAULT—CONTINUED



DFC 34 CYLINDER 4 EUI FAULT—CONTINUED



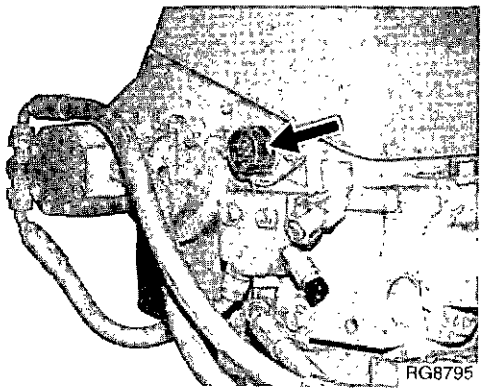
DFC 35 CYLINDER 5 EUI FAULT



Cylinder 5 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

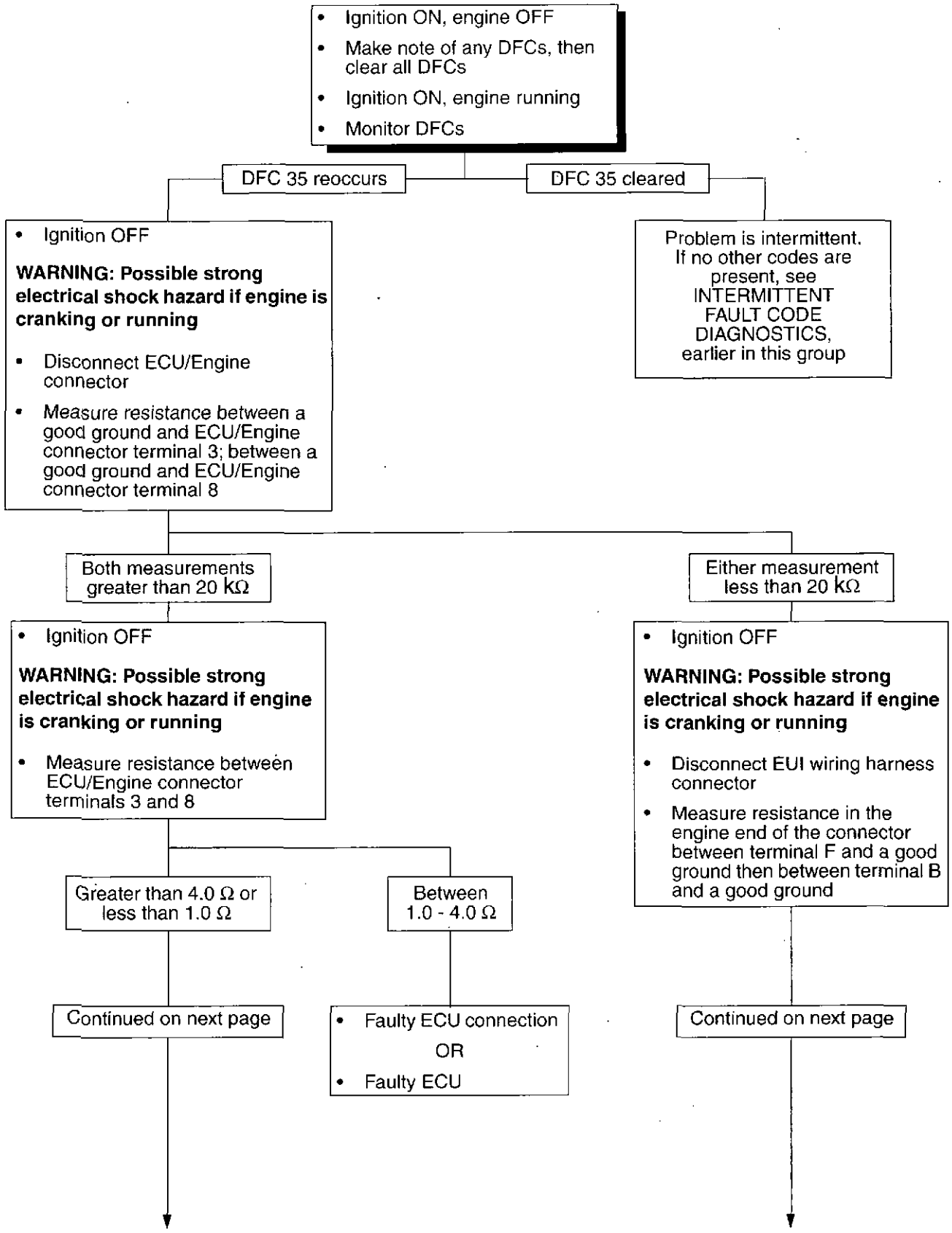
- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 34 and 36 are set along with 35, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.



EUI Harness Connector Location

- **Fault code 35 will set if:**
  - — The ECU detects an open or a short in the cylinder number 5 EUI circuitry.
- **If fault code 35 sets, the following will occur:**
  - — With fault code 35 active, the ECU doesn't control the system any differently. Depending on the cause of code 35, cylinder number 5 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 34 and 36 are set along with code 35, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

DFC 35 CYLINDER 5 EUI FAULT—CONTINUED



DFC 35 CYLINDER 5 EUI FAULT—CONTINUED

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Disconnect EUI wiring harness connector
- Measure resistance in the engine end of the connector between terminals F and B

Greater than 4.0 Ω or less than 1.0 Ω

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Remove rocker arm cover by loosening three hold-down cap screws.
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.
- Disconnect electrical connections to cylinder 5 EUI
- Measure resistance between two terminals on cylinder 5 EUI

Greater than 3.0 or less than 1.0 Ω

- Faulty cylinder 5 EUI

1.0 - 3.0 Ω

- Faulty EUI wiring harness

Between 1.0 - 4.0 Ω

- Open or short in cylinder 5 EUI wiring in vehicle harness

Either measurement less than 20 kΩ

- Ignition OFF

WARNING: Possible strong electrical shock hazard if engine is cranking or running

- Remove rocker arm cover by loosening three hold-down cap screws
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.
- Disconnect electrical connections to cylinder 5 EUI
- Measure resistance between one terminal and to a good ground; then between the other terminal and a good ground on cylinder 5 EUI

Either measurement less than 20 kΩ

- Faulty cylinder 5 EUI

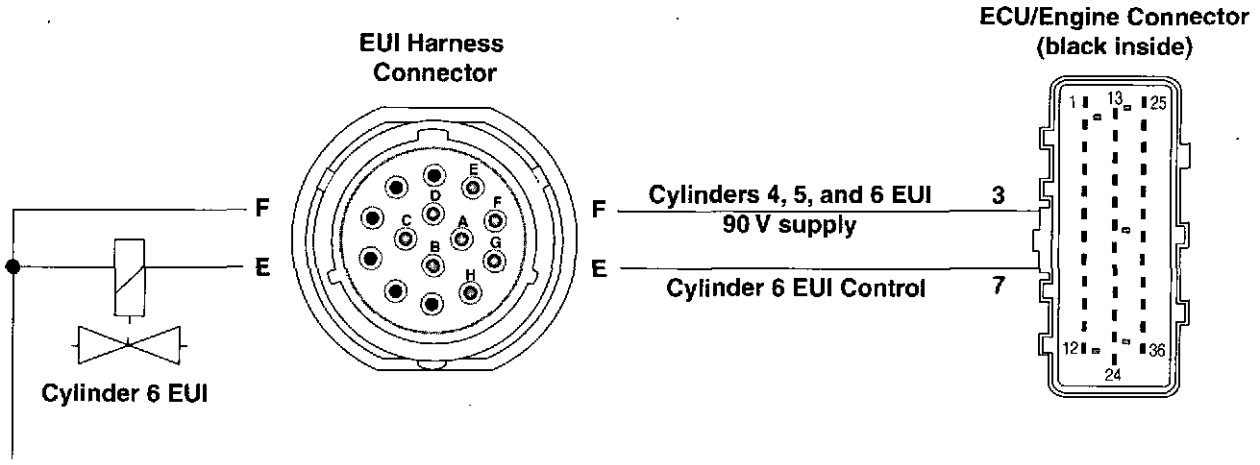
Both measurements greater than 20 kΩ

- Short to ground in EUI wiring harness

Both measurements greater than 20 kΩ

- Short to ground in vehicle harness in circuit with less than 20 kΩ resistance in step 1.

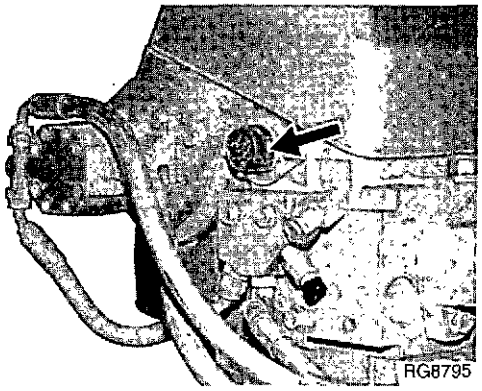
DFC 36 CYLINDER 6 EUI FAULT



Cylinder 6 EUI Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

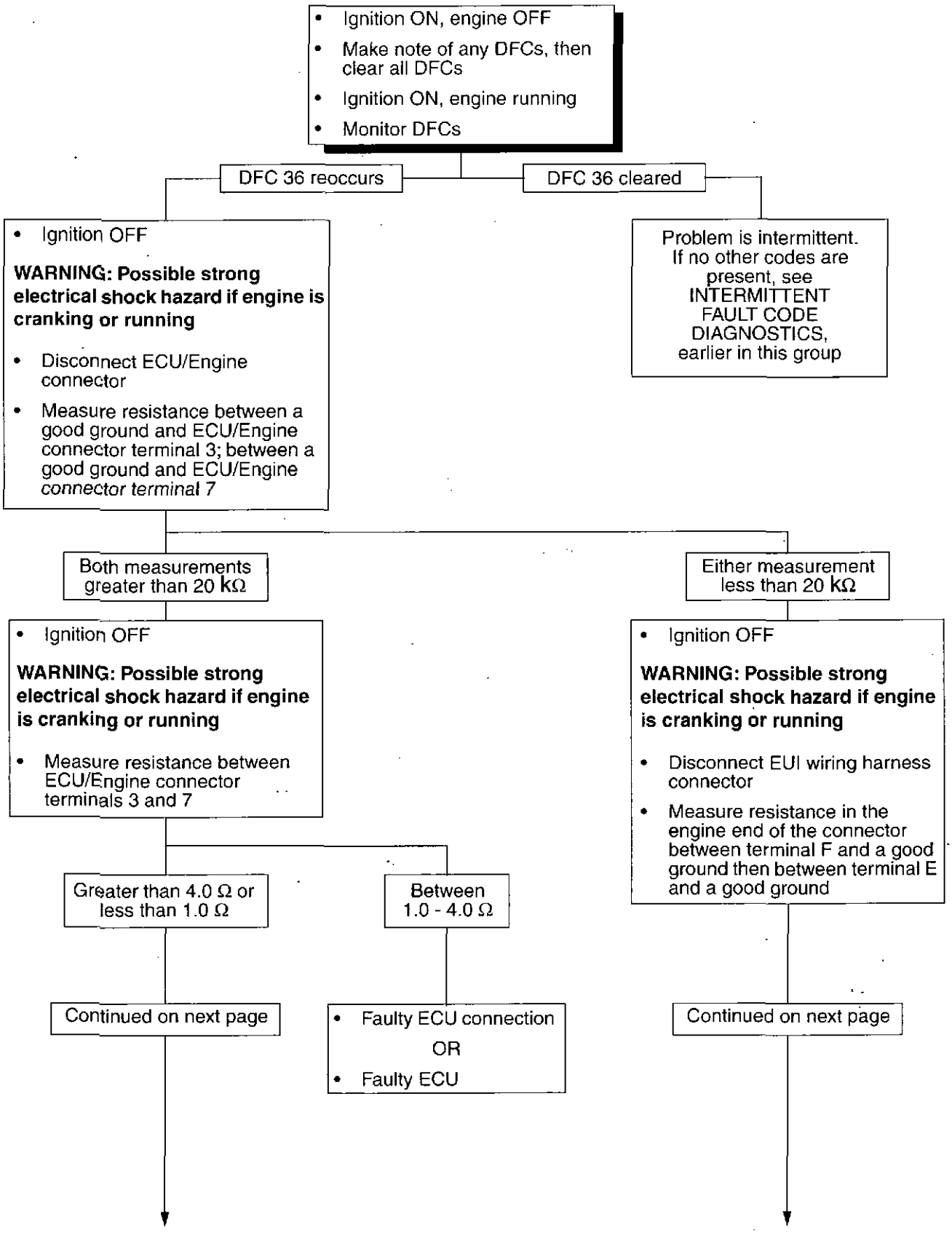
- **EUI (Electronic Unit Injector)**
  - — The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
  - — Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and deenergizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
  - — If fault codes 34 and 35 are set along with 36, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.



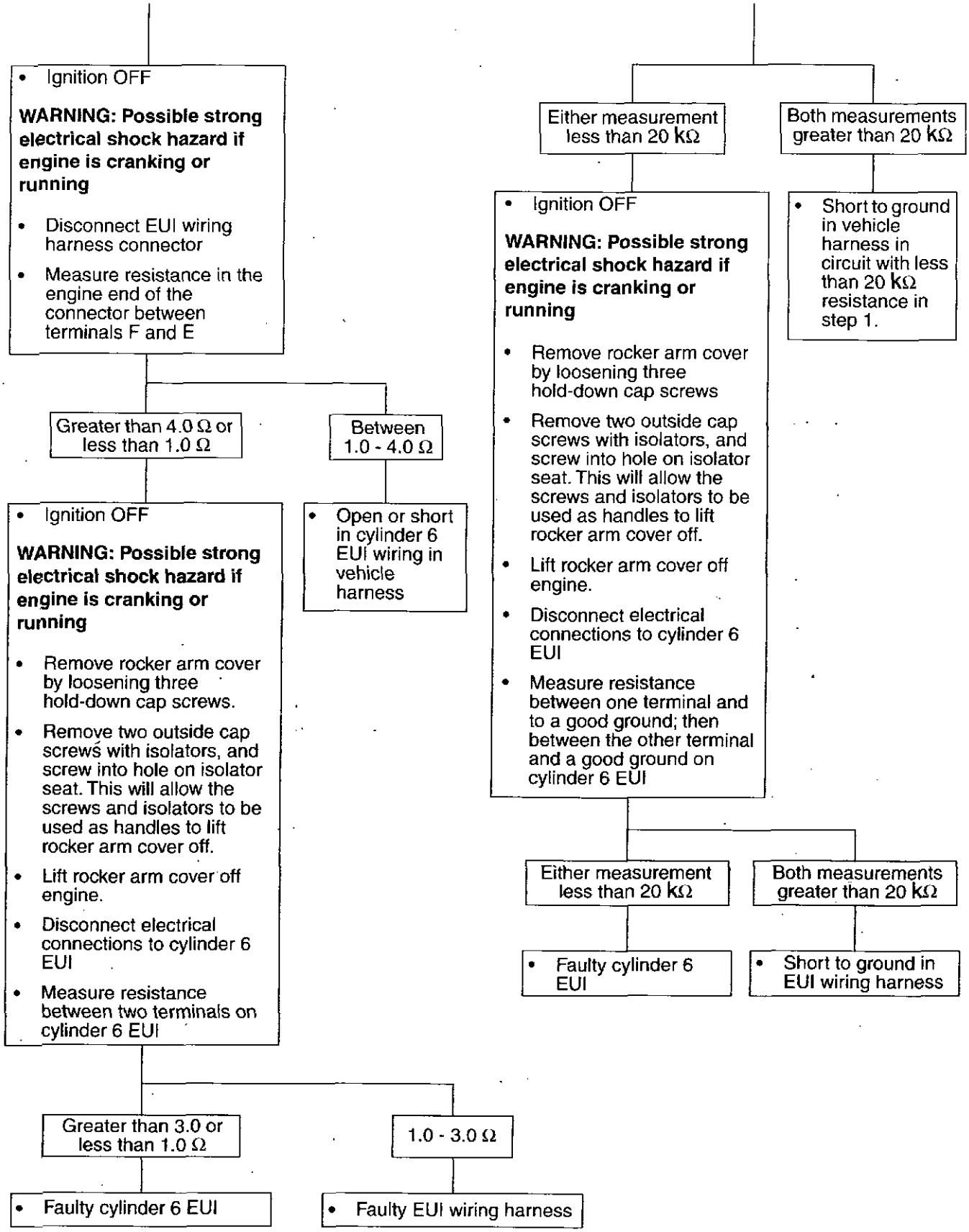
EUI Harness Connector Location

- **Fault code 36 will set if:**
  - — The ECU detects an open or a short in the cylinder number 6 EUI circuitry.
- **If fault code 36 sets, the following will occur:**
  - — With fault code 36 active, the ECU doesn't control the system any differently. Depending on the cause of code 36, cylinder number 6 may not be firing; engine may have a miss, or a dead short.
  - — If fault codes 34 and 35 are set along with code 36, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

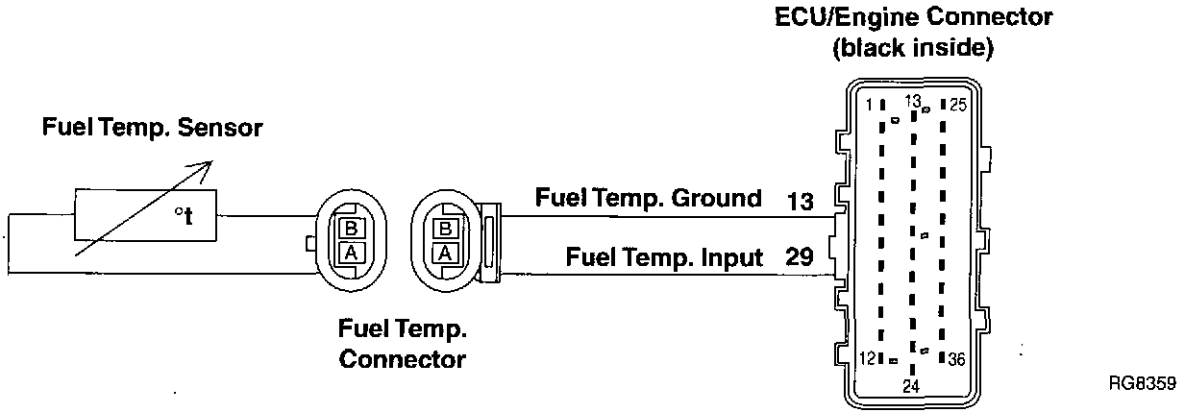
DFC 36 CYLINDER 6 EUI FAULT—CONTINUED



DFC 36 CYLINDER 6 EUI FAULT—CONTINUED



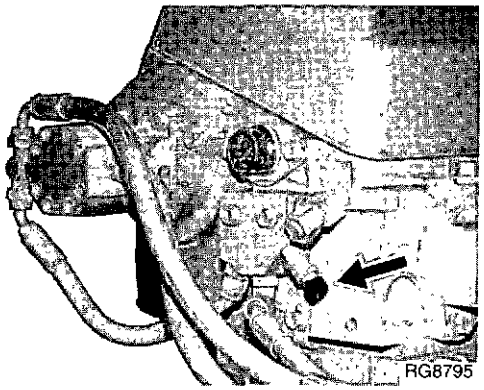
DFC 37 FUEL TEMPERATURE INPUT VOLTAGE TOO HIGH



Fuel Temperature Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Temperature Sensor** *(arrow)*
  - — The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures.
- **Fault code 37 will set if:**
  - — The fuel temperature input voltage exceeds 4.93 volts.
- **If fault code 37 sets, the following will occur:**
  - — The ECU will use a default "limp-home" fuel temperature value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated.

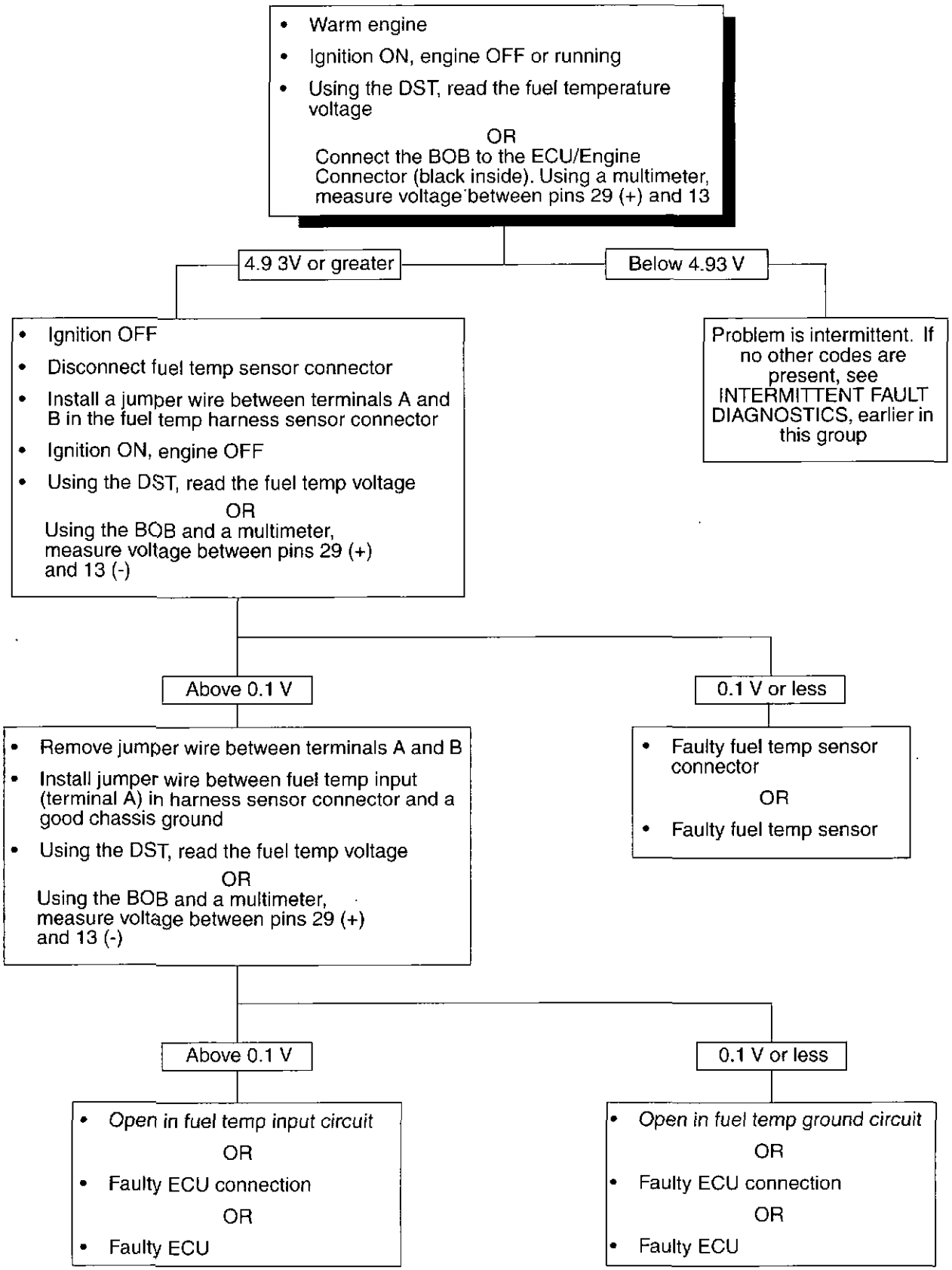


Fuel Temperature Sensor Location

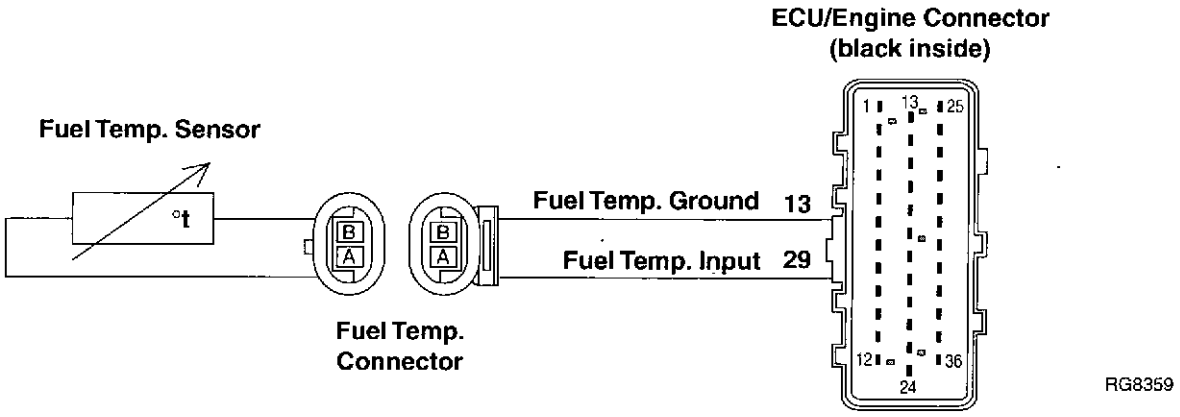
Fuel Temp Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 37 FUEL TEMPERATURE INPUT VOLTAGE TOO HIGH—CONTINUED



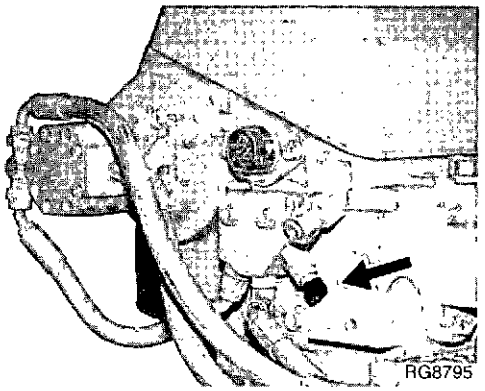
DFC 38 FUEL TEMPERATURE INPUT VOLTAGE TOO LOW



Fuel Temperature Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Temperature Sensor** *(arrow)*
  - — The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures.
- **Fault code 38 will set if:**
  - — The fuel temperature input voltage drops below 0.08 volts.
- **If fault code 38 sets, the following will occur:**
  - — The ECU will use a default "limp-home" fuel temp value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated.

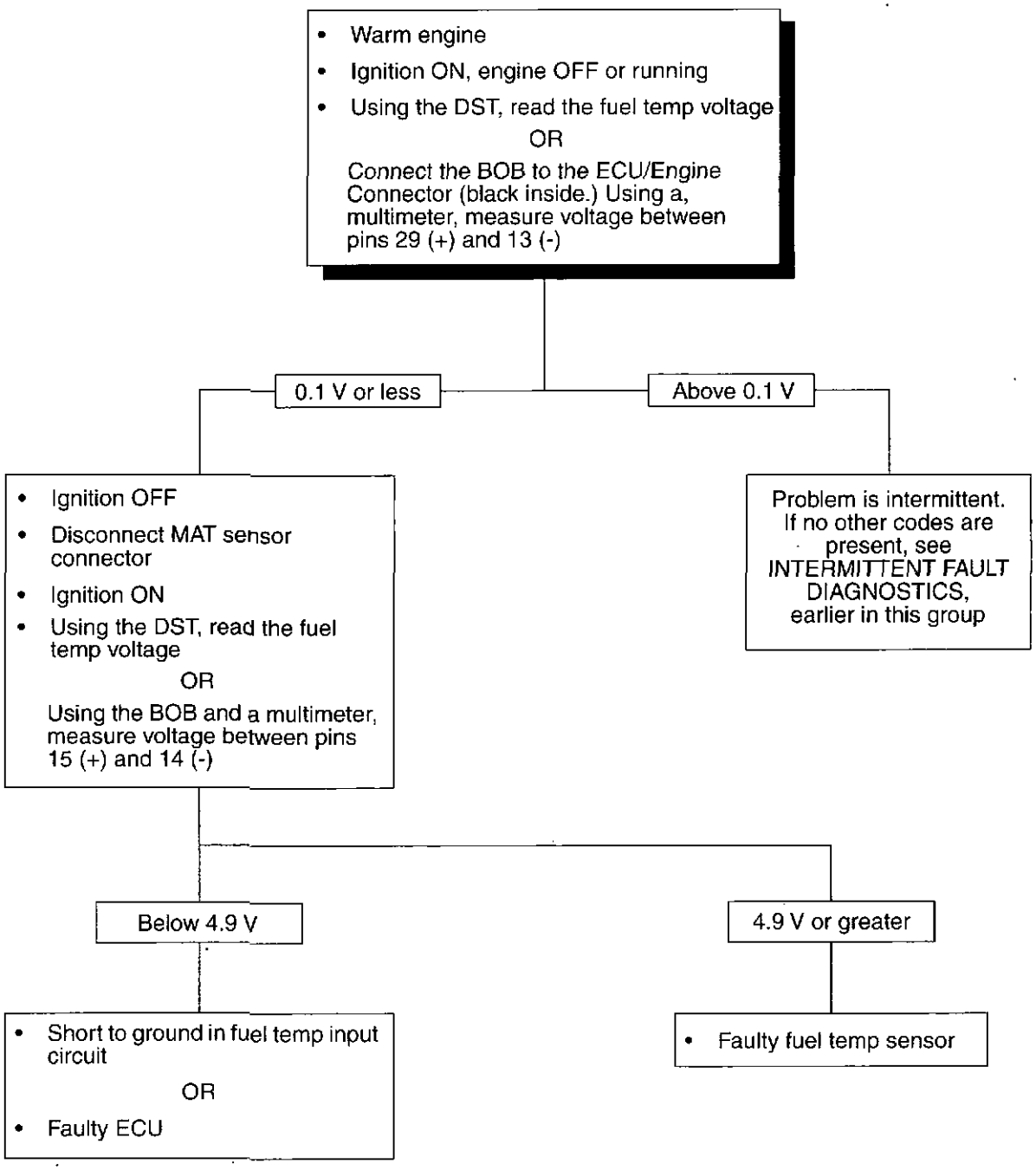


Fuel Temperature Sensor Location

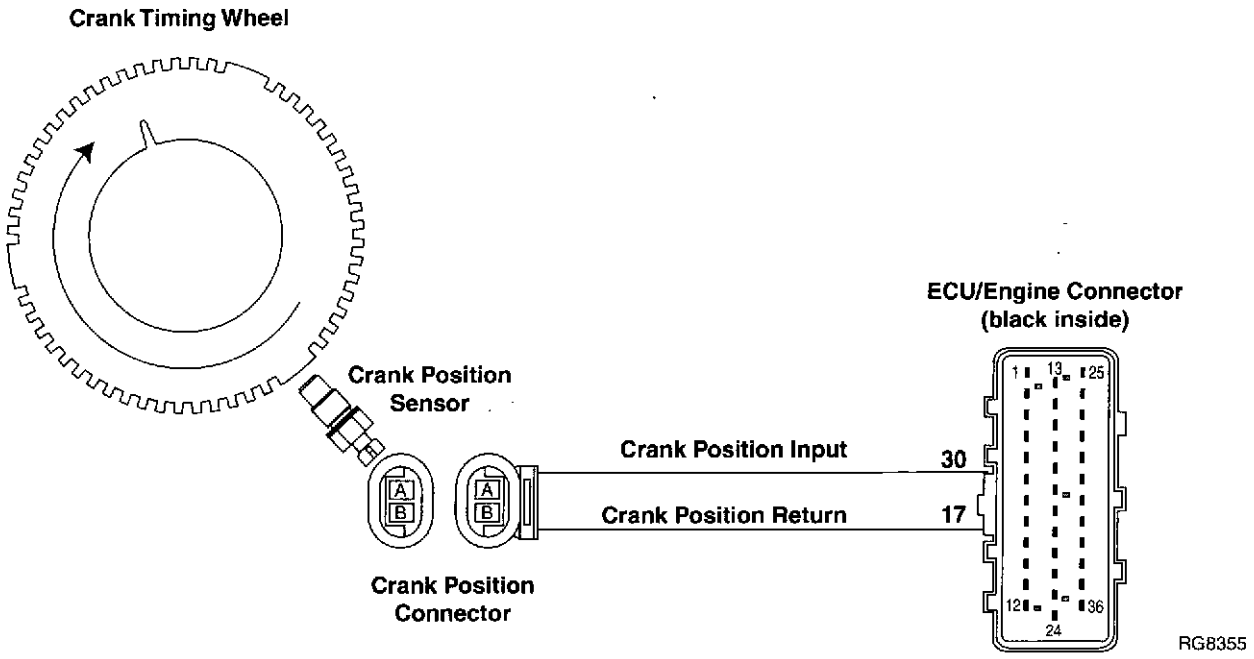
Fuel Temperature Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 38 FUEL TEMPERATURE INPUT VOLTAGE TOO LOW—CONTINUED



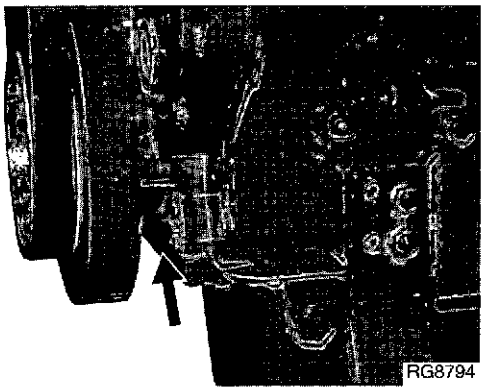
DFC 41 CRANK POSITION INPUT MISSING



Crank Position Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

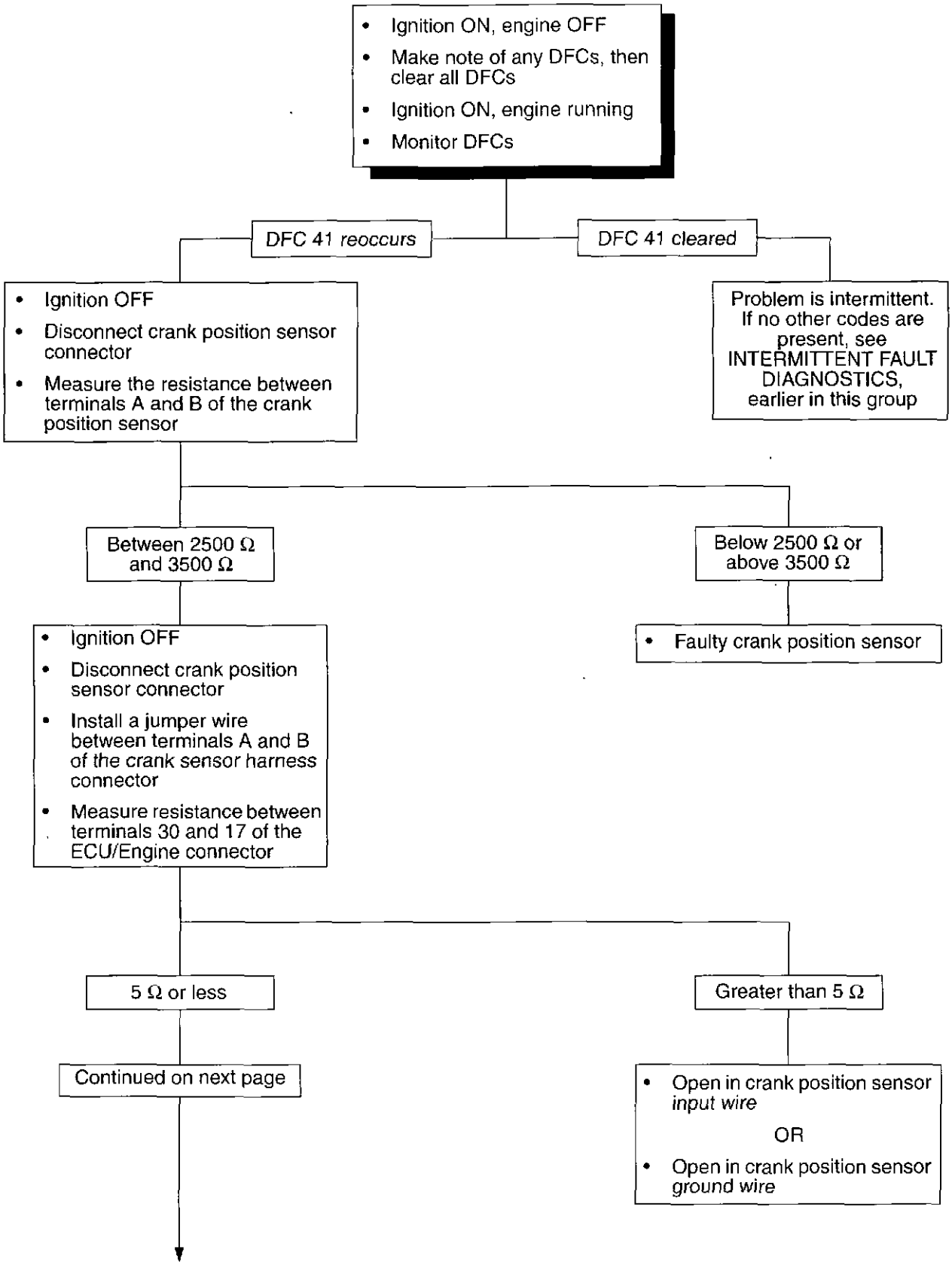
- **Crank Position Sensor** *(arrow)*
  - — The crank position sensor is an inductive type pickup sensor that detects notches on the crank timing wheel. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. The ECU monitors the cam position sensor input to determine piston position in relation to the firing order. Based on information from the crank and cam position sensors, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly.
- **Fault code 41 will set if:**
  - — The ECU does not receive a crank position input on terminal 30 of the engine harness connector.



Crank Position Sensor Location

- **If fault code 41 sets, the following will occur:**
  - — If fault code 43 occurs with code 41, the engine will die and won't restart until at least one of the two codes is repaired.
  - — ECU will use only the cam position sensor input to determine piston position.
  - — The moment the fault code sets, the engine may hesitate, or it may die but will re-start.
  - — Engine power output will be significantly reduced.
  - — Longer cold temperature cranking times will occur.

DFC 41 CRANK POSITION INPUT MISSING—CONTINUED



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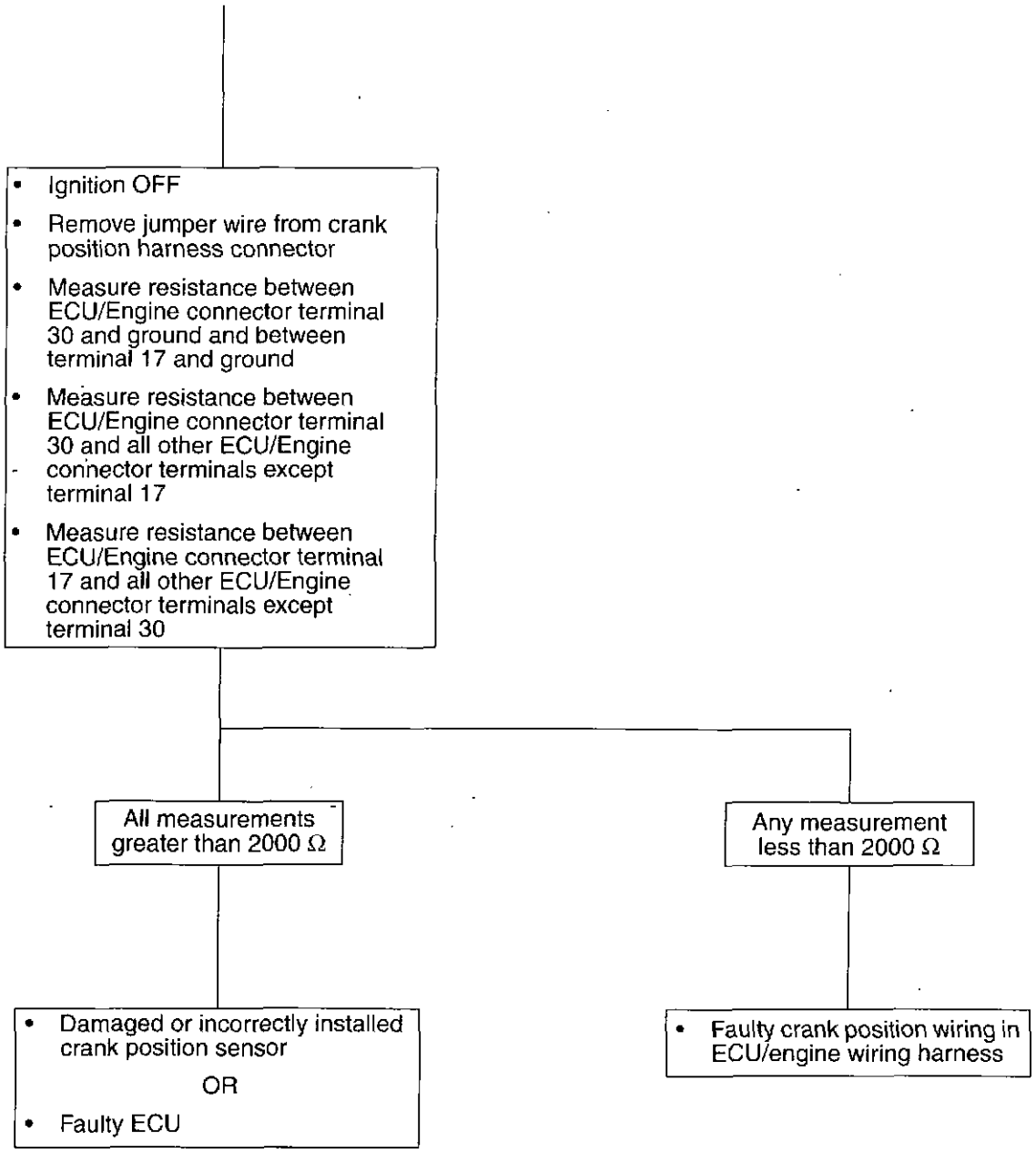
103

DFC 41 CRANK POSITION INPUT MISSING–CONTINUED



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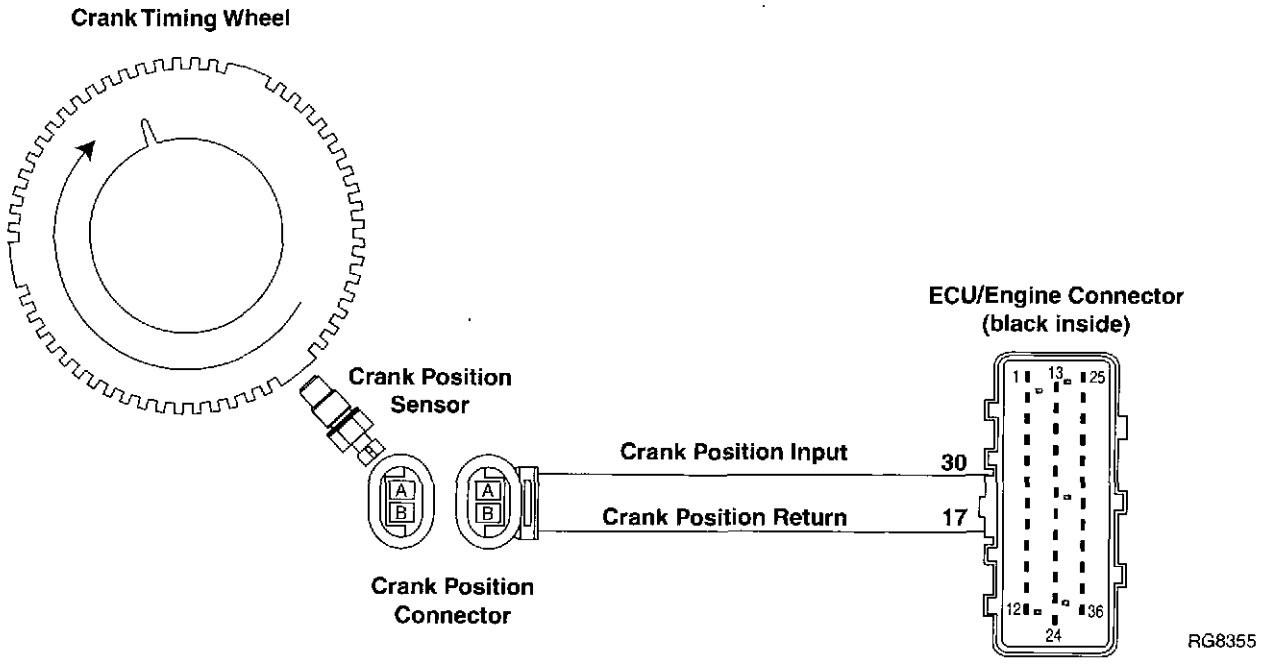
104

DFC 42 CRANK POSITION INPUT OUT OF SYNC



Crank Position Sensor Wiring

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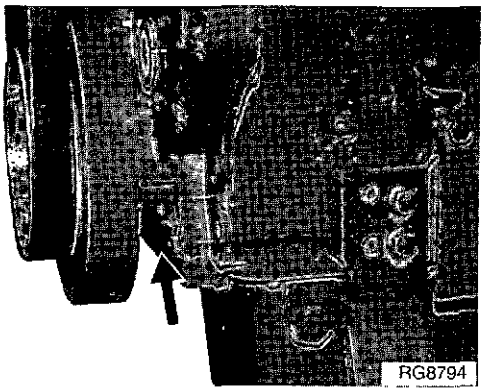
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Crank Position Sensor** *(arrow)*
  - — The crank position sensor is an inductive type pickup sensor that detects notches on the crank timing wheel. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. The ECU monitors the cam position sensor input to determine piston position in relation to the firing order. Based on information from the crank and cam position sensors, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other.
- **Fault code 42 will set if:**
  - — The ECU determines that the crank position input is out of sync with the cam position input.



Crank Position Sensor Location

- **If fault code 42 sets, the following will occur:**
  - — ECU will use only the cam position sensor input to determine piston position.
  - — The moment the fault code sets, the engine may hesitate, or it may die but will re-start.
  - — Engine power output will be significantly reduced.
  - — Longer cold temperature cranking times will occur.

DFC 42 CRANK POSITION INPUT OUT OF SYNC—CONTINUED

- Ignition ON, engine OFF
- Make note of any DFCs, then clear all DFCs
- Ignition ON, engine running
- Monitor DFCs

DFC 42 reoccurs

- Ignition OFF
- *Remove rocker arm cover by loosening three hold-down cap screws.*
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.

NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.

- Remove plug from cylinder block and install JDG820 Flywheel Turning Tool.
- Remove threaded plug from timing hole below oil cooler and filter housing assembly.
- Rotate engine flywheel in running direction until JDG971 Timing Pin engages slot in camshaft.
- Slightly move engine flywheel back and forth with turning tool while attempting to engage a second JDG971 Timing Pin in crankshaft slot.

Crank timing pin engages in slot

- Ignition OFF
- Remove cam and crank timing pins
- Disconnect crank position sensor
- Measure resistance between both terminals in crank position sensor

Between 2500 Ω and 3500 Ω

Continued on next page

Below 2500 Ω or above 3500 Ω

- Faulty crank position sensor

Crank timing pin won't engage slot

- Cam and crank out of time
- Perform cam and crank timing procedures as described in Group 10 of 10.5/12.5 ENGINE REPAIR MANUAL (CTM 100)

DFC 42 cleared

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

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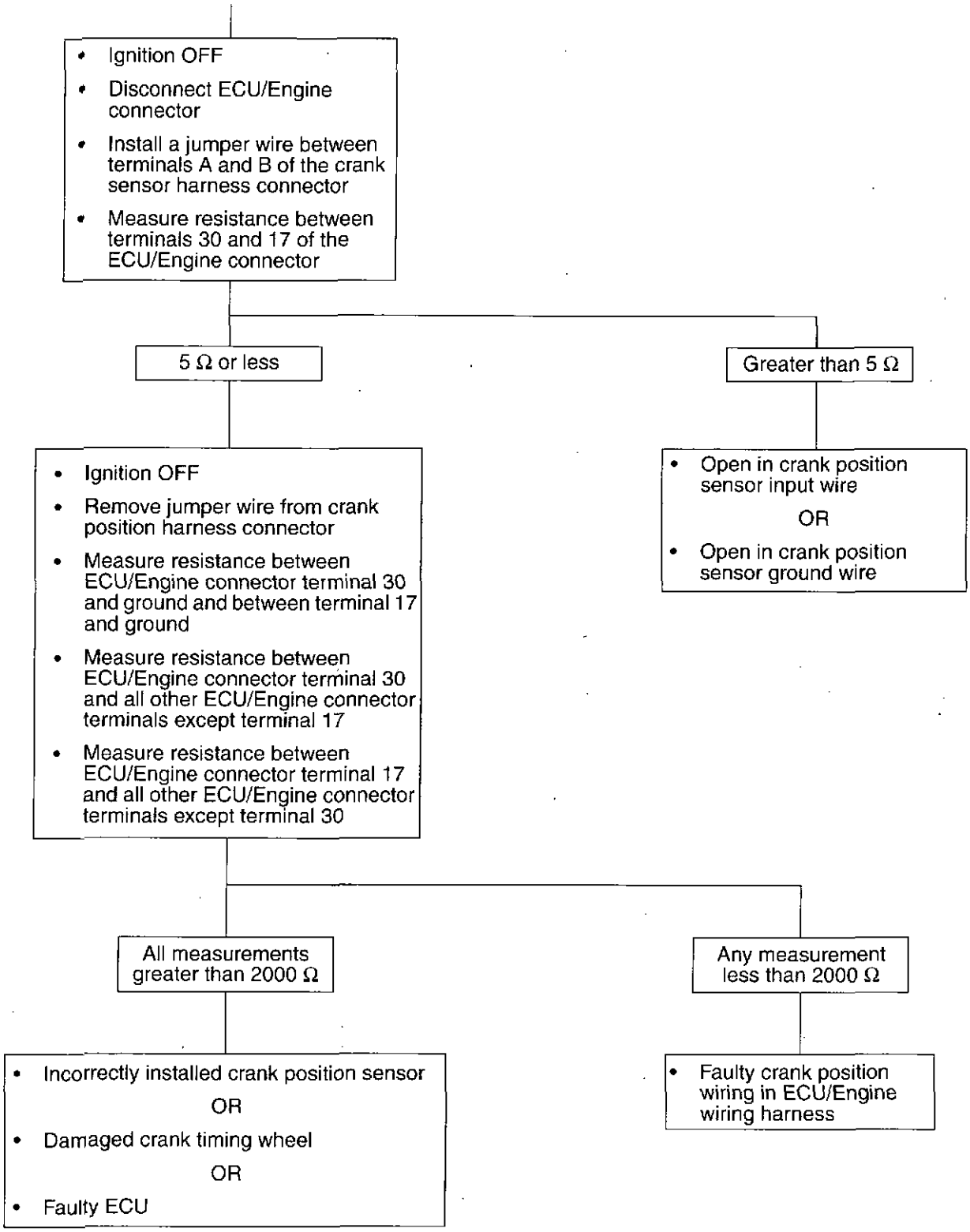
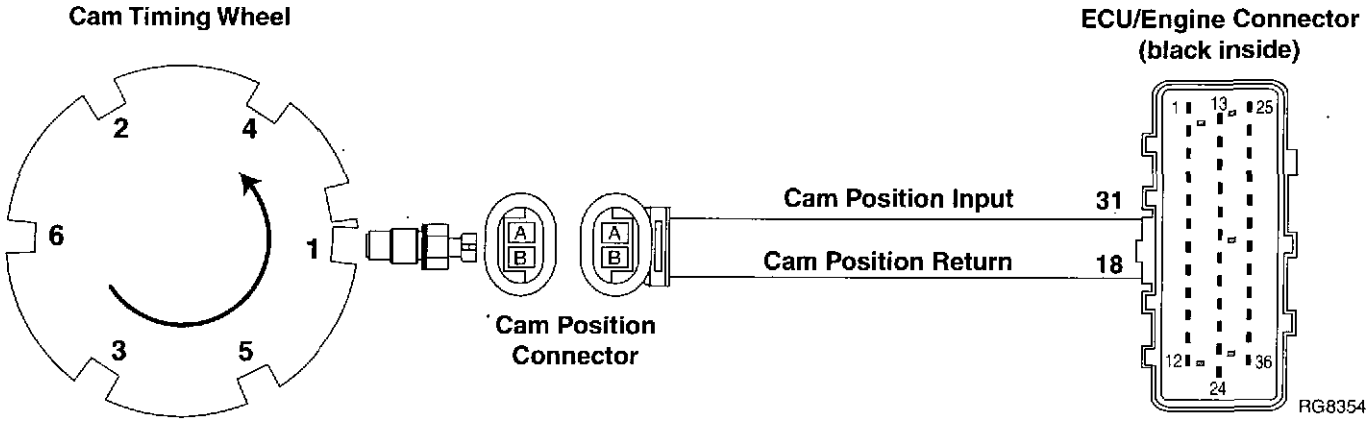
DFC 42 CRANK POSITION INPUT OUT OF SYNC—CONTINUED



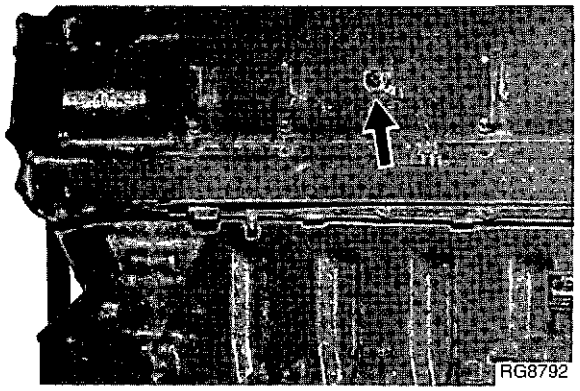
DFC 43 CAM POSITION INPUT MISSING



Cam Position Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

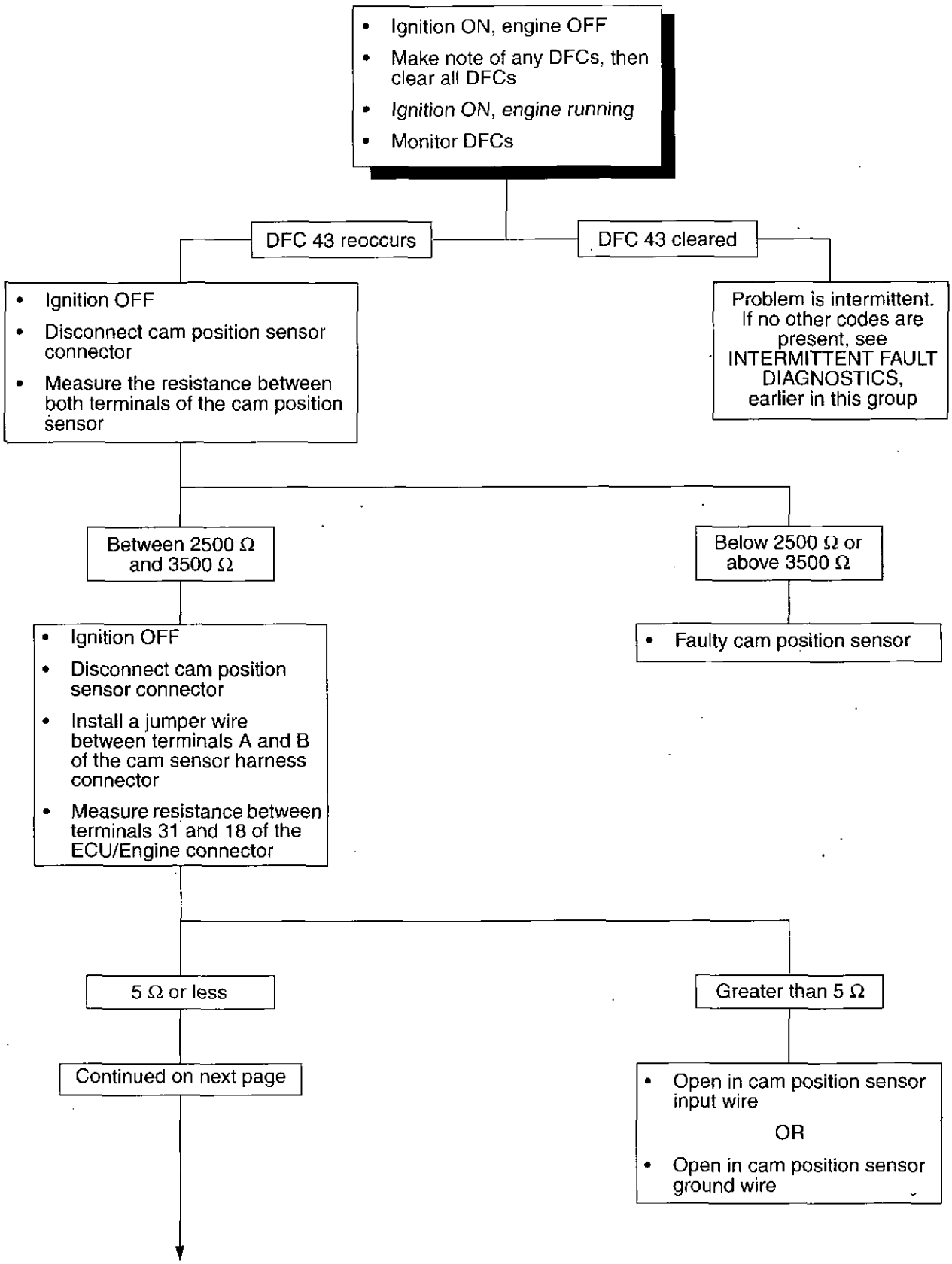
- **Camshaft Position Sensor** *(arrow)*
  - — The cam position sensor is an inductive type pickup sensor that detects 7 notches on the camshaft timing wheel. 6 of the 7 notches correspond to a cylinder; the 7th notch allows the ECU to identify cylinder number 1. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly.
- **Fault code 43 will set if:**
  - — The ECU does not receive a cam position input on terminal 31 of the engine harness connector.



Cam Position Sensor Location

- **If fault code 43 sets, the following will occur:**
  - — If fault code 41 occurs with code 43, the engine will die and won't restart until at least one of the two codes is repaired.
  - — ECU will use only the crank position sensor input to determine piston position.
  - — The moment the fault code sets, the engine may hesitate, or it may die but will re-start.
  - — Prolonged cranking time will be required.

DFC 43 CAM POSITION INPUT MISSING—CONTINUED



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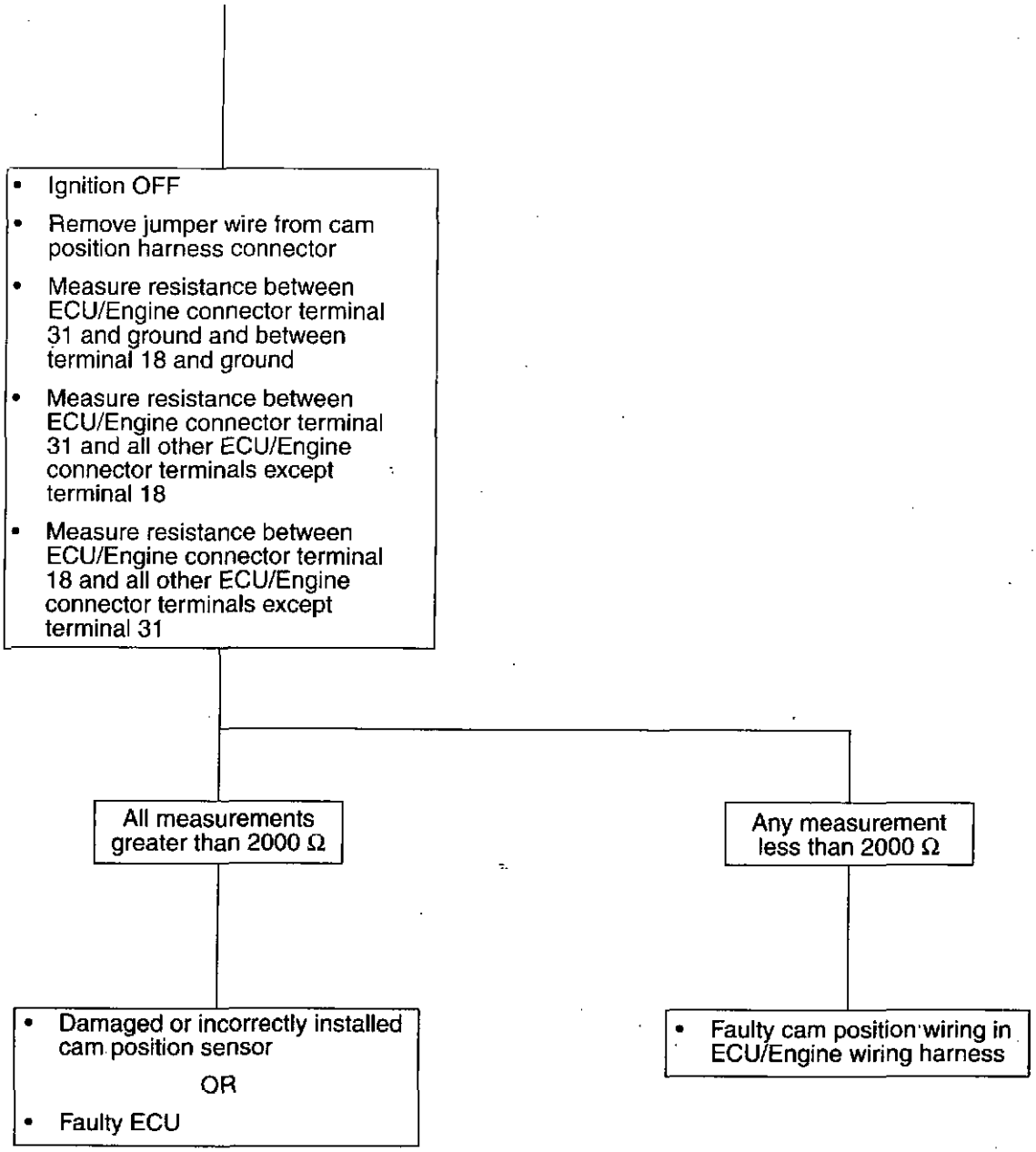
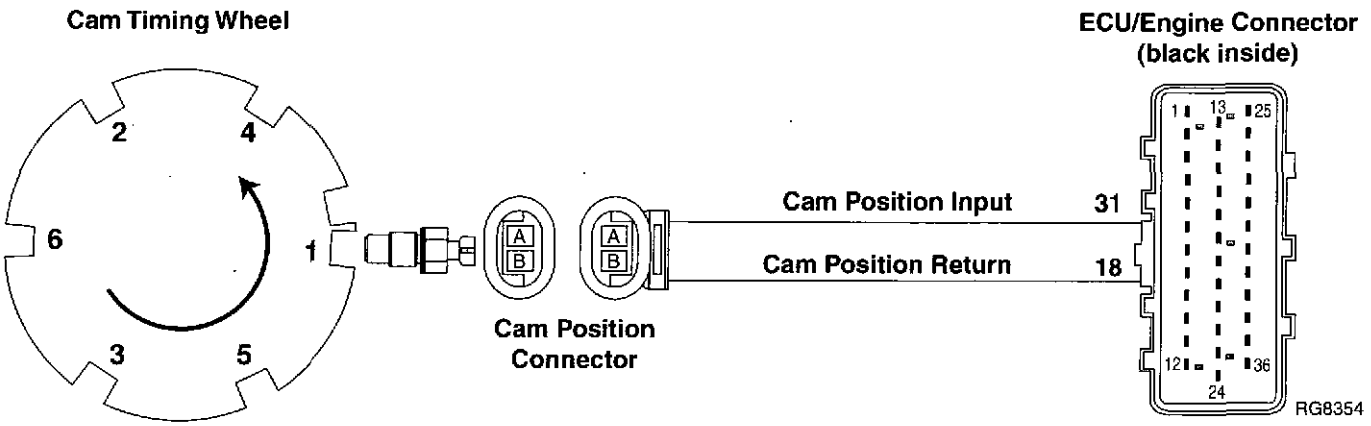
DFC 43 CAM POSITION INPUT MISSING—CONTINUED



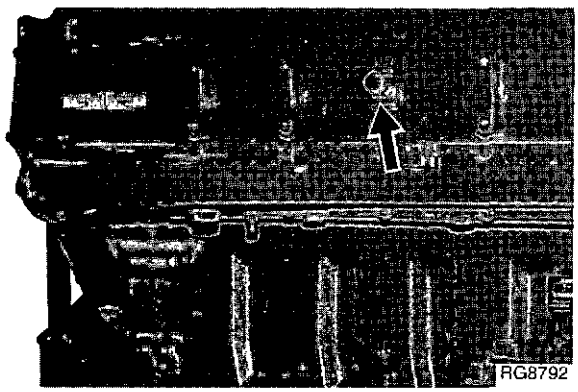
DFC 44 CAM POSITION INPUT OUT OF SYNC



Cam Position Sensor Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Camshaft Position Sensor**
  - — The cam position sensor is an inductive type pickup sensor that detects 7 notches on the camshaft timing wheel. 6 of the 7 notches correspond to a cylinder; the 7th notch allows the ECU to identify cylinder number 1. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other.
- **Fault code 44 will set if:**
  - — The ECU determines that the cam position input is out of sync with the crank position input.



Cam Position Sensor Location

- **If fault code 44 sets, the following will occur:**
  - — ECU will use only the crank position sensor input to determine piston position.
  - — The moment the fault code sets, the engine may hesitate, or it may die but will re-start.
  - — Longer cold temperature cranking times will occur.

DFC 44 CAM POSITION INPUT OUT OF SYNC—CONTINUED

- Ignition ON, engine OFF
- Make note of any DFCs, then clear all DFCs
- Ignition ON, engine running
- Monitor DFCs

DFC 44 reoccurs

DFC 44 cleared

- Ignition OFF
- Remove rocker arm cover by loosening three hold-down cap screws.
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.

NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.

- Remove plug from cylinder block and install JDG820 Flywheel Turning Tool.
- Remove threaded plug from timing hole below oil cooler and filter housing assembly.
- Rotate engine flywheel in running direction until JDG971 Timing Pin engages slot in camshaft.
- Slightly move engine flywheel back and forth with turning tool while attempting to engage a second JDG971 Timing Pin in crankshaft slot.

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

Crank timing pin engages in slot

Crank timing pin won't engage slot

- *Ignition OFF*
- Remove cam and crank timing pins
- Inspect cam timing wheel for nick, burrs, or other damage
- Inspect cam position sensor for damage

- *Cam and crank out of time*
- Perform cam and crank timing procedures as described in Group 10 of 10.5/12.5 ENGINE REPAIR MANUAL (CTM 100)

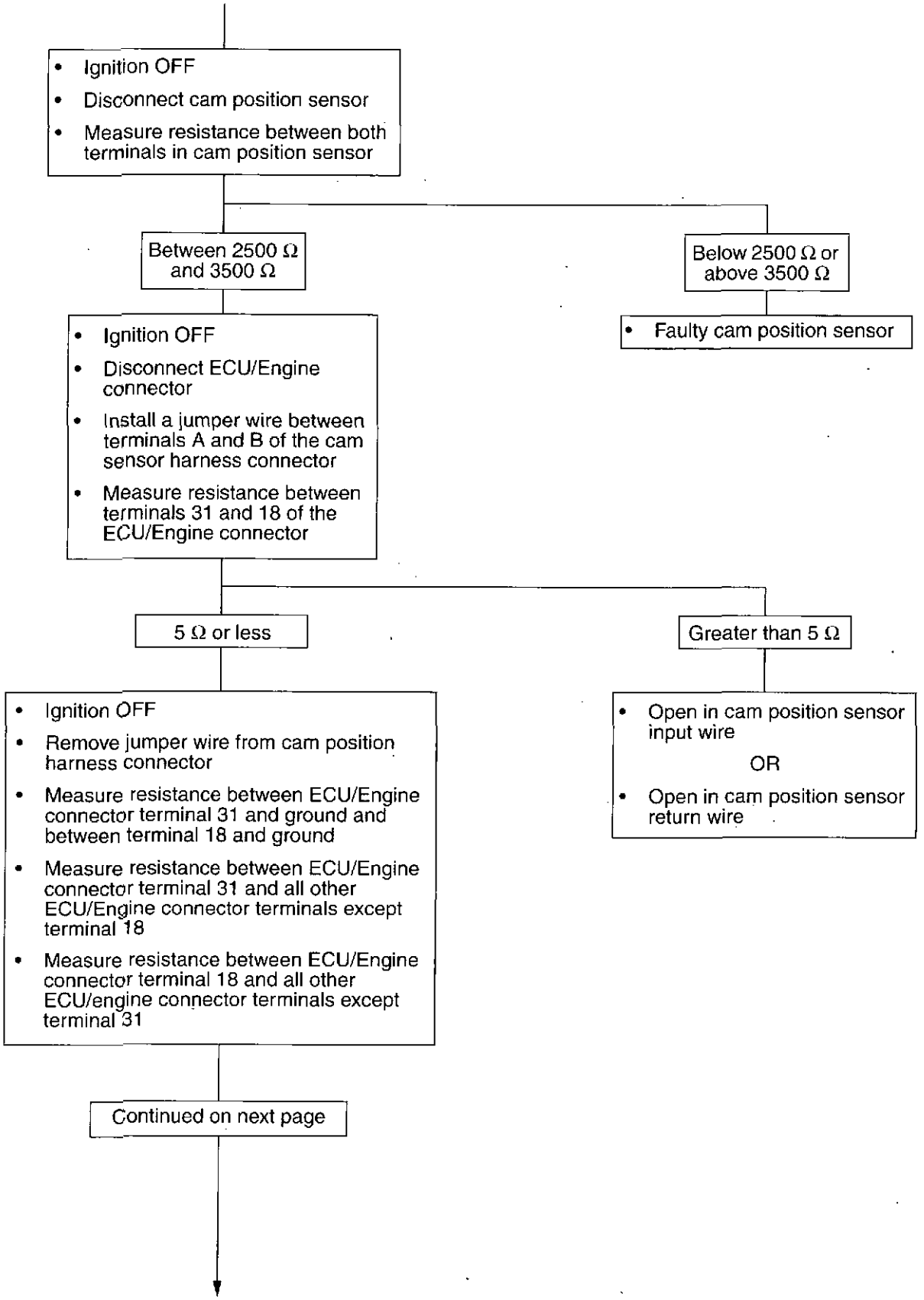
Cam position sensor and timing wheel OK

Faulty component found

Continued on next page

- *Replace faulty component*
- Using the DST, clear DFC 44 and retest

DFC 44 CAM POSITION INPUT OUT OF SYNC—CONTINUED



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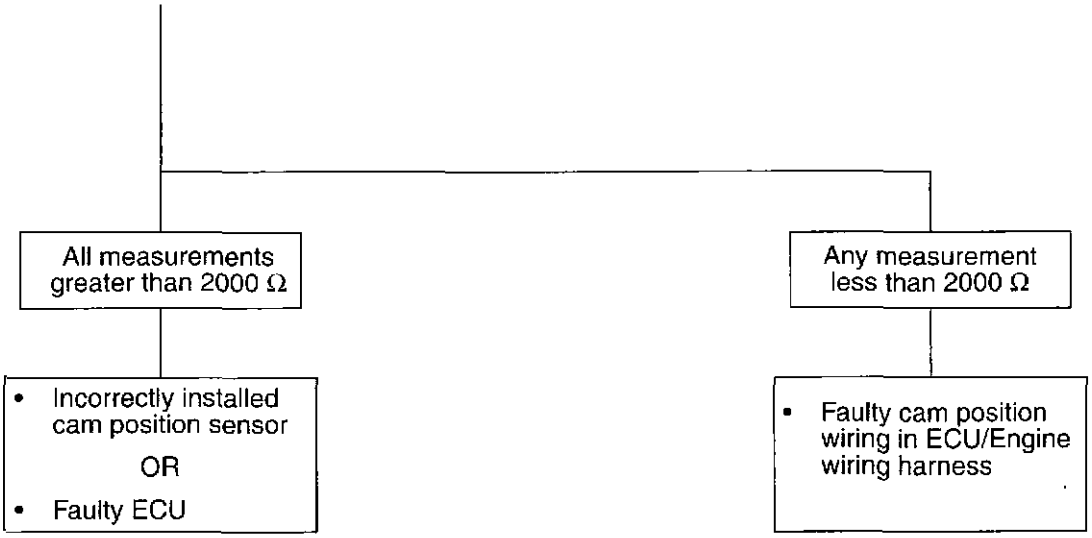
DFC 44 CAM POSITION INPUT OUT OF SYNC—CONTINUED



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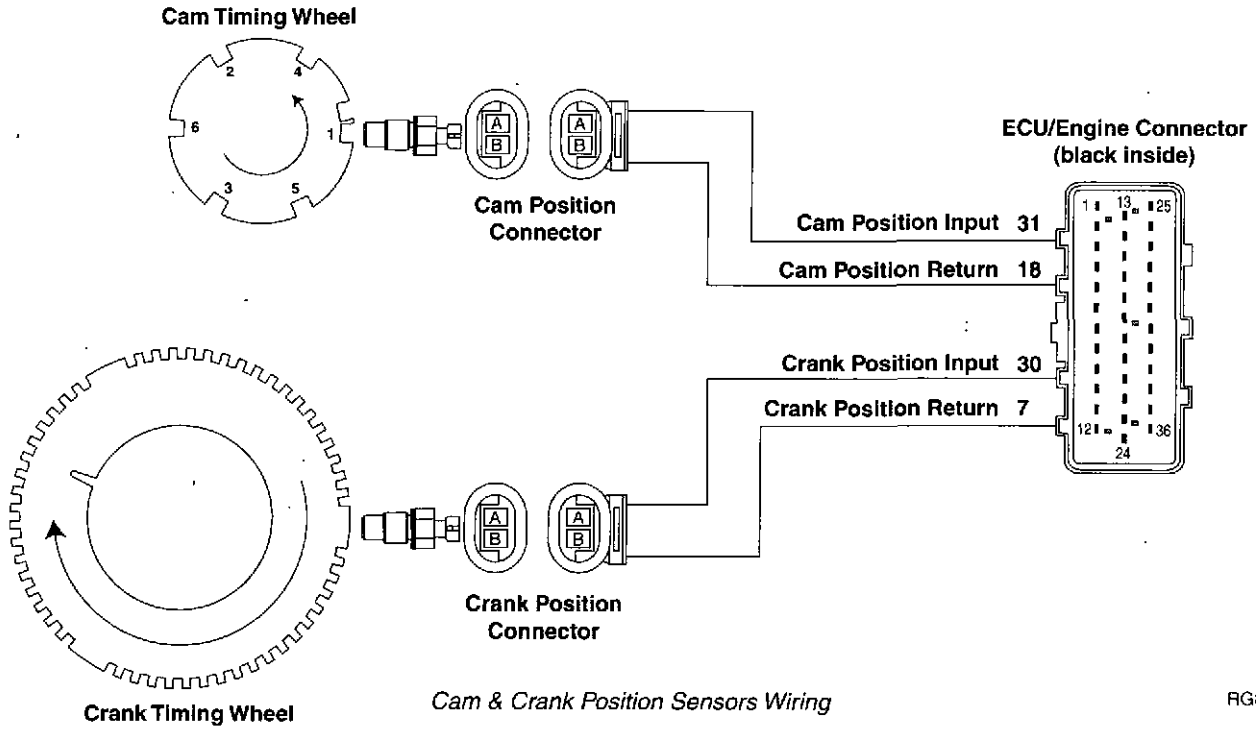
DFC 45 CAM/CRANK INPUTS OUT OF SYNC



Cam & Crank Position Sensors Wiring RG8360

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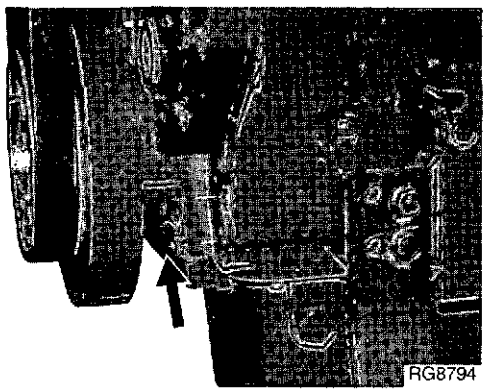
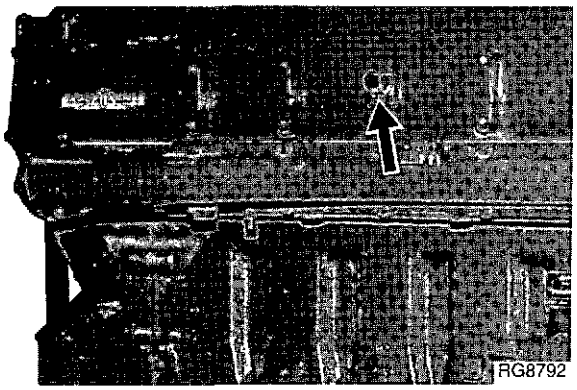
- **Camshaft and Crankshaft Position Sensors**
  - — The cam and crank position sensors are both inductive type pickup sensors that detect notches on the cam and crank timing wheels. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other.



Crank Position Sensor Location

- **Fault code 45 will set if:**
  - — The ECU detects that the cam and crank inputs are not in sync with each other.
- **If fault code 45 sets, the following will occur:**
  - — Depending on the cause of the fault, the engine may die, then it may or may not restart.
  - — If the engine dies and won't restart it is possible that disconnecting the crank position sensor will allow the engine to start.
  - — If the engine continues to run, it will develop low power.



Cam Position Sensor Location

DFC 45 CAM/CRANK INPUTS OUT OF SYNC—CONTINUED

- Ignition ON, engine OFF
- Make note of any DFCs, then clear all DFCs
- Ignition ON, engine running
- Monitor DFCs

DFC 45 reoccurs

DFC 45 cleared

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

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- Ignition OFF
- Remove rocker arm cover by loosening three hold-down cap screws.
- Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off.
- Lift rocker arm cover off engine.

NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.

- Remove plug from cylinder block and install JDG820 Flywheel Turning Tool.
- Remove threaded plug from timing hole below oil cooler and filter housing assembly.
- Rotate engine flywheel in running direction until JDG971 Timing Pin engages slot in camshaft.
- Slightly move engine flywheel back and forth with turning tool while attempting to engage a second JDG971 Timing Pin in crankshaft slot.

Crank timing pin engages in slot

Crank timing pin won't engage slot

- Ignition OFF
- Remove cam and crank timing pins
- Inspect cam timing wheel for nick, burrs, or other damage
- Inspect cam position sensor for damage

- Cam and crank out of time
- Perform cam and crank timing procedures as described in Group 10 of 10.5/12.5 ENGINE REPAIR MANUAL (CTM 100)

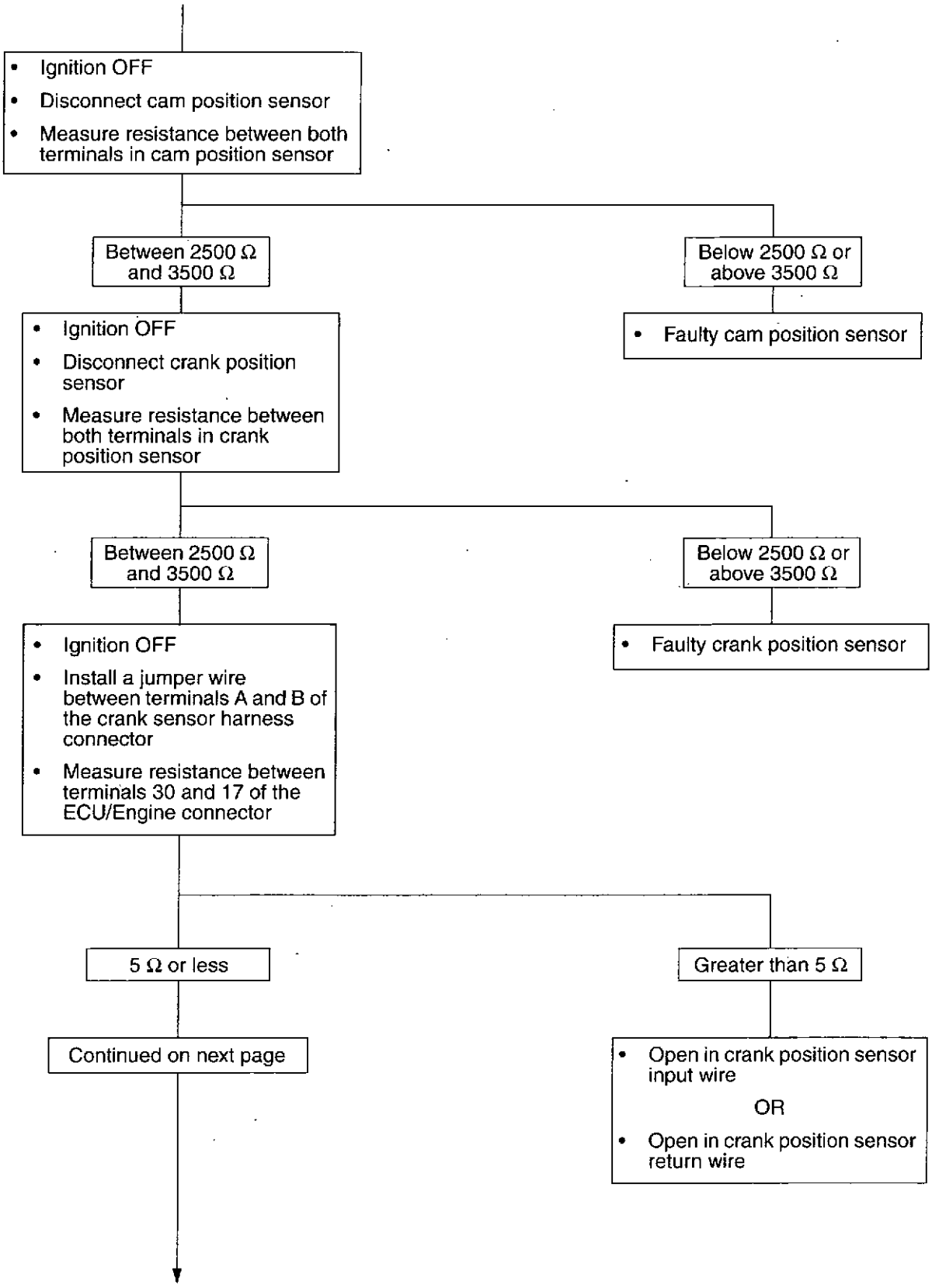
Cam position sensor and timing wheel OK

Faulty component found

Continued on next page

- Replace faulty component
- Using the DST, clear DFC 45 and retest

DFC 45 CAM/CRANK INPUTS OUT OF SYNC—CONTINUED



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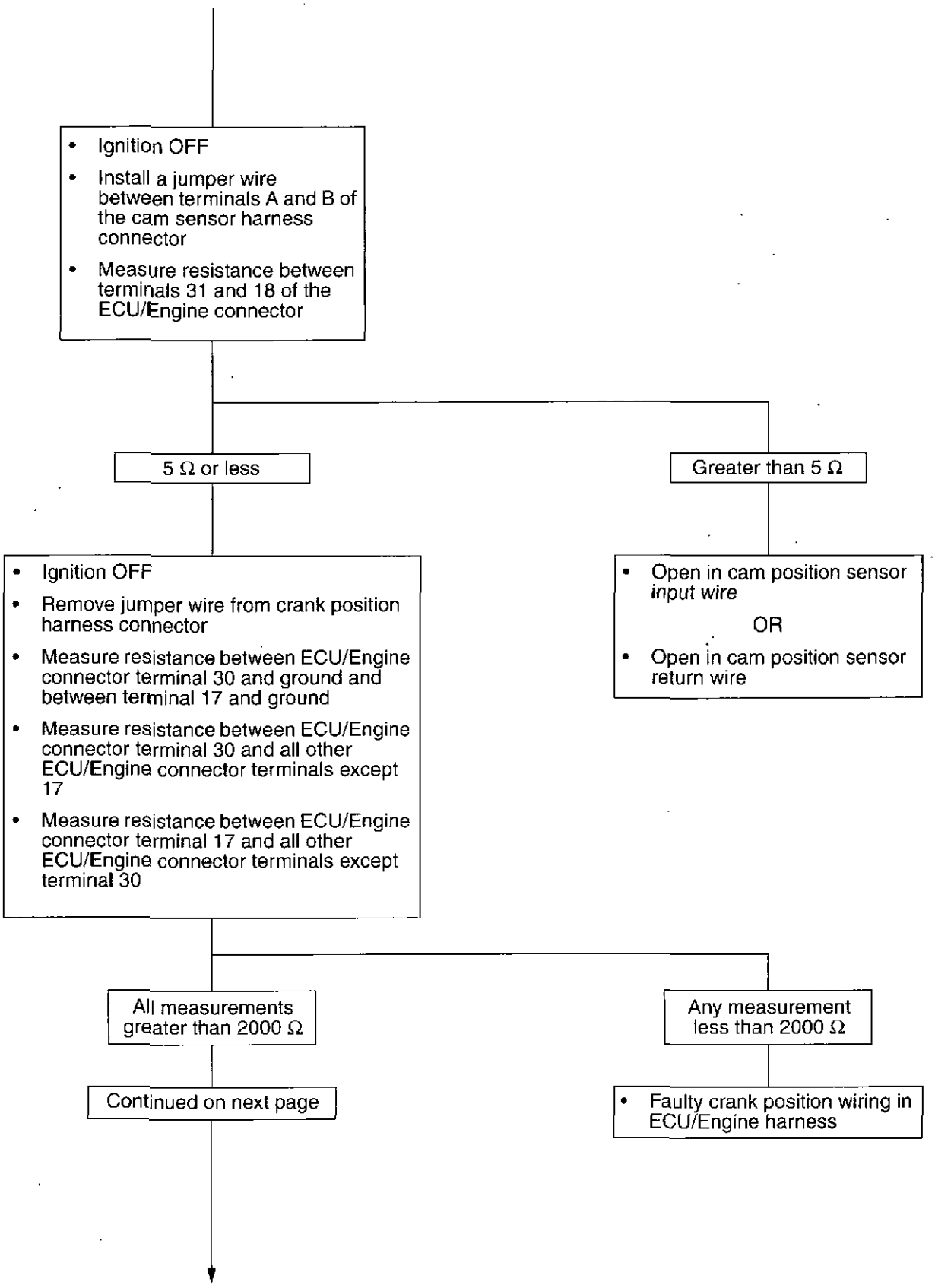
DFC 45 CAM/CRANK INPUTS OUT OF SYNC—CONTINUED



DFC 45 CAM/CRANK INPUTS OUT OF SYNC—CONTINUED

- Ignition OFF
- Remove jumper wire from cam position harness connector
- Measure resistance between ECU/Engine connector terminal 31 and ground and between terminal 18 and ground
- Measure resistance between ECU/Engine connector terminal 31 and all other ECU/Engine connector terminals except 18
- Measure resistance between ECU/Engine connector terminal 18 and all other ECU/Engine connector terminals except terminal 31

All measurements greater than 2000 Ω

- Incorrectly installed crank position sensor

OR

- Damaged crank timing wheel

OR

- Incorrectly installed cam position sensor

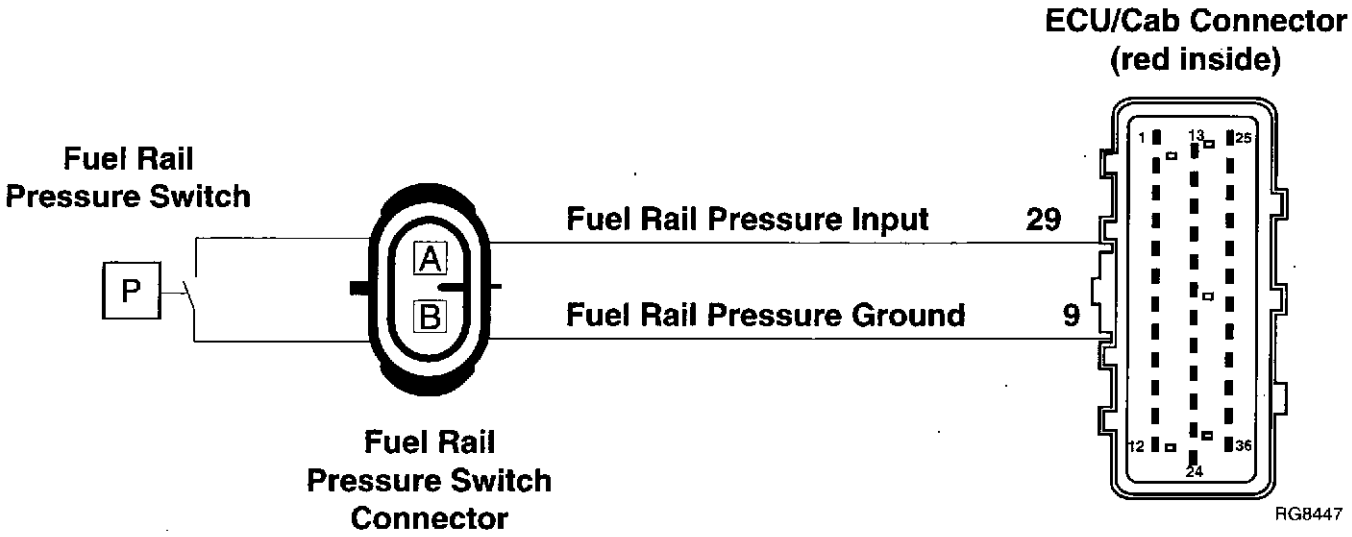
OR

- Faulty ECU

Any measurement less than 2000 Ω

- Faulty cam position wiring in ECU/Engine harness

DFC 50 FUEL RAIL PRESSURE SWITCH FAULT



Fuel Rail Pressure Switch Wiring

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Pressure Switch**
  - — The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi), the switch will open.

- **Fault code 50 will set if:**
  - — The ECU reads normal pressure with the key ON, engine OFF.

- **If fault code 50 sets, the following will occur:**
  - — After 14 minutes, engine power will be derated 10%.
  - — After 20 minutes, engine power will be derated 30%.

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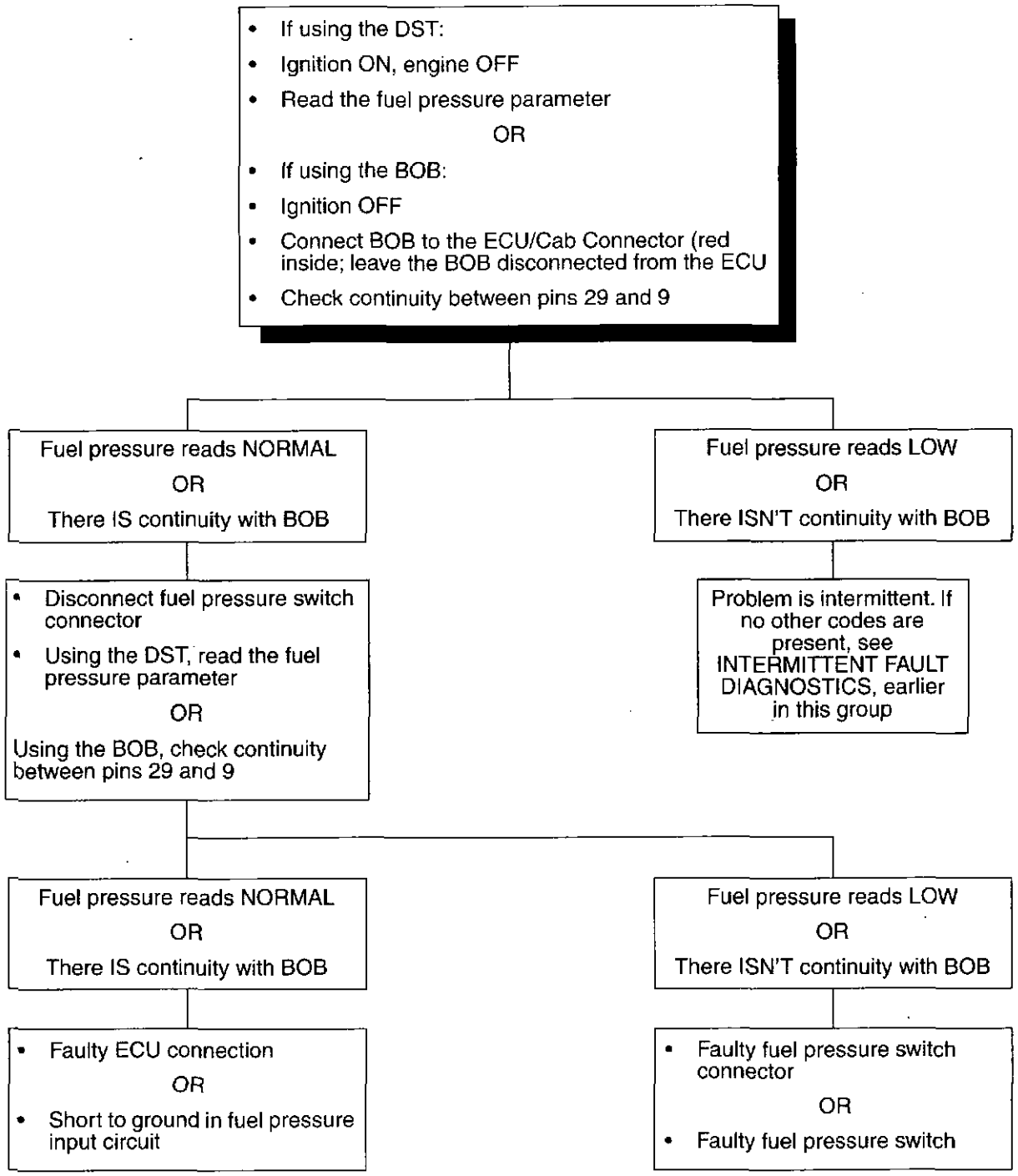
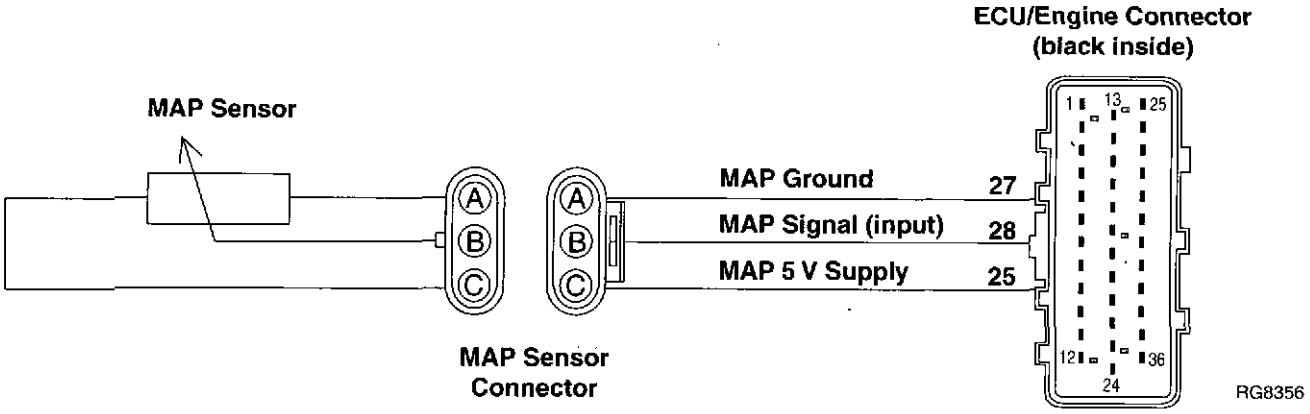
DFC 50 FUEL RAIL PRESSURE SWITCH FAULT—CONTINUED



DFC 52 MAP INPUT VOLTAGE ERRATIC



MAP Sensor Wiring

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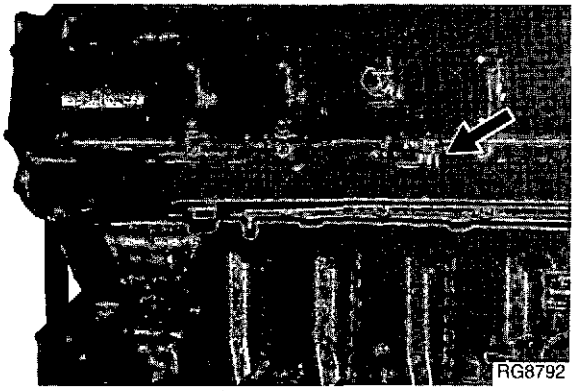
- **MAP (Manifold Air Pressure) Sensor** *(arrow)*
  - — The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, input voltage to the ECU increases. The ECU uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow.
- **Fault code 52 will set if:**
  - — The MAP input changes more erratically than what can occur under normal operating conditions.
- **If fault code 52 sets, the following will occur:**
  - — The ECU will use default "limp home" MAP values.
  - — Engine power will be low.



MAP Sensor Location

DFC 52 MAP INPUT VOLTAGE ERRATIC—CONTINUED

- **If DFCs 21 or 22 are active, repair those codes first**

- Ignition ON, engine OFF
- Make note of any DFCs, then clear all DFCs
- Ignition ON, engine running
- Monitor DFCs while operating engine under varying engine speed and load conditions

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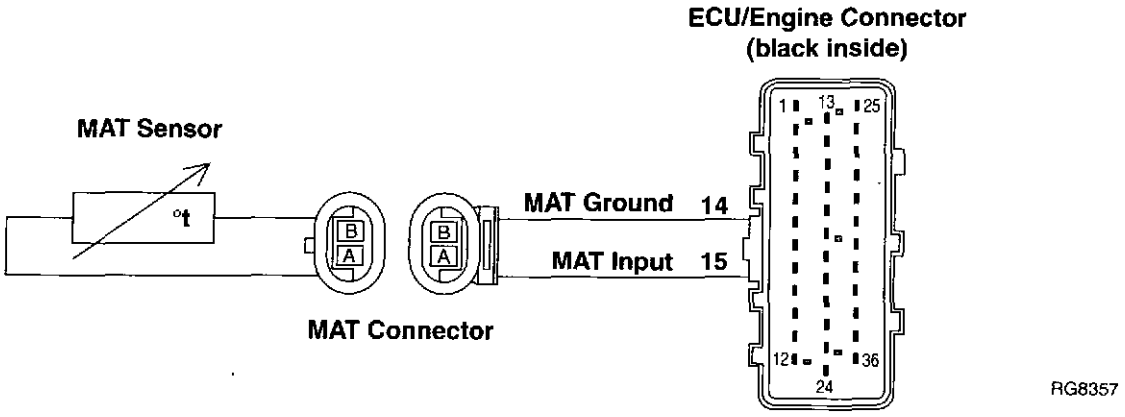
DFC 52 reoccurs

- Code 52 would most likely be caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical grounds or power connections anywhere on the machine. Things to check:
  - — All electrical connectors
  - — Alternator connections
  - — Chassis ground connections, battery ground connection
  - — Corrosion, dirt, or paint can cause intermittent and "noisy" connections
  - — Check the wiring harness for intermittent open and short circuits; particularly the MAP sensor wiring
- Other possible causes of code 52:
  - — Electromagnetic interference (EMI) from an incorrectly installed 2-way radio
  - — Interference from some radar source

DFC 52 cleared

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

DFC 53 MAT INPUT VOLTAGE ERRATIC



MAT Sensor Wiring

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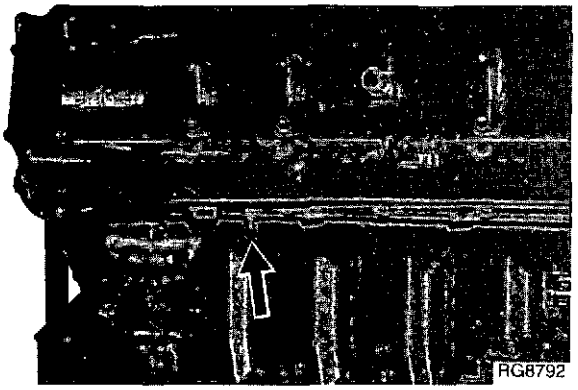
- **MAT (Manifold Air Temperature) Sensor** *(arrow)*
  - — The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow.
- **Fault code 53 will set if:**
  - — The MAT input changes more erratically than what can occur under normal operating conditions.
- **If fault code 53 sets, the following will occur:**
  - — The ECU will use a default "limp-home" MAT value of 20°C (68°F).
  - — Cold temperature starting may be slightly harder than normal.

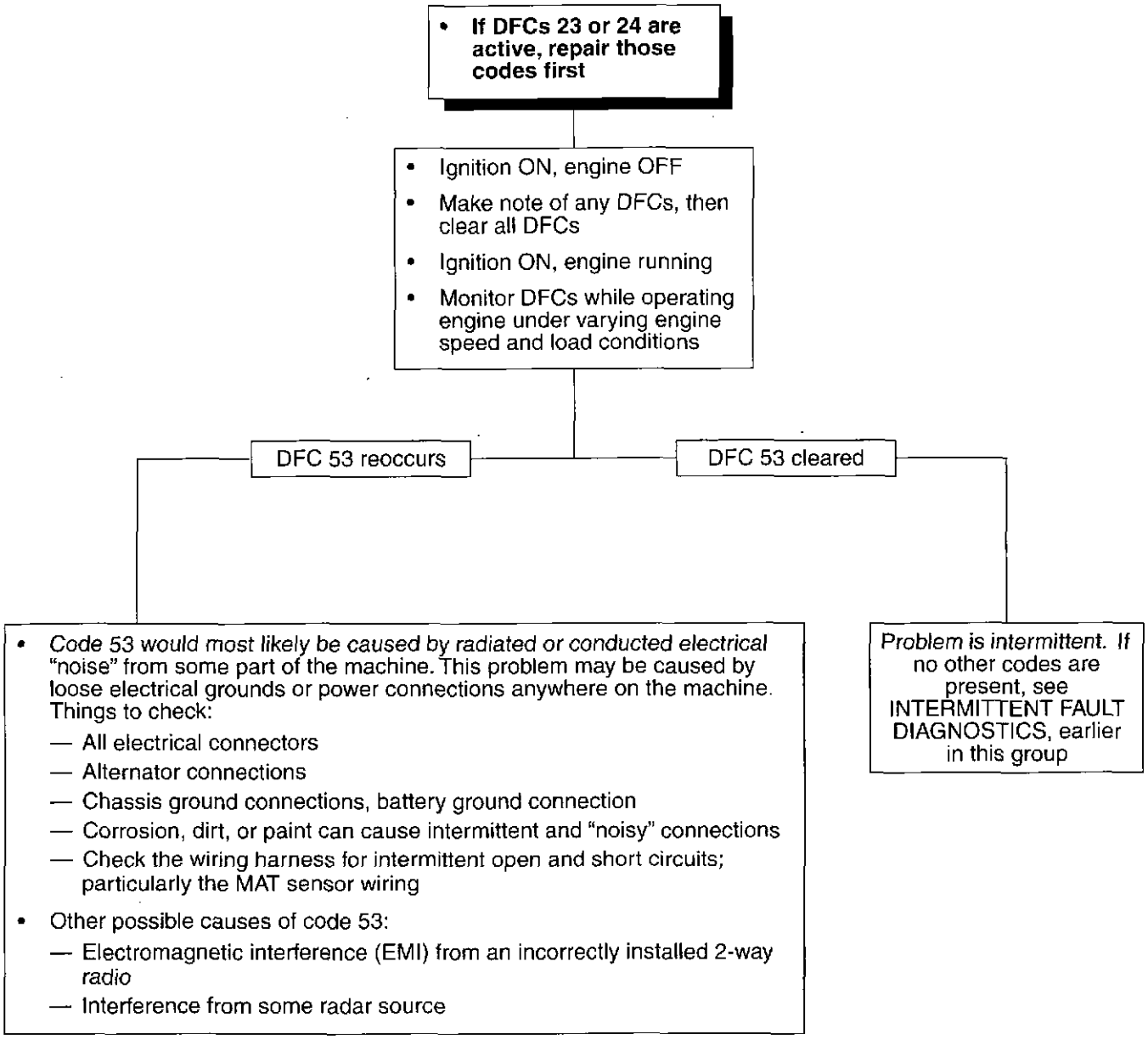


MAT Sensor Location

MAT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	12,540
-10 (14)	8,290
0 (32)	5,490
10 (50)	3,630
20 (68)	2,400
30 (86)	1,590
40 (104)	1,050
50 (122)	700
60 (140)	460
70 (158)	300
80 (176)	200

DFC 53 MAT INPUT VOLTAGE ERRATIC—CONTINUED



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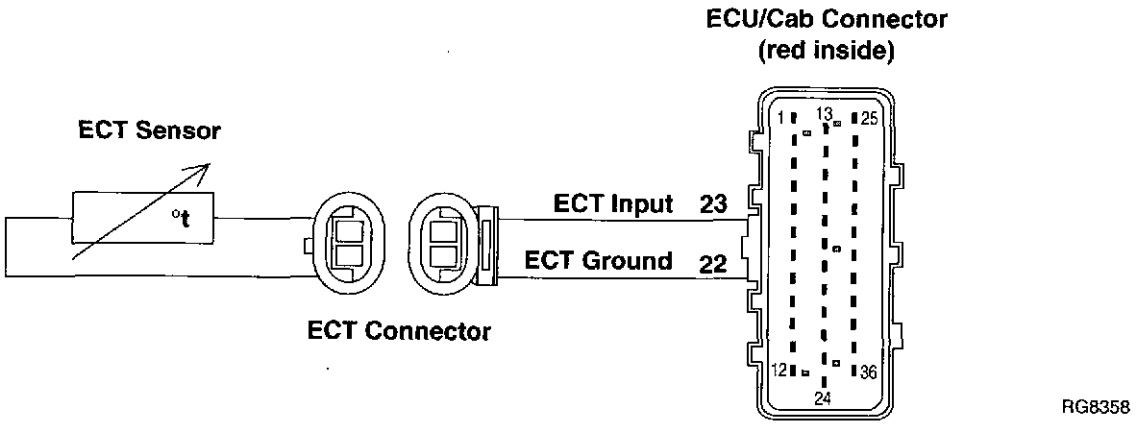
DFC 54 ECT INPUT VOLTAGE ERRATIC



ECT Sensor Wiring

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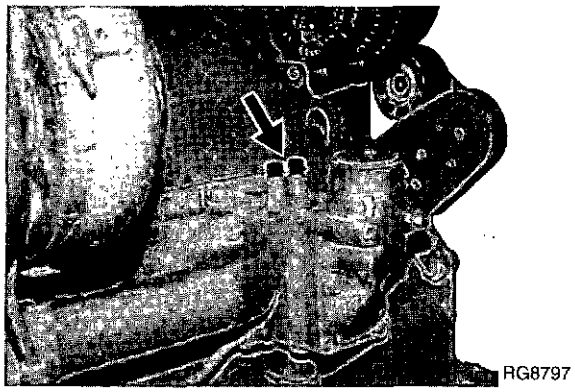
- **ECT (Engine Coolant Temperature) Sensor** *(arrow)*
  - — The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages.
- **Fault code 54 will set if:**
  - — The ECT input changes more erratically than what can occur under normal operating conditions.
- **If fault code 54 sets, the following will occur:**
  - — The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated.

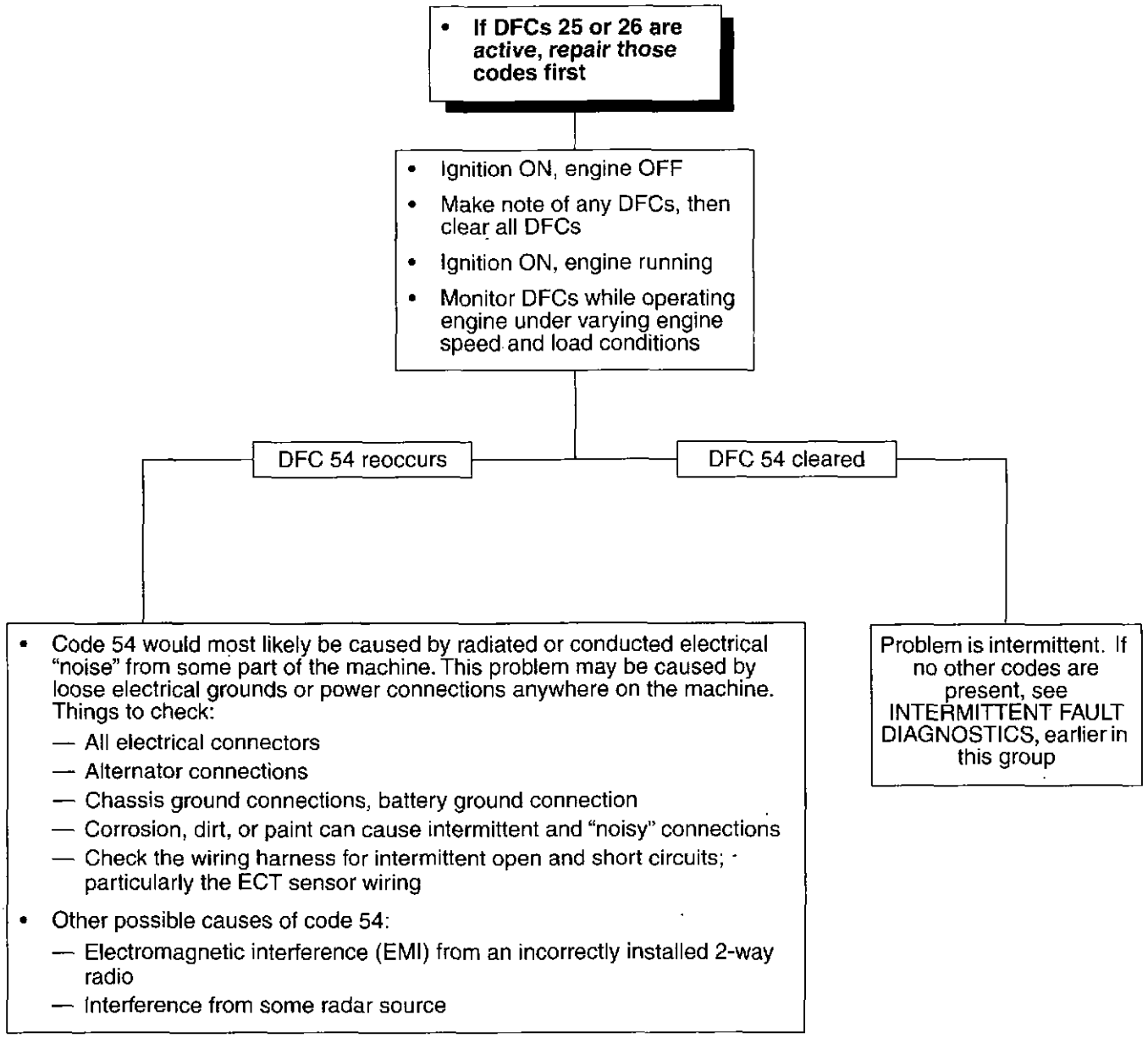


ECT Sensor Location

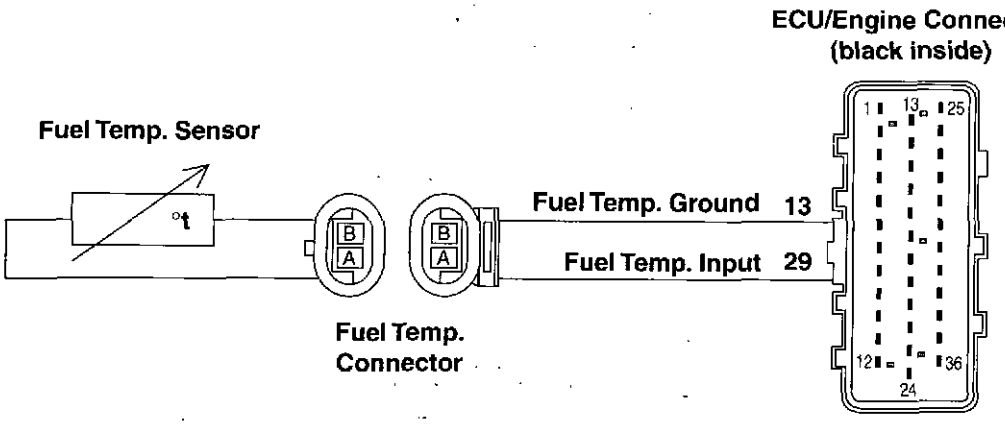
ECT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 54 ECT INPUT VOLTAGE ERRATIC—CONTINUED



DFC 55 FUEL TEMP INPUT VOLTAGE ERRATIC



Fuel Temperature Sensor Wiring

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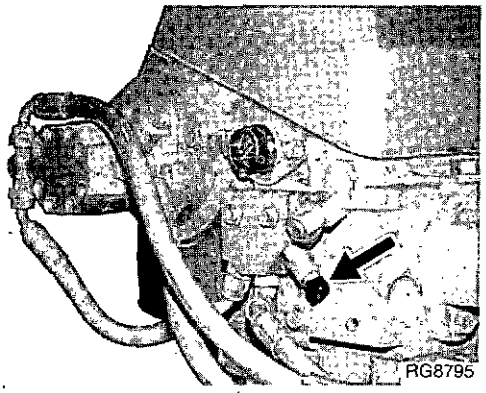
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fuel Temperature Sensor**
  - — The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures.
- **Fault code 55 will set if:**
  - — The fuel temperature input changes more erratically than what can occur under normal operating conditions.
- **If fault code 55 sets, the following will occur:**
  - — The ECU will use a default "limp-home" fuel temperature value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
  - — Engine power will be slightly derated.

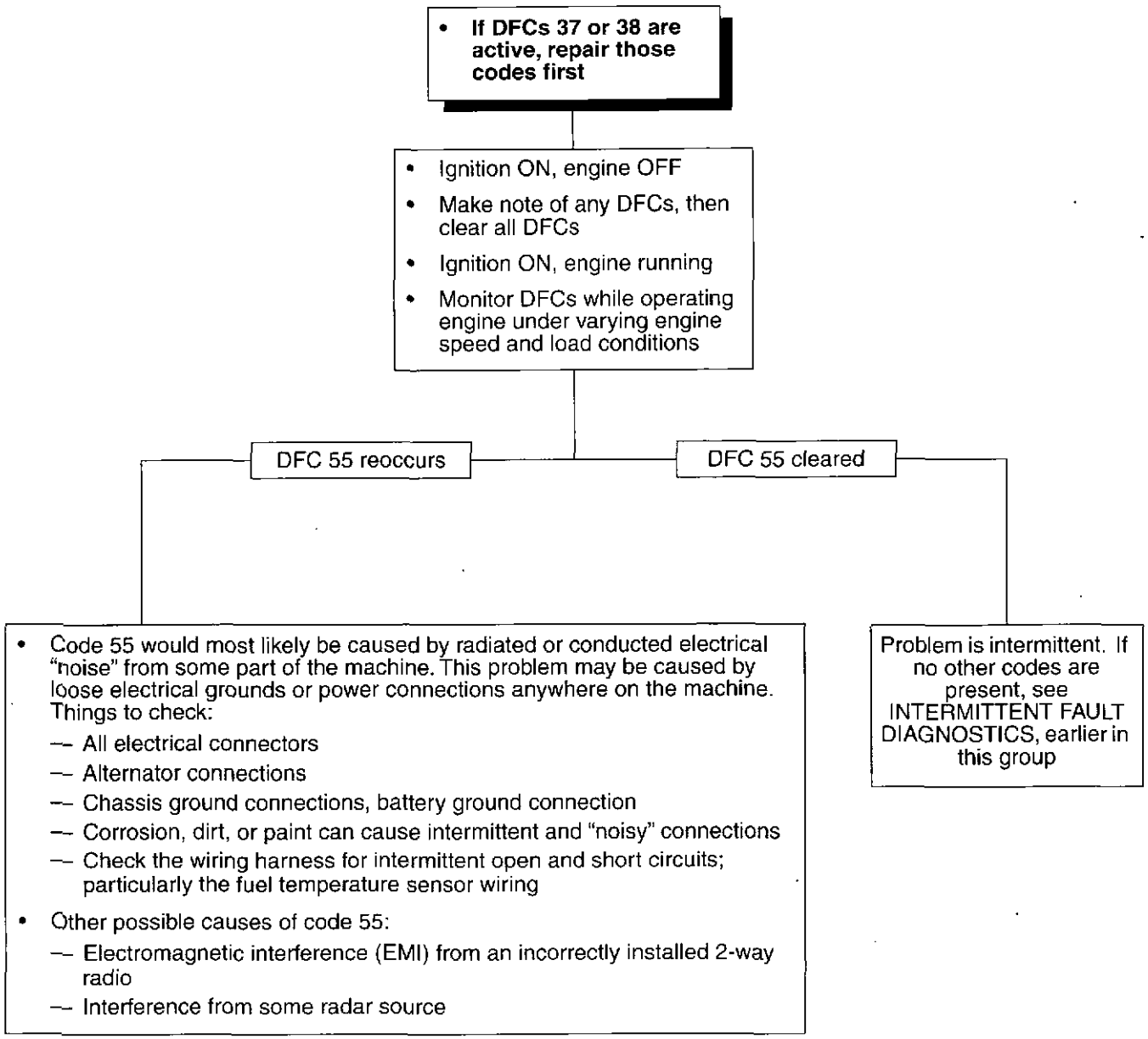


Fuel Temperature Sensor Location

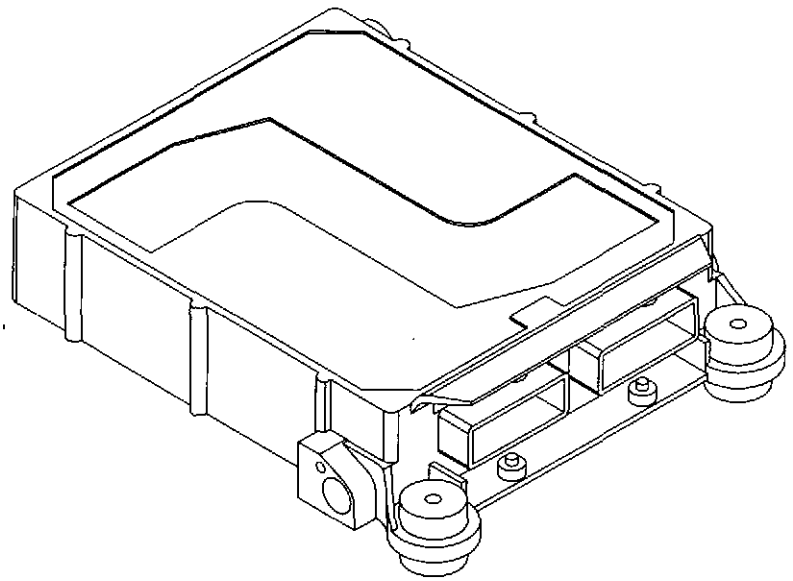
Fuel Temp Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

DFC 55 FUEL TEMPERATURE INPUT VOLTAGE ERRATIC—CONTINUED



DFC 81 ENGINE CONTROL UNIT (ECU) ERROR



RG8436

Engine Control Unit

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **Fault code 81 can be caused by:**
  - — Faulty ECU ground connections.
  - — Cranking the engine until battery voltage drops below 6 volts.
  - — An internal ECU problem.
- **If fault code 81 sets, the following will occur:**
  - — Depending on the severity of the problem, the engine may not run or engine operation may not be adversely affected.

DFC 81 ENGINE CONTROL UNIT (ECU) ERROR—CONTINUED

- Ignition ON, engine OFF
- Using the DST, make note of any DFCs, then clear all DFCs
- Ignition ON, engine running
- Monitor DFCs

DFC 81 reoccurs

- Using the appropriate adapter from JT07328 Connector Adapter Test Kit, test all female terminals in the ECU/Engine and the ECU/Cab connectors. There should be moderate resistance when the test adapter is inserted into the terminal. If a loose terminal is found, replace it.
- Check all ECU ground circuits.
- If DFC 81 occurred after an engine start where battery voltage was low, recharge battery, and retest.
- If none of the above problems are found, replace the ECU and retest.

DFC 81 cleared

Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group

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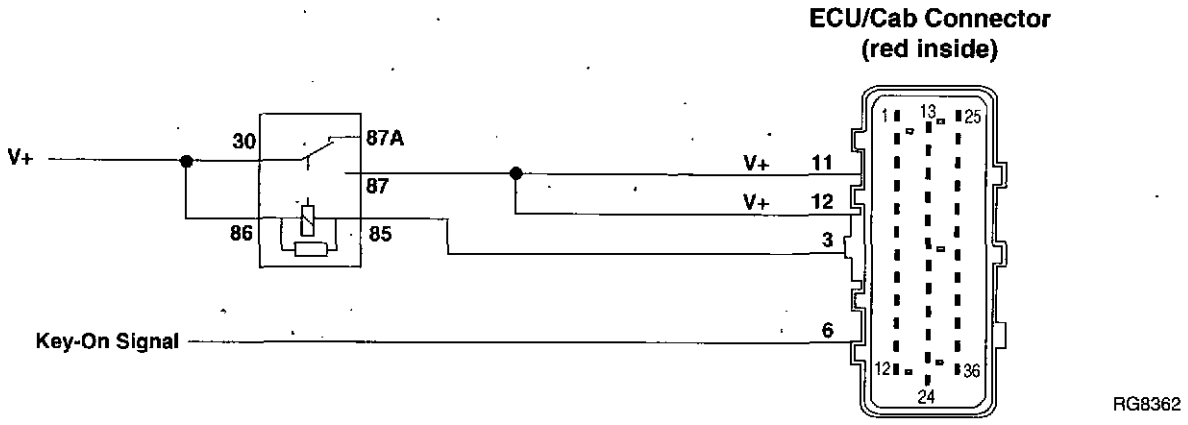
135

DFC 84 POWER DOWN ERROR



ECU Power Wiring

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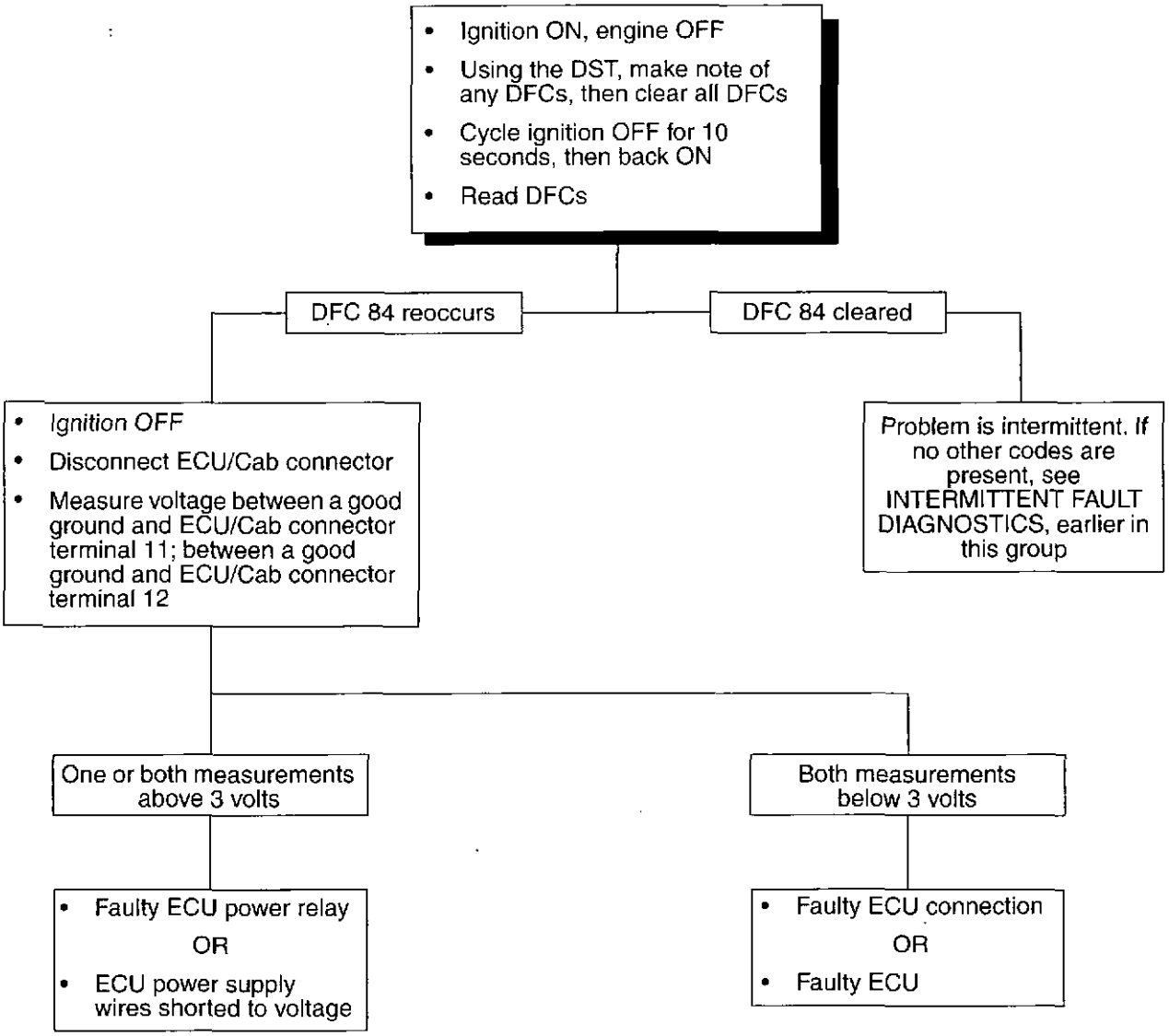
IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

- **ECU Power**
  - — Power is supplied to the ECU through a relay controlled by the ECU. Battery voltage is always available at the relay; the ECU energizes the relay when it "sees" voltage at the switched power input (indicating that the ignition has been turned on). When the ECU energizes the relay, battery voltage is available at ECU/cab connector terminals 11 and 12; this causes the ECU to "boot-up" and ready itself for engine start. When the ECU no longer sees voltage at the switched power input (as when the ignition has been turned off) the ECU goes through a power-down sequence before denergizing the relay.
- **Fault code 84 will set if:**
  - — The ECU power down error occurs when the ECU has attempted to denergize the relay that provides power to it, but voltage still exists at terminals 11 and 12 of the ECU/cab connector.
- **If fault code 84 sets, the following will occur:**
  - — Fault code 84 won't affect engine operation.

DFC 84 POWER DOWN ERROR—CONTINUED



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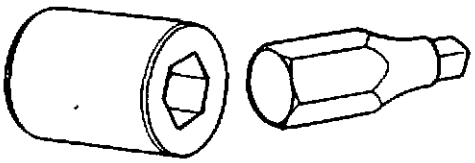
NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC) unless otherwise noted.

Group 105
ENGINE DIAGNOSTICS AND TESTING PROCEDURE TOOLS

Oil Galley Plug Tool JDG782

Used to remove and install oil galley plug.



RG6612

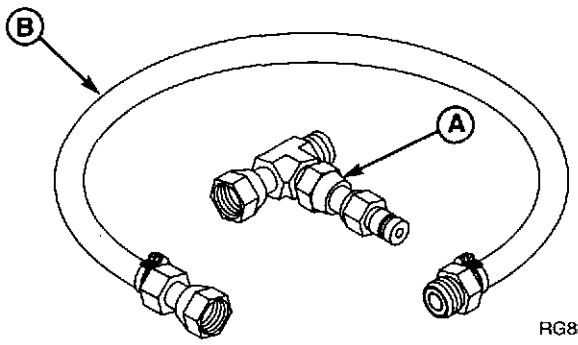
JDG782

Fuel Supply System Test Kit JT03513

Fuel Pressure Test Fitting is used with JT05472 Universal Pressure Test Kit to measure fuel transfer pump pressure. Fuel Air Detection Line is used to determine if air is present in fuel system.

Kit consists of:

A–Fuel Pressure Test Fitting JT03509
B–Fuel Air Detection Line JT03513-1

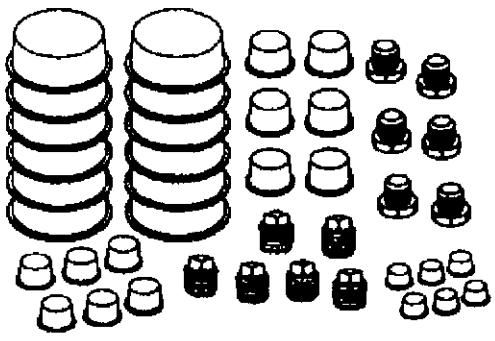


RG8802

JT03513

Fuel System Cap Plug Kit JDG998

Used to protect the fuel system from dirt and debris when disconnecting fuel system components during fuel transfer pump pressure check.



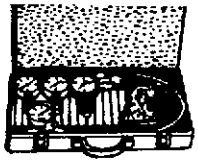
RG8518

JDG998

Group 105
ENGINE DIAGNOSTICS AND TESTING PROCEDURE TOOLS—CONTINUED

Universal Pressure Test Kit JT05412

Used for testing engine oil pressure, intake manifold pressure (turbo boost), and fuel transfer pump pressure.



RG5162

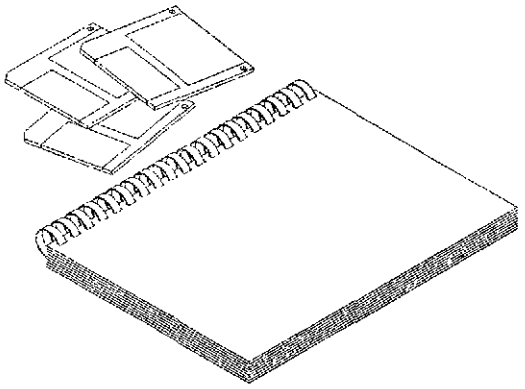
JT05412

Group 115
ELECTRONIC CONTROL SYSTEM DIAGNOSTIC TOOLS

10.5/12.5 ECU Communication
Software Kit. JDIS122

Used with JDIS121 - 10.5/12.5 ECU Communication Hardware Kit. Together, the kits enable a Windows (3.X or '95) compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port.

NOTE: Available from John Deere Distribution Service Center (DSC). ***United States and Canadian Agricultural dealers DO NOT ORDER without first contacting your Branch or TAM.***

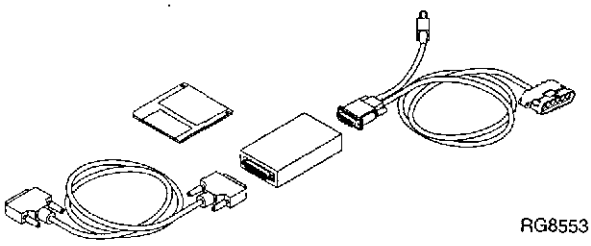


JDIS122

10.5/12.5 ECU Communication
Hardware Kit JDIS121

Used with JDIS122 - 10.5/12.5 ECU Communication Software Kit. Together, the kits enable a Windows (3.X or '95) compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port.

NOTE: Available from John Deere Distribution Service Center (DSC). ***United States and Canadian Agricultural dealers DO NOT ORDER without first contacting your Branch or TAM.***

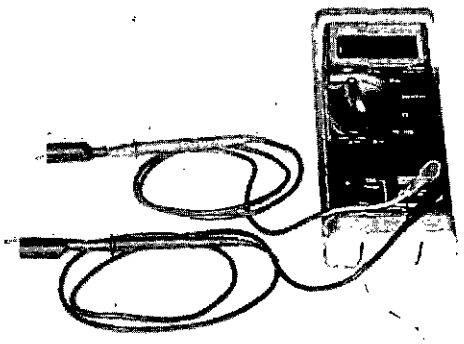


RG8553

JDIS121

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



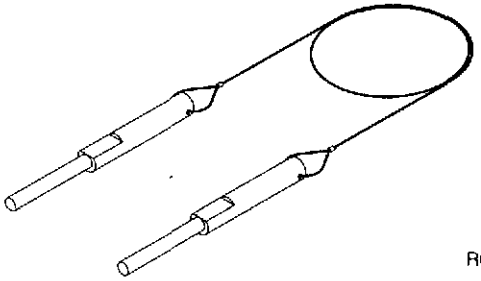
RW11274

JT05791

Group 115
ELECTRONIC CONTROL SYSTEM DIAGNOSTIC TOOLS—CONTINUED

Cam/Crankshaft Timing Lock Pins (2) JDG971

Used to verify cam/crank gear train is correctly timed. Use with JDG820.

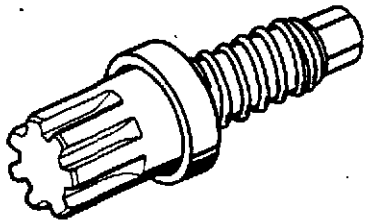


RG8519

JDG971

Flywheel Turning Tool JDG820

Used to rotate flywheel on engine, with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) I.D. flywheel housing guide bore diameter, to verify cam/crank gear train is correctly timed. JDE81-1 may be used also if JDG820 is not available. Use with JDG971 Timing Pins.

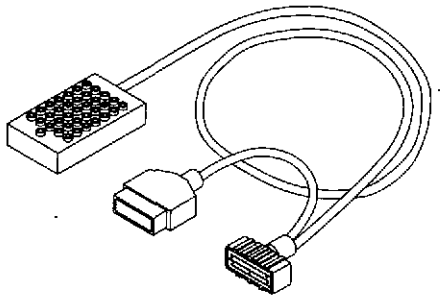


RG7056

JDG820

10.5/12.5 Engine Control Unit Break-Out-Box JT02171

Used during diagnostics to allow easy measurement of electronic control system voltage and resistance values.

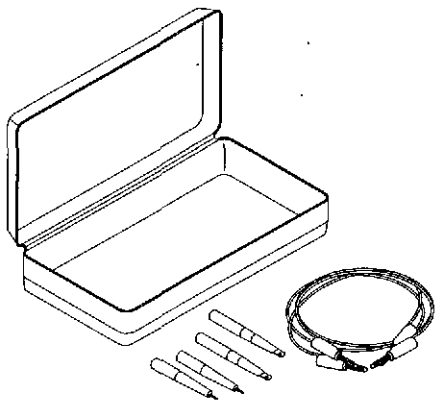


RG8533

JT02171

Connector Adapter Test Kit JT07328

Used with JT05791 Digital Multimeter to make voltage and resistance measurements in control system wiring harness connectors. Can also be used to test terminals for proper fit.



JT07328

GROUP 105
ENGINE DIAGNOSTICS AND TESTING PROCEDURES SPECIFICATIONS

ITEM	SPECIFICATION
Oil Pressure:	
Minimum No Load at Idle	100 kPa (1.0 bar) (15 psi)
Maximum Full Load at Rated Speed	450 kPa (4.5 bar) (65 psi)
Thermostats (2 Used):	
Initial Opening (Range)	80–84°C (175–182°F)
Full Open (Nominal)	94°C (202°F)
Fuel Transfer Pump Pressure:	
Normal (Idle)	410–480 kPa (4.1 –4.8 bar) (60–70 psi)
Cranking (Minimum 200 rpm)	70–170 kPa (0.7–1.7 bar) (10–25 psi)

	TORQUE
Fuel System O-ring-Face-Seal Fittings:	
Final Filter-to-Fuel Manifold	24 N·m (18 lb-ft)
Transfer Pump-to-Final Filter	24 N·m (18 lb-ft)

INTAKE MANIFOLD PRESSURE (TURBOCHARGER BOOST) SPECIFICATIONS

ENGINE MODEL	FUEL SYSTEM OPTION CODES	POWER RATING @RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED (rpm)	PRESSURE SPECIFICATION
OEM INDUSTRIAL APPLICATIONS				
6105AF	1601, 1603	224 (300)	2100	134–154 kPa (1.3–1.5 bar) (19–22 psi)
6105HF	1610, 1620	242 (325)	2100	128–148 kPa (1.3–1.5 bar) (19–21 psi)
6125AF	1601, 1611	261 (350)	2100	144–166 kPa (1.4–1.7 bar) (21–24 psi)
	1602, 1612	280 (375)	2100	159–183 kPa (1.6–1.8 bar) (23–27 psi)
	1603, 1613	298 (399)	2100	173–199 kPa (1.7–2.0 bar) (25–29 psi)
	1610, 1620	242 (325)	2100	134–154 kPa (1.3–1.5 bar) (19–22 psi)
6125HF	1601, 1611	317 (425)	2100	148–170 kPa (1.5–1.7 bar) (21–25 psi)
	1602, 1612	336 (450)	2100	162–186 kPa (1.6–1.9 bar) (23–27 psi)
	1603, 1613	354 (474)	2100	172–198 kPa (1.7–2.0 bar) (25–29 psi)
	1604, 1614	373 (500)	2100	182–210 kPa (1.8–2.1 bar) (26–30 psi)
OEM GENERATOR SET (STANDBY) APPLICATIONS				
6125AF	1604, 1614	288 (386)	1800	182–210 kPa (1.8–2.1 bar) (26–30 psi)
	1605, 1615	311 (417)	1800	201–231 kPa (2.0–2.3 bar) (29–33 psi)
	1606, 1616	339 (454)	1800	223–257 kPa (2.2–2.6 bar) (32–37 psi)
	1607, 1617	247 (331)	1500	136–156 kPa (1.4–1.6 bar) (20–23 psi)
	1608, 1618	262 (351)	1500	150–172 kPa (1.5–1.7 bar) (22–25 psi)
	1609, 1619	289 (387)	1500	171–197 kPa (1.7–2.0 bar) (25–29 psi)
6125HF	1605, 1615	423 (567)	1800	250–288 kPa (2.5–2.9 bar) (36–42 psi)
	1606, 1616	367 (492)	1800	210–242 kPa (2.1–2.4 bar) (30–35 psi)
	1607, 1617	313 (419)	1500	184–212 kPa (1.8–2.1 bar) (27–31 psi)
	1608, 1618	362 (485)	1500	215–247 kPa (2.1–2.5 bar) (31–36 psi)

INTAKE MANIFOLD PRESSURE (TURBOCHARGER BOOST) SPECIFICATIONS —CONTINUED

ENGINE MODEL	DEERE MODEL	RATED SPEED (rpm)	PRESSURE SPECIFICATION
JOHN DEERE VEHICLE APPLICATIONS			
6125ADW01	744H (4-Wheel Drive Loader)	2000	93–107 kPa (0.9–1.0 bar) (14–16 psi)
6125ADW03	744MH (4-Wheel Drive Loader)	2000	93–107 kPa (0.9–1.0 bar) (14–16 psi)
6125ADW70	Hitachi LX230-3 (4-WD Loader)	2000	93–107 kPa (0.9–1.0 bar) (14–16 psi)
6105HRW01	9200 (4-Wheel Drive Tractor)	2100	124–142 kPa (1.2–1.4 bar) (18–21 psi)
6125HRW01	9300 (4-Wheel Drive Tractor)	2100	113–130 kPa (1.1–1.3 bar) (16–19 psi)
6125HRW02	9400 (4-Wheel Drive Tractor)	2100	144–166 kPa (1.4–1.7 bar) (21–24 psi)
6125HZ001	6850 (Forage Harvester)	2100	149–172 kPa (1.5–1.7 bar) (22–25 psi)
6125HZ002	6750 (Forage Harvester)	2100	115–132 kPa (1.1–1.3 bar) (17–19 psi)

GROUP 115
ELECTRONIC CONTROL SYSTEM DIAGNOSTICS SPECIFICATIONS

Refer to illustrations on following pages for electronic control system component locations.

A wiring diagram is provided later in this group.

TORQUE CURVE SELECTION

NOTE: 6750/6850 Self-Propelled Forage Harvester applications only use one torque curve.

9000 Series 4WD Tractor

	PST Transmission	12 Speed MST Transmission	24 Speed MST Transmission
Torque Curve 1	– When none of the below conditions are met	– When none of the below conditions are met	– When none of the below conditions are met
Torque Curve 2	– When in gear 3F	– When in gear B1	– When in gears A3H or B1L
Torque Curve 3	– 3-pt. hitch lowered OR – Vehicle speed less than 0.5 mph and PTO engaged	– 3-pt. hitch lowered OR – Vehicle speed less than 0.5 mph and PTO engaged OR – When in gears A1, A2, A3, or AR	– 3-pt. hitch lowered OR – Vehicle speed less than 0.5 mph and PTO engaged OR – When in gears A1L, A1H, A2L, A2H, A3L, ARL, or ARH
Torque Curve 4	– When in gears 1F, 2F, or 1R	Not Used	Not Used

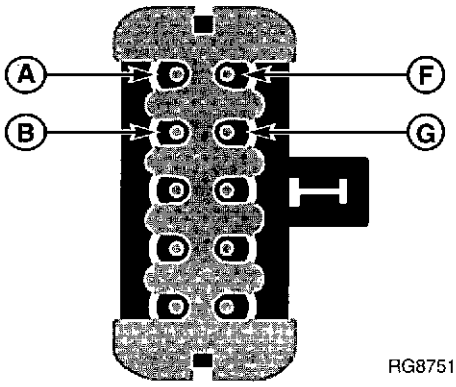
GROUP 115
ELECTRONIC CONTROL SYSTEM DIAGNOSTICS SPECIFICATIONS—CONTINUED

744H Loader

Torque Curve 1	–When in any gear other than 1st
Torque Curve 2	–When in 1st gear
Torque Curve 3	Not used
Torque Curve 4	Not used

OEM Engines

Torque Curve 1	Intermittent Default Power Curve 4	–No jumper wires installed
Torque Curve 3	Intermittent Power Curve 1	–Jumper wire installed between terminals B and G only
Torque Curve 5	Continuous Default Power Curve 3	–Jumper wire installed between terminals A and F only
Torque Curve 7	Continuous Power Curve 2	–Jumper wire installed between terminal s A and F and jumper wire installed between terminals B and G

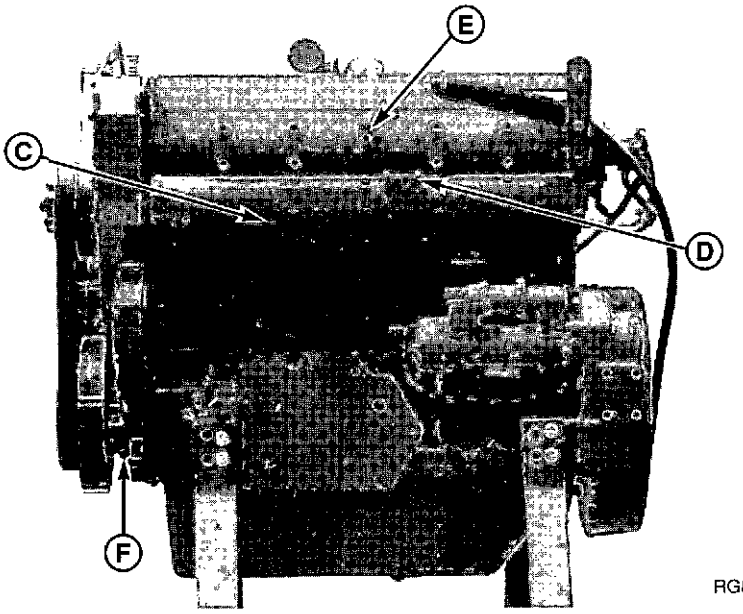


Performance Program Connector

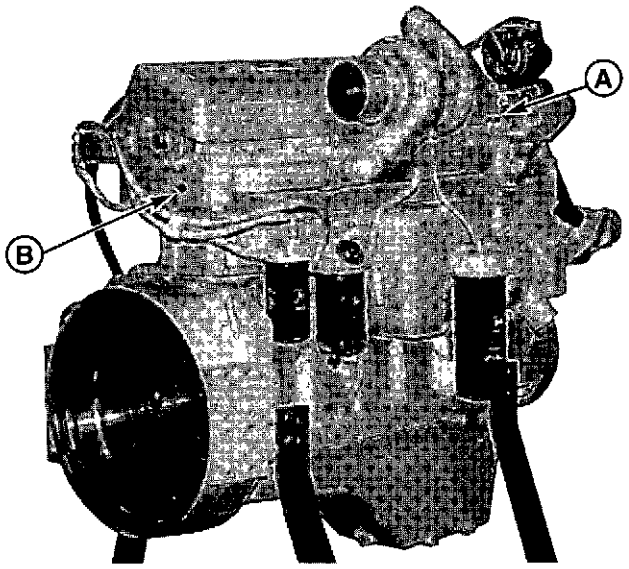
ECU TERMINAL IDENTIFICATION

ECU/Cab Connector (red)	Terminal Number	ECU/Engine Connector (black)
unused	1	unused
unused	2	case ground
ECU power relay	3	EUI 4, 5, 6 90 volt supply
fault code output	4	EUI 1, 2, 3, 90 volt supply
unused	5	unused
switched power input	6	cylinder 4 EUI control
unused	7	cylinder 6 EUI control
engine speed output	8	cylinder 5 EUI control
ground	9	unused
ground	10	cylinder 2 EUI control
battery power input	11	cylinder 3 EUI control
battery power input	12	cylinder 1 EUI control
unused	13	fuel temperature ground
unused	14	MAT ground
torque curve select 1	15	MAT input
PWM throttle input	16	unused
EOL enable	17	crank position return
unused	18	cam position return
unused	19	unused
unused	20	unused
torque curve select 3	21	unused
ECT and analog throttle gnd	22	unused
ECT input	23	unused
unused	24	unused
SAE J1708 communication	25	MAP 5 volt supply
SAE J1708 communication	26	unused
fuel value output	27	MAP ground
unused	28	MAP signal
fuel rail pressure switch input	29	fuel temperature input
unused	30	crank position input
torque curve select 2	31	cam position input
transport max speed governor select	32	unused
isochronous governor select	33	unused
analog throttle 5 volt supply	34	unused
analog throttle input	35	unused
unused	36	unused

6105H/6125H ENGINES ELECTRONIC CONTROL SYSTEM COMPONENT LOCATION



Left-Side Sensor Locations



Right-Side Sensor Locations

A - Engine Coolant Temperature
B - Fuel Temperature Sensor
C - Manifold Air Temperature (MAT) Sensor
D - Manifold Air Pressure (MAP) Sensor
E - Camshaft Position Sensor
F - Crankshaft Position Sensor

Index

JOHN DEERE SERVICE PUBLICATIONS REPORT

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Manual Number (and issue date)_____ ❑ EPC (CD-ROM)
Parts Catalog Number (and date) _____ ❑ Printed Book
Description of error or suggestion: _____

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Machine Name & Model Number_____
SPG or FRM Number (and issue date) _____
Description of new job:_____

Restudy Existing Job: Job No._____ Time Listed in Manual _____ Our Time _____
Reason: _____

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