SERVICE REPAIR

MANUAL

Hyster K177 (H45XM, H50XM, H55XM, H60XM, H65XM) Forklift Service Repair Manual

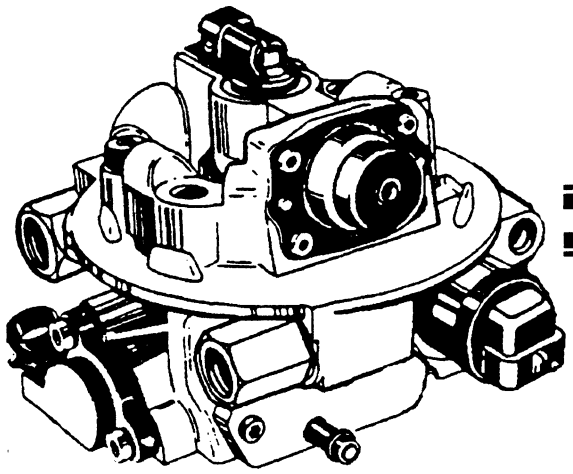
HYSTER

ELECTRONIC ENGINE CONTROL

GM 2.2L

TROUBLESHOOTING AND REPAIR

H2.00–3.20XM (H40–65XM)



HYSTER

PART NO. 897460

2200 SRM 490

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure that all slings, chains or cables are correctly fastened and that the load being lifted is balanced. Make sure that the crane, cables and chains have the capacity to support the weight of the load.

- Do not lift heavy parts by hand. Use a lifting mechanism.

- Wear safety glasses.

- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.

- Always use correct blocks to prevent the unit from rolling or falling. See "How To Put The Lift Truck On Blocks" in the **OPERATING MANUAL** or the **PERIODIC MAINTENANCE** section.

- Keep the unit and working area clean and in order.

- Use the correct tools for the job.

- Keep the tools clean and in good condition.

- Always use **HYSTER** *APPROVED* parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.

- Make sure that all nuts, bolts, snap rings and other fastening devices are removed before using force to remove parts.

- Always fasten a DO NOT OPERATE sign to the controls of the unit when making repairs or if the unit needs repairs.

- Make sure you follow the **DANGER, WARNING** and **CAUTION** notes in the instructions.

- Gasoline, Liquid Petroleum Gas (LPG), and Diesel are flammable fuels. Make sure that you follow the necessary safety precautions when handling these fuels and when working on these fuel systems.

- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area has ventilation.

CONTENTS

This section is for the following models:

H2.00–3.20XM (H40–65XM)

"THE QUALITY KEEPERS"

HYSTER APPROVED PARTS

INTRODUCTION

GENERAL

This section has the troubleshooting and repair procedures for the parts of the electronic engine controls. Users of this section must know the components and operation as described in the section **ELECTRONIC ENGINE CONTROL – Description and Operation, 2200 SRM 525.**

The electronic engine control system is made of many parts. The main parts are the Throttle Body Injection (TBI) unit and the Electronic Control Module (ECM). These parts and their sensors give information about engine operation and the systems it controls. The ECM has the ability to perform some troubleshooting of itself and of other parts of the system. When a problem is found, the ECM turns "ON" the "Malfunction Indicator" lamp that is in the instrument cluster. A diagnostic trouble code (DTC) is kept in the memory of the ECM.

TROUBLESHOOTING PROCEDURE

Before using this part of the manual, you need to know the information and the correct troubleshooting procedures. If the correct troubleshooting procedures are not followed, as described in this section, it can result in replacement of good parts. Troubleshooting charts use a "SCAN" tool where possible. The "SCAN" tool has the ability to save time in troubleshooting and preventing the replacement of good parts.

HOW THIS SECTION IS ARRANGED

This section is in five parts that describe the troubleshooting and repair procedures. They are as follows.

INTRODUCTION

TROUBLESHOOTING CHARTS

TROUBLESHOOTING – POOR OPERATION

SYSTEM TEST CHARTS

REPAIRS

Where Do I Start?

There are three things to do to start troubleshooting. The first item is to become familiar with the electronic engine control system.

Secondly, always start your work with a good visual/physical inspection. See the following paragraph for more explanation.

The last item on the "Where Do I Start" list is the "On–Board Diagnostic" (OBD) System Check.

VISUAL/PHYSICAL INSPECTION

A careful visual and physical inspection must be done as part of any diagnostic procedure. This can cause the repair of a problem without further steps. Inspect all vacuum hoses for correct routing, restrictions, cuts or bad connections. Be sure to inspect hoses that are difficult to see beneath the air filter. Inspect all the wires in the engine compartment for proper connections, damaged spots, or contact with sharp edges or the exhaust manifolds. This visual/physical inspection is very important. It must be done carefully.

KNOWLEDGE/TOOLS REQUIRED

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. One should be familiar with wiring diagrams, the meaning of voltage, ohms, amps, the basic theories of electricity, and understand what happens in an open or shorted wire. To perform the troubleshooting procedures, the use of a diagnostic "SCAN" tool is required. A tachometer, test lamp, ohmmeter, digital voltmeter with 10 megohms impedance, vacuum gauge, and jumper wires are also required. Special tools that are required for system service and the ones described above are shown at the end of this section.

DAMAGE FROM STATIC DISCHARGE (STATIC ELECTRICITY)

Electronic components used in control systems use a very low voltage, and can be easily damaged by static discharge or static electricity. Less than 100 volts of static electricity can cause damage to some electronic components. There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat; in which a charge of as much as 2 to 5,000 volts can build up. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object

and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity Static charges of either type can cause damage, therefore, it is important to use care when handling and testing electronic components.

NOTE: To prevent damage by static electricity, DO NOT touch the ECM connector pins.

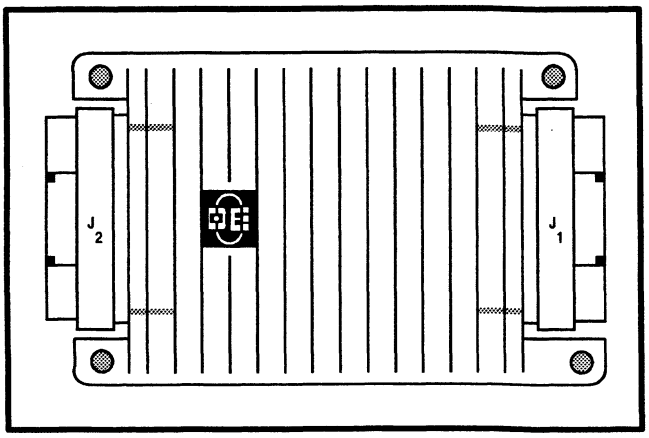


FIGURE 1. ECM

TROUBLESHOOTING INFORMATION

The troubleshooting charts and function checks in this section are designed to find a bad circuit or component through logic based on the process of elimination. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are no multiple failures. The ECM does constant testing on certain control functions. The ECM communicates the source of a malfunction with Diagnostic Trouble Codes (DTC). The DTC's are two digit numbers that can range from 12 to 99. When a malfunction is found by the ECM, a DTC is set and the "Malfunction Indicator" lamp is turned "ON".

"Malfunction Indicator" Lamp (MIL)

This lamp is on the instrument cluster and has the following functions.

It lets the operator know that a problem has occurred and that the vehicle must be taken for service as soon as possible.

It displays Diagnostic Trouble Codes (DTC's) kept by the ECM which help the technician troubleshoot system problems.

As a bulb and system check, the lamp will come "ON" with the ignition switch **ON** and the engine not running. When the engine is started, the lamp will turn "OFF."

If the lamp remains "ON", the system has found a problem. This problem is referred to as a "current" DTC. If the problem goes away, the lamp will go out after 10 seconds. In either condition a "DTC" will remain in the ECM.

When the lamp remains "ON" while the engine is running, or when there is a malfunction, the "On–Board Diagnostic" (OBD) System Check must be done.

When a problem is not regular or constant, the "Malfunction Indicator" lamp will turn "ON" for approximately ten (10) seconds and then will go turn "OFF". However, the diagnostic trouble code (DTC) will be kept in the memory of the ECM until the DTC's are cleared (see DTC clearing in this section). An DTC that is not constant can reset. If it is a problem that is not constant a DTC Chart is not used. However you can use the "Other Troubleshooting Checks" on the page facing the troubleshooting chart for that DTC to help locate the problem.

Reading Diagnostic Trouble Codes (DTC)

The Diagnostic Link Connector (DLC) is used to communicate with the ECM. See FIGURE 2. The DLC is installed on the bracket on top of the valve cover. It is used in the assembly plant to receive information in checking that the engine is operating correctly before it leaves the plant. The DTC(s) kept in the ECM's memory can be read with a "SCAN" tool connected to the DLC. They can also be read by counting the number of flashes of the "Malfunction Indicator" lamp when terminal "B" of the DLC connector is connected to ground. The terminal can be connected to ground at terminal "A" (external ECM ground).

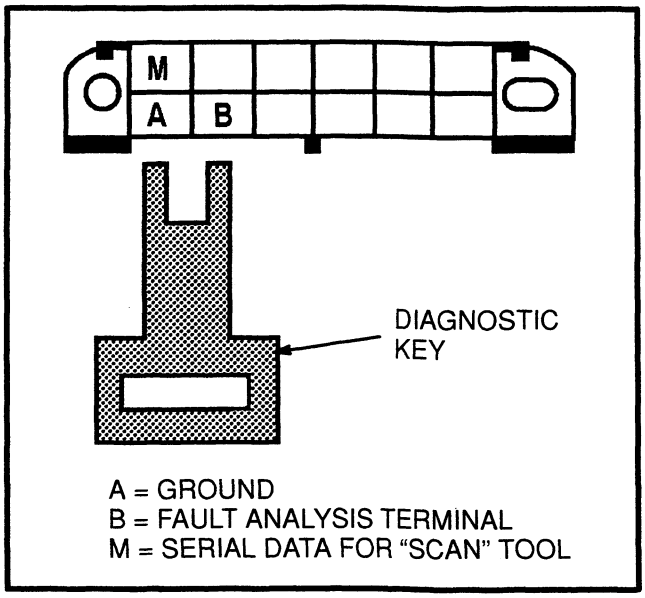


FIGURE 2. DIAGNOSTIC LINK CONNECTOR (DLC)

The ignition switch must be moved to the **ON** position, with the engine not running, and terminals "A" and "B" connected. At this point, the "Malfunction Indicator" lamp will flash DTC 12 three times consecutively (see FIGURE 3. The following is the flash sequence for "12": "long pause, flash, pause, flash–flash, long pause,.flash, pause, flash.flash, long pause flash, pause, flash–flash." DTC 12 (which means no crankshaft rpm signal) indicates that the ECM's diagnostic system is operating correctly at this time. If DTC 12 is not indicated, a problem is in the diagnostic system itself.

Following the output of DTC 12, if additional codes are stored, the "Malfunction Indicator" lamp will flash the DTC three times. If more than one DTC has been stored in the ECM's memory, the DTC's will be flashed starting with the newest DTC set and finishing with the oldest DTC set. Remember each DTC will be flashed three times. When all DTC's have been flashed the sequence will start over again with DTC 12.

Clearing Diagnostic Trouble Codes (DTC's)

There are two ways to clear DTC's, manually or with a "SCAN" tool.

For the manual procedure do the following steps:

1. Jumper the DLC terminal "A" to "B".
2. Turn the ignition key on (engine not running).
3. Push the throttle to above 80%.

The order of the above three steps is not important, as long as all three items are present at the same time. (The Malfunction Indicator lamp must not be flashing or "ON" at this time. If the TP Sensor voltage does not go high enough, then the DTC's will not clear.)

NOTE: Disconnecting the battery will not clear DTC's on this ECM.

When using the second method, "SCAN" tool, install the tool according to the operators manual of the tool. Select clear DTC's from the tools menu. This operation electronically clears all ECM DTC's.

After using either procedure, always check for DTC's again to see that the DTC's are cleared.

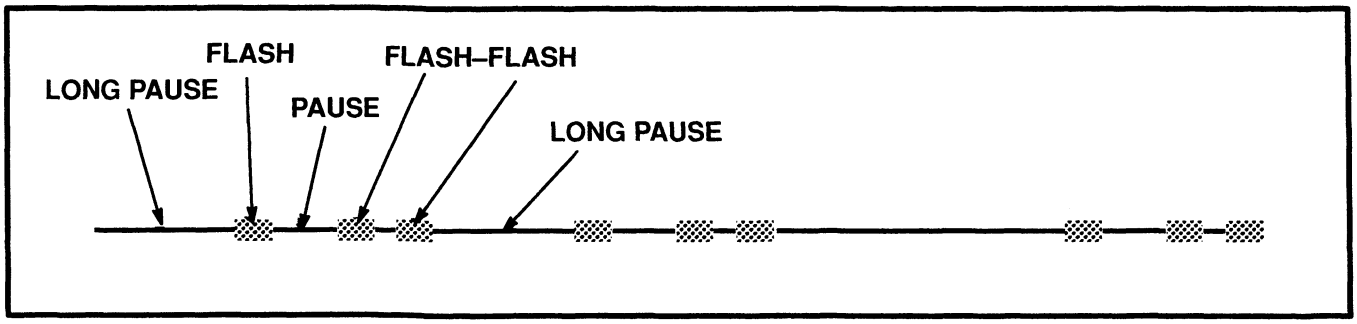


FIGURE 3. DIAGNOSTIC TROUBLE CODE 12 EXAMPLE

TABLE 1. ECM DIAGNOSTIC CODES AVAILABLE

CODE	DESCRIPTION	TURN ON "MALFUNCTION INDICATOR" LAMP
14	Engine Coolant Temperature Sensor Circuit – High Volts	Yes
15	Engine Coolant Temperature Sensor Circuit – Low Volts	Yes
21	Throttle Position Sensor – High Volts	Yes
22	Throttle Position Sensor – Low Volts	Yes
31	Governor Circuit Malfunction	Yes
33	MAP Sensor Circuit – High Volts	Yes
34	MAP Sensor Circuit – Low Volts	Yes
42	EST Circuit Malfunction	Yes
51	ECM Internal Problem	Yes

⚠ CAUTION

To prevent ECM damage, the key must be OFF when disconnecting or reconnecting ECM power.

Diagnostic Mode

When the DLC terminal "B" is connected to ground with the ignition **ON** and the engine "OFF", the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a DTC 12 by flashing the "Malfunction Indicator" lamp (indicating the system is operating correctly).

2. Display any additional stored DTC's by flashing the "Malfunction Indicator" lamp. Each DTC will flash three times, then DTC 12 will flash again.

3. The IAC valve moves to its fully extended position, blocking the idle air passage. (This can be useful in checking the minimum idle air setting.)

Field Service Mode

If the diagnostic terminal is connected to ground with the engine running, the system will enter the Field Service mode. This will cause the engine to run at approximately 1500 rpm and 8° before top dead center spark advance. While the system is in Field Service Mode, new trouble codes can be kept in the ECM.

ECM Learning Ability

The ECM has a "learning" ability that lets it make corrections for variations in the idle system to improve idle performance. If the battery is disconnected for any reason, the "learning" process resets and begins again. To "teach" the vehicle, make sure that the engine is at operating temperature. Drive the lift truck at part throttle, with moderate acceleration, and idle until normal performance returns.

TABLE 2. "SCAN" TOOL INFORMATION

Test under following conditions: Idle speed, upper radiator hose hot, throttle closed, NEUTRAL, all accessories "OFF"		
"SCAN" Position	**Units Displayed**	**Values**
Engine Speed	rpm	+100 rpm from
Idle Speed	rpm	ECM idle command (changes with temperature
Coolant Temp.	°C /°F	85 to 100°C/180° to 212°F
Ignition Volts	volts	12.5 to 14.5 v
MAP	Volts/kPa	1 to 2 (depends on Vac. and BARO press.), 30–40 kPa
BARO	Volts/kPa	1 to 2 (depends on BARO pressure), 98–102 kPa
Throttle Position	volts	.45 to 1.25 v
Throttle Angle	0 to 100%	0
Governor TPS	0 to 100%	0
Desired Governor TPS	0 to 100%	0
Governor Enable	Yes/No	Yes
Governor rpm Control	Active/Not Active	Not Active
Governor rpm Mode	High rpm/Normal	Normal
Idle Air Control	Counts/Steps	Between 5 and 50
rpm Overspeed	Yes/No	No
Fuel Trim	Steps	N/A
Injector Pulse Width	MSec	.8 to 3.0 mSEC
Spark Advance	No. of Degrees	Varies
Base Timing	N/A	N/A
Knock Signal	Yes/No	No
Knock Retard	No. of Degrees	0 Degrees
Governor mph Control	Active/Not Active	Not Active
Vehicle Speed	mph	0 mph
mph Overspeed	Yes/No	No
Low Oil Pressure	Yes/No	No
Power Steering Switch	Normal/High	Normal
Emergency Stop	Active/Not Active	Not Active
Lift Mode	Active/Not Active	Not Active
EEPROM ID	number	XXXX (varies with calibration) – 2201
Time From Start	hrs., min., sec.	0:00:00 – 18:12:15

On–Board DIAGNOSTIC (OBD) System Check

The On–Board Diagnostic (OBD) System Check is a troubleshooting chart to find a problem caused by a malfunction in the electronic engine control system. It must be the starting point for any troubleshooting.

The "SCAN" data shown in TABLE 2 can be used for comparison after doing the troubleshooting checks and finding the on–board diagnostics working correctly with no trouble codes shown. The data are an average of display values from normally operating vehicles and show a display of a normally operating system.

After the visual/physical inspection, the "On–Board Diagnostic (OBD) System Check" is the starting point for all troubleshooting procedures.

The correct procedure to find a problem is to follow three basic steps.

1. Are the On–Board Diagnostics working? This is determined by doing the "OBD System Check" Since this is the starting point for the troubleshooting procedures , always begin here.

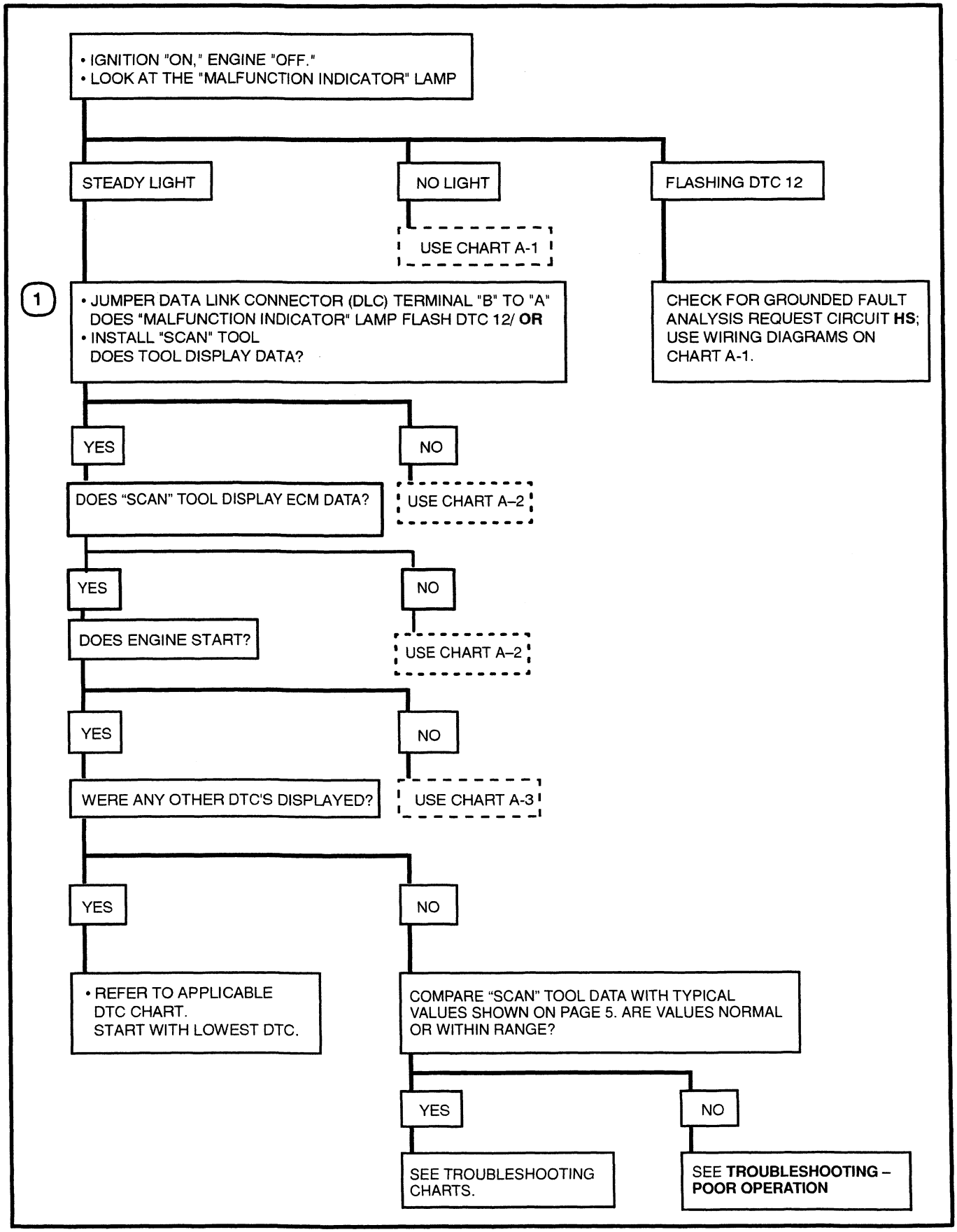
If the On–Board Diagnostics do not work, the "OBD System Check" will not lead to a troubleshooting chart to fix the problem. If the On–Board Diagnostics are working correctly, go to the next step.

2. Is there a Diagnostic Trouble Code? If there is a DTC, go directly to the DTC chart for that number. This will determine if the fault is still there. If there is no DTC, then;

3. "SCAN" Serial Data transmitted by the ECM. This involves reading the information available on the Serial Data Stream with one of the tools available for that purpose. Information on these tools and the meaning of the displays can be found in the operator's manual of the tool. Readings for a certain operating condition can be found in TABLE 2.

Test Description: The number(s) below are a reference to number(s) in circles in the troubleshooting chart on the next page.

1. Diagnostic Trouble Code (DTC) 12 means no rpm reference pulses from the ignition module. This is correct when engine is not running



ON–BOARD DIAGNOSTIC SYSTEM CHECK

TROUBLESHOOTING CHARTS

GENERAL

The following troubleshooting charts are designed to give an efficient method of fault analysis on the electronic engine controls.

⚠ WARNING

This troubleshooting requires the operation of the engine for some of the tests. Make sure the tests are done carefully to prevent injury:

- **Put the lift truck on a level surface. Lower the carriage and forks and apply the parking brake. Make sure the lift truck can not move and cause an injury during the tests. Use blocks as necessary to prevent movement of the lift truck.**
- **The fuel system and the engine must operate correctly. Any problems or leaks in the fuel system and the engine must be repaired before doing troubleshooting.**
- **The fan and the drive belts can remove fingers or cause other injuries. Be careful that your hands and tools do not touch the moving fan or the drive belts.**
- **The engine exhaust and other parts of the engine are hot. Do not touch a hot surface and cause a burn.**

⚠ CAUTION

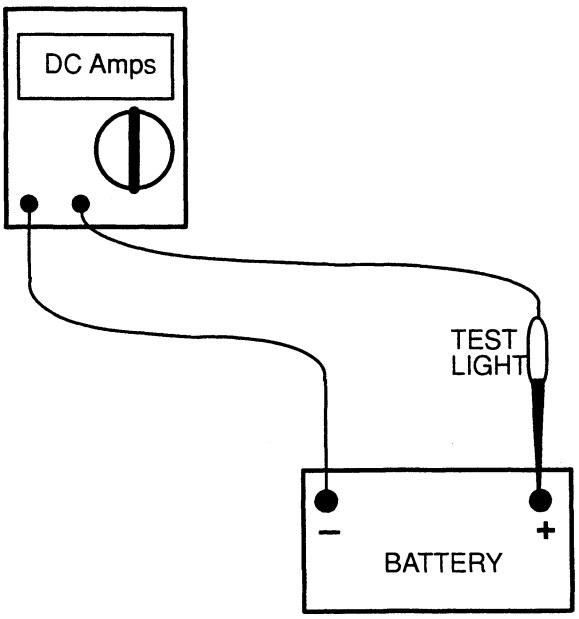
Electronic equipment can be damaged if troubleshooting and repairs are not done correctly. The following CAUTIONS must be followed when doing troubleshooting or repairs on an engine with an ECM:

- **Always disconnect the battery negative cable before disconnecting and removing any parts except as described in TROUBLESHOOTING.**
- **Never start the engine unless the battery is correctly connected.**
- **Never disconnect the battery from any equipment when the engine is running.**
- **Never disconnect the battery from the charging system when the engine is running.**
- **If the battery must be charged with a battery charger, ALWAYS disconnect the battery from the electrical system.**
- **Make sure that all electrical connections are clean and have good electrical contact.**
- **Never connect or disconnect the wiring harness at the ECM when the key switch is "ON".**
- **Always disconnect the battery and the ECM connectors if electric arc welding must be done on the vehicle.**
- **If the engine compartment is cleaned with steam, make sure that any water or steam is not sent toward the ECM or its sensors. The heat and steam can damage the electronic components and cause corrosion in the electrical connections.**
- **Use only the tools and test equipment described in "TOOLS AND TEST EQUIPMENT" to prevent damage to good components and to obtain correct test results.**
- **All voltage measurements must be made with a digital voltmeter with a rating of 10 megohm input impedance.**
- **When a test light is used in troubleshooting, the test light must have less than 0.3 amps (300 milliamps) of maximum current flow. A test for a correct test light is shown in FIGURE 4.**

TOOLS AND TEST EQUIPMENT

The following tools are necessary for troubleshooting the system:

- Ohmmeter
- Digital voltmeter. The voltmeter must have a minimum input impedance of 10–megohms. (A digital voltmeter and ohmmeter are normally included in a multi–meter test instrument.
- Tachometer with inductive trigger signal sensor.
- Test light that has a low current draw as described in FIGURE 4.
- Vacuum pump with a gauge. This vacuum pump is held and operated with the hand. The gauge must be able to indicate a gauge pressure (vacuum) of 34 kPa [20 inches of mercury (20" Hg)]. (See the PRESSURE CONVERSION CHART at the end of this section.)
- Spark tester. The spark tester is used to check the secondary ignition. The spark tester is also called an ST125 and creates a 25 kilovolt load on secondary ignition components.



If the ammeter indicates **less** than 0.3 amps (300 milliamps), the test light **can be used**.

If the ammeter indicates more than 0.3 amps (300 milliamps), the test light **can not be used** because it can cause damage to the electronic components.

FIGURE 4. CURRENT FLOW TEST FOR A TEST LIGHT

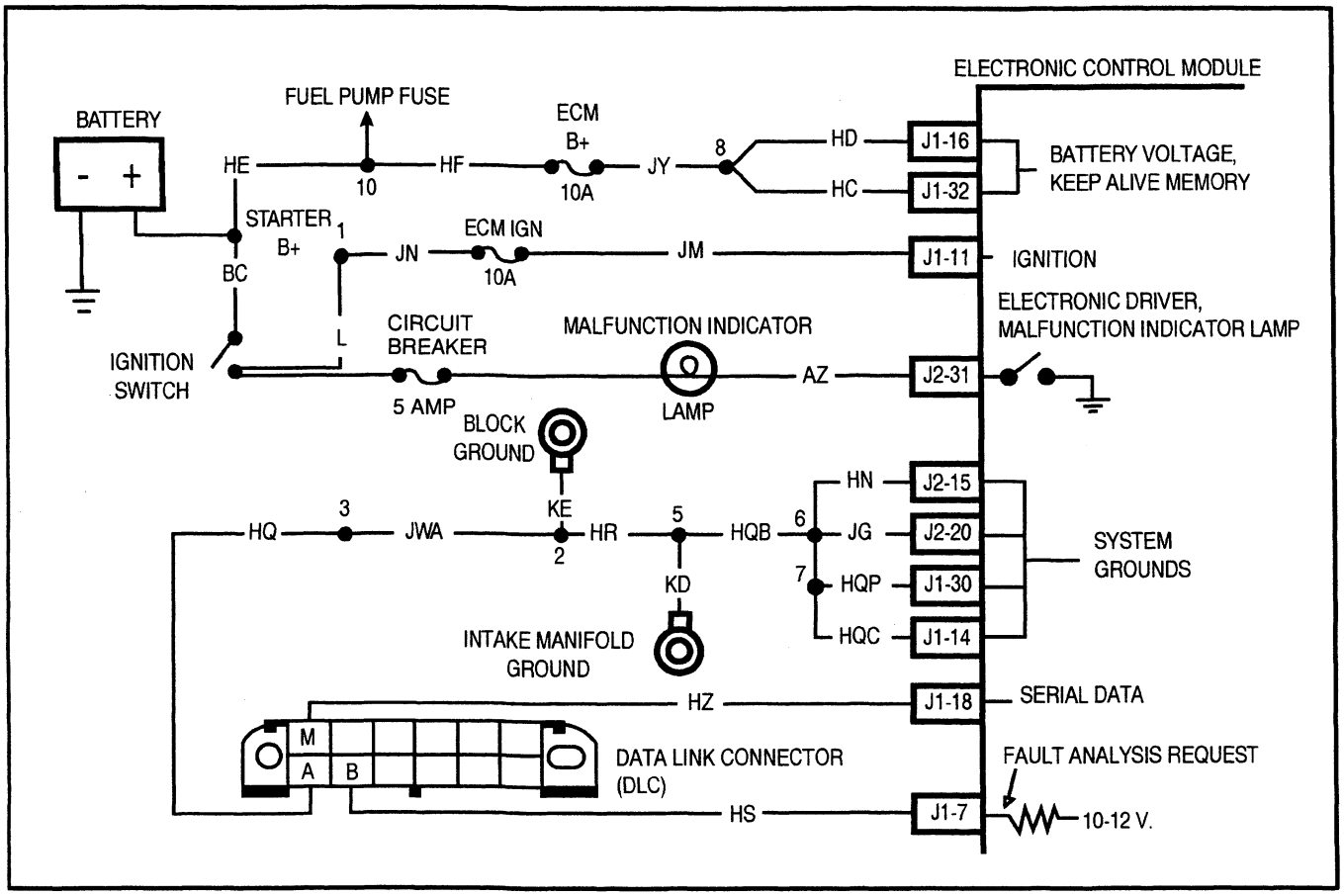


CHART A–1
NO "MALFUNCTION INDICATOR" LAMP

CIRCUIT DESCRIPTION

The "Malfunction Indicator" lamp will be "ON" when the ignition is **ON** and engine is not running. Voltage from the ignition switch is supplied to the light bulb. The Electronic Control Module (ECM) will control the lamp and turn it "ON" by connecting it to ground through circuit AZ.

Test Description: The number(s) below are a reference to number(s) in circles in the troubleshooting chart on the next page.

1. This test gives a ground circuit for the Malfunction Indicator Lamp circuit. If lamp works now, then the external circuits are correct.

2. This tests circuits HD, HC, and JM for voltage.

3. Using a test light connected to Battery +, check each of the system ground circuits to be sure there is a good ground.

4. If a fuse is open, remember to locate any short circuits to ground or other high ampere causes on that circuit.

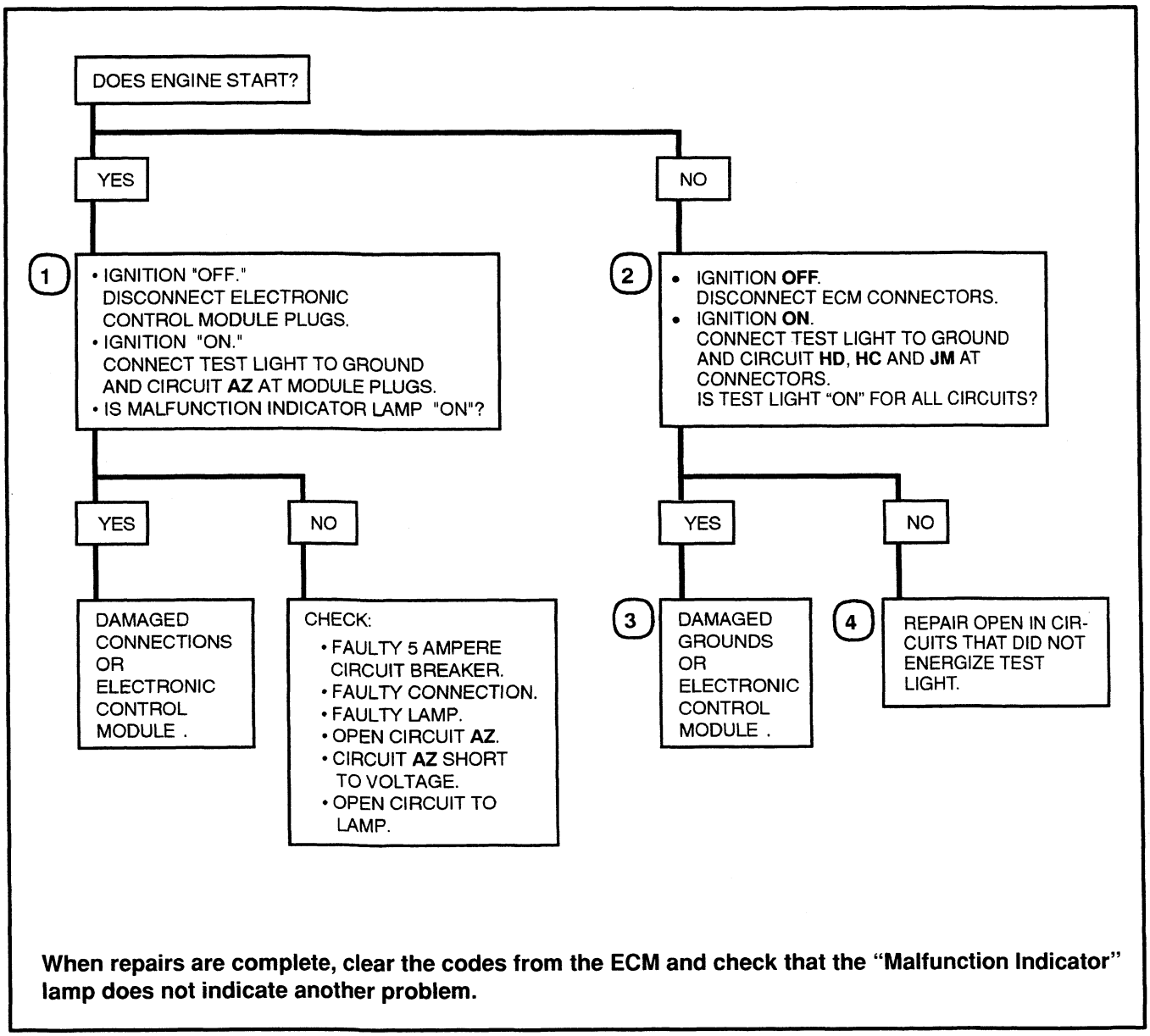
Other Troubleshooting Checks:

If engine runs correctly, check for the following:

- Fault in the light bulb.
- Circuit AZ is open.
- 5 ampere circuit breaker is no good. This will cause no dash indicator lights, gauges, or seat belt reminder.

If Engine Cranks But Will Not Run:

- ECM Battery + fuse/circuit JY or HD or HC open.
- ECM ignition fuse/circuit JM/JN is open.
- Poor connections to ECM.



When repairs are complete, clear the codes from the ECM and check that the "Malfunction Indicator" lamp does not indicate another problem.

CHART A–1 – NO "MALFUNCTION INDICATOR" LAMP

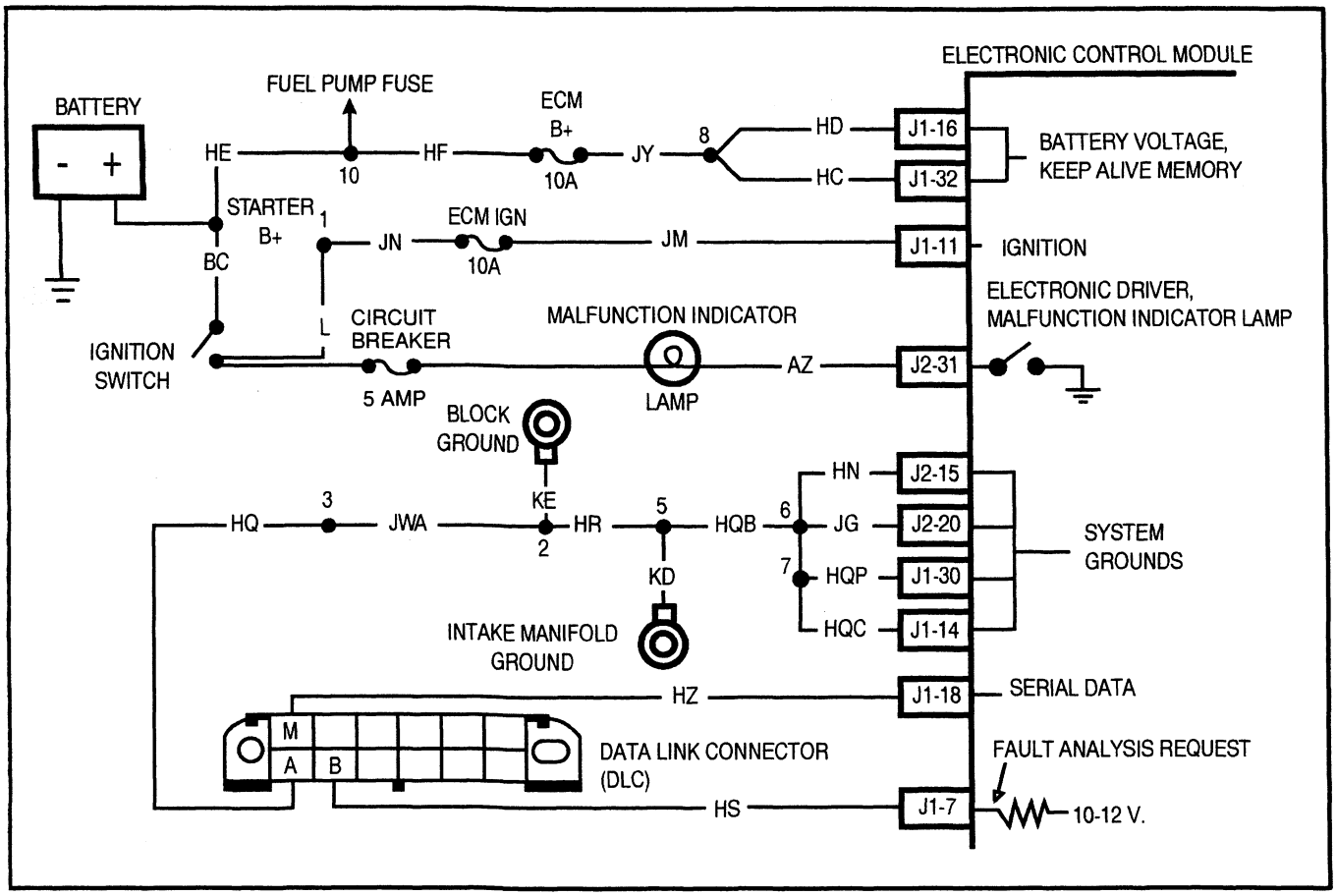


CHART A–2
NO "SCAN" DATA, NO DTC 12, "MALFUNCTION INDICATOR" LAMP ON

CIRCUIT DESCRIPTION

The "Malfunction Indicator" lamp (MIL) will be "ON" when the ignition is **ON** and the engine is "not running. Voltage from the ignition switch is supplied to the light bulb. The ECM will control the light and turn it "ON" by connecting it to ground through circuit AZ to the ECM.

With the diagnostic terminal is connected to ground, the light will flash a DTC 12, followed by any trouble code(s) kept in memory. A steady light means a short to ground in the light control circuit AZ, or an open in circuit HS.

Test Description: The number(s) below are a reference to number(s) in circles in the troubleshooting chart on the next page.

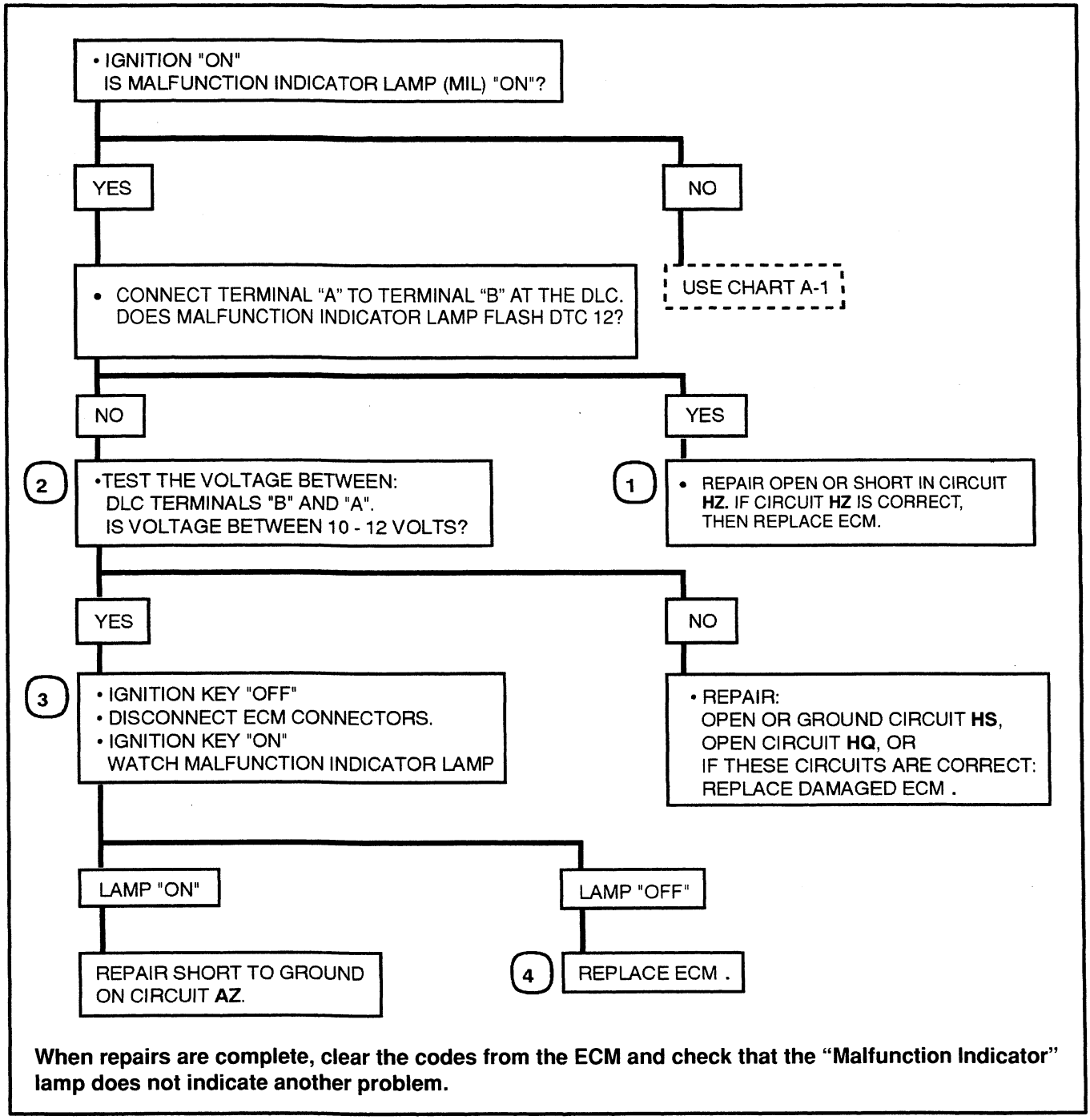
1. If there is a problem with the ECM that causes a "SCAN" tool to not read data from the ECM, then the ECM will not flash a DTC 12.

- If DTC 12 does flash, be sure that the "SCAN" tool is working correctly on another vehicle.
- If the "SCAN" is working correctly and circuit HZ is good, the ECM can be the cause for the "NO SCAN DATA" symptom.

2. This step will check for an open diagnostic circuit HS.

3. If the light turns "OFF" after the ECM connector J2 is disconnected, then circuit AZ has a short circuit to ground.

4. At this point, the "Malfunction Indicator" lamp wiring is good. If DTC 12 does not flash, replace the ECM.



When repairs are complete, clear the codes from the ECM and check that the "Malfunction Indicator" lamp does not indicate another problem.

CHART A–2 – NO "SCAN" DATA, NO DTC 12, "MALFUNCTION INDICATOR" LAMP ON