2002 GENERAL INFORMATION

Computer Relearn Procedures - Import

INTRODUCTION

NOTE: Before replacing any component that scan tool suggests are faulty. Ensure that all wiring connections and harness connectors are okay. Ensure that power and ground circuits are functioning properly. For circuit identification, see appropriate WIRING DIAGRAMS article for vehicle being tested.

BODY CONTROLS

Vehicles equipped with body, air conditioning, anti-lock brake or memory computers may require a computer relearn procedure after components are replaced or the vehicle battery is disconnected. Vehicle computers memorize and store vehicle information and operation selections. When the vehicle battery is disconnected, vehicle computer memory may be lost, requiring relearning or resetting. Depending on the vehicle and how it is equipped, the following memories may exist:

- Seat position.
- Tilt/telescoping steering wheel position.
- Mirror position.
- Radio presets and anti-theft code.
- Clock.
- Remote keyless entry custom features.
- Door key lock entry custom features.
- Power window or sunroof operation.

These do not affect vehicle operation. For systems that do not affect operation, see appropriate article for relearn procedures. Other computer relearn procedures are required for vehicle or system operation. These may include:

- Initial control unit programming.
- Traction control yaw sensor initializing.
- Multiplex communication.
- Anti-theft system or engine immobilizer system passwords.

ENGINE CONTROLS

Vehicles equipped with powertrain control computers may require a computer relearn procedure after the vehicle battery is disconnected. Vehicle computers memorize and store vehicle operation patterns for optimum driveability and performance. When the vehicle battery is disconnected, this memory is lost, which may result in a driveability problem. Depending on the vehicle and how it is equipped, the following driveability problems may exist:

- Rough or unstable idle.
- Hesitation or stumble.
- Rich or lean running.
- Poor fuel mileage.
- Harsh or poor transmission/transaxle shift quality.

Default data is used until NEW data from each key start is stored. As the computer restores its memory from each new key start, driveability is restored.

Driveability problems may occur during the computer relearn stage. To accelerate computer relearn process after battery removal and installation, specified computer relearn procedures should be performed. See appropriate procedures for specified manufacturer.

ACURA

POWERTRAIN CONTROL MODULE RESET PROCEDURE/CLEARING DIAGNOSTIC TROUBLE CODES (ALL MODELS)

NOTE: Some models have an anti-theft code built into radio circuit. Clearing codes cancels clock and radio settings; make note of anti-theft code and station presets before beginning reset procedure. After PCM reset, radio will not operate until anti-theft code is entered.

NOTE: If service check connector is connected and no DTC is stored in PCM, MIL will remain on when the ignition is turned on.

To reset Powertrain Control Module (PCM) (clear DTCs), use Honda PGM tester or OBD-II scan tool following manufacturer's instructions. After DTCs are cleared and PCM is reset, remove SCS service connector, if connected. Disconnect Honda PGM Tester or scan tool from DLC. DTCs can also be cleared by turning ignition off and removing BACK UP (RADIO) fuse (7.5-amp) from underhood fuse/relay block (located next to battery). On all models, leave fuse out for at least 10 seconds to reset PCM.

KNOWN-GOOD POWERTRAIN CONTROL MODULE SUBSTITUTION

NOTE: Use this procedure when diagnostic testing suggests substituting PCM with known-good unit.

On models equipped with engine immobilizer system, acquire key cut from non-immobilizer key blank. Remove PCM from test vehicle. Install known-good PCM from donor vehicle into test vehicle. Tape donor vehicle's ignition key head-to-head to test vehicles temporary key. PCM will recognize code from donor vehicle's key and allow test vehicle to be started and tested.

SYSTEM READINESS TEST CODES

If battery has been disconnected, DTCs have been cleared or PCM has been reset, readiness codes will reset. In some states part of emission testing is to ensure readiness codes are complete. If readiness codes are not complete, emission test cannot be finished.

To check if readiness codes are complete, turn ignition switch on, engine off. MIL will illuminate for 15-20 seconds. If MIL goes off, readiness codes are complete. If MIL blinks several times, one or more readiness codes are not complete.

To set each code, drive vehicle or run engine as described in following procedures.

Catalytic Converter Codes

NOTE: Once test is started DO NOT turn ignition switch off. When negative battery cable is disconnected, all readiness codes are cleared. When PCM is cleared with scan tool, all readiness codes are cleared.

For test purposes ensure ambient temperature is 20-95Â°F (-7-35Â°C).

1. Connect scan tool to DLC. Start engine and hold at 3000 RPM with no load until radiator fan comes on.
2. Drive vehicle for about 10 minutes, without stopping. Preferably on highway where speed can be varied.
3. With A/T in "D" position, M/T in 5th gear, drive at steady speed between 50 and 62 MPH for 30 seconds.
4. Repeat step 4 three times. Between each repetition, close throttle completely for 1-2 seconds. If engine is

stalls or is shut off during this part of procedure, repeat procedure starting in step 2.

5. Readiness code should now be set. Use scan tool to check readiness code.

EVAP Leak Monitor Code

NOTE: When negative battery cable is disconnected, all readiness codes are cleared. When PCM is cleared with scan tool, all readiness codes are cleared. If engine is stalls or is shut off between steps 6-16 , repeat procedure again.

1. Ensure fuel level is between 60 and 90 percent of fuel tank capacity (not full).
2. Turn ignition switch off.
3. Let vehicle set for more than 8 hours.
4. Ensure outside temperature is 20-95Â°F (-7-35Â°C)
5. Connect scan tool to DLC.
6. Start engine and drive for about 20 minutes.
7. Maintain vehicle at steady speed between 50 and 70 MPH, without moving accelerator pedal, for about one minute.
8. Bring vehicle to a stop. Leave engine running at idle speed.
9. Repeat steps 7 and 8 two more times.
10. Using scan tool, check readiness code. If readiness code is not complete go to next step.
11. When ambient temperature is less than 32Â°F (0Â°C), hold engine speed at 3,000 RPM with no load (in park or neutral) until radiator fan comes on.
12. When ambient temperature is more than 86Â°F (30Â°C), remove and install gas cap.
13. Drive vehicle on highway for about 20 minutes.
14. Maintain vehicle at steady speed between 50 and 70 MPH, without moving accelerator pedal, for about one minute.
15. Bring vehicle to a stop. Leave engine running at idle speed.
16. Repeat steps 14 and 15 two more times.
17. Readiness code should now be set. Use scan tool to check readiness code.

HO2S Monitor Code

NOTE: Once test is started DO NOT turn ignition switch off. When negative battery cable is disconnected, all readiness codes are cleared.

Ensure ambient temperature is 20-95Â°F (-7-35Â°C).

1. Connect scan tool to DLC.
2. Start engine and hold at 3000 RPM with no load (in park or neutral) until radiator fan comes on.
3. Let engine idle for 5 seconds.
4. Drive vehicle at steady speed between 50 and 62 MPH for about two minutes
5. With A/T in "D" position, M/T in 5th gear, decelerate from 62 MPH by completely releasing throttle for 5 seconds.
6. Bring vehicle to a stop. Leave engine running at idle speed. If engine is stalls or is shut off during this part of procedure, repeat procedure starting in step 4.
7. Readiness code should now be set. Use scan tool to check readiness code.

HO2S Heater Monitor Code

NOTE: Once test is started DO NOT turn ignition switch off. When negative battery cable is disconnected, all readiness codes are cleared.

1. Connect scan tool to DLC.
2. Start engine and let idle for 10 minutes.
3. Readiness code should now be set. Use scan tool to check readiness code.

AUDI

READINESS CODE

NOTE: While limited diagnostic information is available, vehicle manufacturer does not support diagnostic information using aftermarket scan tools. To properly diagnose vehicle, it is recommended to use VAS 5051 scan tool with VAS 5051/1 adapter cable or VAG 1551 scan tool with 1551/3A adapter cable and VAG 1598/31 test box.

Readiness code must be generated when Engine Control Module (ECM) memory is cleared, battery voltage or ECM is disconnected. Readiness code appears on scan tool as an 8-digit display in display field 1 of MEASURING VALUE BLOCK - 086. Each of the 8 digits is related to a specific exhaust related system. During a test sequence OBD system checks function of each of the 8 systems. Test sequence once started must be run completely. During test sequence if test is successful scan tool changes display digits from "1" to "0". When readiness code is generated, display should read 0 0 0 0 0 0 0 0 in display field 1 of measuring value block 086. If during testing, a malfunction is recognized, a DTC is stored in memory. Retrieve DTCs and repair as necessary. See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTICS SYSTEM in appropriate SELF DIAGNOSTICS article.

Readiness code is returned to 1 1 1 1 1 1 1 1 if DTC memory is erased, voltage supply to ECM is lost, or a new ECM is installed. To check readiness code, connect VAS 5051 or equivalent scan tool to DLC. DLC is located behind cover under left side of steering column. Turn ignition on. Using scan tool, select vehicle system 01 - ENGINE ELECTRONICS. From selection 1, select diagnostic function 08 - READ MEASURED VALUE BLOCK. From button field 2, enter 086 for DISPLAY GROUP - 086. Press "Q" button to confirm input. Using scan tool, observe display field 1 in display group 086. See Fig. 1 and Fig. 2 . Readiness code should display 0 0 0 0 0 0 0 0. If readiness code displays as specified, continue DTC testing. If no DTCs are stored testing is complete. If readiness code does not display as specified, generate readiness code. See GENERATING READINESS CODE.

	Display fields			
	1	2	3	4
Display group 086: Readiness code				
Display	00000000	XXXXXXXX	XXXXXXXX	
Indicated	**Ready-Bits completed tests**	individual tests carried out	individual tests carried out	
Functional range	**1 = not completed 0 = completed**	1 = not completed 0 = completed	1 = not completed 0 = completed	
Specified value	00000000	XXXXXXXX	XXXXXXXX	
Note	*See figure 3.*			

Note for display field 1:

Display field 1 is the most important. This indicates which system was checked via On Board Diagnostic (OBD) since the last time DTC memory was erased or a new control module was implemented. Once DTC memory is erased, all testable values are set to "1", after the test is performed successfully, the values are set to "0".

G00077128

Fig. 1: Display Group 086: Readiness Code
Courtesy of AUDI OF AMERICA, INC.

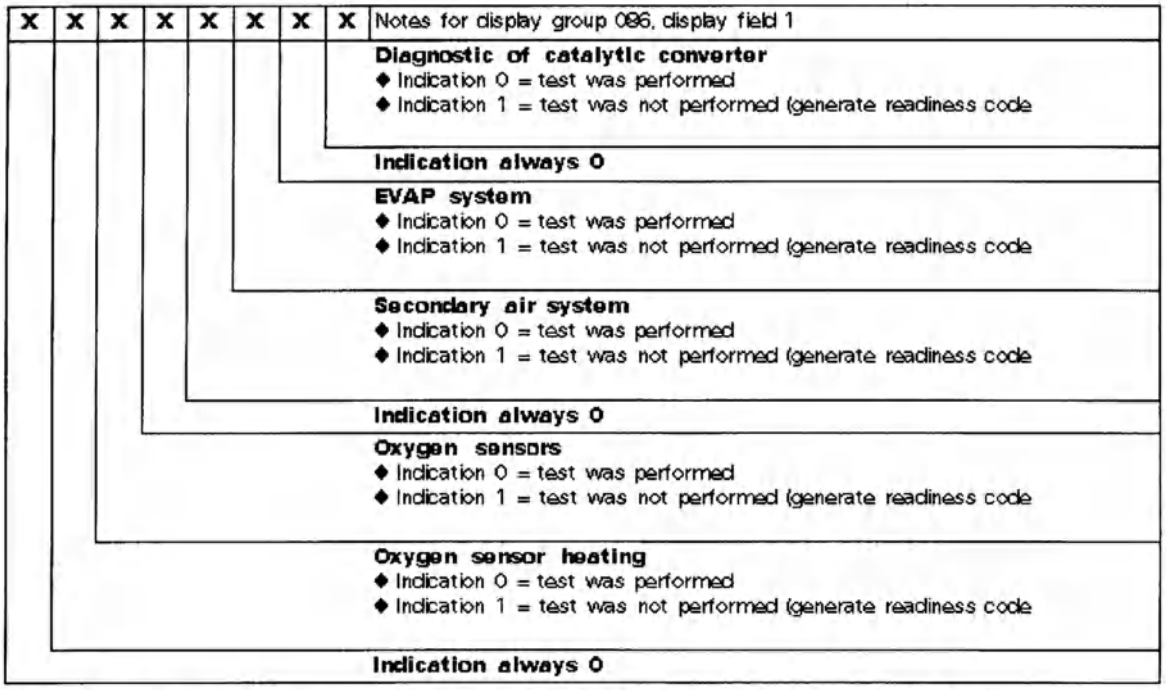

Fig. 2: Notes On Display Group 086
Courtesy of AUDI OF AMERICA, INC.

GENERATING READINESS CODE

NOTE: While limited diagnostic information is available, vehicle manufacturer does not support diagnostic information using aftermarket scan tools. To properly diagnose vehicle, it is recommended to use VAS 5051 scan tool with VAS 5051/1 adapter cable or VAG 1551 scan tool with 1551/3A adapter cable and VAG 1598/31 test box.

NOTE: During readiness code generating procedure, if test result is indicated as "OK" after selecting a display group, testing has already been carried out and it is okay to proceed to next work step.

Readiness code must be generated if Engine Control Module (ECM) memory is cleared, battery voltage is disconnected or ECM is disconnected. To generate readiness code, vehicle must be stationary, transmission in Park or Neutral, all electrical consumers off, A/C switched off and coolant temperature at least 176Â°F (80Â °C). If possible it is best to warm-up vehicle by test driving. Connect VAS 5051 or equivalent scan tool to DLC. DLC is located behind cover under left side of steering column.

Using scan tool, retrieve DTCs. See RETRIEVING DIAGNOSTIC TROUBLE CODES in appropriate SELF DIAGNOSTICS article. If DTCs were stored, perform appropriate test. See DIAGNOSTIC TROUBLE CODE DEFINITIONS in appropriate SELF DIAGNOSTICS article. Using scan tool, clear DTC memory. See FUNCTION 05 - CLEARING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM in appropriate SELF DIAGNOSTICS article. After clearing DTC memory. Follow scan tool instructions to complete readiness code generation. Using scan tool, observe display field 1, in display group 086. See Fig. 1 and Fig. 2 . Readiness code should display 0 0 0 0 0 0 0 0. If readiness code displays as specified, testing is complete.

PCM CODING (ALL MODELS)

NOTE: After coding ECM and starting engine for first time, allow engine to idle for several minutes so ECM can go through learn function. Idle speed may be

erratic while ECM is learning.

If Engine Control Module (ECM) is replaced, it is necessary to code new ECM. If new ECM is not properly coded, the following problems may occur:

- Driveability problems (i.e., harsh shifting).
- False malfunctions stored in ECM memory.
- Increased fuel consumption.
- Increased exhaust emissions.
- Reduction in transmission life.
- All ECM functions are not carried out (i.e., EVAP system operation).

Coding Engine Control Module (A4, A6 & S4)

Connect VAS 5051 or equivalent scan tool to Data Link Connector (DLC). DLC is located behind cover under left side of steering column. Turn ignition on. On scan tool, select vehicle system 01 - ENGINE ELECTRONICS. From selection 1, select diagnostic function 07 - CODE CONTROL MODULE. Press "Q" button to confirm input. Following scan tool instructions, access ECM coding information. Enter ECM code as necessary. For ECM coding options, see ENGINE CONTROL MODULE CODING OPTIONS (A4) or ENGINE CONTROL MODULE CODING OPTIONS (A6) table.

As an example, a properly coded ECM for an A4 model with Front Wheel Drive (FWD) with traction control (ASR/ESP) and 5-speed automatic transmission would read 16501 on the VAS 0551 scan tool.

ENGINE CONTROL MODULE CODING OPTIONS (A4 & S4)

Application/Code	Option
Country/Emissions	
16	(1) USA ULEV
Drive/Additional Functions	
0	Front Wheel Drive With Anti-Lock Brake System
2	All Wheel Drive With Anti-Lock Brake System
5	Front Wheel Drive With Traction Control (ASR/ESP)
3	All Wheel Drive With Traction Control (ESP)
Transmission	
0	5-Speed Manual Transmission
5	Automatic Transmission 01V
Vehicle Type	
1	A4
(1) USA export model with Ultra Low Emissions Vehicle.	

ENGINE CONTROL MODULE CODING OPTIONS (A6)

Application/Code	Option
Country/Emissions	
07	(1) USA LEV
Drive/Additional Functions	
2	All Wheel Drive Without Electronic Stability Program
5	Front Wheel Drive With Anti-Slip Regulation

7	All Wheel Drive With Electronic Stability Program
Transmission	
0	5-Speed Manual Transmission
5	Automatic Transmission 01V
Vehicle Type	
2	A6
(1) USA export model with Low Emissions Vehicle.	

Coding Engine Control Module (TT)

Connect VAS 5051 or equivalent scan tool to Data Link Connector (DLC). DLC is located behind cover under left side of steering column. Turn ignition on. On scan tool, select vehicle system 01 - ENGINE ELECTRONICS. From selection 1, select diagnostic function 07 - CODE CONTROL MODULE. Press "Q" button to confirm input. Following scan tool instructions, access ECM coding information. Enter ECM code as necessary. For ECM coding options, see ENGINE CONTROL MODULE CODING OPTIONS (TT)table.

ENGINE CONTROL MODULE CODING OPTIONS (TT)

Application/Code	Option
Country/Emissions	
07	(1) USA LEV
Drive/Additional Functions	
4	Front Wheel Drive Without Electronic Stability Program
5	Front Wheel Drive With Anti-Slip Regulation
6	All Wheel Drive Without Electronic Stability Program
7	All Wheel Drive With Electronic Stability Program
Transmission	
0	5-Speed Manual Transmission
1	6-Speed Manual Transmission
Vehicle Type	
0	TT
(1) USA export model with Low Emissions Vehicle.	

BMW

ALL MODELS

NOTE: When DME control unit is disconnected or its power supply interrupted, all stored intermittent DTCs as well as substitute values are cleared/lost. Current hard DTCs cannot be cleared.

After disconnecting battery or replacing DME control unit, drive vehicle to enable DME control unit to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until DME control unit completes relearn function. System Readiness Test (SRT) information was not available from manufacturer.

COMPONENT ACTIVATION

Use BMW MoDIC (hand-held scan tester), BMW Service Tester (Sun 2013 Engine Analyzer) and applicable

BMW diagnostic software to activate components. Select DRIVE COMPONENTS MODE (D300). Detailed information on this mode is displayed on screen.

POWER WINDOW CALIBRATION

Power windows will require calibration to establish upper and lower stop points is battery is disconnected. Turn ignition on. Lower window(s) to stop and hold switch for 5 seconds. Raise window(s) to stop and hold switch for 5 seconds. Turn ignition off.

SUN ROOF CALIBRATION

3-Series & 7-Series

Push sun roof button in up/tilt direction and hold. After about 20 seconds, sunroof panel will make a small down-up movement. Release button for no more than 5 seconds and push and hold it in up/tilt direction again. Sun roof will run through a full open and close cycle. Once this cycle is completed, initializaton and adaptation is complete.

NOTE: If motor runs in the wrong direction when pushing the button in the up/tilt direction, preventing proper initialization, get the sunroof to the closed position, and disconnect power to the motor for about 15 seconds. Reconnect the motor and start the initialization procedure again, and it should work properly.

HONDA

POWERTRAIN CONTROL MODULE RESET PROCEDURE (ALL MODELS)

CAUTION: Before disconnecting battery, obtain anti-theft code for radio. After battery is reconnected, the word CODE will appear on radio display. Enter 5-digit anti-theft code using select buttons and radio will begin working. If code is entered wrong 10 times, leave radio on at least one hour and enter code correctly. Any time radio power is lost, pre-selected radio stations will have to be set. For more information, see owner's manual.

NOTE: For Passport reset procedure, see appropriate SELF-DIAGNOSTICS - PASSPORT, RODEO & RODEO SPORT article.

Using Honda PGM Tester or OBD-II scan tool, clear ECM/PCM memory. Follow manufacturer's instructions. On all models except Passport, ECM/PCM may reset without scan tool. Turn ignition off. Remove BACK UP or CLOCK/RADIO (7.5-amp) fuse from underhood fuse/relay box for 10 seconds.

KNOWN-GOOD POWERTRAIN CONTROL MODULE SUBSTITUTION

Accord, Odyssey & S2000

NOTE: Use this procedure when diagnostic testing suggests substituting PCM with known-good unit.

On models equipped with engine immobilizer system, acquire key cut from non-immobilizer key blank. Remove ECM/PCM from test vehicle. Install known-good ECM/PCM from donor vehicle into test vehicle. Tape donor vehicle's ignition key head-to-head to test vehicles temporary key. ECM/PCM will recognize code from donor vehicle's key and allow test vehicle to be started and tested.

Civic, CR-V & Insight

Remove PCM from test vehicle. Install known-good PCM in test vehicle. Using Honda PGM Tester or OBD-II scan tool, rewrite immobilizer code into PCM with scan tool. This will allow known-good PCM to recognize

immobilizer code and allow engine to be started and tested. After completing test, reinstall PCMs and rewrite immobilizer code with scan tool.

IMMOBILIZER (ACCORD, INSIGHT, ODYSSEY, PRELUDE & S2000)

ECM/PCM is part of immobilizer system. Replacement ECM/PCM must have immobilizer code rewritten, using Honda PGM Tester. To perform rewrite procedure requires the vehicle, all master keys, all valet keys and a Honda PGM Tester with an immobilizer program card. Any key not learned during rewrite will not start vehicle. Follow Honda PGM Tester instructions. For more information, see appropriate IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

SYSTEM READINESS TEST CODES

All Honda engines have specific system readiness codes that are part of the on-board diagnostics for the emissions systems. If the vehicle battery has been disconnected or discharged, these codes are erased. In some states where Inspection/Maintenance (I/M) testing of vehicle emissions is performed, these codes must be set. If all the codes are not set, the I/M test cannot be completed.

The Malfunction Indicator Light (MIL) is used to display state of system readiness. To determine if readiness codes are set, turn ignition on, but do not start engine. MIL should come on for 15-20 seconds. If MIL then goes off, readiness test codes are set. If MIL blinks several times, readiness test codes are not set completely. To reset each code, drive vehicle or run engine as described in following procedures.

Air/Fuel (A/F) Ratio Sensor Monitor

NOTE: Once procedure is started DO NOT turn ignition off. When negative battery cable is disconnected, all readiness test codes are cleared.

1. Ensure ambient temperature is 20-95Â°F (-7-35Â°C). Connect scan tool to DLC. Start engine, and hold at 3000 RPM under no load condition with transaxle in Park or Neutral until radiator cooling fan comes on. Allow engine to idle for 5 seconds.
2. Drive vehicle at a steady speed between 50-62 MPH with transaxle in D4 position for about 2 minutes. With transaxle in D4 position, decelerate from 62 MPH by completely releasing throttle for at least 5 seconds. If engine is stopped, accelerate back up to 62 MPH for about 2 minutes and repeat deceleration process. Readiness code should now be set. Use scan tool to check readiness code.

Catalytic Converter

NOTE: Once procedure is started DO NOT turn ignition off. When negative battery cable is disconnected, all readiness test codes are cleared.

1. Ensure ambient temperature is 20-95Â°F (-7-35Â°C). Connect scan tool to DLC. Start engine, and hold at 3000 RPM under no load condition with transaxle in Park or Neutral until radiator cooling fan comes on.
2. Drive vehicle on highway/freeway for about 10 minutes without stopping. Driving speed can vary.
3. Drive vehicle at a steady speed between 50-60 MPH with transaxle in D4 position for about 30 seconds.
4. Repeat step 3, three times. Between each repetition, close throttle completely for 1-2 seconds. If engine is stalls or is stopped during this part of the procedure, repeat procedure starting in step 2. After procedure is complete, use scan too to check readiness code.

EGR Monitor

NOTE: Once procedure is started DO NOT turn ignition off. When negative battery cable is disconnected, all readiness test codes are cleared.

1. Connect scan tool to DLC. Start engine, and hold at 3000 RPM under no load condition with transaxle in Park or Neutral until radiator cooling fan comes on.

2. Drive vehicle at a steady speed between 50-62 MPH with transaxle in D4 position for more than 10 seconds.
3. With transaxle in D4 position, decelerate from 62 MPH by completely releasing throttle for at least 5 seconds. If engine is stalls or is stopped during this part of the procedure, repeat procedure starting in step 2. After procedure is complete, use scan too to check readiness code.

EVAP Leak Monitor

NOTE: When negative battery cable is disconnected, all readiness test codes are cleared. If engine is stalls or is stopped while performing steps 2-5, repeat procedure from beginning.

1. Ensure fuel level is between 60 and 90 percent of fuel tank capacity (not full). Turn ignition off and allow vehicle to sit for more than 8 hours. At start of procedure, ensure ambient temperature is 20-95Â°F (-7-35Â°C). Connect scan tool to DLC.
2. Start engine and drive vehicle for about 15 minutes. During drive, keep vehicle speed steady between 50-70 MPH, without moving accelerator pedal, for about 1 minute. Bring vehicle to a stop. Allow engine to run at idle speed.
3. Repeat step 2, two more times, for a total of 3 times. Readiness code should now be set. Use scan tool to check readiness code. If readiness code is not set, go to next step.
4. If ambient temperature is less than 32Â°F (0Â°C), hold engine speed at 3000 RPM under no load condition with transaxle in Park or Neutral until radiator cooling fan comes on.
5. Remove and install gas cap.
6. Drive vehicle for about 20 minutes on highway/freeway. During drive, keep vehicle speed steady between 50-70 MPH, without moving accelerator pedal, for about 1 minute. Bring vehicle to a stop. Allow engine to run at idle speed.
7. Repeat step 6, two more times, for a total of 3 times. Readiness code should now be set. Use scan tool to check readiness code.

HO2S Monitor

NOTE: Do not turn ignition off. When negative battery cable is disconnected, all readiness test codes are cleared. Ensure ambient temperature is 20-95Â°F (-7-35Â°C).

1. Connect scan tool to DLC. Start engine, and hold at 3000 RPM under no load condition with transaxle in Park or Neutral until radiator cooling fan comes on. Let engine idle for 5 seconds.
2. Drive vehicle at a steady speed between 50-62 MPH with transaxle in D4 position for about 2 minutes.
3. With transaxle in D4 position, decelerate from 62 MPH by completely releasing throttle for at least 5 seconds. If engine is stopped, go back to step 2 and start over. Check for readiness code with scan tool.

HO2S Heater Monitor

NOTE: When negative battery cable is disconnected, all readiness test codes are cleared.

Connect scan tool to DLC. Start engine, and let idle for 10 minutes. Check for readiness code with scan tool.

HYUNDAI

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

INFINITI

ECM PROGRAMMING

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

ECM is a part of Nissan Anti-Theft System (NATS). Replacement ECM must have immobilizer code rewritten, using CONSULT-II tester. To perform rewrite procedure requires the vehicle, all keys and a CONSULT-II tester with a NATS Program Card (E960U). Any key not learned during rewrite procedure, will not start vehicle. Follow CONSULT-II tester instructions to rewrite immobilizer code.

ISUZU

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function. If testing determines that PCM needs to be replaced, or testing directs that PCM be programmed, see EEPROM PROGRAMMING PROCEDURE.

EEPROM PROGRAMMING PROCEDURE

NOTE: Refer to latest Isuzu Technical Communication System (ITCS) information for reprogramming or flashing procedures. Programming PCM/EEPROM requires the use of a scan tool and special manufacturer equipment.

Connect TECH 2 scan tool to DLC and retrieve program information from PCM. Ensure that battery is fully charged. Turn ignition on. Ensure that Vehicle Interface Module cable connection is securely connected to DLC. Follow scan tool instructions to program EEPROM using latest software available from ITCS. If PCM fails to program, recheck PCM connections. Ensure that most recent ITCS information is being used. Attempt to program PCM. If it still can not be programmed properly, replace PCM. Reprogram new PCM, then perform On-Board Diagnostic II System Check. See ON-BOARD DIAGNOSTIC II SYSTEM CHECK under SELF-DIAGNOSTIC SYSTEM in appropriate SELF-DIAGNOSTICS article. Start engine and run for one minute. Use scan tool to check for any stored DTCs.

JAGUAR

PRINCIPLES OF OPERATION

Newly released modules require configuration after being installed on the vehicle. All configurable modules will be packaged in a kit which contains a warning label and a multi-language sheet reemphasizing requirements to configure replacement modules. Powertrain Control Module (PCM) has to be standard J1962 lead.

MODULE CONFIGURATION

There are two modes of configuration data. First type requires configuration information so that module can interact with vehicle correctly. This information will be transferred into new module so that new module will contain same settings as old module. Modules on vehicle that require configuration when installing a replacement module are:

- Anti-lock brake control module with traction control.
- Anti-lock brake control module with traction control and dynamitic stability control.
- Remote keyless entry driver door module.
- Steering lock control module.
- Driver seat module.
- Audio control module.
- Vehicle emergency message system/Jaguar assist.

- Dual automatic temperature control.
- Instrument cluster with message center.
- Rear electronic module.
- General electronic module.

To carry out configuration process, upload old information from old module using PDU (if applicable). Install new module. For additional information on the anti-lock brake control module, appropriate ANTI-LOCK article in BRAKES. For additional information on the DDM, see appropriate POWER DOOR LOCK article in ACCESSORIES & EQUIPMENT. For additional information on the instrument cluster, see appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. For additional information on the GEM and the REM, appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT. PDU will not retain stored configuration information for longer than 24 hours. Download stored information into new module using PDU (if applicable).

CUSTOMER DRIVEN PREFERENCES

Second type of configuration data is customer preference driven. These are items that the customer may or may not want to have enabled. Typically, customer preference items can be toggled on or off with compatible scan tool. You may need to ask the customer which preferences they had enabled prior to installation of new module. To carry out customer configuration process, use PDU. On PDU select CUSTOMER PREFERENCE INDEX for modules on the vehicle that have customer preference items. Configure items as necessary. See CUSTOMER PREFERENCE INDEX table.

CUSTOMER PREFERENCE INDEX

Customer Preference	Index Module	Configurable Item State
GEM, DDM	Smart Locks	ON/OFF
GEM, DDM	Automatic Locks	ON/OFF
GEM	Illuminated Exit	ON/OFF
DDM	Horn Chirp	ON/OFF

POWERTRAIN CONTROL MODULE PROGRAMMING

S-Type

If battery has been disconnected, engine should be allowed to idle for three minutes as stored idle and drive values contained within PCM have been lost. This may cause a driveability concern if following procedure is not carried out. Once the engine reaches normal operating temperature, engine speed should be increased to 1200 RPM and maintained for approximately two minutes. This will allow PCM to relearn idle values. For PCM to complete it's learning strategy, the vehicle should be driven for approximately 5 miles of varied driving.

X-Type

If battery has been disconnected, engine should be allowed to idle until it has reached normal operating temperature as stored idle and drive values contained within the PCM have been lost. Allow vehicle to idle for a further three minutes. Drive vehicle at constant speeds of approximately 30, 40, 50,60 and 70 mph for three minutes each. This will allow PCM to relearn idle values. Driveability concern may exist if procedure is not carried out.

POWER WINDOW CALIBRATION (XK8)

If battery is disconnected, power windows will require calibration to establish upper and lower stop points. Turn ignition on. Lower window(s) to stop and hold switch for 2 seconds. Raise window(s) to stop and hold switch for 2 seconds. Repeat procedure for all power windows. Turn ignition off.

RADIO SECURITY CODE

If battery is disconnected, radio will require anti-theft security code to be entered. Turn radio on. Radio should

display CODE. Using preset buttons, enter code number from security card. A "beep" will sound when correct code is entered. If code is incorrectly entered after 3 successive attempts, radio must be left on for one hour before it will accept code entry.

REMOTE KEYLESS ENTRY TRANSMITTER

NOTE: All remote transmitters are programmable and must be set at the same time. If an attempt is made to program a fifth remote entry device after four remote entry devices have already been programmed, the attempt shall erase all remote entry device associations and start a new set of four remote entry device associations with fifth remote device programming attempt.

Programming (or reprogram) of remote transmitters into remote keyless entry Driver Door Module (DDM) is carried out with PDU. Due to complexity of the electronics involved with the remote keyless entry, of which the DDM is a part, and the multiplexed communication network which are connected to it preclude the use of general electrical test equipment. Therefore, reference should be made to the PDU User Guide for detailed instructions on programming the remote transmitters.

TRANSMISSION CONTROL MODULE DRIVEABILITY COMPUTER RELEARN PROCEDURE

Manufacturer does not provide a specific computer relearn procedure for obtaining proper driveability. If vehicle battery was disconnected or TCM was replaced, driving the vehicle will enable the TCM to perform a computer relearn procedure for obtaining proper driveability. Inform customer that driveability may differ from what they are accustomed to until the TCM completes the computer relearn procedure.

KIA

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

LAND ROVER

To enable shorter cranking times, when ignition is turned off, ECM memorizes crankshaft and camshaft positions. If battery or ECM is disconnected, memory is lost. Drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

IMMOBILIZER

If ECM is replaced ECM must learn identification code for immobilizer ECU and remote handsets. A Land Rover TestBook must be used to reconfigure the immobilization system.

POWER WINDOW CALIBRATION

If battery is disconnected, power windows will require calibration to establish upper and lower stop points. Immediately after Central Control Unit (CCU) or battery is connected, CCU will energize down contacts on all window switches. To ensure calibration is successful; ensure that alarm is disarmed and vehicle is unlocked, that all doors and tailgate are in closed position, that sunroof is open to full hardback or softback position. DO NOT open any door until calibration procedure is completed. Turn ignition on, using appropriate window switch raise each window until motor stalls and window is fully closed. Turn ignition off. If calibration is not successful CCU will sound a warning for about .8 seconds and windows will fully lower. If calibration fails, repeat procedure.

LEXUS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM

completes relearn function.

IMMOBILIZER SYSTEM

NOTE: Not all models are equipped with immobilizer system. Models equipped with immobilizer system can be identified by ignition key having a solid urethane head.

NOTE: A valid key must be available when replacing PCM or immobilizer unit, or both components must be replaced. When replacing an immobilizer system component, all working keys need to be reprogrammed into system. Replacing PCM or immobilizer unit will erase previously programmed keys.

NEW TRANSPONDER KEY CODE

NOTE: This must be done when a new transponder key ECU is installed. The new transponder key ECU is in automatic key code registration mode. Up to 3 key codes and one sub-key can be registered at one time. In automatic registration mode, last key registered becomes sub-key.

1. Security indicator will flash until first key is inserted into ignition switch. Insert NEW key in ignition switch.
2. Once key registration is under way, security indicator should turn off. After key registration is complete, security indicator should illuminate. Remove NEW key.
3. If programming additional keys, repeat process starting with step 1. If additional keys do not need programming, procedure is complete. Security indicator should go out once last key (sub-key) is registered.
4. After registration is complete and system is operating normally, when ignition key is removed from ignition lock cylinder, security indicator should flash indicating system is properly functioning. If a key is not inserted into ignition switch with transponder key ECU in automatic registration mode, security indicator will remain illuminated indicating keys have not been registered. If ignition key registration cannot be completed with transponder key ECU in automatic registration mode, a code 2-1 will be displayed by security indicator, and when inserting the already registered ignition key, a code 2-2 will be displayed by security indicator.

ADDITIONAL MASTER KEY

NOTE: Additional master key may be registered by 2 different methods: using ignition switch, or using LEXUS scan tool. It is possible to register up to 5 master key codes and 3 sub-key codes.

Using Ignition Switch

NOTE: Ensure driver's door is closed and key is not inserted in ignition switch.

1. Insert registered master key in ignition.
2. Perform this step within 35 seconds. Turn ignition switch on/off 5 times. Open/close driver's door 6 times. Remove master key from ignition.
3. Perform this step within 10 seconds. Insert new key to be registered in ignition.
4. After one minute, additional master key is registered. Security indicator should turn off. If programming additional keys, repeat process starting with step 2. If additional keys do not need programming, remove master key from ignition.

Using LEXUS Scan Tool

1. Insert registered master key in ignition. Turn ignition on.

2. Perform this step within 2 minutes. Select LS430, IMMOBILIZER, KEY CODE UTILITY and TRANSPONDER CODE REGISTRATION from LEXUS scan tool.
3. Perform this step within 20 seconds. Remove master key.
4. Perform this step within 10 seconds. Insert master key to be registered in ignition. Security indicator should flash. After one minute, additional master key is registered. Security indicator should turn off.

REGISTRATION OR CHANGE OF KEY NUMBER

NOTE: Ensure this operation is performed when transponder key ECU is replaced. Key number is stamped on key number plate.

Registration Of Key Number (Using LEXUS Scan Tool)

1. Insert registered master key in ignition. Turn ignition on.
2. Select LS430, IMMOBILIZER, KEY CODE UTILITY and KEY NO. REGISTRATION.
3. Insert key number of key number plate according to Lexus scan tool screen. Observe scan tool and ensure key number is registered to transponder key ECU.

Change Of Key Number (Using LEXUS Scan Tool)

1. Insert registered master key in ignition. Turn ignition on.
2. Select LS430, IMMOBILIZER, KEY CODE UTILITY and KEY NO. CHANGE.
3. Insert key number of key number plate according to Lexus scan tool screen. Observe scan tool and ensure key number is changed. Remove master key.

ERASURE OF TRANSPONDER KEY CODE

NOTE: There are 2 different methods to erase the transponder key code: using ignition switch, or using LEXUS scan tool. All other master and sub-key codes are deleted. When using ignition key which was used before deleting, it is necessary to register the code again.

Using Ignition Switch

NOTE: Ensure driver's door is closed and ignition key is not inserted in ignition switch.

1. Insert master key in ignition.
2. Perform this step within 35 seconds. Turn ignition switch on/off 6 times. Open/close driver's door 7 times. Security indicator will be off.
3. Perform this step within 10 seconds. Remove master key. Security indicator should flash for one second, then go off. Procedure is now completed. Key code should now be erased. If key cannot be removed from ignition, key code deletion is canceled. Security indicator will turn off. Repeat procedure from step 1.

Using LEXUS Scan Tool

1. Insert master key in ignition. Turn ignition on.
2. Perform this step within 2 minutes. Select LS430 from menu. Select IMMOBILIZER, KEY CODE UTILITY and TRANSPONDER CODE REGISTRATION. After these operations, proceed to additional operations following prompts on tester screen.
3. Perform this step within 10 seconds. Remove master key.
4. Procedure is now completed. Key code should now be erased. If key cannot be removed from ignition, key code deletion is canceled. Security indicator will turn off. Repeat procedure from step 1.

SUN ROOF REINITIALIZATION

Tilt sun roof to fully tilted position. Release switch, then depress switch again and hold for 10 seconds. Sun roof will tilt down, slide open, slide closed and tilt up in that order. Reinitialization is now complete.

MAZDA

CAUTION: DO NOT crank engine before replacement PCM is programed to immobilizer system or PCM will be severely damaged. If test procedures require replacement of PCM on a vehicle equipped with immobilizer system, vehicle must be sent to authorized Mazda dealer to have replacement PCM programed.

PROGRAMMING POWERTRAIN CONTROL MODULE

NOTE: Before performing PCM programming procedure, check for any applicable Technical Service Bulletins (TSBs) that may apply to vehicle application.

Description

Flash Electronically Erasable Programmable Read Only Memory (EEPROM) is contained in an Integrated Circuit (IC) inside of Powertrain Control Module (PCM). The EEPROM contains the vehicle strategy and any calibration information specific to vehicle. The IC is reprogrammable and at times it may become necessary to reprogram or reflash the entire contents. This is usually due to an after production strategy change or the Flash Vehicle Identification (VID) Block has been previously reprogrammed and has reached its limit. The VID block can be tailored to accommodate various hardware changes made since vehicle production. This procedure can only be performed using Ford's Service Bay Technical System (SBTS) or equivalent.

A replacement PCM will have a label stating PROGRAMMING REQUIRED. This indicates that it is necessary to retrieve VID data from the original PCM before removing PCM from vehicle. This procedure can be performed using New Generation Star (007-00500) scan tool or equivalent. See FLASH VEHICLE IDENTIFICATION BLOCK PROCEDURE. If original PCM is damaged, nonfunctional or incapable of communicating, it will be necessary to manually reprogram VID block. This procedure can only be performed by contacting the "AS BUILT" data center for programming information.

Flash Vehicle Identification Block Procedure

NOTE: If using a generic scan tool, follow scan tool manufacturer's instructions to perform this procedure.

1. To perform this procedure NGS scan tool, Ford Service Function (FSF) card and NGS Flash Cable (007-00531) must be used. Plug flash cable into scan tool. Plug other end of flash cable into Data Link Connector (DLC). From the scan tool main menu, select SERVICE BAY FUNCTIONS, POWERTRAIN CONTROL MODULE and then PROGRAMMABLE MODULE INSTALLATION.
2. Scan tool display should show 2 selections. The first is selection is for old PCM information to be retrieved and stored. The second selection is for restoring new PCM with information that has been retrieved from the old PCM. Follow scan tool display instructions or refer to instruction sheet included with FSF card. If Flash Vehicle Identification (VID) Block has been reprogrammed previously, scan tool will display a message indicating the need to reflash entire Integrated Circuit (IC). This procedure can only be performed using Ford's Worldwide Diagnostic System (WDS).

KEY REPLACEMENT OR ADDITION

Customer Supplied 2 Or More Valid Keys

1. Cut new transponder equipped key(s). Using first key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn first key to ON position. SECURITY light should illuminate. Turn first key to LOCK position and remove from ignition. SECURITY light should go out.
2. Using second key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn second key to LOCK position and remove key.

3. Repeat step 2 with first key. Repeat step 2 with third key. Repeat step 2 with each new or valid key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically.

Customer Supplied Only One Or No Valid Keys

1. Cut new transponder equipped key(s). Using new key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn new key to ON position. SECURITY light should be flashing at 300-millisecond interval. Turn new key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to 1.2-second interval.
2. Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with new key. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.
3. Using new second key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new second key to LOCK position and remove key.
4. Repeat step 3 with new third key. Repeat step 3 with each new key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically.

STEERING LOCK REPLACEMENT

NOTE: When replacing steering lock, coil and keys should be replaced as a set.

Customer Supplied 2 Or More Valid Keys

1. Remove old steering lock. See STEERING LOCK under REMOVAL & INSTALLATION in appropriate IMMOBILIZER SYSTEMS article. Connect new steering lock to ignition switch connector. Connect old steering lock to coil connector.
2. Insert valid first key into old steering lock. Insert new key into new steering lock. Turn new key to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn new key to ON position. SECURITY light should illuminate. Turn new key to LOCK position. SECURITY light should go out.
3. Remove valid first key from old steering lock. Place valid second key into old steering lock. Using new key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position.
4. Disconnect coil connector from old steering lock and reconnect into new steering lock. Using new key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.
5. Repeat step 4 with each new key. Waiting 30 seconds will cause program to quit automatically. Complete installation of steering lock.

Customer Supplied Only One Or No Valid Keys

1. Replace steering lock, see STEERING LOCK under REMOVAL & INSTALLATION in appropriate IMMOBILIZER SYSTEMS article. Using new key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn new key to ON position. SECURITY light should be flashing at a 300-millisecond interval. Turn new key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to a 1.2-second interval.
2. Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with new key. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new key to LOCK position and remove key.
3. Using new second key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new second key to LOCK position and remove key.
4. Repeat step 3 with new third key. Waiting 30 seconds will cause program to quit automatically.

IMMOBILIZER UNIT

NOTE: When customer does not supply any valid keys, PCM must also be replaced.

Customer Supplied Only One Or No Valid Keys

1. Cut new transponder equipped key(s). Using first new key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn first new key to ON position. SECURITY light should be flashing at a 300-millisecond interval. Turn first new key to LOCK position and wait about 5 minutes until SECURITY light flashing has decreased to a 1.2-second interval.
2. Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay illuminated. Start engine with first new key. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn first new key to LOCK position and remove from ignition.
3. Using second new key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn second new key to LOCK position and remove key.
4. Repeat step 3 with valid key or new third key. Repeat step 3 with each new key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically.

Customer Supplied Two Or More Valid Keys

1. Cut new transponder equipped key(s). Using first valid key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second. Turn first valid key to ON position. SECURITY light should illuminate. Turn first valid key to LOCK position and remove key from ignition. SECURITY light should go out.
2. Using second valid key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn second new key to LOCK position and remove key.
3. Repeat step 2 with new third key. Repeat step 2 with each new key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically.

POWERTRAIN CONTROL MODULE

NOTE: When customer does not supply any valid keys, immobilizer unit must also be replaced.

Customer Supplied 2 Or More Valid Keys

1. Cut new transponder equipped key(s), if necessary. After PCM is replaced. Using valid first key, turn ignition switch to ON position. SECURITY light should illuminate for 1-2 seconds. Turn valid key to LOCK position.
2. Using valid first key, turn ignition switch to ON position, then LOCK position 6 times. DO NOT leave key in either position for more than one second. Ensure sixth turning is done within one second. Remove valid first key.
3. Using valid second key, turn ignition switch to ON position. SECURITY light should illuminate for 1-2 seconds. Turn valid second key to LOCK position and remove key.
4. Using valid first key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn valid first key to LOCK position and remove key.
5. Repeat step 4 with additional valid key or new third key. Repeat step 4 with each new key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically.

Customer Supplied Only One Valid Key

1. Cut new transponder equipped key(s), if necessary. After PCM has been replaced. Using new first key, turn ignition switch to ON position. SECURITY light should illuminate for 1-2 seconds. Turn new first key to LOCK position.
2. Using valid key, turn ignition switch to ON position, then LOCK position 6 times. DO NOT leave key in either position for more than one second. Ensure sixth turning is done within one second. SECURITY light should be flashing at a 300-millisecond interval. Wait about 5 minutes until SECURITY light flashing has decreased to a 1.2-second interval.
3. Input code word. See INPUTTING CODE WORD. SECURITY light should stop flashing and stay

illuminated. Using valid key, turn ignition switch to ON position. SECURITY light should illuminate for 1-2 seconds. Turn valid key to LOCK position and remove key.

4. Using new second key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn new second key to LOCK position and remove key.
5. Repeat step 4 with each new key, up to 8 keys total. Wait 30 seconds, program will quit automatically. After reprogramming is complete, clear DTCs with New Generation Star (NGS) tester.

IMMOBILIZER UNIT & POWERTRAIN CONTROL MODULE

NOTE: Keys may be new or valid. If errors occur during reprogramming in steps 1 or 2, start over from step 1. If errors occur during step 3, go to REPROGRAM ERROR RECOVERY.

1. Cut new transponder equipped key(s), if necessary. After replacing immobilizer unit and PCM. Using first key, turn ignition switch to ON position. SECURITY light should illuminate and then go out. Turn first key to LOCK position and remove key. SECURITY light should flash repeatedly in single pulses.
2. Using second key, turn ignition switch to ON position. SECURITY light should illuminate and then go out. Turn second key to LOCK position and remove key. SECURITY light should flash in double pulses repeatedly.
3. Using third key, turn ignition switch to ON position. SECURITY light should illuminate and then go out. Turn third key to LOCK position and remove key. SECURITY light should flash repeatedly in triple pulses.
4. Repeat step 3 with each new key, up to 8 keys total. Waiting 30 seconds will cause program to quit automatically. After reprogramming is complete, clear DTCs with NGS tester.

REPROGRAM ERROR RECOVERY

1. Using first key, start engine. After SECURITY light illuminates for 1-2 seconds, turn first key to LOCK position. Using first key, turn ignition switch to ON position, then LOCK position 5 times. DO NOT leave key in either position for more than one second.
2. Using first key, turn ignition switch to ON position. SECURITY light should illuminate. Turn first key to LOCK position and remove key. SECURITY light should go out.
3. Using second key, start engine. SECURITY light should illuminate for 1-2 seconds and engine should continue to run. Turn second key to LOCK position and remove key.
4. Repeat step 3 with first key. Repeat step 3 with third key, then with each new key, up to 8 keys total. Waiting seconds will cause program to quit automatically. After reprogramming is complete, clear DTCs with NGS tester.

INPUTTING CODE WORD

1. Code word is comprised of 8 digits from 1-9. The code word is part of immobilizer unit. To obtain code word call manufacturer with immobilizer unit serial number.
2. The immobilizer unit code word is input to PCM by cycling ignition key and counting number of SECURITY light flashes. Wait about 5 minutes until SECURITY light flashing has decreased to 1.2-second interval. Input code word with SECURITY light sequence. See Fig. 3.
3. Turn ignition switch to ON position for length of time required for SECURITY light to flash the same number of times that coincides with first code word digit. Turn ignition switch to LOCK position for at least one flash, but for less than 30 seconds. Repeat procedure for each code word digit. When code word is registered correctly, SECURITY light will stop flashing and stay illuminated. Continue immobilizer system reprogram procedure.

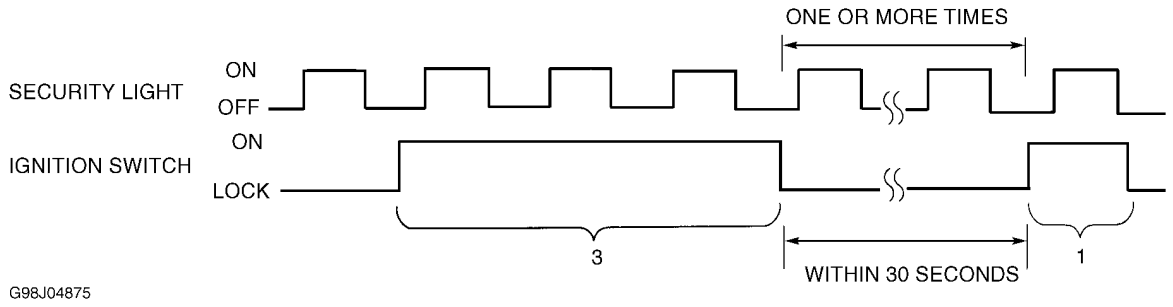

Fig. 3: Inputting Immobilizer Systems Code Word (Example: 31)
Courtesy of MAZDA MOTORS CORP.

MERCEDES-BENZ

If battery has been disconnected or replaced, following items must be reset or normalized:

- Reset clock in instrument cluster. Reset timer for stationary heater if equipped. See OWNERS MANUAL.
- Normalize power windows. See SYNCHRONIZATION OF POWER WINDOWS.
- Normalize steering angle sensor. See ACTIVATING STEERING ANGLE SENSOR.
- Normalize sliding roof. See SYNCHRONIZATION OF SLIDING/TILT-UP ROOF.
- Normalize seats (easy entry/exit function). See EASY ENTRY/EXIT FUNCTION.

SYNCHRONIZATION OF POWER WINDOWS

NOTE: C-class models do not require synchronization of rear power windows. Synchronization procedure can also be performed with STAR DIAGNOSIS tester.

Synchronization of power windows links counter reading of window position to relevant Door Control Module (DCM). Synchronization must be performed whenever desynchronization occurs (battery disconnected or control module replaced). Synchronization is necessary for automatic raising/lowering function of power windows.

To synchronize power windows, press appropriate window switch in up position. When window reaches full up position maintain pressure for 3-5 seconds. When DCM detects motor lock-up for specified period position counter is reset to zero. Repeat procedure for each window.

ACTIVATING STEERING ANGLE SENSOR

If battery is disconnected or voltage supply to steering angle sensor is interrupted, ESP control module switches to FAULT. EL. STAB. PROGRAM, LOCATE WORKSHOP will be displayed in multifunction display in instrument cluster and steering angle sensor must be reactivated.

To re-acitvate steering angle sensor, start engine and run at idle speed. Turn steering wheel from lock-to-lock and then back to straightahead position. Fault should clear and FAULT. EL. STAB. PROGRAM, LOCATE WORKSHOP display should go out.

SYNCHRONIZATION OF SLIDING/TILT-UP ROOF

Synchronization must be performed whenever desynchronization occurs (battery disconnected or control module replaced). Synchronization is necessary for convenience opening and closing of sliding/tilt-up roof.

To synchronize sliding/tilt-up roof, press sliding roof switch forward opening sliding/tilt-up roof to full tilt up position. After roof reaches full tilt-up position, maintain pressure on switch for 5 seconds. When DCM detects

motor lock-up for specified period, position counter is reset to zero. Sliding/tilt-up roof is now synchronized, allowing sliding roof panel to stop before mechanical limit stop is reached.

EASY ENTRY/EXIT FUNCTION

NOTE: Synchronization procedure can also be performed with STAR DIAGNOSIS tester. Easy entry/exit function is activated through multifunction display in instrument cluster.

To allow easier entry or exit from vehicle. Driver's seat and steering column are moved to easy entry/exit position. Seat and steering column are move to full-back and full-up positions. To recalibrate easy entry/exit function:

- Using power seat switch, raise head restraint to full-up position. Maintain switch pressure for one second after full-up position is reached.
- Move seat bottom to full forward position. Maintain switch pressure for one second after full forward position is reached.

Easy entry/exit function is now calibrated, and if activated will move seat to full-back and steering column to full-up positions when transmission is place in Park or Neutral position and door is opened.

CONTROL MODULE VERSION CODING

NOTE: Hand Held Tester (HHT) or STAR DIAGNOSIS tester is necessary for performing version coding.

All Control Modules (CM) have a version coding feature. Coding must be performed when a new CM is installed. Version coding can be performed automatically or manually using Hand Held Tester (HHT).

Automatic Coding

Before removing Control Module (CM), using HHT read and store existing version code. After installation of new module, download previous version code using HHT.

Manual Coding

If version code number cannot be read, vehicle equipment and version must be determined. A corresponding code number must be obtained from spare parts microfiche and manually entered with HHT. Version coding data for each CM is different, following data is typical of information needed for coding:

- Vehicle model.
- Country version.
- Convenience feature.
- Remote trunk release.
- Lock confirmation via blinker lights.
- Engine displacement.
- Transmission code.
- Non-catalytic converter or three-way catalyst equipped.
- 19 MPH (30 km/h) limitation.

ENABLING CODE FUNCTION FOR RADIO

NOTE: Code must be obtained from customer. When vehicle is shipped new, a CODE CARD is included with the owner's manual.

Audio 5 & 10 Models Or Sound 10, 20 & 30 Models (CLK, E & SLK Class)

NOTE: Audio 5 & 10 models are identified by similar controls on each side of display and a cassette player above display.

After reconnecting radio, turn ignition on. CODE appears on display. Enter 5-digit code number using station buttons. After entering correct code, press seek-UP/seek-DOWN or SCAN button to confirm. Radio will turn on if code entered is correct.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 10 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 60 minutes. Radio and ignition switch must remain on during the waiting period.

Becker 2000 (CL, S & SL Class)

Turn ignition on. Turn radio on. Retrieve code number from customer or code card. Enter first digit of code number by pressing station button No. 1 until correct digit appears. Enter remaining digits by repeating procedure with second station button and so on. Confirm correct code is displayed by pressing SEEK button. Radio will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 15 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 24 hours. Radio and ignition switch must remain on during the waiting period.

Becker Mexico, Grand Prix, Europa & Avus Models (SL Class)

Turn ignition on. Turn radio on. CODE will be displayed on radio. Enter 3-digit customer supplied code number by turning tuning knob to right until first digit is correctly displayed. Press AUTOMATIC button moving display to next digit. Confirm correct code is displayed by pressing AUTOMATIC button. Radio will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 15 minutes. Radio and ignition switch must remain on during the waiting period. If wrong code is entered 9 times, "_ _ _ _" will be displayed, radio is no longer operational, and must be returned to manufacturer for reactivation.

Radio With Navigation Control Module (CL, S & SL Class)

Turn ignition on. Turn navigation control unit on. Press buttons No. 1 and 6 simultaneously within 8 minutes after switching unit on. CODE will be displayed. Enter customer supplied code number using station number keys on unit. Confirm correct code is displayed by pressing cursor keys or SCAN button. Unit will turn on if correct code is entered.

If wrong code is entered 3 times, code entry is denied for 15 minutes. If wrong code is entered 9 times, code entry is denied for 24 hours. Radio and ignition switch must remain on during the waiting period.

Radio With 4-Digit Fixed Code (CL, S & SL Class)

Turn ignition on. Turn radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. Confirm correct code by pressing SEEK button. Unit will turn on if correct code is entered.

If wrong code is entered 3 times, code entry is denied for 15 minutes. If wrong code is entered 9 times, code entry is denied for 24 hours. Radio and ignition switch must remain on during the waiting period.

Radio & Radio With Navigation Control Module With 5-Digit Fixed Code (CL, S & SL Class)

Turn ignition on. Turn navigation control unit or radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. On radios, confirm correct code by pressing TUNE, AUTO/SEEK or SC button. On navigation control unit, confirm correct code by pressing ENTER button. Unit will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio. If wrong code is entered 3 times, WAIT will be displayed and code entry is denied for 10 minutes. If wrong code is entered 9 times, WAIT will be displayed and code entry is denied for 30 minutes. Radio and ignition switch must remain on during the waiting period.

Radio (ML Class)

Turn ignition on. Turn radio on. CODE will be displayed. Enter customer supplied code number using station number keys on radio. Confirm correct code by pressing seek forward or seek back buttons. Unit will turn on if correct code is entered.

If wrong code is entered, CODE will be displayed on radio and code will need to be researched and entered again. If wrong code is entered 3 times, code entry is denied for 10 minutes. If wrong code is entered 9 times, code entry is denied for 60 minutes. Radio and ignition switch must remain on during the waiting period.

PROGRAMMING SUPPLEMENTAL RESTRAINT SYSTEM CONTROL MODULE

CAUTION: When programming control module, avoid interrupting control module voltage supply. Damage to control module may result. Control module parameters can only be set once. DO NOT connect Hand-Held Tester (HHT) to Data Link Connector (DLC) with ignition on. Damage to HHT may result.

NOTE: Hand-Held Tester (6511 0001 99) is necessary to set control module parameters.

After replacing control module, when ignition is turned on, SRS warning light will continuously blink or stay on, indicating that control module parameters need to be programmed. Turn ignition off. Connect HHT to DLC. DLC is located in right rear corner of engine compartment. It may be necessary to use Adapter (140 589 1463 00) to connect HHT to DLC. Follow HHT prompts to program replacement control module. Currently all control modules are programmed with the same parameters. After control module parameters are set, SRS warning light will go out.

MITSUBISHI

ENGINE CONTROL MODULE

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

ENCRYPTED CODE REGISTRATION METHOD (IMMOBILIZER)

NOTE: If PCM is replaced, immobilizer-ECU should also be replaced. PCM has an encrypted code for immobilizer-ECU, and encrypted code is registered in immobilizer-ECU and ignition key.

NOTE: Using key ID register function will cause all key ID's that have been previously registered in immobilizer-ECU to be erased. All keys need to be registered. Those which have been registered before should be on hand before using this function. If registering more than one key, do not disconnect scan tool halfway through the registration process. After registering key IDs, check that engine can be started using all keys that have been registered. If engine will not start, see DIFFICULT TO START/NO START (CRANKS OKAY) in TESTING - NO CODES article.

If Immobilizer-ECU or PCM is replaced, or an ignition key is added encrypted codes of all ignition keys must be registered. (A maximum of eight different ignition key can be registered.) When the immobilizer-ECU has been replaced, scan tool MB991502 (MUT-II) must be used to register immobilizer-ECU and input vehicle secret code and register password (secret code) that owner specifies into immobilizer-ECU. If an attempt is made to start the engine with an unregistered ignition key, cranking occurs, but fuel supply is cut off disabling

engine. After about 10 seconds, theft-alarm indicator in instrument cluster will blink for about 30 seconds.

Diagnostic Aids

If none of the functions can be used, use scan tool to check for any stored DTCs. If any DTCs are stored, perform appropriate test. See DIAGNOSTIC TROUBLE CODE DEFINITIONS in appropriate SELF-DIAGNOSTICS article. Then repeat operation. If an incorrect password is input five times in a row, immobilizer-ECU judges that an unauthorized operation is being attempted. Start-prevention mode will be set, and engine operation will stop and all special functions will be disabled. If ignition switch is turned on, and left in that position for approximately 20 minutes, "Unauthorized operation, start- prevention mode" will be cancelled.

Key Id Register

All ignition keys can be registered with MUT-II scan tool or equivalent. Additional ignition keys can be registered with or without scan tool. If an ignition key is registered using scan tool, no registered ignition keys must be lost. Registration with scan tool is as follows:

1. Connect MUT-II or equivalent scan tool to Data Link Connector (DLC). Turn ignition switch on.
2. On scan tool at SYSTEM SELECT, press YES. Select IMMOBILIZER, press YES. Select SPECIAL FUNC, press YES. Select KEY ID REGISTER, press YES. If DTC 11 is stored, CAN'T EXECUTE will be displayed. Perform appropriate test procedure, see appropriate IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

   NOTE: NOTE: Four separate digits must be input to make up password.

3. Input password. Use UP and DOWN keys to change current password digit to a value between 0 and 9. Use the LEFT and RIGHT keys to move to a different password digit. Press the YES key to accept password. If an incorrect password is input 5 times in a row, this screen is displayed and Immobilizer-ECU switches to unauthorized operation, start-prevention mode.
4. Press YES key to start key ID registration.
5. Scan tool will display COMPLETED when key ID registration is successful. If an error occurs during key ID registration, message CAN'T EXECUTE will be displayed. If key has already been registered, KEY ID HAS BEEN REGISTERED will be displayed.
6. Number of keys currently registered will be displayed on scan tool. To register an additional key, replace the ignition key with next key to be registered within 5 seconds and then press YES key. Key ID registration screen will be displayed, then register another key. A maximum of eight different keys can be registered. If key ID registration is complete, press the NO key.
7. This completes the registration operation. Turn ignition switch to LOCK position and leave it off for about ten seconds.
8. Check that engine can be started with each ignition key that was registered. Using scan tool, check that immobilizer system or MFI system DTCs did not set.
9. Turn ignition switch to LOCK position. Disconnect scan tool.

Registration Of Additional Keys (With Scan Tool)

An additional key is registered with MUT-II scan tool while keeping all existing registered key data. To register additional keys with scan tool, no registered keys must be lost. To register an additional key using scan too1 to perform following:

1. Connect MUT-II or equivalent scan tool to Data Link Connector (DLC). Turn ignition switch to ON position.
2. On scan tool at SYSTEM SELECT, press YES. Select IMMOBILIZER, press YES. Select SPECIAL FUNC, press YES. Select KEY ID REGISTER, press YES. If DTC 11 is stored, CAN'T EXECUTE will be displayed. Perform appropriate test procedure, see appropriate IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

3. Follow scan tool instructions to add an additional key. If an error occurs during key ID registration, scan tool will display CAN'T EXECUTE. If key has already been registered, KEY ID HAS BEEN REGISTERED will be displayed.
4. The number of keys currently registered will be displayed. To register an additional key, replace ignition key with next key to be registered within 5 seconds and then press YES key. Key ID registration screen will be displayed, then register another key. A maximum of eight different keys can be registered. If key ID registration is complete, press the NO key.
5. This completes the registration operation. Turn ignition switch to LOCK position and leave it off for approximately ten seconds.
6. Check that engine can be started with each registered ignition key.
7. Using scan tool, check that immobilizer system and/or MFI system DTCs did not set. Turn ignition switch to LOCK position. Disconnect scan tool.

Registration Of Additional Keys (Without Using Scan Tool)

Additional ignition keys can be registered without using the scan tool by operating two ignition keys that already have been registered to the vehicle and operating an additional key to be registered. A maximum of 8 ignition keys can be registered. To register additional keys without using scan tool:

1. Using a key (Key A) which has already been registered to the vehicle, turn ignition switch to ON position. Leave Key A in ON position for about 5 seconds. Turn ignition off, and remove Key A.
2. Using a second key (Key B) which has already been registered to the vehicle, turn ignition switch to ON position. Leave Key B in ON position for about 5 seconds. Turn ignition off, and remove Key B. Key B must be turned on within 7 seconds of removing first key.
3. If Key B is correct, immobilizer-ECU enters additional key entry mode. Theft-alarm indicator light in instrument cluster blinks about twice a second. After theft-alarm indicator light begins to blink, turn ignition switch to OFF and ON positions using new transponder key. Time during which new key can be registered is limited to less than 30 seconds after theft-alarm indicator blinks.
4. To register another key, turn ignition to OFF position. Place ignition key to be registered in ignition switch, and turn key to ON position within seven seconds. To add additional keys, repeat procedure. A maximum of 8 ignition keys can be registered. Additional key registration mode is terminated when any following condition is met:
    - Ignition key is in ON position more than 30 seconds (time-out of addition entry mode).
    - Engine control relay is off after key is turned to OFF position.
    - Start communication with scan tool.
5. Ensure additional registered keys can start engine, after ignition is turned off and engine control relay is turned off.

RADIO SECURITY CODE

Radio will require anti-theft security code to be entered if battery is disconnected. Turn radio on. Radio should display "codE". Using first 4 preset buttons, enter code number from customer supplied security card. Each preset button applies to code number digit. For example, No. 1 button sets the first digit of code number. Cycle button until desired number appears. Once code is entered, press TAPE or CD (as applicable) button. A "beep" will sound when correct code is entered. If code is incorrectly entered after 3 successive attempts, radio must be left on for one hour before it will accept code entry.

NISSAN

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

IMMOBILIZER PROGRAMMING

ECM is a part of Nissan Anti-Theft System (NATS). Replacement ECM must have immobilizer code rewritten, using CONSULT. To perform rewrite procedure requires the vehicle, all keys and a CONSULT tester with a NATS Program Card (E960U). Any key not learned during rewrite will not start vehicle. Follow CONSULT tester instructions.

SUN ROOF INITIALIZATION

NOTE: Following procedure should be performed if battery is disconnected and reconnected, or battery is discharged and recharged to provide proper automatic operation and jam protection operation of power sun roof.

Ensure ignition is on. With sun roof in any position. Press and hold power sun roof switch until power sun roof tilts all the way upward. Hold switch in tilt position for 3 seconds. This resets sun roof motor memory.

PORSCHE

ALL MODELS

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

BOXSTER

NOTE: Ensure all codes are correct before entering. Codes cannot be changed.

Alarm/Drive Block Control Unit Programming

1. If control unit requires replacement, new control unit must be coded. It will be necessary to obtain immobilizer (drive block) code and teaching code from Porsche Cars North America (PCNA) prior to replacement. To obtain codes, complete code request form (Technical Bulletin, Boxster bulletin group 9, number 9801) from nearest Porsche dealer. Proof of ownership (valid title or registration) is required. Original transponders can be reused, but require recoding to new control unit.
2. Install control unit. Connect Porsche System Tester 2 and turn on. Select BOXSTER and begin control unit search sequence. Select ALARM SYSTEM, TEACHING FUNCTIONS AND IMMOBILIZER. Enter 16-digit immobilizer code obtained from PCNA and press ENTER. Confirm code entry by pressing F7.

SAAB

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

PROGRAMMING IMMOBILIZER

If ECM was disconnected or replaced, or battery was disconnected immobilizer must be reset. Connect Tech 2 or equivalent scan tool to DLC. Turn ignition on. On scan tool select BODY, and then TWICE. Select IMMOBILIZING. Immobilizer will self program after about 10 seconds.

SUBARU

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

SUZUKI

After disconnecting battery or replacing ECM, drive vehicle to enable ECM to relearn driveability. Inform your customer that they may experience driveability different from what they are accustomed to until ECM completes relearn function.

TOYOTA

SERVICE PRECAUTIONS (PRIUS)

WARNING: When performing any inspection or service procedure on this vehicle, ensure following service precautions are followed to prevent personal injury or death due to the extremely high voltage.

The following service precautions must be followed:

- Ensure ignition is off and ignition key is removed from ignition before performing any inspection or service procedure in engine compartment, as engine may automatically start and shut off when ignition is on and READY light is illuminated. READY light is displayed just above the shift lever position indicator on instrument cluster at center of instrument panel.
- Read all service and warning labels in engine compartment before performing any procedures in engine compartment.
- All high-voltage wiring harness connectors contain Orange connectors. DO NOT touch any wiring harness that contains Orange connectors.
- High-voltage battery and other high-voltage components may be identified by HIGH VOLTAGE caution labels on them. DO NOT touch these components.
- If necessary to inspect or service high-voltage system, ensure ignition is off. Remove service plug and wait at least 5 minutes to ensure high voltage is fully discharged before touching any high-voltage wiring harness, connectors or components. Service plug is located on service plug assembly at driver's side front corner of trunk compartment, near high-voltage battery. See Fig. 4. Ensure service plug is stored in a location in which no one may install service plug while technician is working on the vehicle.
- If necessary to touch any high-voltage wiring harness, connectors or components, ensure service plug is removed and battery voltage or less exists at electrical connector. Use Toyota insulated gloves when touching any high-voltage wiring harness, connectors or components. Ensure insulated gloves are dry and in good condition and that no holes exist in insulated gloves. Test insulated glove by applying air to glove before touching any high-voltage wiring harness, connectors or components.
- DO NOT wear any metal objects while working on vehicle which may accidently drop and cause a short circuit.
- If any high-voltage wiring harness connector is disconnected, ensure terminal on wiring harness connector is wrapped with tape to prevent wiring harness connector from contacting any surface.
- If servicing high-voltage system, place sign on roof of vehicle to indicate to other technicians that high-voltage system is being serviced.

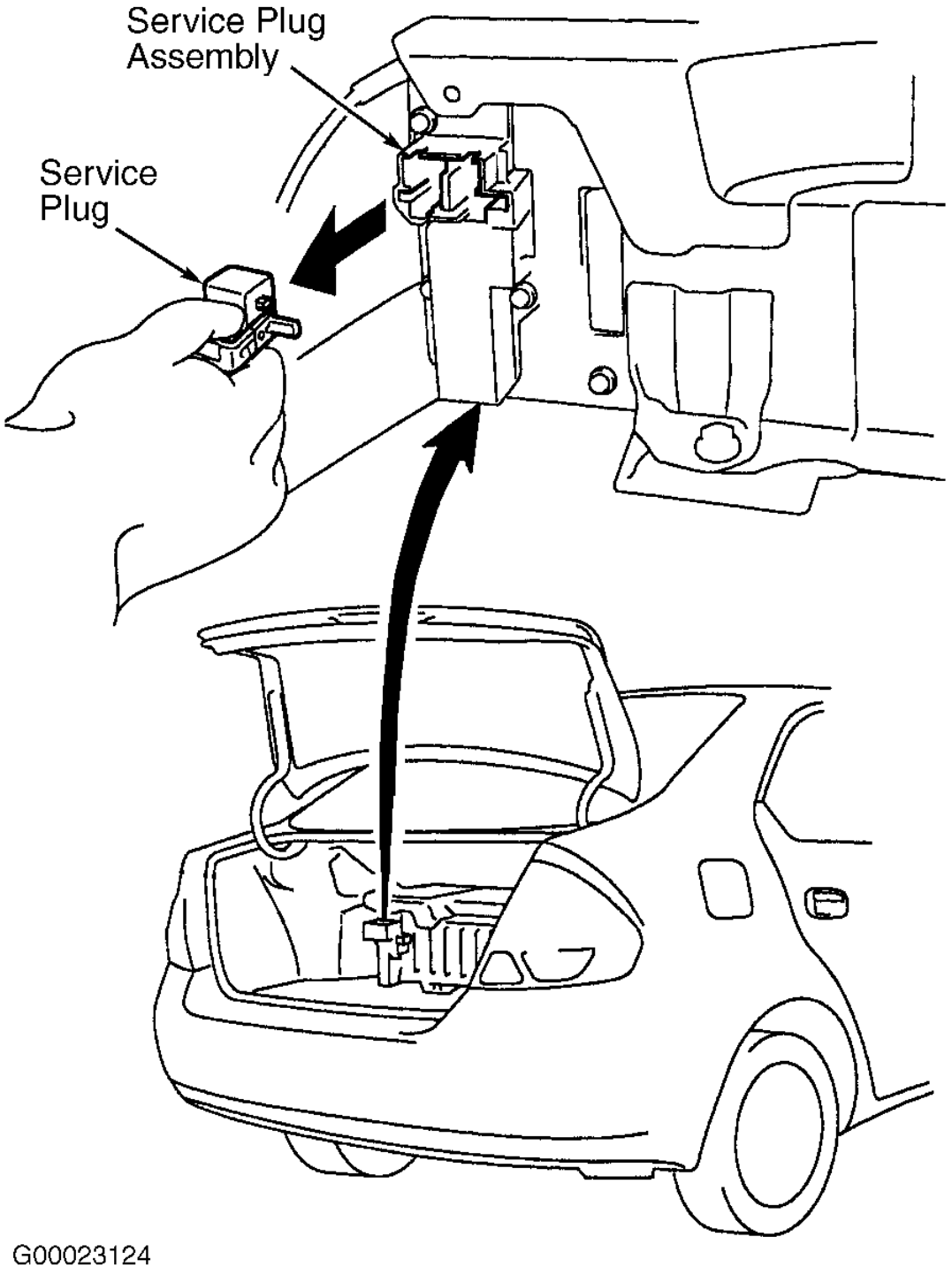

Fig. 4: Locating Service Plug & Service Plug Assembly (Prius)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

IMMOBILIZER PROGRAMMING (EXCEPT PRIUS)

NOTE: In the case of having lost all the already registered master ignition keys, you are not able to do additional registration or deletion of ignition key codes. You must change the Engine Control Module (ECM) and then perform ignition key registration.

Ignition Key Registration

NOTE: This procedure MUST BE performed ONLY when NEW Engine Control Module (ECM) is installed. A new ECM is in automatic registration mode and up to 3 ignition key identification codes may be registered in the ECM at one time. In automatic registration mode, the last ignition key to be registered becomes the sub-key.

NOTE: A master key is a Black-colored ignition key and a sub-key is a Gray-colored ignition key.

1. Ensure SECURITY indicator light is flashing. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.
2. Insert ignition key into ignition lock cylinder. Note that SECURITY indicator light should now remain on steady.
3. Once ignition key registration is under way, SECURITY indicator light should turn off. After ignition key registration is complete, SECURITY indicator light should come on steady. Remove ignition key.
4. If ignition key registration was complete, and system is operating normally, SECURITY indicator light should flash when ignition key was removed from ignition lock cylinder. If ignition key registration was not completed with ECM in automatic registration mode, a code 2-1 will be displayed by SECURITY indicator light. See Fig. 5. When inserting an already registered ignition key, a code 2-2 will be displayed by SECURITY indicator light. See Fig. 5.
5. If programming additional ignition keys, repeat process starting with step 1. If additional ignition keys do not need programming, procedure is complete. SECURITY indicator light should turn off once last ignition key (sub-key) is registered.
6. To complete automatic registration mode, without removing or installing registered ignition key in ignition lock cylinder, depress and release brake pedal at least 5 times within 15 seconds, or request automatic registration mode completion by using Toyota hand-held tester connected to data link connector No. 3. Data link connector No. 3 is located at driver's side of instrument panel.

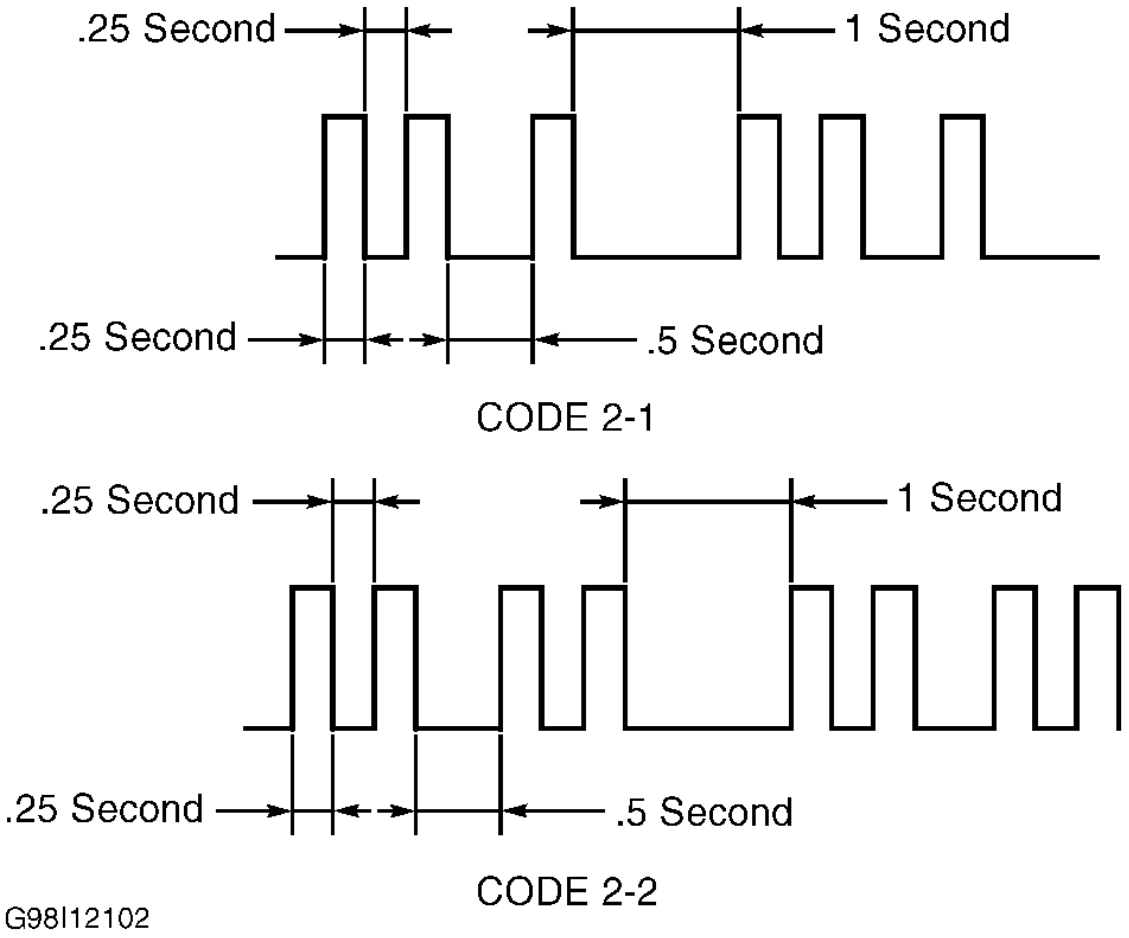

Fig. 5: Identifying Code Displays
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ADDITIONAL MASTER KEY REGISTRATION (EXCEPT PRIUS)

NOTE: A master key is a Black-colored ignition key. Additional master key may be registered by 2 different methods: using brake pedal and accelerator pedal, or using Toyota hand-held tester. It is possible to register up to 7 master key codes including the already registered key code.

NOTE: When any operation time described in following procedures is over, registration mode completes. When next procedure is performed while timer is working, the timer completes counting time and then the next timer starts.

Using Brake Pedal & Accelerator Pedal

1. Insert registered master key into ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, depress and release accelerator pedal 5 times.
2. Within 20 seconds of depressing and releasing accelerator pedal 5 times, depress and release brake pedal 6 times and remove master key from ignition lock cylinder.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert master key to be registered in ignition lock cylinder.
4. Within 10 seconds of inserting master key to be registered in ignition lock cylinder, depress and release accelerator pedal one time. Ensure SECURITY indicator light flashes. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.

5. After one minute, additional master key should be registered and SECURITY indicator light should then turn off. If registering additional master keys, repeat process starting with step 3 within 10 seconds.
6. The registration mode is complete after removing master key from ignition lock cylinder and depressing and releasing brake pedal at least once within 10 seconds after SECURITY indicator light has turned off, or at least 10 seconds has passed.

Using Toyota Hand-Held Tester

1. Connect hand-held tester to data link connector No. 3. When using hand-held tester, more detailed procedures may be displayed on tester while performing this procedure.
2. Insert registered master key in ignition lock cylinder. Turn ignition on. Select MASTER KEY REGISTRATION on hand-held tester. Within 20 seconds, remove master key from ignition lock cylinder.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert master key to be registered in ignition lock cylinder. Ensure SECURITY indicator light flashes. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.
4. After one minute, additional master key should be registered and SECURITY indicator light should then turn off. The registration mode is complete after removing master key from ignition lock cylinder and depressing and releasing brake pedal at least once within 10 seconds after SECURITY indicator light has turned off, or at least 10 seconds has passed.

ADDITIONAL SUB-KEY REGISTRATION (EXCEPT PRIUS)

NOTE: A sub-key is a Gray-colored ignition key. Additional sub-key may be registered by 2 different methods: using brake pedal and accelerator pedal, or using Toyota hand-held tester. It is possible to register up to 3 sub-key codes including the already registered key code.

NOTE: When any operation time described in following procedures is over, registration mode completes. When next procedure is performed while timer is working, the timer completes counting time and then the next timer starts.

Using Brake & Accelerator Pedal

1. Insert registered master key in ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, depress and release accelerator pedal 4 times.
2. Within 20 seconds of depressing and releasing accelerator pedal 4 times, depress and release brake pedal 5 times and remove master key from ignition lock cylinder.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert sub-key to be registered in ignition lock cylinder.
4. Within 10 seconds of inserting sub-key in ignition lock cylinder, depress and release accelerator pedal one time. Ensure SECURITY indicator light flashes. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.
5. After one minute, additional sub-key should be registered and SECURITY indicator light should then turn off. If registering additional sub-keys, repeat process starting with step 3 within 10 seconds.
6. The registration mode is complete after removing sub-key from ignition lock cylinder and depressing and releasing brake pedal at least once within 10 seconds after SECURITY indicator light has turned off, or at least 10 seconds has passed.

Using Toyota Hand-Held Tester

1. Connect hand-held tester to data link connector No. 3. When using hand-held tester, more detailed procedures may be displayed on tester while performing this procedure.
2. Insert registered master key in ignition lock cylinder. Turn ignition on. Select SUB-KEY REGISTRATION on hand-held tester. Within 20 seconds, remove master key from ignition lock cylinder.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert sub-key to be registered in

ignition lock cylinder. Ensure SECURITY indicator light flashes. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.

4. After one minute, additional sub-key should be registered and SECURITY indicator light should then turn off. The registration mode is complete after removing sub-key from ignition lock cylinder and depressing and releasing brake pedal at least once within 10 seconds after SECURITY indicator light has turned off, or at least 10 seconds has passed.

ERASURE OF TRANSPONDER KEY CODE (EXCEPT PRIUS)

NOTE: There are 2 different methods to erase the transponder key code: using brake pedal and accelerator pedal, or using Toyota hand-held tester. All other master and sub-key codes are deleted leaving the master key code which was used when performing the operation. When using the ignition key which was used before deleting, it is necessary to register the code again.

NOTE: When any operation time described in following procedures is over, registration mode completes. When next procedure is performed while timer is working, the timer completes counting time and then the next timer starts.

Using Brake & Accelerator Pedal

1. Insert registered master key in ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, depress and release accelerator pedal 6 times.
2. Within 20 seconds of depressing and releasing accelerator pedal 6 times, depress and release brake pedal 7 times.
3. Within 10 seconds of depressing and releasing brake pedal 7 times, remove master key from ignition lock cylinder. Procedure should now be complete and transponder key code should now be erased. If master key cannot be removed from ignition lock cylinder, the transponder key code erasure is cancelled.

Using Toyota Hand-Held Tester

1. Connect hand-held tester to data link connector No. 3. When using hand-held tester, more detailed procedures may be displayed on tester while performing this procedure.
2. Insert registered master key in ignition lock cylinder. Turn ignition on. Request KEY CODE DELETION from hand-held tester. Ensure SECURITY indicator light flashes. SECURITY indicator light is displayed as a vehicle icon near the center of the tachometer.
3. Within 10 seconds of requesting KEY CODE DELETION on hand-held tester, remove master key from ignition lock cylinder. Procedure is now complete and transponder key code should now be erased. If master key cannot be removed from ignition lock cylinder, transponder key code erasure is cancelled and SECURITY indicator light will turn off.

IMMOBILIZER COMPONENT REPLACEMENT PROGRAMMING PROCEDURES (PRIUS)

WARNING: Read service precautions before proceeding with any service procedure on engine immobilizer system. See SERVICE PRECAUTIONS (PRIUS).

NOTE: Proper procedure must be followed when replacing transponder key Electronic Control Unit (ECU) and/or hybrid vehicle control Electronic Control Unit (ECU).

Programming When Replacing Transponder Key Electronic Control Unit

Once replacement transponder key Electronic Control Unit (ECU) is installed, register ignition keys to transponder key ECU. See IGNITION KEY REGISTRATION. Insert ignition key into ignition lock cylinder and turn ignition switch to ON position. Leave ignition switch in ON position for at least 30 minutes and then start the engine.

Programming When Replacing Hybrid Vehicle Control Electronic Control Unit

Once replacement hybrid vehicle control Electronic Control Unit (ECU) is installed, insert ignition key into ignition lock cylinder and turn ignition switch to ON position. Leave ignition switch in ON position for at least 30 minutes and then start the engine.

Programming When Replacing Transponder Key Electronic Control Unit & Hybrid Vehicle Control Electronic Control Unit

Once replacement transponder key Electronic Control Unit (ECU) and hybrid vehicle control Electronic Control Unit (ECU) are installed, register ignition keys to transponder key ECU. See IGNITION KEY REGISTRATION. Once ignition keys are registered, insert ignition key into ignition lock cylinder and start the engine.

Programming If All Ignition Keys Are Lost

NOTE: Procedure must be followed if all ignition keys are lost.

Purchase NEW ignition keys along with NEW transponder key Electronic Control Unit (ECU). Replace original transponder key ECU with replacement transponder key ECU. Insert NEW ignition key into ignition lock cylinder and turn ignition switch to ON position. Leave ignition switch in ON position for at least 30 minutes.

Ignition Key Registration

NOTE: This procedure MUST BE performed ONLY when NEW transponder key Electronic Control Unit (ECU) is installed. A new transponder key ECU is in automatic registration mode and up to 2 master key identification codes and one sub-key identification code may be registered in transponder key ECU at one time. In automatic registration mode, the last ignition key to be registered becomes a sub-key.

NOTE: Master key is a Black-colored ignition key that opens all locks. A sub-key is a Gray-colored ignition key that will not open the trunk.

1. Check that battery is connected and there is no ignition key in the ignition lock cylinder. Check that SECURITY indicator light is flashing. SECURITY indicator light is displayed as a vehicle icon near the clock at the center of instrument panel.
2. To register the first master key, insert master key into ignition lock cylinder. SECURITY indicator light should turn off for one second and then turn back on. Remove master key from ignition lock cylinder.
3. To register the second master key, insert master key into ignition lock cylinder. SECURITY indicator light should turn off for one second and then turn back on. Remove master key from ignition lock cylinder.
4. To register the sub-key, insert sub-key into ignition lock cylinder. SECURITY indicator light should turn off for one second and then turn back on. Remove sub-key from ignition lock cylinder. Ensure SECURITY indicator light starts flashing.
5. If the registration was complete and system is operating normally when ignition key was removed from ignition lock cylinder, the SECURITY indicator light should flash. If ignition key registration was not completed with transponder key Electronic Control Unit (ECU) in automatic registration mode, a code 2-1 will be displayed by SECURITY indicator light. See Fig. 6. When inserting an already registered ignition key, a code 2-2 will be displayed by SECURITY indicator light. See Fig. 6.
6. To complete automatic registration mode after more than one key has been registered, insert master key into ignition lock cylinder and turn ignition switch to from LOCK to ON position 5 times within 10 seconds without removing master key from ignition lock cylinder.

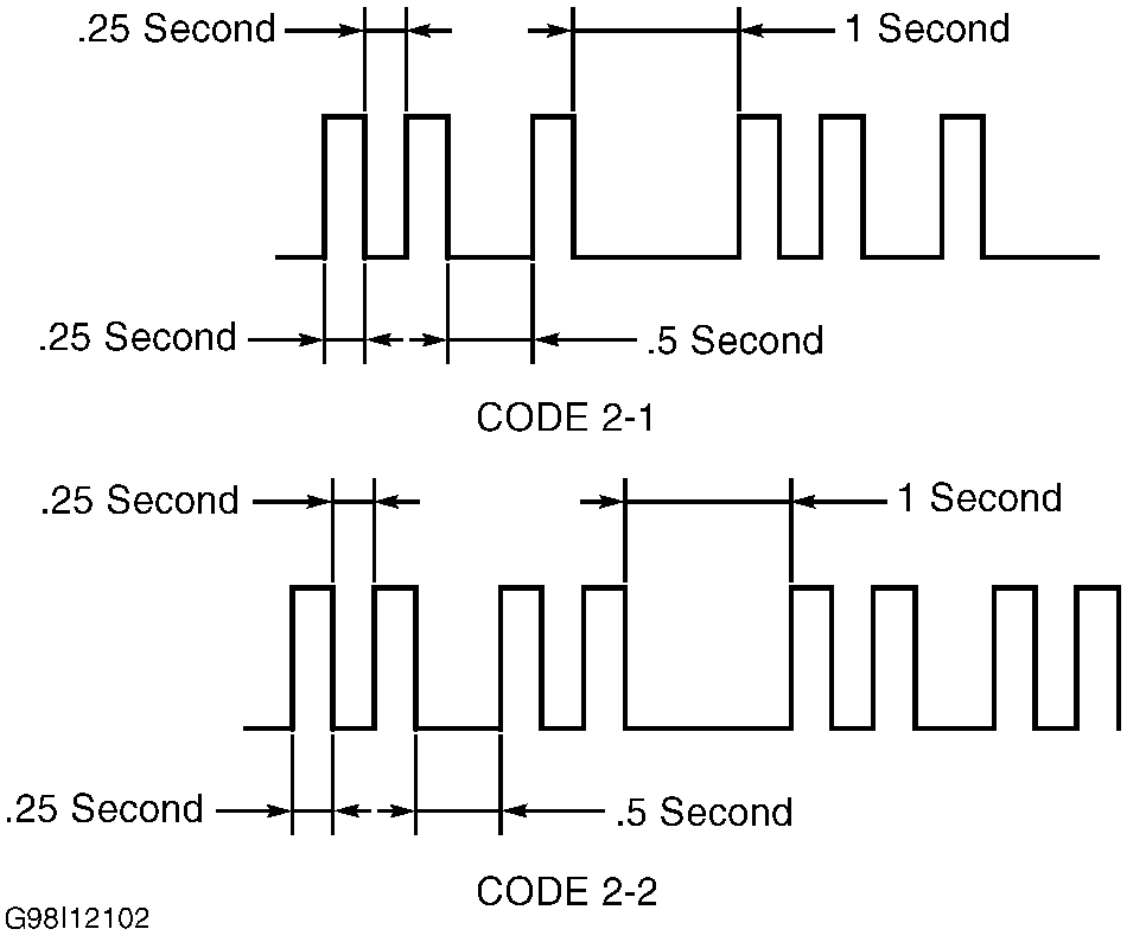

Fig. 6: Identifying Code Displays
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Additional Master Key Registration

NOTE: Master key is a Black-colored ignition key that opens all locks.

1. Ensure all doors are closed and there is no ignition key in ignition lock cylinder. Insert registered master key into ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, repeatedly turn ignition switch to from LOCK to ON position 5 times, and then open and close the driver's door 6 times. Driver's door must be opened and closed within 15 seconds after inserting master key into ignition lock cylinder.
2. Within 20 seconds of opening and closing the driver's door 6 times, remove master key from ignition lock cylinder. Master key must be removed from ignition lock cylinder within 20 seconds after the first opening and closing of the driver's door.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert master key to be registered in ignition lock cylinder.
4. Within 10 seconds of inserting master key to be registered in ignition lock cylinder, turn ignition switch to from LOCK to ON position. Leave ignition switch in ON position for at least 60 seconds.
5. After ignition switch has been in ON position for at least 60 seconds, turn ignition off and remove ignition key from ignition lock cylinder. If registering additional master keys, repeat process starting with step 3 within 10 seconds. Once all master keys are registered, open and close the driver's door.

Additional Sub-Key Registration

NOTE: A sub-key is a Gray-colored ignition key that will not open the trunk.

1. Ensure all doors are closed and there is no ignition key in ignition lock cylinder. Insert registered master key into ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, repeatedly turn ignition switch to from LOCK to ON position 4 times, and then open and close the driver's door 5 times. Driver's door must be opened and closed within 15 seconds after inserting master key into ignition lock cylinder.
2. Within 20 seconds of opening and closing the driver's door 5 times, remove master key from ignition lock cylinder. Master key must be removed from ignition lock cylinder within 20 seconds after the first opening and closing of the driver's door.
3. Within 10 seconds of removing master key from ignition lock cylinder, insert sub-key to be registered in ignition lock cylinder.
4. Within 10 seconds of inserting sub-key to be registered in ignition lock cylinder, turn ignition switch to from LOCK to ON position. Leave ignition switch in ON position for at least 60 seconds.
5. After ignition switch has been in ON position for at least 60 seconds, turn ignition off and remove ignition key from ignition lock cylinder. If registering additional sub-key, repeat process starting with step 3 within 10 seconds. Once all sub-keys are registered, open and close the driver's door.

Erasure Of Transponder Key Code

NOTE: Procedure is used to erase all key codes from transponder key Electronic Control Unit (ECU). All other master and sub-key codes are deleted leaving the master key code which was used when performing the operation. When using the ignition key which was used before deleting, it is necessary to register the code again.

1. Ensure all doors are closed and there is no ignition key in ignition lock cylinder. Insert registered master key into ignition lock cylinder. Within 15 seconds of inserting master key into ignition lock cylinder, repeatedly turn ignition switch to from LOCK to ON position 6 times, and then open and close the driver's door 7 times. Driver's door must be opened and closed within 15 seconds after inserting master key into ignition lock cylinder.
2. Within 20 seconds of opening and closing the driver's door 7 times, remove master key from ignition lock cylinder. Master key must be removed from ignition lock cylinder within 20 seconds after the first opening and closing of the driver's door.

POWER SLIDING DOOR REINITIALIZATION PROCEDURE (SIENNA)

NOTE: Following procedure should be performed if power sliding door system does not operate properly under the following conditions: battery is disconnected and reconnected, battery is discharged and recharged, or open power sliding door warning light remains on even with power sliding doors closed.

1. If power sliding door system does not operate properly and open power sliding door warning light remains on, even with power sliding doors closed, go to next step. If power sliding door system does not operate properly after battery is disconnected and reconnected or battery is discharged and recharged, go to step 4.
2. Ensure power sliding door main switch is in OFF position. Power sliding door main switch is located on driver's side of instrument panel, just to the left of steering column and is marked as PWR DOOR OFF. Close power sliding door by hand. Disconnect battery for one minute and then reconnect the battery.
3. Turn on power sliding door system by placing power sliding door main switch in the ON position. Wait 5 seconds and then go to next step.
4. Ensure power sliding door main switch is in ON position if not previously done. Power sliding door main switch is located on driver's side of instrument panel, just to the left of steering column and is marked as PWR DOOR OFF. Open one of the power sliding doors by using the power sliding door control switch. Power sliding door control switches are located near center of instrument panel, just below the stereo.

5. Wait 3 seconds after power sliding door stops at the fully open position and then close power sliding door by using power sliding door control switch on instrument panel or by using remote keyless entry transmitter.
6. Wait 3 seconds after power sliding door stops at the fully closed position and then repeat steps 4 and 5 .

SUN ROOF INITIALIZATION (CAMRY & CELICA)

Camry

NOTE: Following procedure should be performed if battery is disconnected and reconnected, or battery is discharged and recharged to provide proper automatic operation and jam protection operation of power sun roof.

1. Ensure ignition is on. Depress and hold TILT UP side of power sun roof switch until power sun roof tilts all the way upward and then tilts downward a little. Power sun roof switch is located on headliner, just in front of power sun roof.
2. Check proper operation of open/closing and tilt up/down function for power sun roof using power sun roof switch. Power sun roof should operate anytime ignition is on, or for 43 seconds after ignition is off provided both front doors are closed. It will stop operating if any front door is opened. Depressing SLIDE OPEN side of power sun roof switch for one second should open power sun roof. Depressing TILT UP side of power sun roof switch for one second should close power sun roof. To tilt power sun roof upward, depress and hold TILT UP side of power sun roof switch for one second. To tilt power sun roof downward, depress and hold SLIDE OPEN side of power sun roof switch for one second.

Celica

Close power sun roof using power sun roof switch and continue to depress power sun roof switch briefly after power sun roof is fully closed. Power sun roof switch is located on headliner, just in front of power sun roof.

VOLKSWAGEN

NOTE: While limited diagnostic information is available, vehicle manufacturer does not support diagnostic information using aftermarket scan tools. To properly diagnose vehicle, it is recommended to use VAS 5051 scan tool with VAS 5051/1 adapter cable or VAG 1551 scan tool with 1551/3A adapter cable and VAG 1598/31 test box.

NOTE: If Engine Control Module (ECM) memory is cleared, ECM is disconnected or loses battery voltage, it is necessary to generate a ECM readiness code. See READINESS CODE.

ENGINE CONTROL MODULE PROGRAMMING (ALL MODELS)

NOTE: Once procedure is started DO NOT turn ignition off during ECM programming. After coding ECM and starting engine for first time, allow engine to idle for several minutes so ECM can go through learn function. Idle speed may be erratic while ECM is learning.

If Engine Control Module (ECM) is replaced, it is necessary to code new ECM. If new ECM is not properly coded, the following problems may occur:

- Driveability problems (e.g., harsh shifting).
- False malfunctions stored in ECM memory.
- Increased fuel consumption.
- Increased exhaust emissions.
- Reduction in transmission life.

- All ECM functions are not carried out (e.g., EVAP system operation).
- On front wheel drive vehicles Anti-Slip Regulation (ASR), (ASR warning lamp comes on).

Before ECM is replaced on any model perform following procedure. Turn ignition off. Connect Scan Tool (VAG 1551/1552) using Adapter cable (VAG 1551/3) to Data Link Connector (DLC). Turn ignition on. Prior to removing original ECM, print out ECM identification. On scan tool, press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Print out ECM identification by pressing PRINT button. Press right arrow button. On scan tool, press 0 and 6 buttons to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input. Turn ignition off.

Remove original ECM and install new ECM. Turn ignition on. On scan tool, press 0 and 1 buttons to select ADDRESS WORD 01: ENGINE ELECTRONICS. Press right arrow button. Press 0 and 7 buttons to select FUNCTION 07: CODE CONTROL MODULE. Press "Q" button to enter input. Enter appropriate code for vehicle. See appropriate ENGINE CONTROL MODULE CODING TABLE or VARIATION TABLE as follows. After coding ECM, press 0 and 6 buttons to select FUNCTION 06: END OUTPUT. Press "Q" button to enter input.

After installing and/or coding ECM perform following procedures:

- Use scan tool to check DTC memory, erase if necessary. See RETRIEVING DIAGNOSTIC TROUBLE CODES in appropriate SELF-DIAGNOSTICS article.
- Perform adaptation of throttle valve control module. See ADAPTATION OF THROTTLE VALVE CONTROL MODULE in appropriate SELF-DIAGNOSTICS article.
- On vehicles equipped with cruise control, activate cruise control to ECM. See CRUISE CONTROL SYSTEMS article in ACCESSORIES & EQUIPMENT.
- On vehicles equipped with automatic transmission, perform adaptation of kickdown switch or automatic transmission basic setting. See ADAPTATION OF KICKDOWN FUNCTION or AUTOMATIC TRANSMISSION BASIC SETTING PROCEDURE in appropriate SELF-DIAGNOSTICS article.
- On vehicles equipped with factory alarm system, perform adaptation of immobilizer to ECM. See appropriate ANTI-THEFT & POWER DOOR LOCKS article in ACCESSORIES & EQUIPMENT.
- Using scan tool, generate a ECM readiness code. See READINESS CODE.

Engine Control Module Coding Options (1.8L Turbo)

NOTE: These options relate to Golf, Jetta, Beetle and Passat models equipped with 1.8L engine.

ENGINE CONTROL MODULE CODING VARIATION OPTIONS (BEETLE)

Application/Code	Option
Transmission	
00003	Automatic
00001	Manual

ENGINE CONTROL MODULE CODING OPTIONS (GTI & JETTA)

Application/Code	Option
Country/Emissions	
06	(1) USA TLEV
07	(2) USA LEV
Drive/Additional Functions	
0	Front Wheel Drive
2	All Wheel Drive
4	All Wheel Drive Without Anti-Slip Regulation (ASR), Data Bus
5	Front Wheel Drive With Anti-Slip

	Regulation (ASR), Data Bus
6	All Wheel Drive Without Anti-Slip Regulation (ASR), Data Bus
7	All Wheel Drive With Anti-Slip Regulation (ASR), Data Bus
Transmission	
0	5-Speed Manual Transmission
1	6-Speed Manual Transmission
3	Automatic Transmission 01M
5	Automatic Transmission 09A
Vehicle Type	
1	A-Class e.g. Golf
(1) USA export model with Transitional Low Emissions Vehicle (TLEV). (2) USA export model with Low Emissions Vehicle (LEV).	

ENGINE CONTROL MODULE CODING OPTIONS (PASSAT)

Application/Code	Option
Country/Emissions	
07	(1) USA LEV
16	(2) USA ULEV
Drive/Additional Functions	
0	Front Wheel Drive Without Anti-Slip Regulation (ASR)
2	All Wheel Drive Without Anti-Slip Regulation (ASR)
5	All Wheel Drive With Anti-Slip Regulation (ASR)
7	All Wheel Drive With Anti-Slip Regulation (ASR)
Transmission	
0	5-Speed Manual Transmission
1	6-Speed Manual Transmission
5	Automatic Transmission 01V (Tiptronic)
Vehicle Type	
1	B-Class e.g. Passat
(1) USA export model with Low Emissions Vehicle (LEV). (2) USA export model with Ultra Low Emissions Vehicle (ULEV).	

Engine Control Module Coding Options (1.9L Diesel)

NOTE: This procedure relates to GTI, Jetta, and Beetle models equipped with 1.9L diesel engine.

ENGINE CONTROL MODULE CODING VARIATION OPTIONS (1.9L)

Transmission	ABS	Code
Automatic	Yes	00001
Automatic	No	00002
Manual	Yes	00002
Manual	No	00004

Engine Control Module Coding Options (2.0L)

NOTE: This procedure relates to Cabrio, Golf, GTI, Jetta, Beetle and Passat models equipped with 2.0L engine.

ENGINE CONTROL MODULE CODING VARIATION OPTIONS (2.0L)

Transmission	ABS	Air Bag	Coding
Manual			
No		No	00001
Yes		No	00011
No		Yes	00021
Yes		Yes	00031
Automatic			
No		No	00003
Yes		No	00013
No		Yes	00023
Yes		Yes	00033

Engine Control Module Coding Options (2.8L)

NOTE: This procedure relates to EuroVan, Jetta, and Passat models equipped with 2.8L engine.

For Passat 2.8L with engine code ATQ, see Fig. 7. For EuroVan 2.8L with engine code AXK, see Fig. 8. For Jetta with engine code AFP, see ENGINE CONTROL MODULE CODING VARIANTS (2.8L W/ENGINE CODE AFP)table.

ENGINE CONTROL MODULE CODING VARIANTS (2.8L W/ENGINE CODE AFP)

Application/Code	Option
Transmission	
00031	Automatic
00033	Manual

Country/Exhaust	Drive/Additional Functions	Transmission	Vehicle model
00 = ---	0 = Front-wheel drive without ASR	0 = 5-speed manual transmission	0 = ---
01 = ---	1 = ---	1 = ---	1 = Passat
02 = ---	2 = All-wheel drive without Electronic Stability Program (ESP)	2 = ---	2 = ---
03 = ---	3 = ---	3 = ---	3 = ---
04 = ---	4 = ---	4 = ---	4 = ---
05 = ---	5 = Front-wheel drive with Anti-Slip Regulation (ASR)	5 = Automatic transmission 01V	5 = ---
06 = ---	6 = ---	6 = ---	6 = ---
07 = US engines with LEV emissions limit	7 = All-wheel drive with Electronic Stability Program (ESP)	7 = ---	7 = ---

The code number is put together as shown in the following example:

Passat:				1
Automatic transmission:			5	
Front-wheel drive with ASR and databus:		5		
Emissions values per US LEV standard:	07			
Code number:	07	5	5	1

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Fig. 7: Engine Control Module Coding Variants (2.8L W/Engine Code ATQ)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

The code number is put together as shown in the following example:

1. Position	2. Position	3. Position	4. Position Suspension	5. Position Transmission
0	0	0	0 = without ESP 1 = with ESP	1 = discontinued 2 = discontinued 3 = auto. trans.
0	0	0	1	3

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Fig. 8: Engine Control Module Coding Variants (2.8L W/Engine Code AXK)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

READINESS CODE

NOTE: Throttle Valve Control Module (TVCM) (J338) adaptation is part of Readiness Code procedures. TVCM adaptation can also be performed by it self, see THROTTLE VALVE CONTROL MODULE in appropriate SELF-DIAGNOSTICS article. For further information, see SELF-DIAGNOSTIC SYSTEMS in appropriate SELF-DIAGNOSTICS article.

Description

Readiness code must be generated whenever ECM memory is cleared, ECM loses battery voltage or is replaced. Readiness code appears as an 8-digit display in diagnostic function MEASURING VALUE BLOCK 086, display field 1 of scan tool. Each of the 8 digits is related to a specific exhaust related system. During a test sequence OBD system checks function of each of the 8 systems. OBD system checks components and generates Readiness Code at regular intervals during normal driving.

NOTE: Not all eight diagnostic functions in Readiness Code are used. See Fig. 9.

Reading Readiness Code

Readiness code is returned to 0 1 1 0 1 1 0 1 if DTC memory is erased, voltage supply to ECM is lost, or a new ECM is installed. To read readiness code, connect scan tool to DLC. DLC is located left side of steering column. Turn ignition on. Follow scan tool manufacturer's instructions and read Readiness Code. See Fig. 9. Readiness code should display 0 0 0 0 0 0 0 0. If readiness code displays as specified, testing is complete. If readiness code does not display as specified, generate readiness code. See GENERATING READINESS CODE.

Generating Readiness Code

NOTE: Before generating readiness code, perform a long road test. Coolant temperature needs to be greater than 176Â° F (80Â° C). Idle, partial throttle, full throttle and overdrive, all must be attained several times. During test drive, apply full throttle until engine speed exceeds 3500 RPM. Read readiness code. OBD system checks components and generates Readiness Code at regular intervals during normal driving.

NOTE: During readiness code generating procedure, if test result is indicated as OK after selecting a display group, testing has already been carried out and it is okay to proceed to next work step.

1. To generate readiness code, vehicle must be stationary, transmission in Park or Neutral, all electrical consumers off, A/C switched off and coolant temperature at least 176Â°F (80Â°C). If possible it is best to warm-up vehicle by test driving. Connect scan tool to DLC. DLC is located at left side of steering column.
2. Using scan tool, retrieve DTCs. See RETRIEVING CODES in appropriate SELF-DIAGNOSTICS article. If DTCs are stored. Perform appropriate test and repair as necessary. See DIAGNOSTIC TROUBLE CODE IDENTIFICATION in appropriate SELF-DIAGNOSTICS article. Using scan tool, clear DTC memory. See CLEARING CODES in appropriate SELF-DIAGNOSTICS article.
3. After clearing DTC memory. Follow scan tool instructions to complete generating readiness code. During test sequence if test is successful scan tool changes display digits from 1 to 0. See Fig. 9. Readiness code should display 0 0 0 0 0 0 0 0. If readiness code displays as specified, testing is complete.

Explanation of 8-digit readiness code

Readiness code is not generated unless all indicated positions display a 0								
1	2	3	4	5	6	7	8	Diagnostic function
							0	Catalytic converter
						0		Catalytic converter heating (no diagnostic yet, always "0")
					0			EVAP canister system (tank ventilation system) and leak detection system
				0				Secondary Air Injection (AIR) system
			0					A/C system (no diagnostic yet, always "0")
		0						Oxygen sensors
	0							Oxygen sensor heating
0								EGR recirculation (not available, always "0")

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Fig. 9: Reading Readiness Code
Courtesy of VOLKSWAGEN UNITED STATES, INC.

VOLVO

ALL MODELS

Engine Control Module Programming

Replacement of Engine Control Module (ECM) or Transmission Control Module (TCM) requires reprogramming with Volvo System Tester. At time of publication, no information was available from manufacturer.

Radio Security Code

Radio will require anti-theft security code to be entered if battery is disconnected. Turn radio on. Radio should display "COdE". Using first 4 preset buttons, enter code number from customer supplied security card. Each preset button applies to code number digit. For example, No. 1 button sets the first digit of code number. Cycle button until desired number appears. A "beep" will sound when correct code is entered. If code is incorrectly entered after 3 successive attempts, radio must be left on for one hour before it will accept code entry.

Article GUID: A00148164

Back To Article

* PLEASE READ THIS FIRST *

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Failure to depressurize ABS could lead to physical injury.

- NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
- NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
- DO NOT attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
- Only use specially designed brake hoses/lines on ABS equipped vehicles.
- DO NOT tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
- DO NOT mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
- DO NOT contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
- When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
- ONLY use recommended brake fluids. DO NOT use silicone brake fluids in an ABS equipped vehicle.
- When installing transmission devices (CB's, telephones, etc.) on ABS equipped vehicles, DO NOT locate the antenna near the ABS control unit (or any control unit).
- Disconnect all on-board computers, when using electric welding equipment.
- DO NOT expose the ABS control unit to prolonged periods of high heat (185 Â°F/85Â°C for 2 hours is generally considered a maximum limit).

Article GUID: A00044069

GENERAL INFORMATION

Trouble Shooting - Basic Procedures

* PLEASE READ THIS FIRST *

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections
Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article

Alternator Light Stays Off With Ignition Switch ON	
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	
Loose drive pulley	Tighten drive pulley attaching nut
Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections

Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

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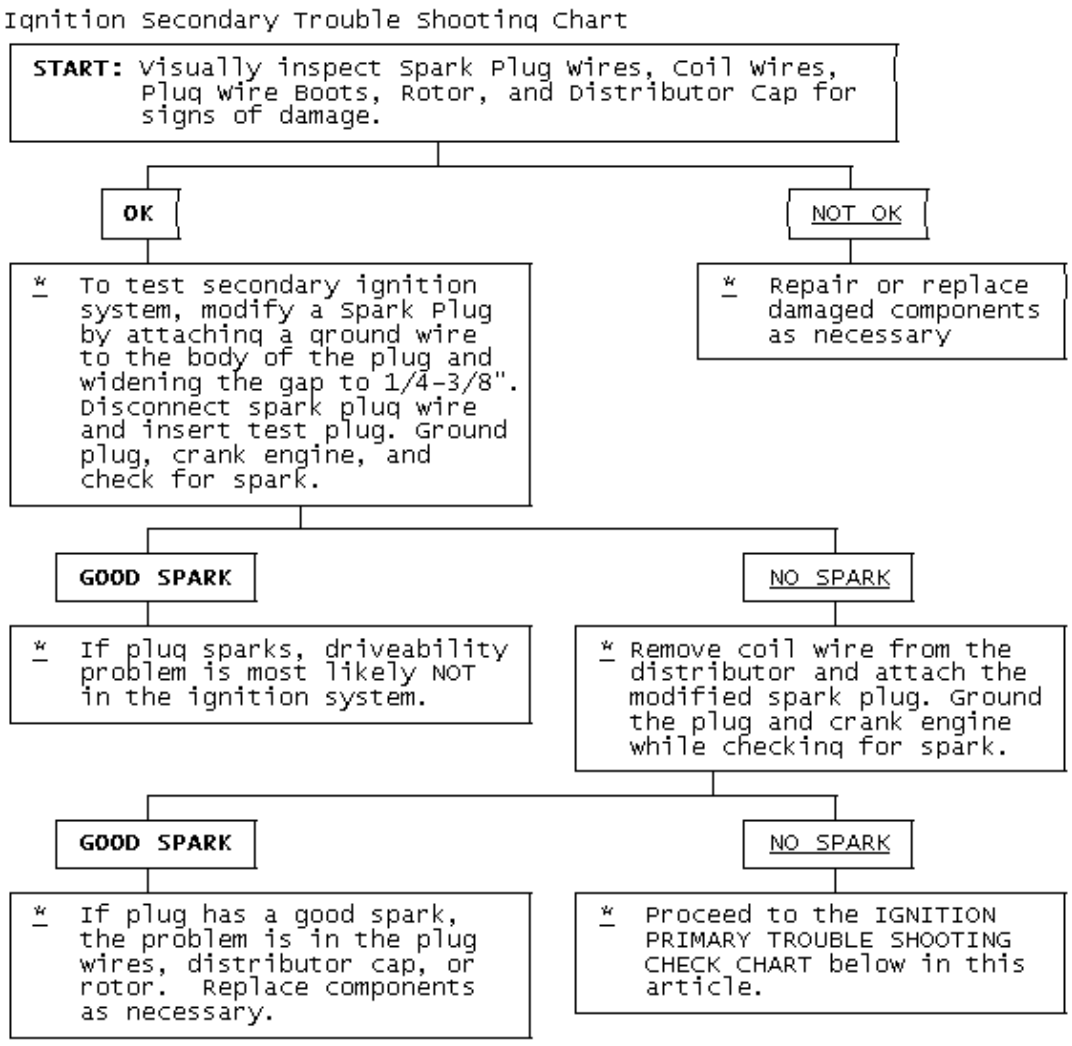

Fig. 1: Ignition Secondary Trouble Shooting Chart

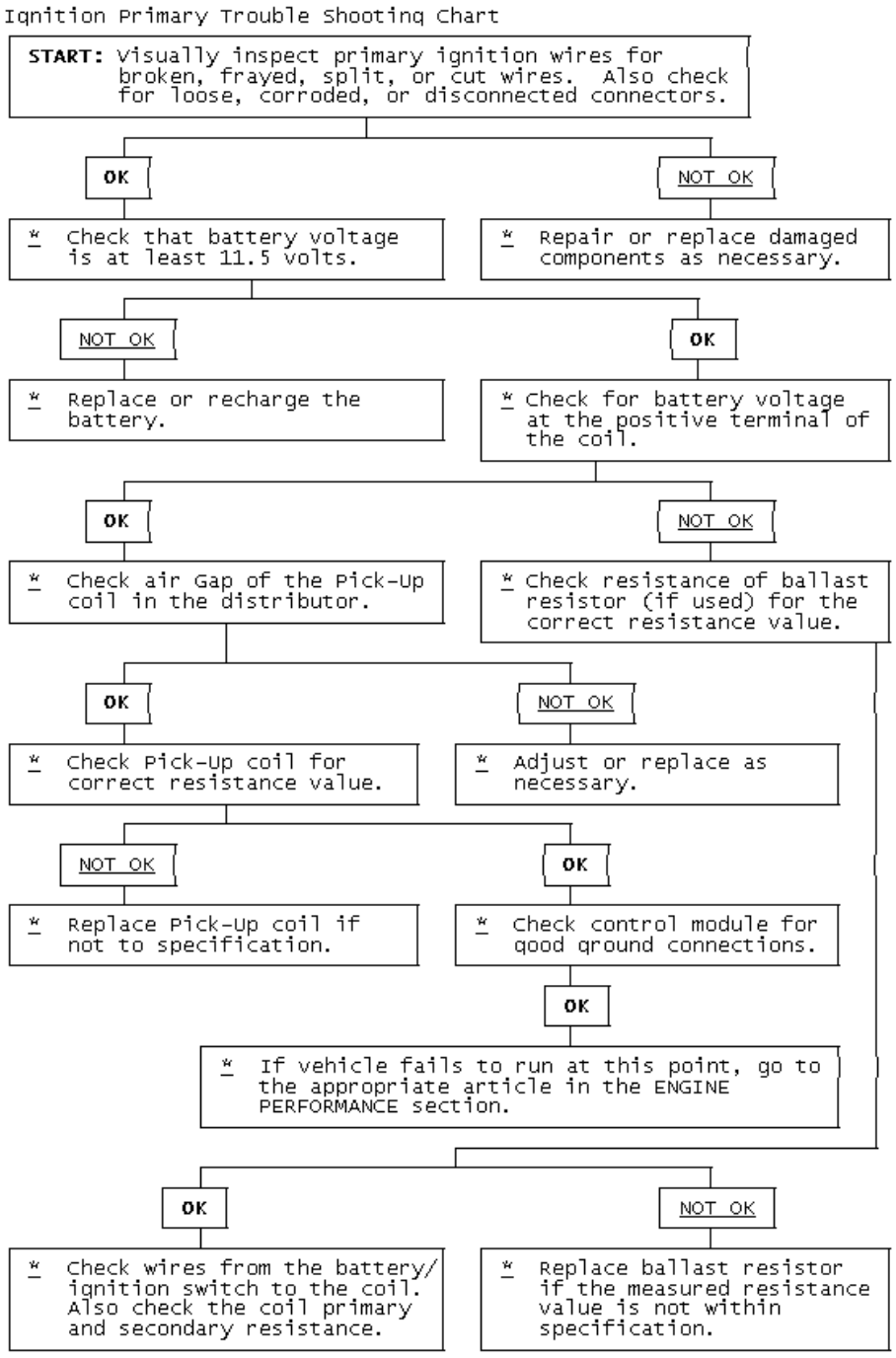

Fig. 2: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION

Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article

Engine oil too heavy	Check that proper viscosity oil is used
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
Starter Relay Operates but Solenoid Does Not	

Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

WARNING: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.

.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.
.....	Temperature above system capacity.

HEATER SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.

Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.
.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad

Excessive Pedal Effort	
Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
Excessive Pedal Travel	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
Incorrect installation of inboard disc pad	Remove and replace

	correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

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COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay
Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	
Impurities In Coolant	Clean/Flush System

Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

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BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction
Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES

Worn camshaft lobes	Replace camshaft, See ENGINES
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing,See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
Faulty Acceleration	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES
Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required

Exhaust system leak	repair exhaust system leak
Engine Detonation	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks
Excessive combustion chamber deposits	Remove built-up deposits
Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal
Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings,

	See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES
Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES
Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals

Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block
Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
Noisy Valve Train	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve

	lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES
Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
Burned,Sticking or Broken Valves	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

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BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	
Choke vacuum kick setting incorrect	Reset vacuum kick setting,see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	
Choke vacuum kick setting incorrect	Reset choke vacuum kick

Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
Sag or Stall After Warmup	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	
Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see,FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see

DIESEL ENGINE TROUBLE SHOOTING

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NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Bad starter connections or bad starter	Check connections and/or replace starter
Engine Cranks Slowly, Won't Start	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS
Glow plug control not functioning	Check controller, see FUEL SYSTEMS
Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections

Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/Idles Rough W/out Smoke or Noise	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS

Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube

Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

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BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Cranks Normally)	
Cold start valve inoperative	Test valve and circuit
Poor connection;vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit

Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor con- nections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

IGNITION SYSTEM TROUBLE SHOOTING

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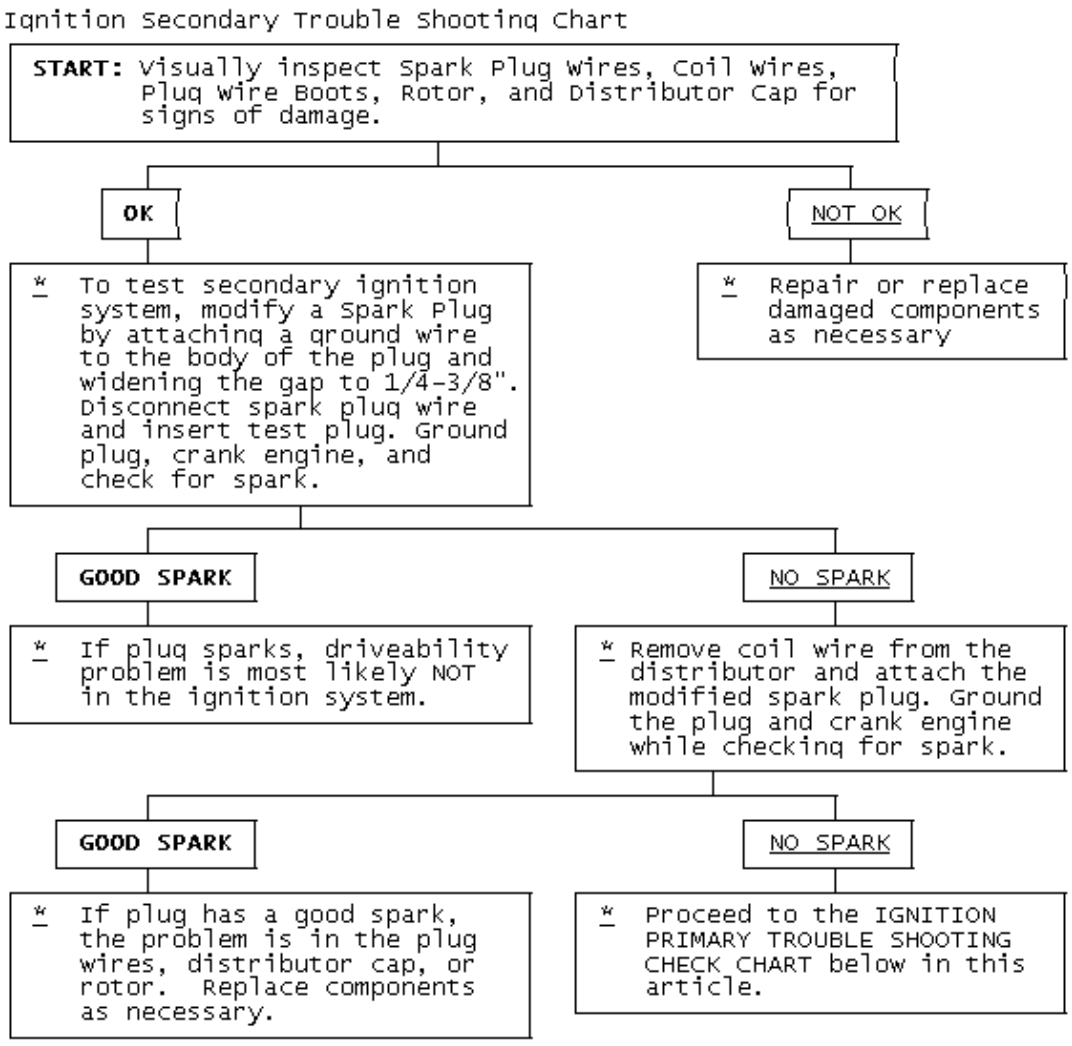

Fig. 3: Ignition Secondary Trouble Shooting Chart

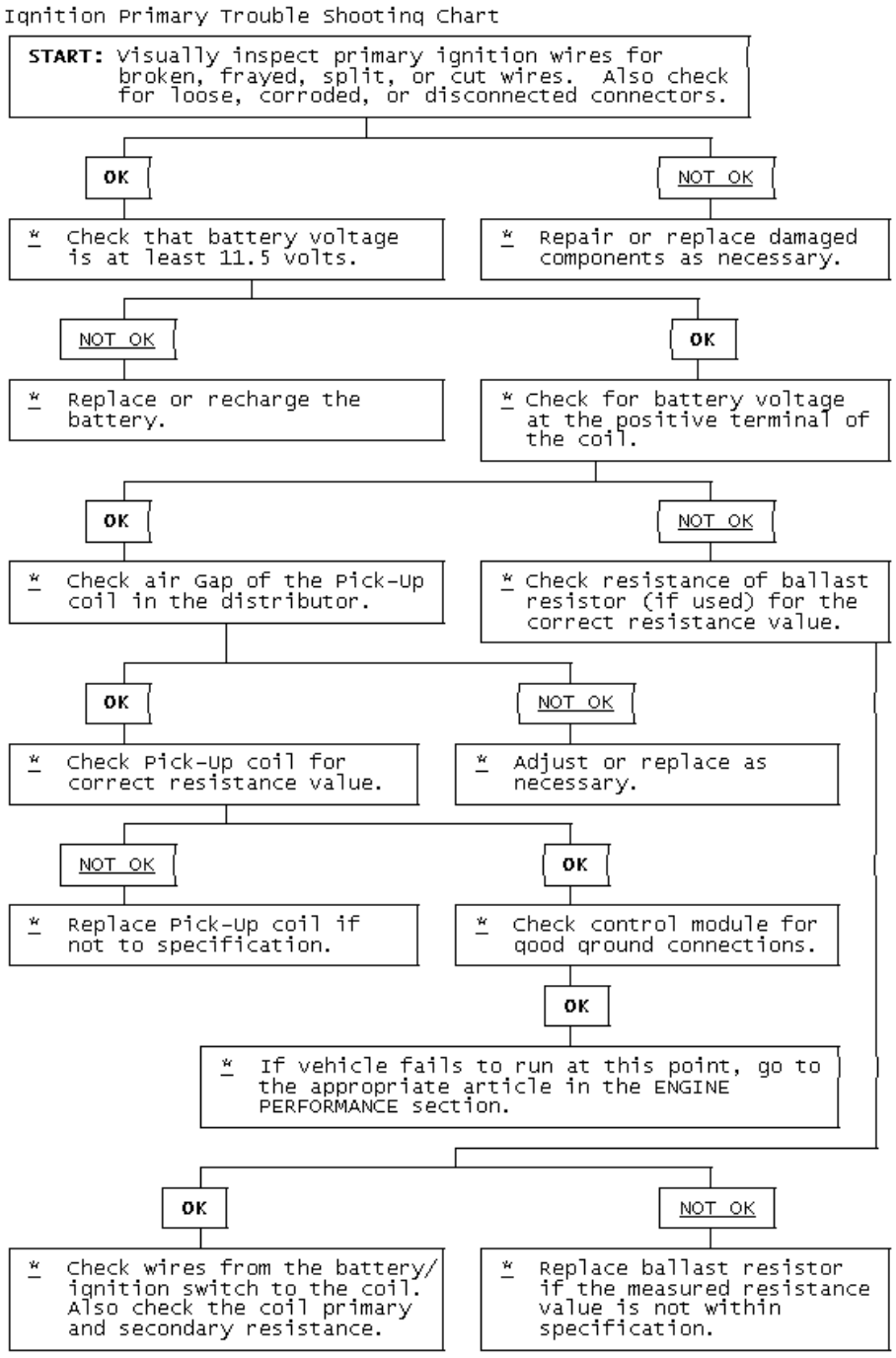

Fig. 4: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION

Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING

	SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch

Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

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BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or

	clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system
Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	

Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	
Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION & POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	
Curb idle mixture not balanced	Readjust carburetor, see

	ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs
Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Hard Starting	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan

	belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
Dieseling	
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate blinding
Binding choke linkage or fast idle cam	Eliminate binding
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean,

	see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	
Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate

	binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required
Engine Surges	
Improper PCV valve airflow	Replace PCV valve
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs

Binding carburetor power piston	Eliminate binding
Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
Engine Stalls	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

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NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

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MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize

Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition (1)
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

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BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned

	components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
Rattling	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate
Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
Slipping	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	
Worn or damaged release	Replace release bearing

Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing
Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused ive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if

they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can d into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.
- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

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DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	

Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing
Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates (1)	Replace Clutch Plates
Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange
(1) Limited slip differential only.	

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

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BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

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BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts

Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary
Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL

	ALIGNMENT article
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

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BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts
Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article

Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	
Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	
Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	
Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article

Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension
Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed to low	Adjust to correct setting

Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article
Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING

	COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

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unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Noise in Steering	
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
High Steering Shaft Effort	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	
Sheared shift tube joint	Replace as necessary
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN article
Improper gate plate adjustment	See STEERING COLUMN article

Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

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BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT
Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION

Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
Abnormal Tire Wear	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers
Frame misalignment	Check frame for damage
Spring Noises	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	
Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

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BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION

Premature Tire Wear	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
Pulls to One Side	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section
Hard Steering	
Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	

Strut rod or control arm bushing worn	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	
Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	
Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Camber Not Adjustable	
Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

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