



# BUREAU OF AUTOMOTIVE REPAIR



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## **BAR-97 EMISSION INSPECTION SYSTEM SPECIFICATIONS**

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**July 2017**

**DESIGN GUIDELINES AND PERFORMANCE CRITERIA FOR THE AUTOMATED BAR-97 ACCELERATION SIMULATION MODE (ASM) EMISSION INSPECTION SYSTEM (EIS) FOR USE IN GARAGES LICENSED TO TEST AND / OR REPAIR VEHICLES SUBJECT TO CALIFORNIA'S ENHANCED INSPECTION AND MAINTENANCE (I/M) PROGRAM.**

The Bureau of Automotive Repair (BAR) is part of the State of California, Department of Consumer Affairs and is responsible for administering the vehicle inspection and maintenance (I/M) program known as Smog Check. The bureau is also responsible for developing inspection procedures and test equipment specifications, and certifying equipment and calibration gases. BAR-74<sup>®</sup>, BAR-80<sup>®</sup>, BAR-84<sup>®</sup>, BAR-90<sup>®</sup>, BAR-90ET<sup>®</sup>, BAR-97<sup>®</sup>, BAR-97<sup>®</sup>, and ASM<sup>®</sup> are copyrighted trademarks of the bureau used to identify specifications and equipment.

## **BAR-97 ACCELERATION SIMULATION MODE (ASM) SPECIFICATION**

### **ORGANIZATION OF SPECIFICATION**

This document provides the specifications for the BAR-97 equipment and procedures to be used for performing inspections required by Sections 4000.1, 4000.2 and 4000.3 of the California Vehicle Code in accordance with the provisions contained in Division 26, Part 5, Chapter 5 (§44000 et. seq.) of the Health and Safety Code.

- Section 1      This section is an introduction, providing background about emission testing equipment, summarizing the BAR-90ET and the enhancements added to the BAR-97. System security and integrity are also included in this section.
- Section 2      This section gives the specifications, including performance standards, for all test-related hardware such as the computer, the analyzer, the dynamometer, the fuel cap tester, the low pressure fuel evaporative tester, the analyzer cabinet, and the bar code scanner.
- Section 3      This section describes in detail the software specification, including data storage; the form, manner and frequency of electronic transmission including transmission of test, calibration and vehicle records, sequences and procedures for performing required tests.
- Section 4      This section outlines the warranty requirements, certification terms, EIS in-use performance measures, and gas audit procedures.
- Section 5      This section defines the certification procedures.
- Section 6      This section describes aftermarket parts approval, warranty, and in-use performance requirements.

**SECTION 1. INTRODUCTION****1.1 BACKGROUND INFORMATION**

The Bureau of Automotive Repair (BAR) has been developing specifications and certifying analyzers since the early 70s. Each generation of analyzers has been more reliable, accurate and complex. The first analyzer specifications were published in 1974. Subsequent specifications were published in 1980, 1984, 1990, and in 1996. Analyzers meeting the appropriate specifications were granted a BAR-74<sup>®</sup>, BAR-80<sup>®</sup>, BAR-84<sup>®</sup>, BAR-90<sup>®</sup> or BAR-90ET<sup>®</sup>, BAR-97<sup>®</sup> certificate.

The BAR-74 and BAR-80 analyzers were required to measure only hydrocarbons (HC) and carbon monoxide (CO). The BAR-80 was substantially more accurate than the BAR-74 because of improvements in the design of the infrared optical bench, rudimentary self-diagnostics and an on-board calibration gas cylinder. However, it was not until the BAR-84 specifications were developed that the analyzers became computerized. BAR-84 analyzers also had to be gas-calibrated once every seven days or be prevented from further testing. Computerization also allowed the analyzer to make the pass/fail decision automatically and allowed the BAR to require a number of other features to detect analyzer tampering, alleviate some pattern-failure problems, and give special instructions to the customer regarding warranty coverage.

The BAR-90 was the first Inspection and Maintenance (I/M) emissions analyzer designed around a personal computer system. This gave the BAR the ability to greatly refine the test procedure. Special testing and preconditioning procedures were programmed to minimize pattern failures, thereby improving the correlation of the Smog Check test procedure with the federal certification test procedure. The BAR-90 Test Analyzer System (TAS) has been used to perform uniform and consistent tests for California's biennial motor vehicle I/M Program since January 1, 1990, and, as of March 6, 2002, is still used in rural change of ownership areas.

Features of the BAR-90 TAS included: (a) vehicular emission measurements of HC, CO, CO<sub>2</sub> and O<sub>2</sub>; (b) engine RPM measurements; (c) exhaust dilution determinations; (d) the capability to add a bar code scanner for more convenient and accurate data entry; (e) a dedicated printer for vehicle inspection reports and other general purpose printouts; (f) data recording on standard 1.44Mb 3.5" floppy diskettes USB Drive and on a 40-megabyte hard disk; (g) information display to the TAS operator; (h) bidirectional communications via dial-up telephone line and modem; and (i) fully menu driven, interactive, simple microprocessor-controlled operation. The TAS was designed and constructed to provide reliable and accurate service in the automotive repair and service center environment and to maximize man/machine interface simplicity.

The BAR-90 developed and certified by California has been used *de facto* for performing no-load, two-speed emissions tests not only throughout the United States, but in other nations (e.g., Canada, Germany, Mexico, Sweden, Taiwan) as well.

On March 30, 1994, urgency legislation defined California's enhanced Smog Check II program. The new program is designed to clean the air and to meet the requirements of the federal Clean Air Act while meeting the special needs of the state. Key elements of the program were outlined in the revised State Implementation Plan (SIP) submitted to the U.S. Environmental Protection Agency (USEPA) on June 30, 1995. The key elements include:

- a) Acceleration Simulation Mode (ASM) loaded-mode testing using a dynamometer at licensed Smog Check Stations in the enhanced program areas<sup>1</sup>
- b) Continued use of the BAR-90 no-load, two-speed idle test in basic areas where biennial testing is required, in change of ownership areas where testing is only required for vehicle sales or purchases, and when statewide testing heavy duty vehicles.
- c) More stringent certification standards, prerequisites and examinations for Smog Check Technicians.
- d) Targeting of high-emitting vehicles for inspection at state-contracted test-only facilities.
- e) Identification of gross polluting vehicles using results of initial emissions tests, remote sensing devices (RSDs) and a high emitter profile which is based on such factors as vehicle age make, engine size, type of emissions control system, the vehicle's individual Smog Check history, and previous RSD readings.
- f) Automatic electronic transmission of vehicle identification information for vehicles being tested, inspection data and inspection certification status from the Smog Check Stations to a central host computer system and to the Department of Motor Vehicles (DMV).
- g) Revised repair cost minimum and revised criteria for issuing emissions cost waivers; added an optional, one-time only, economic hardship extension.

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<sup>1</sup>**Enhanced Areas:** These areas do not meet federal or state air quality standards for ozone and are California's smoggiest urbanized areas. Biennial Smog Checks are required here. Thirty six percent (36%) of the vehicles in these areas must have their biennial Smog Checks performed at Test-Only stations.

**Partially Enhanced Areas:** These areas were opted into the enhanced program by the local air pollution control district/air quality management district. Although similar to the Enhanced areas, no vehicles in a Partially Enhanced area are directed to have their biennial Smog Checks performed at Test-Only stations.

**Basic areas:** Vehicles in these less-smoggy or less populated areas must have biennial testing at licensed test-and-repair stations.

**Change of Ownership areas:** These more rural areas of the state require emissions testing only when a vehicle changes ownership or is registered for the first time in California.

As a result of the 1994 amendments, software modifications were made to the BAR-90 analyzer in 1996 to incorporate mandatory program changes. A name change to BAR-90ET was also made to differentiate the old from the new. The BAR-90ET incorporates the ability to identify the vehicle being tested and verify that the vehicle is at the proper test facility, electronically transmit inspection, repair and certification data, the use of the bar code scanner, and the revised emissions and gross polluter standards. Effective July 1, 1996, the BAR-90ET is the only TAS authorized to perform required Smog Check inspections in the basic and change-of-ownership only areas and, in the enhanced areas, is authorized to perform inspections on vehicles with greater than 8,500 pounds GVWR.

The 1994 amendments also required significant modifications to the BAR-90ET for use in the enhanced program areas. Again, a name change to BAR-97 was made to differentiate the BAR-90ET from the BAR-97. Thus, *in addition to the requirements for BAR-90ET*, the BAR-97 incorporates as mandatory components an NO channel and a dynamometer capable of performing the ASM steady-state test and/or transient tests, as well as a fuel cap test and other lane features.

Recent additions resulted in a name change to BAR-97 Revised. The additions include previous requirements outlined in Addendum 1 through Addendum 8 plus several new requirements.

The 2017 version of the BAR-97 EIS Specification is updated to require that the BAR-97 EIS run on hardware and software that meet the current industry standard as determined by BAR. The current industry standard shall be considered personal computers using an operating system currently supported by Microsoft. In addition, the BAR-97 EIS shall use the standard transmission control protocol/Internet Protocol (TCP/IP) communication between the BAR-97 EIS and BAR's Vehicle Information Database (VID).

The BAR-97 EIS shall be upgradeable as necessary to meet changing requirements due to changes in technology and/or regulation.

## 1.2 COMMON TERMS

The following words may have been used interchangeably within this document:

analyzer	software
BAR-97	EIS
EIS	unit
instrument	

### 1.3 ELECTRONIC TRANSMISSION

#### 1.3.1 Electronic Transmission (ET) Overview

A required component of the enhanced program is the electronic transmission of data -- information about the vehicle under test and the test results. Electronic Transmission (ET) is the name that BAR has given to the electronic network that enables the EIS to automatically connect to the BAR's centralized Vehicle Information Database (VID) via TCP/IP. The majority of the software protocols are confidential; however, the protocols that are not confidential are provided in greater detail in §3 of this Specification.

**a) Mandatory ET Service:**

In order to comply with the ET mandate, each Smog Check station shall obtain and maintain ET services through BAR's designated ET contractor. Effective July 1, 1996, the following criteria shall be met before an EIS is used for I/M test certification: (1) the EIS shall be connected to, and shall be fully functional with the ET service and (2) the EIS shall possess, and be operational with the current software or hardware update.

**b) ET Service Description:**

At the beginning of the test, following the technician's entry of the vehicle license plate number and VIN into the EIS using a bar code scanner, the ET software (via TCP/IP) initiates an automated call (initial call) to the VID. Vehicle-specific information (previous failed test results, waiver or extension data, emissions recall information, technical service bulletins, gross polluter status, test-only requirement) and test requirements are electronically returned from the VID. Information that the technician previously filled in manually will be automatically entered into the EIS and the technician will be responsible for verifying that the information is correct. If the vehicle information does not result in a matched VID record, a second call may be necessary.

At the conclusion of the Smog Check inspection, test results, repair results (when required), and smog check certificate number for passed tests, are transmitted electronically to the VID (end-of-test call). For valid passing tests, the VID immediately transmits the certificate number to DMV. The Vehicle Inspection Report (VIR) serves as the customer's record.

Using the ET system, the BAR is also able to send electronic messages to technicians and Smog Check Station owners.

- c) **Optional ACH Debit Transaction Authorization:**  
The ET software update also enables Smog Check stations to automatically order a block of fifty Smog Check Certificates. However, this requires completion of the Automated Clearing House (ACH) Debit Transaction form and is an optional service provided by the BAR's ET contractor. Once the VID has authorized the order, the certificate numbers will be electronically transmitted to the EIS and the EIS will print out a receipt for certificate numbers received.
- d) **Optional Diagnostic and Repair Information:**  
The ET service provides immediate electronic access to diagnostic and repair information for a fee. However, these services are not a substitute for the required set of current manuals or authorized CD-ROM system, which must be maintained on the shop's premises.
- e) **Charges for ET Services:**  
Smog Check stations must maintain ET service in accordance with the terms specified by the BAR's ET contractor.

### **1.3.2 Form, Manner and Frequency of Data Transmittals for ET**

- a) Form: For each inspection, the data transmittal shall consist of the vehicle's test record, calibration record and, when required, repair record (and other records).
- b) Manner: The manner of the data transmittal shall be using the EIS via TCP/IP connection. The EIS must be maintained to ensure proper operation and shall be connected to a fully operational TCP/IP connection during all times of operation.
- c) Frequency: The data shall be transmitted for inspection and repair (when required) and shall include at least two transmissions per inspection, one for the initial call and another for the end-of-test call. If the initial contact results in no match being found, an additional transmission may be required.

### **1.4 TAMPER RESISTANCE**

Controlled access design shall be the responsibility of the manufacturer. All security measures shall be submitted for approval by the BAR. Analyzer operators, State field representatives and manufacturer's representatives shall be prevented, to the BAR's satisfaction, from creating or changing any test results, BAR programs or BAR data files contained in the EIS as called for in this specification. Manufacturers shall utilize special computer BIOS, partitions (or equivalent approved by the BAR), as well as other appropriate software and hardware provisions deemed necessary by the BAR to protect the I/M files and programs. File and program protection may consist of mechanical systems in combination with electronic/software systems. The protection features shall prevent access to the secured disk drives and portions of the hard disk containing I/M

programs and test data. The "control" key, or its functional equivalent giving access to the operating system (OS), shall not be activated except through the use of a special password and a dual entry method on the STATE MENU. The password shall be chosen by the BAR's Engineering Section at the time of certification testing. Access to the OS shall not be available to the manufacturer's service technicians. Other security or protection alternatives, such as more sophisticated BIOS limitations and LPT port key, may be proposed by the manufacturer for approval by the BAR.

In addition, the emission analyzer and the sampling system shall be made tamper-resistant to the BAR's satisfaction. At a minimum, the manufacturer shall develop tamper-resistant features to prevent unauthorized access through the cabinet. Microswitches, keyed locks, software-controlled locks, and software algorithms requiring the use of an access code shall all be utilized where appropriate. Access codes for STATE/QA functions shall be changed daily based on an algorithm provided by the BAR. Service access codes shall be changed daily based on a unique algorithm provided by the manufacturer. Both algorithms must be changed as part of any software update. Manufacturers may utilize a combination lock on the doors securing the disk drives as long as the locks are built-in, good quality and the combination can be easily changed by authorized personnel when a security problem is identified. The following examples illustrate ineffective and unacceptable security measures: A mercury switch would not be effective if the analyzer can be tipped over to one side to trigger the switch. A keyed lock would not be effective if it is placed in a position that allows the analyzer cabinet to be flexed slightly to bypass the lock. If there is a dynamometer control cabinet separate from the secured area of the analyzer cabinet, it shall be secured in a manner approved by the BAR.

The Smog Check technician shall have access to the required compact disc (CD) drive. However, access security to the BIOS, I/M related programs and data must be secured from this drive when accessed by a technician. The manufacturer shall provide security for the CD drive to prevent unauthorized read/writes (to memory, ROM, hard drive, etc.). This security shall guard against unauthorized executables that are executed from the CD. The manufacturer shall submit their method for providing this security to BAR for approval.

A software-controlled solenoid lock shall be used on the secured drive door of all EIS units submitted for certification. This solenoid lock may be used instead of, or in addition to, any key or combination lock that may be provided. The solenoid lock shall be controlled by the EIS software, unlatching the doors in response to authorized requests from the STATE MENU, always maintaining the appropriate levels of security. All BAR-97 EIS units shall have sensors, such as microswitches, to detect the open/closed state of the doors, as well as other secured areas of the EIS. The EIS shall monitor these sensors and shall define an inappropriate state as a tamper.

Manufacturers may offer analyzers with additional disk drives that can run optional software application programs. However, the optional disk drives shall be secured from

the BIOS, operating system and all other I/M related programs and test data (or equivalent acceptable to the BAR).

If tampering occurs, a software lockout algorithm shall be activated which aborts any existing test sequence and prevents further I/M testing until the lockout is cleared by a BAR field representative (or other representatives authorized by BAR such as QAs). In addition, manufacturers must describe, to the BAR's satisfaction, what security measures will be taken to prevent the unauthorized use of access codes, keys and combinations to the secured areas of the analyzer under each of the following circumstances:

- a. Tampering has occurred.
- b. A manufacturer's service technician quits or is fired.
- c. A combination, key or critical access code is obtained by an unauthorized person(s) such as a Smog Check technician.

Neither BAR field representatives (or other representatives authorized by the BAR such as contractor quality assurance personnel (QAs)) nor manufacturer's service representatives may have access to the analyzer's OS or be able to modify files on the hard disk. At no point shall technicians have access to either the OS or the BIOS.

The use of microswitches to detect unauthorized entry is acceptable. However, unauthorized access to the secured areas of the analyzer shall be detected even when the power is off. The analyzer shall record the type and location of each tamper (excluding the underhood tamper flag). The tamper attempts shall be recorded in a tamper file which includes the date of the tamper-caused lockout, the type and location of the lockout, the date the lockout was cleared and who it was cleared by (State or manufacturer's service representative). The specific tamper type and location shall only be accessible through the STATE MENU - LOCKOUT EIS function.

The lockout system shall be designed so that it can be activated by a BAR field representative from the STATE MENU. Only BAR field representatives (or other representatives authorized by BAR) may remove lockouts put in place from the STATE MENU. Manufacturers shall develop a system by which their service technicians shall be prevented, by some method approved by the BAR, from clearing BAR installed lockouts.

In particular, the following policies shall apply to the manufacturers' field representatives:

- a) They shall not be capable of
  - 1). clearing a State/QA-installed lockout, or
  - 2). clearing a lockout due to a requirement for a three-day gas calibration/leak check.

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- b) They shall not add, delete or modify the station or technician license number.
- c) They shall not be capable of altering the calibration gas values.
- d) They shall not clear a lockout when there is evidence of physical tampering. Furthermore, they shall report this, or any other type of lockout, to a BAR field office by the end of the next working day following the lockout.
- e) They shall not have access to the OS under any circumstances.

The access codes used by the manufacturer's service representatives shall be changed automatically by the EIS on a daily basis. The algorithm must not be available to manufacturer's field service personnel. The daily service access codes may only be given to authorized field service representatives and may not be provided more than one week in advance.

The tamper resistance features shall be designed so that software programs, especially those which deal with repair and diagnostics of vehicles, can be added at a later date.

Optional software packages, supplied by the manufacturer, shall not interfere with the normal operation of the I/M inspection and testing software, shall not compromise the tamper-resistance of the analyzer (such as giving the technician access to the OS) and shall be approved by the BAR before they are delivered or installed in any BAR-97 analyzers.

Access to and from all required and mandatory-option programs shall be "seamless." These programs shall be accessed from the Main Menu or a submenu, and, when exited, shall return directly to the menu or submenu from which they were accessed, without requiring the EIS to reboot.

**SECTION 2.            **HARDWARE SPECIFICATIONS******2.1        **OVERVIEW****

Section 2 discusses the hardware performance requirements (and design requirements where necessary) for the BAR-97 Emission Inspection System (EIS) needed to perform emissions testing on the vehicles subject to California's I/M program.

This section covers the computer and its peripherals, the emissions analytical train and its sample conditioning system, the dynamometer, the cabinet and its security, bar code scanning, engine speed measurement, and other equipment.

The EIS comprises a personal computer (PC), printer, TCP/IP connection, software facilitating both two-speed idle and loaded-mode testing, five-gas analyzer with sample system, zero air and calibration gases, dynamometer, dynamometer control interface, engine cooling fan, bar code reader, fuel cap tester, tachometer, OBDII interface, opacity measurement system (optional), and cabinet.

**2.1.1      **Computer/Peripheral Compatibility****

Computers must be capable of producing graphic output on monitors and printers. The computer and printer shall be capable of printing graphics and text displayed on the monitor.

Personal Computers shall use a current supported (per Microsoft's "Windows Lifecycle Fact Sheet") version of Microsoft Windows Operating System (OS). When the OS is no longer supported, the OS shall be updated to a newer version. BAR may allow continued use of an unsupported OS at its discretion.

The Windows Lifecycle Fact Sheet is available on Microsoft's website, at:  
<https://support.microsoft.com/en-us/help/13853/windows-lifecycle-fact-sheet>.

**2.2        **GENERAL REQUIREMENTS******2.2.1      **Availability of Circuitry****

All components including circuit board and integrated circuits used in the EIS shall be types and brands that are presently in common usage. Deviations may be allowed upon approval by BAR.

**2.2.2      **Clock/Calendar****

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The EIS shall have a real time clock and calendar that shall make available the current date and time. Both time and date shall be in standard PC format and used to set the computer's date and time on power up.

The EIS shall store the date and time in the *Date of Test*, *Test Start Time* and *Test End Time* fields of the test record and, when appropriate, on the repair record in the *Current Date* and *Current Time* fields.

The communication software shall reset the current EIS date/time settings each time contact is made with the VID except during communication diagnostics. The EIS clock shall be reset to the VID clock at the beginning of each test. If the VID determines that the EIS clock is not keeping correct time, the VID shall set a lockout and a message shall be displayed indicating that service is required.

Resetting the clock after a lockout shall require controlled access available only to the quality assurance contractor (QA), State Representatives and the manufacturer's service technician. The access mechanism or procedures shall be approved by the BAR.

The analyzer clock/calendar shall be equipped with a battery backup feature that has a battery with at least a five-year expectancy. All software updates shall be activated by the clock/calendar as directed by the BAR.

### **2.2.3 Data and File Transfer**

All calibration, vehicle test records and other EIS files shall be capable of being transferred from the EIS in two ways:

- a) By use of a TCP/IP connection that allows the EIS to electronically receive data from and/or transmit data to the VID whenever the EIS connects to the VID.
- b) By use of the Universal Serial Bus (USB) Drive on which data is stored.

### **2.2.4 Capability To Access OBD Fault Codes**

The EIS shall have a port to connect to the OBD II SAE Standardized Link. The link shall enable the EIS to access engine RPM and fault codes for all OBD II equipped vehicles. For certification purposes, BAR requires a description of the OBD II hardware, including its plug and play capability.

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Analyzer manufacturers shall incorporate provisions for reading fault codes from vehicles with on-board diagnostics II (OBD II). The CAN protocol is recommended. The SAE Standardized Link shall connect to the vehicle's on-board diagnostics port to automatically interrogate and retrieve fault codes. See section 3 for details.

### **2.2.5 Analyzer Compatibility**

The EIS shall be compatible with all types of automotive service operating environments. The analyzer shall operate under the conditions and performance requirements of this specification.

**2.2.6 Testing Throughput Capability**

The emissions analyzer shall be designed so that it is capable of performing at least 10 tests per hour for eight consecutive hours without experiencing excessive hangup or other deleterious effects.

**2.2.7 EIS Compatibility and Universal Software**

As stated in Section 3.2.3.a, 'If BAR initiates development of a software update, manufacturers shall cooperate with the BAR and/or BAR-approving third party.' If universal software is used, EIS manufacturers shall not make any change in hardware or software that would make the universal software ineffective. This requirement shall include manufacturer submittal of all device drivers for major components and peripherals. The BAR and /or a third party contractor will compile these drivers, communication protocols, and any algorithms, calculations, adjustments, required to facilitate EIS performance per BAR-97 Specification into a Standard Drivers List.

**2.3 COMPUTERS & PERIPHERAL REQUIREMENTS**

The computer system used by a station to control EIS operation, including the computer and peripheral devices such as monitors and printers, shall meet the following requirements:

- a) The computer, including its hardware and software, shall meet industry standards as determined by BAR. The current industry standard shall be considered PCs with hardware using a Microsoft Windows operating system. The EIS manufacturer shall update the operating system as necessary to ensure the computer's operating system is a version supported by Microsoft. The EIS manufacturer shall update the computer's hardware as necessary to function with a currently supported operating system.
- b) The computer shall be able to read and write to Universal Serial Bus (USB), CD or DVD drives within the automotive repair facility environment.
- c) The computer shall have at least two (2) unused USB ports.
- d) The computer shall have one USB Drive. The USB Drive shall be secured within the cabinet tamper protection system. The secured USB Drive shall be designated the State drive.
- e) The computer system shall be capable of communicating with the VID using a TCP/IP connection.

The computer system shall also be capable of performing the following tasks:

1. Collect, operate on, and record second-by-second readings for HC, CO,

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CO<sub>2</sub>, O<sub>2</sub>, NO, dynamometer speed and load, and engine RPM.

2. Monitor and control dynamometer functions.
3. Transmit test, calibration, and second by second (at BAR request) records to the VID.
4. Read and interpret bar code labels from DMV registration documents, technician identification cards, testing facility and technician licenses, referee labels and VIN labels, and zero and calibration gas cylinder bar code labels
5. Read data from compact discs (CDs), USB Drives and digital video disks (DVDs).
6. Provide storage for archived test and graphic files.
7. Access engine RPM on OBD II equipped vehicles and interface with OBD and OBD II scan tools.
8. Recall as well as provide vehicle inspection report (VIR) reprint capability for at least 100 emission test records.
9. Interface with an optional partial-flow opacity-measuring device, display and record to the test record.
10. Optionally provide multimedia functionality, with audio/video (AVI) capability for video presentations and teleconferencing, and internal hardware for graphic frame capture.

The BAR reserves the right to add additional programs and functional performance requirements, up to the technical limits of the hardware, to improve the Smog Check program.

Manufacturers may offer analyzers with additional drives that can run optional software/hardware application programs; however, the computer shall not be bootable from any additional drive, nor shall any program run from one of these drives have access to the computer's operating system. Programs run from an additional drive shall not be

capable of interfering with, modifying, corrupting or interrupting any inspection-related program, procedure, or file.

### 2.3.1 I/O Ports

The EIS unit must include two baud rate programmable (300 to 115.2K or more) I/O serial ports using BAR CPC female connectors with the following pin outs. One of these ports is for use with an external fuel cap tester (unless the fuel cap test system is provided internally). A second CPC port shall be reserved for a future liquid fuel evaporation tester. Systems may only have 1 external CPC ports if the gas cap tester is internal.

The EIS shall include two USB ports for future communication with BAR approved devices. If only one port is available, its expandability into two ports (hub) shall be demonstrated functional. These ports shall be fully installed including all necessary wiring and connections. Ports may be software disabled, but shall not require additional hardware to become active.

All BAR-reserved serial ports (BAR CPC and DB25) shall use 16550 UART chips or better. All I/O ports shall be clearly labeled and easily accessible and may be shared. All BAR CPC pinouts shall be as follows:

#### **ANALYZER BAR CPC REVERSE CONNECTOR**

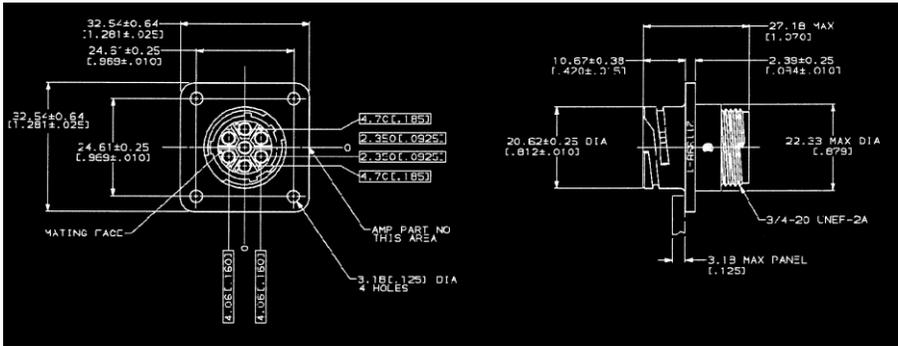
This connector must be compatible with an AMP 211398-1.

<b><u>PINS</u></b>	<b><u>SIGNAL</u></b>
1	GND
2	+12v
3	RTS.....RESET (request to send)
4	RESERVED (open)
5	SHIELD - GND
6	TXD.....TRANSMIT DATA
7	RCV.....RECEIVE DATA

The BAR CPC ports will supply software switchable 12 VDC to equipment attached. The +12V pin must provide circuit protection from shorts, or overload. The circuit protection can be in the form of a fuse, circuit breaker, etc. The circuit protection must be easily accessible to the operating technician for fuse replacement and or circuit breaker reset (unless automatic reset). The circuit must be capable of handling at least 6 watts.

CPC CONNECTOR DIAGRAM

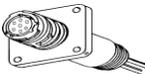
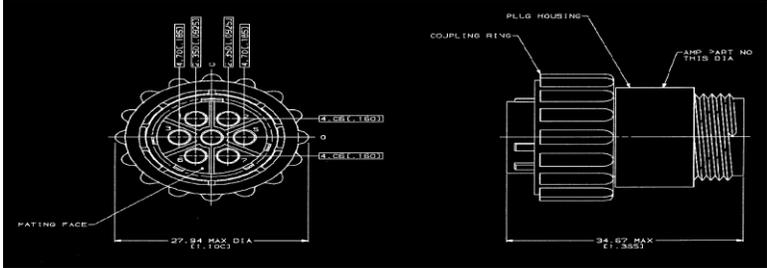
Square



Flange

Receptacle

Example of Flanged Receptacle



Example Plug Assembly

### 2.3.2 Keyboard and Pointing Device

The EIS keyboard shall be fully interfaced with the computer and have all of the necessary normal, numeric, cursor, control, shift, alternate, and function keys needed to operate an industry standard and currently available PC-compatible computer. A full-sized keyboard with at least 101 keys should be provided. The keyboard shall be readily available through retail outlets. The keyboard shall be removable and replaceable without requiring access to a secured area within the EIS cabinet. The PC and keyboard must use a standard connector or wireless connection.

The EIS shall permit the use of a pointing device, such as a computer mouse. BAR may approve other pointing devices, such as light pens. If the pointing device requires use of a USB port, such USB port shall not be considered as one of the two USB ports that shall remain unused. The device driver must be active and compatible with a mouse or other pointing device. The pointing device must have a sensitivity adjustment available to the technician.

The keyboard and the pointing device shall be capable of being replaced without opening the cabinet.

### 2.3.3 Optional Diagnostic Assistance

This function shall be offered as an option. When analyzers are submitted to the BAR for certification, this option shall be demonstrated.

Compatibility with H.324 (from International Telecommunications Union's Telecommunication Standardization Sector - ITU-T) and T120 (white boarding) is required. One multifunction device or multiple devices (video capture board, audio board, modem, etc.) may provide this. The EIS must demonstrate ability to perform all functions.

#### a) Video

All video components listed in this section shall be capable of meeting the following requirements.

1. Capture images in 65536 colors, at a resolution of 800 x 600 pixels, at a minimum rate of one frame per second and saving the frames to the hard drive in TIFF-LZW format. For certification, one 30 second segment of moving video and 10 still frames.
2. Receive full motion audio/video files and play them when triggered by time, manually or upon request via modem. These files shall be in a format that will run under Microsoft.

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3. Capture still images and provide moving video for teleconferencing. The video teleconferencing system must be capable of displaying at least 10 frames per second, color, at a minimum of 160 x 112-pixel resolution.

Alternative standards may be submitted to BAR for approval.

Two BNC video connectors shall provide the capability of connecting two cameras. The connectors shall be externally accessible.

4. Display DVD video from the DVD drive.

**b) Audio**

A speaker is required on this optional system to provide the ability to play AVI files. This speaker shall also have the capability of providing audio for video teleconferencing or diagnostic assistance.

An external speaker connector is required to provide the ability to connect an external speaker or speakers to this audio system. An industry-standard speaker connector shall be used for the external connector and shall be easily accessible.

If equipped with a handset or headset and internal and/or external speakers, they shall be switchable on and off and shall have volume controls easily accessible to the technician.

An internal microphone may be provided at the manufacturer's discretion. The external microphone connector shall be a common type used for microphones. The audio system shall be capable of H.324 telecommunication. The microphone and handset/headset are not required at this time; however, the connectors and the functionality of the audio system with these components are required and must be demonstrated.

### 2.3.4 Printer

The EIS unit shall use a printer capable of printing: at least 4 pages of text per minute, on 8.5" x 11" paper, at 96 characters per line, and 6 lines per inch. This printer will be used to print inspection reports and diagnostic information. The printer must print high-quality graphics at 600dpi or better. Text must be at 300dpi or better. If not continuous feed, the printer must be capable of printing on 8.5" x 14" paper. Printers must have enough memory to print twelve 176 x 144 resolution (1.5" x 1.25") graphic images (pixels) in 64 shades of gray with the remainder of the 8.5" x 14" page filled with text. Page printers (printers that process total pages in memory before printing them) must be expandable to 4Mb of memory. Vehicle inspection reports (VIR) shall be printed for passing and failing vehicle inspections and as duplicates for a passing/failing inspection.

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The printer shall print a VIR duplicating the font and clarity provided in the example VIRs. This is intended to ensure uniformity between manufacturers for style and size.

The printers shall be easily accessible to allow the clearing of paper jams, replacement of paper, ink cartridges, toner, etc. The printer shall be replaceable by the customer with the same make and model.

### 2.3.5 Running Changes and Other Hardware Modifications

Any changes to design characteristics, component specifications and any modifications to the hardware must be approved by BAR. **(NOTE: If software is an integral part of any component, such as the analyzer optical bench, it shall also be subject to the requirements of this section.)** It will be the instrument manufacturer's responsibility to confirm that such changes have no detrimental effect on analyzer performance.

- a) Only BAR-approved hardware configurations and options may be used in BAR-97 analyzers.
- b) All proposed hardware modifications and options must be thoroughly tested before being submitted to BAR.
- c) ALL proposed hardware modifications, including manufacturer-initiated modifications, must be submitted to BAR for testing and approval as follows:
  1. Submit a modified BAR-97 analyzer to BAR Engineering or arrange to update the Engineering test unit.
  2. An application and cover letter containing the following information shall accompany all proposed hardware modifications:
    - i. A description of all of the proposed modifications to be performed (including manufacturer-initiated modifications), a parts list and the installation instructions for the field service representative. Any modifications to the bench or sample system shall also be accompanied with test data and an engineering evaluation regarding the effects of the proposed modifications on the performance and reliability of the analyzer.
    - ii. A timeline showing when the modifications are expected to be performed (start to finish), and how many existing units will be updated.

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- iii. If any special procedures are needed to perform the hardware modifications, describe the procedures for performing the update.
  - iv. If the proposed hardware modifications require changes or additions to the software, documentation for the software update shall be submitted as indicated above.
  - v. Test data showing the EIS meets specification with the modification(s) implemented.
3. Beta Testing- Depending on the type and number of modifications proposed, the bureau may require testing at BAR-approved beta test sites prior to release. The BAR will perform verification tests prior to releasing it for beta testing. See Section 5.12 of this specification for beta testing details.

### **2.4 EXHAUST GAS ANALYSIS EQUIPMENT FOR THE EIS**

This section defines the requirements for the equipment needed to determine the concentrations of the exhaust gases of interest during the **BAR-97** loaded-mode and two-speed idle tests. It covers the analyzers/sensors and sampling systems, including sampling probes, hoses, and filters.

#### **2.4.1 General**

The analyzer shall be compatible with all types of automotive service operating environments. The analyzer shall operate under the conditions and performance requirements listed below.

#### **2.4.2 Measured Gases**

Gases to be measured are hydrocarbons (HC), in parts per million as hexane (ppmh); carbon monoxide (CO), in percent; carbon dioxide (CO<sub>2</sub>), in percent; oxygen (O<sub>2</sub>), in percent; nitric oxide (NO), in ppm. Opacity of diesel exhaust shall be offered as an option.

#### **2.4.3 Types of Analyzers**

HC, CO, and CO<sub>2</sub> shall be measured by means of nondispersive infrared (NDIR) analysis. NO shall be measured by means of nondispersive ultraviolet (NDUV), nondispersive infrared (NDIR), chemiluminescent device (CLD), or other device meeting requirements in this specification. The EIS manufacturer and the device

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manufacturer shall cooperate in the development of a satisfactory communication protocol. These protocols shall be shared upon manufacturer and / or BAR request, to allow device interchangeability through standardized communication. All NO-measuring devices, regardless of technology, must have EIS-manufacturer-generated test data showing that they meet the applicable requirements of this specification.

#### 2.4.4 Sampling Systems (excluding Opacity)

Sampling systems shall draw exhaust gas from the vehicle under test, shall remove particulate matter and aerosols from the sampled gas, shall drain the condensed water from the sample if necessary, and shall deliver the resultant gas sample to the analyzers/sensors for analysis. The sampling system shall, at a minimum, consist of a tailpipe probe, flexible sample line, a continuously draining water removal system, particulate trap, sample pump and flow control components. The sample system and its components shall be designed to conduct loaded mode testing. This may include the need for active water removal from the sample, e.g., installation of a chiller. Provisions shall be made for the introduction of zero air and calibration gases, as discussed below.

#### 2.4.5 Analyzer Requirements

- a) **Automatic Zero:** The analyzer shall conduct an automatic zero adjustment (or equivalent, with BAR approval), prior to each test. The zero adjustment shall include the HC, CO, CO<sub>2</sub> and NO channels. The O<sub>2</sub> channel shall have its span adjusted while the other channels are being zeroed. The analyzer shall perform two steps while zeroing:
1. **Zero Air:** The analyzer shall be zeroed, and the O<sub>2</sub> sensor spanned, using either bottled or generated zero air. See 'c.3.i for zero air requirements.
  2. **Ambient Air:** Ambient air, filtered for particulates, shall be introduced to the analyzer before the sample pump, but after the sample probe, hose and filter/water trap. The analyzer shall record the concentrations of the five measured gases, but shall make no adjustments.

When the analyzer performs a HC hangup check before the start of an inspection, the recorded ambient air readings shall be subtracted from the sampling readings to determine the amount of HC hangup (residual HC) in the sampling system.

The analyzer shall be locked out from testing until (a) the ambient air has less than 15 ppm HC, 0.02% CO and 25 ppm NO, and (b) until the residual HC obtained through the sample probe is less than 7 ppm.

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- b) ***Zero Drift Lockout Threshold:*** If zero and/or span drift cause the infrared signal levels to move beyond the adjustment range of the analyzer, the operator shall be locked out from testing and instructed to call for service. (The analyzer manufacturer shall indicate, in writing, at what point the drift lockout will occur.)
- c) ***Calibration and Leak Check:*** The analyzer shall, to the maximum extent possible, maintain accuracy between gas calibrations taking into account all errors including noise, repeatability, drift, linearity, temperature and barometric pressure.

1. **General:** The analyzer shall automatically require and successfully pass a-USB Drive check, leak check and a gas calibration for HC, CO, CO<sub>2</sub>, O<sub>2</sub> and NO using a method that is approved by the BAR. This must be performed at least every three days or the analyzer shall lock itself out from further I/M tests. The gas calibration shall ensure that accuracy specifications are satisfied or the analyzer shall be automatically prohibited from performing any portion of the I/M test. The gas calibration procedure shall correct the readings to the center of the allowable tolerance range, and shall be within +/- 1.0% of the calibration gas cylinder's label values. When a gas calibration is initiated, the analyzer channels shall actually be adjusted. It is not sufficient to merely check the calibration and do nothing if the analyzer is within allowable tolerances.

The EIS manufacturer shall ensure that the flow rates and fluid pressures through the analyzer benches and sensors stay the same, regardless of whether the source of the flow is the calibration ports or the sample probe. This principle of balanced flow and pressure shall be maintained whether EIS units are equipped with a NO sensor or not. The balance shall be such that low range calibration gas readings, taken on a freshly-calibrated EIS, are within +/-1% or 1 least significant digit of each other when the gas is fed through the calibration port, and then through the sample probe.

2. **Gas Calibration Procedure:** Gas calibration shall be accomplished by introducing gases traceable to the National Institute of Standards and Technology (NIST) into the analyzer either through the calibration port or through the probe. The EIS manufacturers, together with their analyzer / sensor supplier, shall determine which of the following two calibration methods will provide the better and more consistent accuracy for the analyzer / sensor as installed in the EIS.

Single Point - High range calibration gas shall be introduced first, and the analyzer output shall be adjusted to the center of the tolerance range. Low

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range calibration gas shall then be introduced and the analyzer output automatically checked (not adjusted) to verify that it is within the allowable reading tolerances.

Two-Point - Low range calibration gas shall be introduced first, and the analyzer output shall be adjusted to the center of the tolerance range. High range calibration gas shall then be introduced, and the analyzer output shall be adjusted to the center of the tolerance range.

3. Calibration Gases: Calibration span gases and zero air utilized for calibration shall have a  $\pm 2\%$  blend tolerance and a  $\pm 1\%$  certified accuracy, and shall be provided by a BAR-certified gas blender. No more than 2 liters of each gas shall be required to successfully perform a gas calibration; exceptions shall be subject to BAR approval.

The analyzer shall be designed, in a manner approved by the BAR, to accommodate the gas cylinders, air generators and other hardware necessary to perform the three-day gas calibration. Other configurations may be submitted for BAR's consideration. Note that if air generators are used to provide zero air, the resulting oxygen content shall be  $\pm 3\%$  of the nominal value. The analyzer shall be equipped with a gas calibration port. Gas cylinder mounting shall provide adequate room for routine access, servicing and replacement of cylinders, regulators, etc., as well as scanning the cylinder bar code labels. Brackets and other hardware shall be located so that analyzer stability and impact protection are considered in the design. The gas cylinder storage area shall be actively ventilated to prevent gas buildup in case of leakage.

The analyzer manufacturers shall design the connectors used with the gas cylinders so those cylinders containing different concentrations or compositions of gas cannot be switched. As an alternative, manufacturers may use the same connectors on all required cylinders if they display a message instructing the operator to properly connect the hoses to the gas calibration cylinders when they are not connected correctly. In addition for this alternative, some type of reasonably permanent, prominent label or tag shall be used to readily identify which hose should be attached to which cylinder. Other alternatives may be presented to the bureau for consideration. In any event, disposable cylinders shall be equipped with CGA 165 connectors. Jumbo disposable cylinders (zero air only) shall be equipped with CGA 182 connectors. High-pressure cylinders (zero air only) shall be equipped with CGA 590 connectors.

The following calibration gases shall be used:

- i. Zero Air (blend code #37):  
Concentrations: 20.9% O<sub>2</sub>, balance N<sub>2</sub>.  
Impurities: <1 ppm THC, CO, NO; <200 ppm CO<sub>2</sub>.
- ii. Low Range (blend code #32 / without NO #31):

200 ppm	propane
0.50%	carbon monoxide
6.0%	carbon dioxide
300 ppm	nitric oxide <3 ppm NO <sub>2</sub>
Balance:	oxygen-free nitrogen
- iii. High Range (blend code #35 / without NO #34):

3200 ppm	propane
8.00%	carbon monoxide
12.0%	carbon dioxide
3000 ppm	nitric oxide <30 ppm NO <sub>2</sub>
Balance:	oxygen-free nitrogen

BAR-97 EIS units that are not equipped with NO-measurement capability may use tri-blend calibration gases: i.e., gas blends that contain propane, CO, and CO<sub>2</sub> in concentrations as above, but containing no nitric oxide.

- 4. Zero Air Supply Cylinders & Generators: Zero air may be supplied to the analyzer from either: low-pressure (disposable) cylinders, high-pressure (refillable) cylinders, or zero air generators. Specifications for the cylinders may be found in the gas blender specification.<sup>1</sup> If the EIS manufacturer opts to use a zero air generator (ZAG), it shall meet the following minimum requirements.
  - i. Output Air Purity: Generator output air shall meet the purity requirements of c) 3. i., above, when provided with inlet air containing no more than 100 ppm total hydrocarbons as methane, 100 ppm CO, 1,500 ppm CO<sub>2</sub>, and 50 ppm NO<sub>x</sub>.
  - ii. Output Dewpoint: # -40F (# -40°C)

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<sup>1</sup>Specifications and Certification Procedures for Calibration and Audit Gases Used in the California Emissions I/M Program, January 2012.

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- iii. Output Particulates: Filtration shall be 99.99% effective at 0.5 micron.
- iv. Operating Temperature Range: +35°F to +110°F (2°C to 43°C)
- v. Warm up Time: The zero air generator shall be capable of providing a stabilized supply of air meeting the output purity and dewpoint requirements listed above in less than 30 minutes. During the warm up process, outlet flow from the zero air generator shall be prevented. In addition, the ZAG shall provide some indication to the operator that it is warming up. The indication might be a lamp or lamp combination on the face of a ZAG that is external to the EIS, or an electrical or electronic signal to the EIS if the ZAG is internal to the EIS. At the completion of a successful warm up, a System Ready indication shall be activated, and outlet airflow permitted.
- vi. Inlet Air: The ZAG shall accept and purify compressed (“shop”) air. The ZAG shall meet the performance requirements of this specification with inlet air pressures ranging from 80 psig to 120 psig as a minimum. If the inlet air pressure falls below the minimum level for proper operation of the ZAG, an indication shall be given and the outlet air flow shut off.
- vii. NO<sub>x</sub> removal: shall be accomplished at a stage in the purification sequence that will minimize the formation of nitric acid, which could corrode the metal and plastic parts. If scrubbing is used, the scrubber shall have a minimum life of one year when challenged with 50 ppm NO<sub>x</sub>. As an option, the ZAG may be supplied with an elapsed time indication to alert the operator that service is necessary.
- viii. HC & CO Removal: HC and CO shall be removed from the air stream by catalytic action. The catalyst shall have a minimum life span of three years. As an option, the ZAG may be supplied with an elapsed time indication to alert the operator that service is necessary. If, at any time, the catalyst temperature falls below that required for HC and CO removal, outlet flow shall be shut off and an indication given. If the temperature should subsequently rise above its minimum operating temperature, e.g., after a power outage, the indication shall automatically be removed and outlet flow resumed.

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- ix. CO<sub>2</sub> Removal: CO<sub>2</sub> shall be the last component removed. Removal shall be by means of pressure swing absorption (PSA) technology. If the PSA valve fails, the ZAG's outlet flow shall be shut off and an indication given.
- x. Pressure Regulator: A pressure regulator inside the ZAG shall provide a fixed outlet pressure specified by the EIS manufacturer.
- xi. Alternative Configurations: Alternative configurations and removal technologies may be presented to the BAR for consideration.
- xii. Power Spikes: Externally mounted ZAGs shall have a "Power On" lamp. Power spikes shall not affect the operation of the ZAG.
- xiii. Mounting: The air generator may be mounted either internally or externally to the EIS cabinet; however, the configuration (1) shall comply with all applicable electrical and safety codes, (2) shall meet applicable Underwriters Laboratories requirements (or BAR-approved equivalent), and (3) shall not cause the response time requirements of '2.4.5. r) and 2.4.6 g) to be exceeded. In any event, the separation between an externally mounted zero air generator and the EIS cabinet shall not exceed 25 feet.
- xiv. Connecting Hose: As a minimum, the hose connecting an externally mounted zero air generator and the EIS cabinet shall meet the analyzer sample hose requirements specified in section 2.4.6.b, shall be capable of withstanding a minimum of 200 psig internal pressure, and shall out gas no more than 10 ppm hydrocarbons between 35F and 110F. Acceptable materials include the following types of new and clean hose or tubing: copper, stainless steel, nylon or nylon core (type 11 / r78), PTFE/FEP (teflon), superthane or polyurethane (polyether based only), synflex 4262.
- xv. Bar Code Labels: Zero air generators mounted outside the EIS cabinet shall have their bar code labels positioned on an external surface of the generator so that the labels may be conveniently scanned. Zero air generators mounted inside the EIS cabinet shall have their bar code labels mounted on the generator surface that can be scanned if the cabinet is opened. The EIS

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manufacturer shall mount additional labels (identical to those mounted on the generator) on a surface of the EIS cabinet, so that they may be conveniently scanned by the Smog Check technician.

5. High Pressure Zero Air Cylinder Mounting: Low pressure disposable cylinders may be located in or outside the cabinet. Disposable cylinders located outside the cabinet shall be secured with a bracket. High pressure aluminum cylinders shall be attached to a fixed object (wall, pole, etc.) or if not available may be secured to the EIS cabinet, in such a manner as to protect the cylinder's valve and pressure regulator from accidental impact.
6. Cylinder Pressure Regulators
  - i. Pressure regulators shall conform to the requirements of CGA Standard E-4, 3rd Edition (1994) or later.
  - ii. Rated pressure of the regulator shall be equal to or greater than the rated pressure of the cylinder on which it is to be used, corrected to 50°C (122°F). For example, a regulator to be used with a low-pressure disposable cylinder whose fill pressure is 260 psig at 20°C (68°F) must have a rated pressure of  $[(260 + 15) \times (50 + 273) / (20 + 273)] - 15 = 288$  psig, or the next highest standard rating, as a minimum, where 15 as an adder converts psig to psia, and 273 as an adder converts degrees Celsius to degrees Kelvin.
  - iii. Pressure gauges used with the regulators shall conform to all requirements of CGA Standard E-4, (see §5.7).
  - iv. Pressure gauge accuracy shall meet or exceed the requirements of CGA Standard E-4, (see §5.7.3.1).
  - v. Droop/Rise Characteristics: The change in regulator output pressure with decrease in cylinder pressure shall not cause a calibration error of more than  $\pm 1\%$  (see §5.4.15). To meet this requirement, EIS manufacturers may use more than one regulator in series, if necessary.
7. Other Requirements: The gas calibration and leak check procedures shall require no more than five minutes. The analyzer shall provide adequate prompts on the display to guide the Smog Check technician through the

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calibration procedure in a manner that minimizes the amount of gas used. The analyzer shall be designed to keep the loss of calibration gas to an absolute minimum (less than 0.1 liter in 24 hours) if the operator forgets to shut the valve off.

8. Alternate Calibration Frequencies: Proposals for less frequent gas calibrations will be subjected to lengthy accuracy and drift tests. Proposals of this type shall be thoroughly evaluated (e.g., lab as well as field testing in the range of the required span points for accuracy and drift for extended periods of time) and characterized prior to submission to BAR.
- d) **Propane Equivalency Factor (PEF):** The nominal PEF range shall be between 0.490 and 0.540. For each audit/calibration point, the nominal PEF shall be conveniently displayed for the quality assurance inspectors and the BAR field representatives, in a manner acceptable to the BAR. If an optical bench must be replaced in the field, the manufacturer's Field Service Representative (FSR) shall change any external labels to correspond to the nominal PEF of the new bench. The analyzer shall incorporate an algorithm relating PEF to HC concentration. Corrections shall be made automatically. The corrected PEF value may cover the range of 0.470 to 0.560.
- e) **NDIR/UV Beam Strength:** The beam strength from the source to the detector for all channels shall be monitored such that when the beam degrades beyond the adjustment range of the analyzer, the analyzer shall be locked out from operation. The manufacturer shall specify at what point degradation occurs whereby the signal cannot be corrected.
- f) **Date of Last Gas Calibration:** The date of the last gas calibration shall be kept in non-volatile memory (or on the hard disk) and shall be displayed on the status page. When the system check is adjusted, if the date/time change, positive or negative, is greater than 48 hours, three-day gas calibration/leak check shall be required.
- g) **Lockout Criteria:** If the EIS has not successfully passed a gas calibration and a leak check for a period of three days or more, it shall lock itself out from performing an official I/M test and shall display a message to the operator upon startup.
- h) **Audit Gas Pressure:** During a gas audit, analyzer readings shall not change by more than 1% of the reading if the audit gas pressure is modified by  $\pm 1.5$  PSI from the atmospheric absolute pressure at the probe.

i) ***Audit Gas Blends and Gas Audit Procedure:***

There shall be four audit gas blends: Low Range, Mid Range #1, Mid Range #2, and High Range. Their concentrations, with  $\pm 2\%$  blend tolerance and  $\pm 1\%$  certified accuracy, shall be as follows:

- i. *Zero Air*  
Same as zero air calibration gas, except that CO<sub>2</sub> impurity level shall be <1 ppm
- ii. *Low Range*  
Same as Low Range calibration gas
- iii. *Mid Range #1*  
960 ppm propane  
2.40% carbon monoxide  
3.6% carbon dioxide  
900 ppm nitric oxide  
Balance: oxygen-free nitrogen
- iv. *Mid Range #2*  
1920 ppm propane  
4.80% carbon monoxide  
7.2% carbon dioxide  
1800 ppm nitric oxide  
Balance: oxygen-free nitrogen
- v. *High Range*  
Same as High Range calibration gas

**NOTE: BAR reserves the right to audit analyzer accuracy using gas blends having component concentrations other than those listed above.**

The audit procedure shall be as follows (see BAR's 'Gas Audit Protocol' for detailed procedure)

1. Zero the analyzer.
2. Perform a leak check.
3. Enter the State/QA Audit mode or the corresponding field service mode.
4. Flow the Low Range audit gas through the sample probe, ensuring that the pressure at the probe tip is equal to ambient barometric pressure  $\pm 0.1$  in. Hg. (A balloon teed into the gas flow line is an acceptable pressure indicator. It should stand upright, but not inflated.)

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5. When the HC, CO, CO<sub>2</sub> and NO readings have stabilized (no less than 60 seconds of gas flow), record them, as well as the PEF value at each audit blend. **(NOTE: The Gas Audit Mode shall present the HC readings in terms of ppm propane, or shall offer the choice of reading in terms of ppm hexane or ppm propane. The auditor shall select and record readings in terms of ppm propane.)**
6. Repeat Steps 4 & 5 for Mid Range #1, Mid Range #2 and High Range audit gases. This sequence of gases must be strictly followed.
7. Repeat Steps 4 and 5 using zero air, and record the stabilized O<sub>2</sub> reading.
8. Compare the readings with the audit gas values. The following relationship shall be used:

$$A\% = 100 \times \frac{(\text{Reading} - \text{Cylinder Value})}{(\text{Cylinder Value})}$$

Where A = ±4.0% or ±12 ppmp (parts per million as propane) HC, whichever is greater,

± 4.0% or ±0.04% CO, whichever is greater

± 4.0% or ±0.4% CO<sub>2</sub>, whichever is greater

± 5.0% or ± 27ppm NO, whichever is greater

± 5.5% or ± 0.3% O<sub>2</sub>, whichever is greater

*j) Range and Accuracy:***Emissions Analyzer Range and Accuracy**

Gas	Range	Accuracy (% of point)	Accuracy (absolute)	Range	Accuracy (% of point)	Accuracy (absolute)
HC	0-2000 ppmh	±3%	4 ppmh	2001- 5000 ppmh >5000 ppmh	±5% ±10%	N/A N/A
CO	0 - 10.00%	±3%	0.02% CO	10.01-14.00%	±5%	N/A
CO <sub>2</sub>	0 - 16%	±3%	0.3% CO <sub>2</sub>	16.1 - 18%	±5%	N/A
NO	0 - 4000 ppm	±4%	25 ppm	4001-5000 ppm	±8%	N/A
O <sub>2</sub>	0 - 25%	±5%	0.1% O <sub>2</sub>	-	-	-

Rounding beyond the decimal places shown in the table shall follow the standard mathematical practice of going to next higher number for any numerical value of five or more.

**NOTE: This shall also hold true for pass/fail decisions during an I/M inspection. For example, if 2.00% CO passes but 2.01% CO fails and the reading is 2.0049%, the value shall be rounded down and the decision shall be "Pass;" however, if the reading is 2.0050, the value shall be rounded up and the decision shall be "Fail." Thus, the value displayed and printed on the VIR shall be consistent with the value used for the pass/fail decision.**

*k) Repeatability:***Emissions Analyzer Repeatability**

Gas	Range	Repeatability (% of point)	Repeatability (absolute)	Range	Repeatability (% of point)	Repeatability (absolute)
HC	0-1400 ppmh	±2%	3 ppmh	1400-2000 ppmh	±3%	N/A
CO	0 - 7.00%	±2%	0.02% CO	7.01-10.00%	±3%	N/A
CO <sub>2</sub>	0 – 10%	±2%	0.1% CO <sub>2</sub>	10 – 16%	±3%	N/A
NO	0 – 4000 ppm	±3%	20 ppm	-	-	-
O <sub>2</sub>	0 – 25%	±3%	0.1% O <sub>2</sub>	-	-	-

Accuracy and repeatability shall be defined by the test procedures in Section 5.

d) *Noise:***Emissions Analyzer Noise**

Gas	Range	Noise (% of point)	Noise (absolute)	Range	Noise (% of point)	Noise (absolute)
HC	0-1400 ppmh	±0.8%	2 ppmh	1400-2000 ppmh	±1%	N/A
CO	0 - 7.00%	±0.8%	0.01% CO	7.01-10.00%	1±%	N/A
CO <sub>2</sub>	0 – 10%	±0.8%	0.1% CO <sub>2</sub>	10 – 16%	1±%	N/A
NO	0 – 4000 ppm	±1%	10 ppm	-	-	-
O <sub>2</sub>	0 – 25%	±1.5%	0.1% O <sub>2</sub>	-	-	-

Noise shall be defined operationally as follows: Sample Mid Range #1 Audit Gas for 20 seconds. Collect all the analyzer output readings for each channel over the 20 seconds. (For example, if the analyzer outputs are read by the EIS at the rate of twice per second, the total number of readings would be 40.) The peak-to-peak noise shall be calculated as:

$$NOISE = \frac{\sqrt{\sum (X_i - \bar{x})^2}}{n}$$

Where  $x_i$  = the  $i^{\text{th}}$  reading of the set of readings

$\bar{x}$  = the arithmetic average of the set of readings

$n$  = the total number of readings

The noise, as calculated above, shall be within the limits specified in the table above, AND, in the set of data collected, no more than 5% of the readings in the set shall deviate (peak-to-peak) from the average by more than 150% of the specified limits.

- m) **Minimum Analyzer Display Resolution:** The analyzer electronics shall have sufficient resolution and accuracy to achieve the following:

HC	1 ppm	HC
CO	0.01%	CO
CO <sub>2</sub>	0.1%	CO <sub>2</sub>
NO	1 ppm	NO
O <sub>2</sub> (optional)	0.1%	O <sub>2</sub>
RPM	1 mph	RPM
Speed	0.1 mph	

Load

0.1 hp

- n) **Display Refresh Rate:** Dynamic information being displayed shall be refreshed at a minimum of twice per second. Alternatives may be submitted to the BAR for its approval.
- o) **Interference Effects:** The interference effects from non-interest gases shall not exceed  $\pm 4$  ppm for HC,  $\pm 0.02\%$  for CO,  $\pm 0.20\%$  for CO<sub>2</sub>, or  $\pm 20$  ppm for NO. Corrections for collision-broadening effects of combined high CO and CO<sub>2</sub> concentrations shall be taken into account in developing the factory calibration curves, and is included in the accuracy specifications. Interference gases shall be as follows:

<u>Interference Gases</u>	
16%	Carbon Dioxide in Nitrogen
1600 ppm	Hexane in Nitrogen
10%	Carbon Monoxide in Nitrogen
3000 ppm	Nitric Oxide in Nitrogen
75 ppm	Hydrogen Sulfide in Nitrogen
75 ppm	Sulfur Dioxide in Nitrogen
28 ppm each	Benzene, Xylene, Toluene in Nitrogen (NDUV only)
18%	Carbon Dioxide <u>and</u> 9% Carbon Monoxide in Nitrogen Water-Saturated Hot Air

**NOTE:** Interference gases shall have a  $\pm 2\%$  blend tolerance and  $\pm 2\%$  certified accuracy.

- p) **Warm-up Time:** The analyzer shall reach stability within 30 minutes at 35°F from startup. If an analyzer does not achieve stability within the allotted time frame, it shall be locked out from I/M testing and a message shall be displayed instructing the operator to call for service.
- q) **System Lockout During Warm-up:** Functional operation of the gas sampling unit shall remain disabled through a system lockout until the instrument meets stability and warm-up requirements. The instrument shall be considered "warmed-up" when internal analyzer verifications are complete and the zero readings for HC, CO, CO<sub>2</sub>, O<sub>2</sub> and NO have stabilized, within the allowable accuracy values, for five minutes without adjustment.
- r) **Analyzer/Sensor Response Times**  
Analyzer/sensor response times are defined as follows:

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1. Rise time: When a gas is introduced to a sensor's sample cell inlet or inlet port, the time required by the sensors output to rise from first indication of response to the input gas ( $t_0$ ) to a given percentage of the final stable reading of a gas concentration. Two rise times are specified:
  - iv.  $T_{90}$ : The time required to reach 90% of the final gas concentration reading from first indication of response to the input gas.
  - v.  $T_{95}$ : The time required to reach 95% of the final gas concentration reading from first indication of response to the input gas.
  
2. Fall Time: When a gas is removed from a sensor's sample cell inlet or inlet port, the time required by the sensor's output to fall from first indication of withdrawal of the gas ( $t_s$ ) to a given percentage of the final stable reading of a gas's concentration. Two fall times are specified:
  - iv.  $T_{10}$ : The time required to fall to 10% of the stable gas concentration reading from first indication of withdrawal of the gas.
  - v.  $T_5$ : The time required to fall to 5% of the stable gas concentration reading from first indication of withdrawal of the gas.

**Analyzer/Sensor Response Time Requirements**

	<b>HC, CO, CO2</b>	<b>NO</b>
<b>T<sub>90</sub></b>	3.5	4.5
<b>T<sub>95</sub></b>	4.5	5.5
<b>T<sub>10</sub></b>	3.7	4.7
<b>T<sub>5</sub></b>	4.7	5.7

**The differences between  $T_{90}$  and  $T_{10}$  and between  $T_{95}$  and  $T_5$  shall be no greater than 0.3 seconds.**

**Only the  $T_{90}$  and  $T_{10}$  times shall be measured and recorded during 3-day calibrations.**

**Note that the oxygen ( $O_2$ ) sensor's response time is specified as an overall system response time (see ' 2.4.6.g) in harmony with the generally accepted European specifications.**

**During a three-day calibration, the EIS measures the T<sub>90</sub> and T<sub>10</sub> response times of the CO, O<sub>2</sub>, and NO channels. If a channel exceeds its maximum allowable response time by one second (see table above), a warning shall be displayed; exceeding two-seconds shall cause the EIS to fail calibration. From the above table, absolute maximum failing response times for T<sub>90</sub> are 5.5 seconds (CO) and 6.5 seconds (NO); and for T<sub>10</sub> are 5.7 seconds (CO) and 6.7 seconds (NO). For O<sub>2</sub>, the corresponding T<sub>90</sub> and T<sub>10</sub> times are 7.5 seconds and 8.5 seconds, respectively.**

**NO readings shall be time aligned based on last calibration time. For example a new sensor that starts out with a 2 second T<sub>90</sub> response time then degrades to a 3.2 second T<sub>90</sub> response time, as measured during calibration, shall result in an additional time offset of 1.2 seconds.**

- s) ***HC Hangup***  
The HC hangup shall be 7 ppm or less before the EIS permits an I/M test to begin.
- t) ***Emissions Accounting/Accuracy***  
The manufacturer shall ensure that its analytical system provides an accurate accounting of the actual exhaust emissions produced during the test, taking into consideration the individual channel accuracies, repeatabilities, interference effects, sample transport times and analyzer response times.

#### **2.4.6 Sampling System Components**

- i) ***General:*** The system shall be designed to ensure durable, leak-free operation and shall be easily maintained.

The sampling system shall be designed to withstand typical vehicle exhaust temperatures when the vehicle is driven through the ASM5015 test cycle for 120 seconds.

Materials that are in contact with the gases sampled shall not contaminate or change the character of the gases to be analyzed. The sampling system shall be designed to resist corrosion and material degradation for at least five years.

The system shall be designed to ensure durable, leak-free operation and easy maintenance.

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- j) **Sample Hose:** The sample hose shall be 25 ft  $\pm$ 0.5 ft in length, when measured from the front of the EIS cabinet. On the main sample hose, the dual exhaust quick connect fitting shall be located at least 7 feet back from the probe. The auxiliary hose shall be equal in length to the distance from the dual exhaust quick connect to the probe on the main hose. Other configurations may be submitted to BAR for its consideration

The hose material in contact with the exhaust sample shall be nonporous and not subject to out gassing; it shall not absorb, adsorb, react with, or affect the sample in any manner. The outer coating of the hose shall be abrasion-resistant and unaffected by the substances found in a typical service facilities environment.

The sample hose shall be flexible, yet shall resist kinking and crushing, as defined in Section 5.

The sample hose shall be connected to the probe and to the analyzer sample system with screw-type fittings.

- k) **Sample Hose and Probe:** The sample hose and probe shall withstand exhaust gas temperatures at the probe tip of up to 1100°F for five (5) minutes.

- l) **Sample Probe:** The analyzer manufacturer shall equip the analyzer with a sampling probe, which meets the following criteria:

1. Retention - The probe shall incorporate a positive means of retention to prevent it from slipping out of the tailpipe when in use.
2. Hand Grip - A thermally-insulated, securely-attached hand grip shall be provided on the probe in such a manner that easy probe insertion using one hand is insured.
3. Flexibility - Manufacturers shall supply two types of removable probe tips with each analyzer sold. The probe and both probe tips shall meet the following criteria:
  - iv. the probe shall be designed so that the tip extends 16 inches into the tailpipe;
  - v. the probe and probe tip should be designed so the average garage operator can easily remove and reinstall them without special tools;
  - vi. a handle, made of thermally insulating materials, shall be attached to a rigid, reasonably non-crushable portion of tubing made of stainless steel or something equivalent, which can be

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- easily removed from the sample line and reinstalled by the operator; and
- vii. the probe tip shall be shielded so that debris is not scooped up by the probe when it is inserted into the tailpipe.
  - viii. In addition, one of the probe tips supplied with the analyzer shall be of the traditional style meeting the following specifications:
    - a. flexible enough to extend into a 1½-inch diameter exhaust pipe having a three-inch radius, 45-degree bend; and
    - b. the flexible portion shall be constructed so that it is sealed to prevent any sample dilution.
  - ix. Manufacturers shall also supply the analyzer with an essentially straight probe tip (no more than a 15° bend) meeting the following specifications:
    - a. made of stainless steel, 3/16 inch outside diameter (O.D.) solid-wall tubing, which is readily available;
    - b. designed so that the connector between the removable probe tip and the rigid portion of tubing is up inside the tailpipe at least three inches to reduce the effects of any leak that might occur; and
    - c. the probe tip shall be shielded so that debris is not scooped up by the probe when it is inserted into the tailpipe.
4. Serviceability - For the purposes of economical replacement, the flexible portion of the probe assembly shall be designed so it can be replaced. The probes supplied shall be readily available.
5. Materials - The probe shall be made of materials that will withstand exhaust temperatures up to 1100°F. Use of dissimilar metals with thermal expansion factors of more than five percent shall not be used in either the construction of probes or connectors.
6. Audit Gas Introduction - Probes shall be designed to allow, or shall be supplied with an adaptor allowing, the introduction of audit gas from a one-half inch inside diameter flexible hose. The probe tip or the adaptor shall be sized to provide a tight fit so that dilution cannot occur at the probe/hose connection.
7. Probe Cap - A probe tip cap suitable for performing a system leak check shall be provided if the vacuum decay method of leak check is utilized. The cap shall be permanently attached/tethered to the EIS. Otherwise,

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whatever hoses and connectors are necessary shall be provided to allow the operator to perform the leak check.

### **m) *Particulate Filter and Water Trap***

1. The particulate filter shall be capable of trapping at least 97% of all particulates and aerosols 5 microns or larger.
2. The filter element shall not absorb or adsorb hydrocarbons.
3. The water trap shall be sized to remove exhaust sample water from vehicles that are undergoing a loaded-mode test and that are fueled with gasoline, gasohol, propane, compressed natural gas (CNG), as well as with alternative and oxygenated fuels, such as methanol (M85), ethanol (E85), and reformulated gasolines with MTBE as the oxygenate. The filter element, bowl and housing shall be inert to these fuels as well as to the exhaust gases from vehicles burning these fuels. The condensed water shall be continuously drained from the water trap's bowl. Sufficient water shall be trapped, regardless of fuel, to prevent condensation in the sample system or in the optical bench's sample cell over the full range of ambient operating conditions (see §2.4.7, §2.4.8, and §2.4.12, while testing a vehicle under loaded-mode conditions. Consideration shall be given to incorporating active water removal, such as integration of a chiller, to remove the excess moisture generated in vehicle exhaust during a loaded-mode test.
4. All sample system filters shall meet BAR-97 Specification and meet or exceed EIS Manufacturer specifications. In the event BAR in-house aftermarket filter test procedures are deemed insufficient to quantify filter performance per OEM specifications by either EIS Manufacturer or Aftermarket parts supplier, the aftermarket parts supplier shall submit the OEM and aftermarket filters to an independent laboratory (not the same filter manufacturer) for comparison testing. Upon BAR review of independent lab test procedures and results BAR may issue approval.

- n) ***System Leak Check:*** The analyzer shall require that a leak check be successfully passed on the same frequency as the gas calibration.

The analyzer shall not allow an error of more than 1% of reading using High Range BAR-97 span gas to perform the leak check.

- o) ***System Response Time Requirements for Analyzer Channels:***

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The overall system response time of the analytical train comprises the Transport Time and the Analyzer/Sensor Response Time (see section 2.4.5 r).

1. Transport Time: The time from the exhaust sample's entry into the tip of the sample probe until the analyzer/sensor first begins to respond to the sample. The Transport Time shall be no more than 5 seconds for HC, CO and CO<sub>2</sub> and no more than 7.5 seconds for NO and O<sub>2</sub>.
2. System Response Time:
  - iv. HC, CO, & CO<sub>2</sub> Channels: The response rise time (see section 2.4.5.r)1) from the probe to the display shall be no more than eight (8) seconds to T<sub>90</sub>. In addition, the response fall time shall be no greater than 8.3 seconds to T<sub>10</sub>.
  - v. NO Channel: The response rise time (see section 2.4.5 r) i) from the probe to the display shall be no more than 12 seconds to T<sub>90</sub>. In addition, the response fall time shall be no greater than 12.4 seconds to T<sub>10</sub>.
  - vi. O<sub>2</sub> Channel: The response rise time shall be no greater than 15 seconds to T<sub>90</sub>. The response fall time for a step change in concentration from 20.9% O<sub>2</sub> to 0.1% O<sub>2</sub> shall be not greater than 40 seconds.

**p) *Hangup Check (Ref. §2.4.5 s)***

Activation of the emission measurement mode of the EIS shall be prevented unless a successful hangup check has been performed immediately prior to the test sequence. Hangup shall not exceed 7 ppm hexane prior to testing. A unit with a clean sample system shall have a HC hangup time of no more than 120 seconds. If the HC hangup does not drop below 7 ppm within 150 seconds, the following message shall be displayed: "**POSSIBLE DIRTY FILTERS OR SAMPLE LINE.**"

**q) *Dilution***

The analyzer supplier shall demonstrate to the satisfaction of the BAR that the flow rate on the EIS unit shall not cause more than 2% dilution during sampling of the exhaust of a 1.6L engine at normal idle. Two-percent dilution is defined as a sample of 98% exhaust and 2% ambient air.

### **2.4.7 Temperature Operating Range**

The analyzer, including all of the software/hardware enclosed in the cabinet, shall operate within the performance specifications described herein in ambient air temperatures ranging from 35° to 110°F. Analyzers shall be designed so that adequate airflow is

provided around critical components to prevent overheating (and automatic shutdown) and to prevent the condensation of water vapor, which could reduce the reliability and durability of the analyzer.

#### 2.4.8 Humidity Operating Range

The analyzer, including all of the software/hardware enclosed in the cabinet, shall operate within the performance specifications described herein at up to 90% relative humidity throughout the required temperature range.

#### 2.4.9 Opacity

An opacity option shall be offered for use in testing light and medium-duty diesel-powered vehicles. It shall be a partial-flow device, meeting the performance requirements of ISO 11614, and shall interface seamlessly with the analyzer software via an RS232C port. A DB25 pin serial port or other BAR-approved connector is required. Adjustments such as electronic signal filtering shall be incorporated so as to correlate with other opacity-measuring devices and standards. Other methods of measuring opacity may be submitted for BAR consideration. The devices shall be calibrated by a method and at a frequency approved by BAR.

#### 2.4.10 Humidity

Relative humidity shall be measured prior to the start of every inspection in order to calculate Kh, the nitric oxide humidity correction factor. The humidity measurement device shall have the following minimum characteristics:

Relative Humidity Range:	5% - 95%
Sensor Accuracy:	±3% of full scale or better
Operating Temperature Range:	35°F - 110°F

The relative humidity reading shall be recorded in the *Relative Humidity* field of the test record.

#### 2.4.11 Ambient Temperature Measurement

Ambient temperature shall be measured prior to the start of every inspection, and shall be recorded in the *Ambient Temperature* field of the test record. The temperature-measuring device shall have the following minimum characteristics:

Range:	0 - 140°F
Accuracy:	±3°F or better

#### 2.4.12 Barometric Pressure Compensation

Barometric pressure shall be measured prior to the start of every inspection, and shall be recorded in the *Barometric Pressure* field of the test record. The barometric measuring device shall have the following minimum characteristics:

Range:	24 - 32 in. Hg absolute
Accuracy:	±3% of point or better
Operating Temperature Range:	35°F - 110°F

### **2.4.13 Dynamometer Interface**

The dynamometer (or controller if applicable) shall use a BAR-approved connector. The connector (or a separate connector) shall reserve one wire at the dynamometer (or controller if applicable) that shall provide software switchable (on/off) +12V with .5AMP circuit protection to each +12V line. The communications protocol, approved by BAR, shall be made available, upon request, to BAR-approved dynamometer manufacturers. The necessary hardware and software connectivity details shall be sufficient to allow a seamless interface to the system that meets all of the requirements of the specification.

## **2.5 ASM DYNAMOMETER AND AUXILIARY EQUIPMENT SPECIFICATIONS**

### **2.5.5 Dynamometer Identification**

All dynamometers shall have an identification plate permanently affixed showing, as a minimum: the dynamometer manufacturer's name, the system provider's name (i.e., provider who obtained the BAR certification and who markets the system using the dyno), production date, model number, serial number, dynamometer type, maximum axle weight, maximum HP absorbed, roll diameter, roll width, base inertia weight, and electrical requirements (including voltage and amperage).

### **2.5.6 Two-Wheel Drive Vehicle Dynamometer**

The dynamometer and any ramps required for above ground dynamometer use shall accommodate all two-wheel drive light-duty vehicles up to 6,000 lbs. axle weight (unloaded), except for those vehicles equipped with antilock braking systems (ABS) or traction control (TC) which require an all wheel drive (AWD) dyno.

### **2.5.7 All-Wheel-Drive (AWD) Dynamometers**

The dynamometer shall accommodate vehicles with axle weight 6,000 lbs. or less (unloaded) having wheelbases from 85 to 125 inches as a minimum. AWD dynamometers shall insure the application of correct vehicle loading, and shall not damage the four-wheel-drive system of the vehicle. These dynamometers shall be capable of properly testing vehicles equipped with ABS and TC systems.

## **2.5.8 Power Absorption**

### **2.5.4.1 Acceptable Configurations**

Power absorption methods shall be described in the manufacturer's certification submittal package. All configurations are subject to BAR approval.

**2.5.4.2 Power Absorber Range**

The range of the power absorber unit (PAU) shall be sufficient to simulate the load required to perform an ASM5015 test and an ASM2525 test on any vehicle in its weight range. For the ASM5015, the vehicle loading is 50% of the maximum loading required for that vehicle during the Federal Test Procedure (FTP) test; for the ASM2525, the vehicle loading is 25% of the maximum loading required for that vehicle during the FTP test. All dynamometers shall be capable of performing these tests for any vehicle in its weight range. The power absorber shall be able to absorb, at 14 mph and above, a minimum of 25 horsepower continuously for a steady state test lasting at least five minutes, with three minutes between tests for at least 10 consecutive tests.

**2.5.4.3 Power Absorption Unit (PAU) Accuracy**

The power absorber shall be adjustable in 0.1 hp increments and the accuracy of the system (PAU + Parasitic Losses) shall be  $\pm 0.25$  horsepower or  $\pm 2.0\%$  of required loading for dynamometer certification, whichever is greater, in either direction of rotation. (For field auditing the accuracy shall be  $\pm 0.5$  horsepower or 4% of the required loading.)

**2.5.4.4 Vehicle Loading**

The vehicle loading used during the ASM driving cycles shall follow the equation:

$$\text{THP} = \text{IHP} + \text{PLHP} + \text{GTRL}$$

Where:

THP	=	Total horsepower (tire losses and parasitics) for an ASM test.
IHP	=	Indicated Horsepower value set on the dynamometer.
PLHP	=	Parasitic Loss Horsepower due to internal dyno friction.
GTRL	=	Generic Tire/Roll interface horsepower losses at speed, based on primary drive axle weight measured at or before the dyno. Axle weight shall be $\pm 100$ lbs. of actual over a range of 800 - 6000 lbs. and shall record the weight on test record. For passenger cars for which test weights are not available, the actual weight shall be used. Unless otherwise noted, any horsepower displayed during testing shall be THP.

**2.5.5 Inertia****2.5.5.1 Base Inertia**

The dynamometer shall be equipped with a mechanical flywheel(s), or with full inertia simulation providing a total base inertia weight of 2000 lbs.  $\pm 40$  lbs. Any deviation from the 2000 pounds base inertia shall be quantified and the coast-down time shall be corrected accordingly. The actual inertia weight  $\pm 10$  lbs. shall be marked on the dynamometer ID plate or on the flywheel.

**2.5.5.2 Inertia/Inertia Simulation**

The dynamometer, as delivered, shall be capable of conducting, at a minimum, diagnostic level transient inertia simulations with an acceleration rate between 0 to 3.3 mph/sec with a minimum load (power) of 25 hp at 14 mph over the inertia weight range of 2,000 to 6,000 lbs. For the diagnostic level inertia simulation, the 25-hp criterion is a requirement on acceleration only, while for the full inertia simulation option, the requirement is for both acceleration and deceleration. Mechanical inertia simulation shall be provided in 500 lb. minimum increments; electric inertia simulation shall be provided in one (1) lb. increments. Any deviation from the stated inertia shall be quantified and the inertia simulation shall be corrected accordingly. Mechanical or electrical inertia simulation, or a combination of both, may be used, subject to review and approval by the BAR.

**a) Diagnostic Level Simulation**

1. System Response - The torque response to a step change shall be at least 90% of the command value within 300 milliseconds.

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2. Inertia Simulation Error - An inertia simulation error (ISE) shall be continuously calculated any time the actual dynamometer speed is between 5 and 60 mph. The ISE shall be calculated using the equation below and shall be within 3% of the inertia weight selected (IWS) for the vehicle under diagnostics testing when driving a predetermined drive trace. When driving a non-predetermined drive trace, the ISE shall be within 5% of the IWS. If, after the first 5 seconds of the test mode the ISE exceeds this tolerance for more than 3 consecutive seconds, the test mode timer shall be set back to 5 seconds. Should this happen a second time, the test shall be invalid.

$$ISE = [(IWS - I_t) / IWS] \times 100$$

$$I_t = I_m + (1/V) \int_0^t (F_m - F_{r_l}) dt$$

Where:

ISE = Inertia Simulation Error in percent.

IWS = Inertia Weight Selected.

$I_t$  = Total inertia being simulated by the dynamometer.

$I_m$  = Base mechanical inertia of the dynamometer.

$V$  = Measured roll speed.

$F_m$  = Force measured by the load cell.

$F_{r_l}$  = Road load force required by IHP at the measured roll speed.

$t$  = Time.

3. Maximum Vehicle Speed - The dynamometer shall be designed to accommodate a vehicle speed of up to 60 mph.

### 2.5.6 Rolls

#### 2.5.6.1 Size and Type

- a) *Main Rolls (2WD Dynamometers)*: The dynamometer shall be equipped with twin rolls. The rolls shall be electrically or mechanically coupled side-to-side and front-to-rear. The dynamometer roll diameter shall be between 8.5 and 21.0 inches. Other configurations will be considered by BAR. The spacing between roll centers shall be determined by the following equation. The actual spacing shall be within +0.5 and -0.25 inches of the calculated value.

$$\text{Roll Spacing} = (24.375 + D) \times \sin 31.52^\circ$$

Where D = Roll Diameter

Roll spacing and roll diameter expressed in inches.

Alternative roll spacing may be approved by BAR.

- b) *Roll Speed:* Roll speed and roll counter shall be accurate within 0.1 mph for speeds up to 60 mph. The side-to-side (split) rolls shall maintain speed synchronization of  $\pm 0.2$  mph.
- c) *Track Width:* The dynamometer shall have a usable track width of at least 100 inches. The dynamometer rolls shall have a minimum width of 96 inches and the space between the split rolls shall not exceed 30 inches. Tire overhang, the distance from the end of the roll to the tire bulge when the tire is in the widest position, shall not exceed 2 inches. If, during vehicle stabilization, the tire attempts to push outside the usable width, tire/vehicle damage shall be prevented. Tire damage includes, but is not limited to, excessive scrubbing either against the dynamometer or the restraints. The dynamometer shall not damage any part of the vehicle during testing, ingress or egress under normal operation.
- d) *Roll Characteristics:* The roll size, surface finish, and hardness shall be such that tire slippage is minimized, that water removal is maximized, that the specified accuracy of distance and speed measurements are maintained, and that tire wear and noise are minimized.
- e) *AWD Dynamometers:*
  - 1. Auxiliary Rolls - The auxiliary rolls for AWD and traction control vehicles shall be cradle rolls complying with the provisions of section 2.5.6.1a) above or a single roll.
  - 2. Front-to-Rear or Side-to-Side Synchronization - Front-and rear-wheel or side-to-side (split) rolls shall maintain speed synchronization of  $\pm 0.2$  mph.

## **2.5.7 Dynamometer Calibration**

The dynamometer shall be automatically calibrated. Calibration procedures shall be approved by BAR.

### **2.5.7.1 Accuracy Over Operating Ambient Temperature Range**

The dynamometer's accuracy, when warmed up, shall not deviate by more than  $\pm 0.5$  hp over any temperature variation within the full ambient operating temperature range of 35°F to 110°F. This may be accomplished by intrinsic design or by software correction techniques.

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At any constant temperature, the dynamometer shall have an accuracy of ±0.5 hp within 15 seconds of the start of the test, and shall have an accuracy of ±0.25 hp within 30 seconds of the start of the test.

The dyno manufacturer shall demonstrate that its dyno horsepower deviation between cold and warmed-up operation is less than 0.25 hp within an ambient temperature range of 35°F - 110°F. For temperatures outside the specified range, the dyno shall provide correction or proceed with a manufacturer-recommended warm-up sequence until full warm-up condition has been reached.

Alternative means of compensating for cold vs. warm operation may be approved by BAR.

**2.5.7.2 Coast-Down Check**

Each dynamometer's calibration shall be checked every 72 hours by means of an automated dynamometer coast-down check procedure approved by BAR. An integral motor, while recommended, is not required. The coast-down performance check shall be conducted between the speeds of 30-20 mph and 20-10 mph. All rotating dynamometer components shall be included in the coast-down check. If either the measured 30-20 mph coast-down time or 20-10 mph coast-down time is outside the window bounded by Calculated Coast-Down Time (CCDT) (seconds) ±7%, then it shall be locked out for official inspection purposes until recalibration allows a passing value.

- a) Randomly select an IHP2525 value between 8.0 hp and 18.0 hp and set dynamometer PAU to this value. Coast down the dynamometer from 30 to 20 mph.

$$CCDT_{@ 25mph,yy} = \frac{\left( \frac{0.5 \times DIW}{32.2} \right) \times (V_{30}^2 - V_{20}^2)}{550 \times (IHP_{2525_{yy}} + PLHP_{25_{yy}})}$$

Where:

- DIW = Dynamometer Inertia Weight (total inertia weight of all rotating components in the dynamometer)
- V<sub>30</sub> = Velocity in feet/sec at 30 mph
- V<sub>20</sub> = Velocity in feet/sec at 20 mph
- IHP2525<sub>yy</sub> = ASM2525 indicated horsepower, randomly selected during each coast-down check

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PLHP25<sub>yy</sub> = Parasitic horsepower for specific dyno at 25 mph.  
 yy = Placeholder for dyno roll diameter

- b) Randomly select an IHP5015 value between 8.0 hp and 18.0 hp and set dynamometer PAU to this value. Coast down the dynamometer from 20 - 10 mph.

$$CCDT_{@15mph,yy} = \frac{\left(\frac{0.5 \times DIW}{32.2}\right) \times (V_{20}^2 - V_{10}^2)}{550 \times (IHP_{5015,yy} + PLHP_{15,yy})}$$

Where:

DIW = Dynamometer Inertia Weight (total inertia weight of all rotating components in the dynamometer)  
 V<sub>20</sub> = Velocity in feet/sec at 20 mph  
 V<sub>10</sub> = Velocity in feet/sec at 10 mph  
 IHP5015<sub>yy</sub> = Randomly selected ASM5015 indicated horsepower  
 PLHP15<sub>yy</sub> = Parasitic horsepower for specific dyno at 15 mph.  
 yy = Placeholder for dyno roll diameter

All-wheel drive dynamometers capable of disengaging the auxiliary rolls shall perform coast-downs in both the two and four-wheel drive modes at least once every 15 days on the rear rolls, or alternative approved by BAR.

**2.5.7.3 Parasitic Losses**

If the dynamometer is unable to pass the coast-down check, the dynamometer's parasitic loss horsepower (PLHP) shall be determined at 25 and 15 mph.

- a) Calculate the PLHP of the dynamometer at 25 and 15 mph by coasting the dynamometer down with IHP set to zero from 30 - 20 mph and 20 - 10 mph, using the equations below.

1. Parasitic losses at 25 mph

$$PLHP = ((1/2)(DIW/32.2)(V_{30}^2 - V_{20}^2)) / (550 \times CCDT)$$

Where:

PLHP = Parasitic loss horsepower

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DIW	=	Dynamometer Inertia Weight. Total inertia weight of rotating components in pounds.
V <sub>30</sub>	=	Velocity in feet per second at 30 mph.
V <sub>20</sub>	=	Velocity in feet per second at 20 mph.
ACDT	=	Actual coast-down time required for dynamometer to coast from 30 - 20 mph.

2. Parasitic losses at 15 mph

$$PLHP = ((1/2)(DIW/32.2)(V_{20}^2 - V_{10}^2)) / (550 \times ACDT)$$

Where:

PLHP	=	Parasitic loss horsepower
DIW	=	Dynamometer Inertia Weight. Total inertia weight of rotating components in pounds.
V <sub>20</sub>	=	Velocity in feet per second at 20 mph.
V <sub>10</sub>	=	Velocity in feet per second at 10 mph.
ACDT	=	Actual coast-down time required for dynamometer to coast from 20 - 10 mph.

**2.5.8 Other Requirements**

**2.5.8.1 Vehicle Restraint**

The EIS shall be equipped with a means or device for restraining front-wheel-drive vehicles under test. Its primary function shall be to limit the vehicle's side-to-side movement on the dynamometer rolls. This means or device shall be engaged when the test is ready to be performed and shall be disengaged after the test has been completed. The restraint system shall be designed to minimize vertical and horizontal force on the drive wheels so that emission levels are not significantly affected. The restraint system shall allow unobstructed vehicle ingress and egress and shall be capable of safely restraining the vehicle under all reasonable operating conditions. The EIS shall not allow a test to be initiated unless the restraint system is in place. Restraints may also be

provided for rear-wheel-drive vehicles, but if not, rear-wheel-drive vehicles shall have their front wheels securely chocked.

Vehicles on four-wheel drive dynamometers shall be restrained sufficiently to prevent forward/reverse movement in addition to side-to-side movement while minimizing the effects on vehicle emissions.

#### **2.5.8.2 Installation**

Vehicles shall be approximately level (not to exceed  $\pm 5^\circ$  degrees) while being tested on the dynamometer. Dynamometers may be installed in-floor or above-ground, as long as this requirement is met.

#### **2.5.8.3 Load Measuring Device**

If the dynamometer fails a coast-down check or requires a recalibration for any other reason, the load measuring device shall be checked using a dead-weight method (or BAR-approved equivalent), and shall cover at least three points over the range of loads used for vehicle testing. Dead weights shall be traceable to National Institute of Standards and Technology (NIST), and shall be accurate to within  $\pm 0.5\%$ . The dynamometer shall provide automatic load measuring device calibration/verification feature.

The same dead weight (or BAR approved equivalent) shall be used for axle weight scale calibration. Upon new dyno installation or any dynamometer service, the axle weight scale shall be recalibrated with the dynamometer PAU calibration dead weight. Mechanical advantage (leverage) may be used to achieve greater loads than the actual dead weight mass.

#### **2.5.8.4 Wheelbase Selection**

The wheelbase spacing of an all-wheel drive dynamometer shall be adjustable to accommodate vehicles having a wheelbase between 85 and 125 inches. The system shall provide a locking mechanism to secure the dynamometer at the desired wheelbase.

#### **2.5.8.5 Automatic Lift**

Dynamometers shall have an automatic lift between the rolls to allow smooth vehicle transition onto and off the rolls. Alternative methods of effecting this transition may be submitted to BAR for its approval.

#### **2.5.8.6 Driver's Aid**

The EIS shall be equipped with a driver's aid that shall be clearly visible to the driver during the loaded-mode test. The aid shall continuously display the required speed, the number of seconds into the test mode, driver's actual speed/time performance (a display showing deviation between set point and actual drive trace), engine rpm, and necessary

prompts and alerts. The driver's aid shall also be capable of displaying test and equipment status and other messages as required.

#### **2.5.8.7 Driver's Remote Control Device**

Each EIS shall be equipped with a means of allowing the driver to start the test, perform an emergency stop, and perform other necessary and convenient functions related to the test, while inside the vehicle.

#### **2.5.8.8 Fan**

A fan shall be provided for cooling the engine of the vehicle under test. It shall be mobile to position in front of the vehicle. The fan blades shall have a maximum diameter of 30 inches. The rotational axis of the fan shall be at least 16 inches above the shop floor, and no greater than 35 inches above the floor. The fan must provide at least 3000 cubic feet per minute (cfm) of air speed at all speed settings. If the fan blade diameter is less than 20 inches, the fan must be adjustable by rotating the fan housing, or by raising and lowering the fan housing. The adjustment positions of the fan must not allow the catalyst to be cooled abnormally.

#### **2.5.8.9 Augmented Braking**

During ASM testing, augmented braking shall consist of applying 500 lbs. of braking at the roll surface, wherever possible given the limitations of the PAU. If, during an ASM test, the correct applied load for a given vehicle exceeds the 500 lbs., the PAU shall maintain the correct vehicle load until the rolls come to a stop (i.e. the load will not drop 500lbs. but maintain the heavier loading). The 500 lbs. of braking is made up of tire losses, dynamometer parasitic losses, and PAU load.

#### **2.5.8.10 Safety Provisions**

The dynamometer shall provide a means of facilitating the removal of the vehicle in case of system failure or power outage.

#### **2.5.8.11 Dynamometer Controller**

The dynamometer controller may be a separate unit or included in the analyzer cabinet. Regardless, the dynamometer controller and its inputs, outputs and functionality shall not vary over the operating temperature range, and shall be unaffected by AC voltage variations of  $\pm 10\%$  or less, EMI/RFI, and shall be resistant to shock and vibration.

### **2.6 CABINET & PERIPHERAL REQUIREMENTS**

All cabinets, including modifications are subject to BAR approval and shall be tamper resistant as specified in section 1.4.

#### **2.6.1 Power Cord**

The analyzer shall be supplied with a 25-foot UL-approved power cord. The manufacturer shall design the cabinet so that convenient storage is provided for the

excess cord not needed to reach the nearest power outlet.

### **2.6.2 Power Requirements**

The EIS shall operate only on alternating current (AC). No direct current (DC) models will be acceptable. The EIS shall not be powered by a portable AC generating unit. The manufacturer may seek an exception to this rule if it can be shown, to the satisfaction of the BAR that the analyzer is immune to the line frequency variations of the portable AC generating unit. Immunity to line frequency variations is defined here as line frequency variations which will not cause more than one percent of full scale (FS) disturbances on any of the analyzers. Additionally, any AC portable generating unit used with the EIS shall not have frequency excursions exceeding one hertz from 60 hertz.

Input power shall be 115 VAC, 60 hertz. All instruments shall meet the specified requirements over an input voltage variation of at least  $\pm 12$  volts. Maximum allowable performance change due to line voltage variations shall not exceed one-third of the accuracy requirements.

### **2.6.3 Instrument Construction**

The instrument shall be designed and constructed to provide reliable and accurate service in the automotive repair environment. The analyzer shall be supplied with a cabinet that is equipped with a storage area large enough to secure all accessories and operating manuals

#### **a) Materials**

The materials used in instrument construction shall be resistant to corrosive type substances found in the automotive repair environment and be designed to last for at least the period of the warranty.

#### **b) Finish**

The exterior and interior finish of the entire cabinet and console shall be sufficiently durable to withstand the chemicals and environmental conditions

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normally encountered in the automotive repair environment for the period of the warranty.

c) **Mobility**

The analyzer may be a permanently mounted or mobile with wheel cabinet. Wheels shall be at least five inches in diameter and have a locking mechanism capable of preventing movement on a 15° incline.

If mobile, the analyzer shall be designed so that movement over rough surfaces (three-inch deep holes) and on 15° incline will not cause it to tip over. Analyzers shall not tip over when placed at the center of an inclined plane that makes an angle of 10 degrees with the horizontal and rotated 360° stopping in the position where it is most likely to tip over. In addition, the analyzer shall not become unstable or tip over when rolled straight off the edge of a two-inch high platform or when one wheel is rolled over a drain, two inches below the surface, inside an 18-inch diameter depression.

d) **Identification**

The analyzer serial number, the date of production, the EIS number and the PEF shall be conveniently displayed to the quality assurance inspectors and the BAR field representatives, in a manner meeting the BAR's approval. The first two characters of the EIS number shall be alphas denoting the manufacturer's initials, and shall not be changeable from the keyboard even in the manufacturer's service mode. The initials chosen are subject to approval by the BAR to prevent duplication between manufacturers. The remaining six characters shall be numeric. The numbers shall be right justified. Zeroes shall be used to fill any blank spaces between the initials and the numerics. For example, the EIS number for analyzer #23 from Hobo Electronics would be "**HE000023**."

- e) **Electrical Design**  
Provisions shall be made for storing the power cord in a manner satisfactory to the BAR. Fuses or circuit breakers shall be used to protect individual electrical circuits and emission analyzers. Main circuit breakers and fuses shall be readily accessible from the exterior of the cabinet. Analyzer operation shall be unaffected by electrical line noise and voltage surges. The analyzer shall be sufficiently protected from voltage surges to prevent damage to the analyzer from the simultaneous start up of a 220-volt compressor, an arc welder, hydraulic controls and other equipment commonly found in the typical automotive test and/or repair environment.
- f) **Electromagnetic Isolation and Interference**  
Electromagnetic signals found in an automotive environment shall not cause malfunctions or changes in accuracy in the electronics of the EIS. The instrument design shall insure that readings do not vary as a result of electromagnetic radiation and induction devices normally found in the automotive garage environment (including high energy vehicle ignition systems, RF transmission radiation sources and building electrical systems).
- In addition, the manufacturer shall ensure that the analyzer processor and memory components are sufficiently protected to prevent the loss of programs and test records.
- g) **Vibration and Shock Protection**  
System operation shall be unaffected by the vibration and shock encountered under the normal operating conditions encountered in an automotive environment. Instruments, motors, pumps, and disk drives shall be shock-mounted to absorb any vibration that might affect the system operation.
- h) **Instruction Manual & Accessories Storage**  
A drawer and/or enclosed cabinet with shelves shall be provided to store the analyzer operating instruction manual, the BAR Smog Check Manual (expected to consist of two two-inch loose leaf binders), the BAR Repair Manual (expected to consist of the equivalent of one two-inch binder), and EIS accessories.

## 2.7 BAR CODE SCANNER

A non-contact bar code scanner capable of reading both code 39 and 128 symbologies and all necessary interface software and hardware designed to read labels meeting SAE

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specifications J1877 and J1892 is required on all analyzers\*\*. The bar code scanner shall be able to autodiscriminate between the symbologies. The bar code scanner shall be capable of reading a VIN through a windshield. The bar code scanner shall be capable of reading a DMV bar code having a maximum length of 7¼" (seven and one quarter inches). The bar code scanner shall be capable of reading a calibration gas bar code having a maximum length of 4 inches on a surface with a maximum radius of curvature of 6⅝ inches.

In addition to collecting information from the VIN label, scanners may also be required to enter emission application information from the BAR recognized abbreviated lookup manuals.

The BAR recommends that the manufacturers contact the vehicle manufacturers and BAR-certified gas blenders to inquire about obtaining bar-coded labels for testing purposes.

### **2.7.1 Minimum Required Configuration for Bar Code Scanner**

The analyzer shall be equipped with a standard port configuration and standard connector for the bar code scanner. Scanner and communication must be BAR approved (proprietary scanner systems will not be permitted). The bar code scanner will be used to load emission control system information from application manuals and from the permanent bar code labels placed on the vehicle by the manufacturer. The supplied bar code scanner shall come with at least a twenty (20) foot long self coiling cord and be able to read bar codes placed on the door frames and under the hoods. Manufacturers will be expected to include any software necessary to utilize the data gathered from labels.

### **2.8 FUEL CAP TESTER**

The EIS shall include a fuel cap testing system meeting the following specifications. The fuel cap tester may be provided separately but must provide the serial communication described below.

- a) The fuel cap tester shall test the leak rate of fuel caps to prevent evaporative emissions.
- b) The tester shall be designed so that tethered caps can be accommodated without moving the EIS and shall be capable of pressurizing the fuel cap for this test. The pressurizing system shall apply a controlled pressure of 30 inches of H<sub>2</sub>O to the

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\*\*The bar code scanner shall be of standard, "off-the-shelf" technology approved by BAR.

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fuel cap. The system shall indicate a fail if the leak rate is greater than 60cc per minute. The system shall indicate a pass if the leak rate is 60cc or less per minute. The leak test shall last no longer than 20 seconds.

- c) The tester shall have the capability to change the leak rate pass/fail setpoint if needed at a later date.
- d) The system shall be tamper resistant.
- e) Fuel cap test equipment shall indicate a pass/fail condition.
- f) The tester shall have an indicator and/or screen prompt informing the technician when the system is ready to test (pressurized and power turned on).
- g) The tester shall have a means of controlling the maximum reservoir pressure and relieving overpressure.
- h) If the tester is battery operated, it must be equipped with an automatic shut-off and a low-battery indicator.
- i) Data Transmission (for External Cap Tester Only)  
The tester shall be equipped with a serial data port and shall transmit pass/fail and calibration information to the EIS database via the data link.

1. BAR-97 Communication Data Link

The fuel cap tester shall communicate with the EIS to record information such as pass/fail, calibration, etc. Communication and power to the unit shall be provided by one cable (if the unit is external). A BAR CPC serial port as shown below, shall be used for communication and to provide the power needed to operate the fuel cap tester. Other methods of providing power and communication may be submitted to BAR for approval.

2. The connector on the EIS and pin outs shall be as follows:

**ANALYZER BAR CPC REVERSE CONNECTOR**

This connector must be compatible with an AMP 211398-1 connector. The BAR CPC ports will supply software switchable 12V DC to equipment attached. The 12V pin shall be protected for power surges over .5 AMPS. The circuit protection shall be easily accessible to the technician unless it is an automatic reset system. The pin-out shall be as follows:

<b><u>PINS</u></b>	<b><u>SIGNAL</u></b>
--------------------	----------------------

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1	GND
2	+12v
3	RTS.....RESET (request to send)
4	RESERVED (open)
5	SHIELD - GND
6	TXD.....TRANSMIT DATA
7	RCV.....RECEIVE DATA

The power for the tester will be provided via the BAR CPC connector as shown above.

NOTE: No serial interface cable shall exceed 35 feet unless it has been demonstrated to the BAR Engineering Unit that sufficient shielding has been provided to prevent radio frequency interference (RFI).

3. Communication protocol will be provided by the BAR on a need-to-know basis.

j) Calibration and Accuracy

1. Each system will have a calibrated, screened orifice PASS/FAIL MASTER cap set. The set shall be individually calibrated; the calibration shall be traceable to the NIST. The master cap set shall consist of a PASS MASTER flowing 52 to 56cc per minute and a FAIL MASTER flowing 64 to 68cc per minute (both measured at 30 in. H<sub>2</sub>O pressure). The tester shall be checked every three days with the master calibration caps. The calibration caps shall be calibrated before initial usage and on an annual basis unless quality control tracking suggest less frequent intervals are appropriate. The calibration method shall be NIST traceable. Equipment out of calibration may not be used.
2. The tester accuracy shall be  $\pm 3$ cc per minute and shall be capable of maintaining its accuracy from 35° to 110°F and at elevations from -60 to 7,000 feet.

k) Adapters

1. The system shall be capable of testing at least 95% of the California motor vehicle fleet from model year 1976 up to and including model year 1995 year (excluding pressurized fuel systems such as CNG, LPG, etc.) that are equipped with evaporative control systems.

2. Adapter set shall have a means of indicating which vehicles they fit.

### **2.9 ENGINE RPM DETECTION**

The analyzer shall utilize a tachometer capable of detecting engine RPM with a 0.5 second response time and an accuracy of  $\pm 3\%$  of the true RPM. Prompts may be provided to assist the technician in locating a RPM signal on vehicles equipped with DIS. Based on the vehicle identification information entered by the technician, the analyzer shall advise the technician regarding which vehicles require a primary pickup, which require that an alternate counting algorithm be used and which require the use of an auxiliary piece of equipment. Analyzers shall be provided with all the software and hardware that is necessary to make them capable of reading engine speed on all vehicles manufactured prior to analyzer certification that are included in the Smog Check Program (except those powered by diesel engines). As a minimum, analyzers must be equipped with a spark plug wire direct pickup, a non-contact pickup, and an (on board diagnostics) OBD II interface connection. For analyzer certification, analyzers shall be capable of reading engine RPM on all spark ignition vehicles. Beginning with 1996 model year vehicles, the system shall be capable of detecting engine RPM via OBD II.

### **2.10 TESTING HEAVY-DUTY GASOLINE-POWERED VEHICLES**

Manufacturers shall supply the analyzer with the hardware and software necessary to test heavy-duty gasoline-powered vehicles manufactured prior to certification. At a minimum, accessories shall allow for 40-foot motorhomes to be tested without degrading the emission analyzer response time and provide the technician with an accurate indication of the engine speed. If there is an appropriate category in Table 4, the default should be ASM.

### **2.11 DUAL EXHAUST**

For vehicles with dual exhaust, the analyzer supplier shall provide a dual probe-and-hose arrangement, designed so that the flows from each tailpipe reach the main sample hose at the same time and shall have the same flow  $\pm 10\%$ . A quick-connect coupling may be used to connect an auxiliary probe and hose, but no quick-connect coupling shall be used in the primary single-exhaust path. The quick-connect fitting, if used, shall have a leakproof shutoff when not in use. The fitting for connecting the auxiliary hose shall be located at least 7 feet from the probe end of the main sample hose. The auxiliary hose length shall be equal to this probe-to-fitting distance  $\pm 3$  inches.

### **2.12 OEM AND AFTERMARKET CONSUMABLE PARTS**

All consumable EIS parts (hoses, probes, filters, tachometer leads, cables, etc.) and BAR approved replacements shall meet or exceed the requirements of the applicable sections of this specification. In addition, all consumable parts including aftermarket

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replacements shall be marked with a BAR registered code to verify authenticity. This requirement applies to the part, not the part packaging. The code shall be permanent and easily visible. Manufacturers shall affix, stamp, engrave, print, etc. the code in a manner acceptable to BAR.

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## SECTION 3. BAR-97 SOFTWARE SPECIFICATION

### 3.1 Overview

Section 3 specifies the software requirements for BAR-97 emission inspection systems (EIS). It includes inspection procedures, sequences, decisions, responses and prompts, as well as necessary information to be loaded, security issues, lockouts, file structures, etc. It also contains requirements for communication with the BAR's Vehicle Information Database (VID).

### 3.2 EIS SOFTWARE COMPONENTS

#### 3.2.1 General

The program software used in the EIS shall consist of a process control system as well as data look-up files. The software consists of inspection test procedures and criteria; necessary station, technician, and vehicle information; security measures, utilities and ancillary modules. Its features include vehicular emission measurements of HC, CO, CO<sub>2</sub>, NO and O<sub>2</sub>, engine RPM measurements, exhaust dilution determinations, bar code scanning, interface with a dynamometer, communication to and from the VID, etc.

The software shall ensure the EIS accurately operates within specified standards and records and transmits valid test data. The EIS shall identify inaccuracies and prohibit vehicle inspection until the inaccuracies are corrected.

The EIS shall allow performance of an official two-speed idle test (TSI) and related program functions such as, calibration, Manual Testing Mode, etc. without dynamometer and NO<sub>x</sub> measurement device being present.

Manufacturers shall permit BAR access and provide the necessary tools to view to all parameters that are used for 'self diagnostics' if the parameters are not 'hard coded' in the software. Parameters include items such as:

- Variables for calibration frequencies.
- Variables for allowable bench drift (i.e., how much drift does the EIS allow prior to determining there is a problem).
- Variables for determining how often or severe a problem must be prior to locking the unit out.
- Variables for 'self correction' (i.e., if an EIS was on a more frequent calibration schedule, but the problem that caused the more frequent calibration schedule was no longer present).

The variables shall be accessed through the Quality Assurance (QA)/State menu. When data is being stored or accessed, the computer shall display a message indicating that the disk is in operation and the EIS shall not be moved or disturbed. Following each disk

read/write operation, the hard disk read/write head shall be moved to a safe position and parked.

### **3.2.2 Boot-up Configuration**

On each POWER ON, the EIS shall automatically self-diagnose all computer systems, including memory checking, hard disk and loading of all necessary operating software without technician intervention. If any corruption is found on the hard disk during the hard disk check and if check files are saved (usually saved as \*.chk files), then the check files must be deleted so that the hard disk will not contain an excessive number of these files. Upon satisfactory computer component checkout (including hard disk data structures), the application software shall present a menu of available EIS operations. All offered features shall be menu-driven. For smog check related features, context-sensitive, on-line help shall be provided which can be accessed preferably with a single keystroke or mouse click.

### **3.2.3 Software Modifications and Software Update Certification**

Periodic software updates will be necessary. Software updates may be required by the BAR or the manufacturer. In either case, the manufacturer shall submit the software to BAR for testing and approval (see §3.2.3 (d), below). After receiving approval, the manufacturer is responsible for installing the software in their respective EIS units throughout the state. The cost of the software update is the responsibility of the EIS owner if the software update is required by the BAR, and is the responsibility of the manufacturer if they require the update. (Software update costs are not required to be included as part of the EIS cost.)

Updates to the software specifications will be provided to the manufacturers by the BAR. The manufacturers shall provide the software code to the BAR upon each update. The software version number is to be indicated on the EIS status screen, on each vehicle test record and the VIR. The version number shall consist of a four digit numeric code to be made up of the last two digits of the year, followed by a two-digit version number.

All software updates shall cause the software version number to change. There will be a separate field in the test record indicating the software version currently in use and another field used to indicate the version number that the software will be updated to when its activation date is reached. This will permit the BAR to search the records prior to the update activation date to determine how many EIS units have been updated by looking at the update field. The update field in the test record shall go blank when the update is activated.

Areas in the software where changes or additions might be required include: preconditioning procedures and emission test sequences (as applicable for ASM and two-speed idle tests), various lookup tables, functional tests, diagnostic and repair procedures, data communication procedures, criteria affecting emission standards selection or referral of failing vehicles to a Referee/STAR-Certified Station, vehicle exemptions, capability to read on-board diagnostics fault codes and vehicle pass/fail criteria. Other areas not specifically mentioned may also be impacted at some point, but we do not expect to request changes in all these areas at once.

To maintain the integrity of California's Inspection and Maintenance (I/M) program, QA and BAR field personnel will be instructed to lock out EISs that have unauthorized modifications or are running unapproved software versions. The following criteria apply to software and hardware updates:

- a) Only BAR-approved software shall be used in an EIS. BAR intends to accommodate software developed by third parties as long as system security and integrity are not compromised. In addition, the BAR may initiate the development of software updates by third parties for use in all EISs. If BAR initiates development of a software update, manufacturers shall cooperate with BAR and/or a BAR-approved third party. (This section does not prohibit manufacturers from charging reasonable fees for software updates or from requiring nondisclosure agreements when software updates are developed by third parties.)
- b) All proposed software updates shall be thoroughly tested by the manufacturer before being submitted to the BAR. Updates shall be encrypted in a manner approved by the BAR. The EIS shall be capable of accepting software updates via CD, USB drive or remote server connection.
- c) All proposed software updates generated by the manufacturer shall be submitted to the BAR with a written description of the reason for the update, such as the problem that the update corrects.
- d) Manufacturers shall submit software updates to BAR for testing and approval as follows:
  1. Software updates must be submitted on a mutually agreed upon medium.
  2. Each new software version submitted to the BAR, including minor revisions, must have a new and unique software version number.
  3. All proposed software updates must be accompanied by a cover letter with the following information:
    - i. A description of all of the changes contained in the proposed software update, including manufacturer-initiated modifications.
    - ii. A timeline of when the update is expected to be installed (start to finish) and how many units will be updated.
    - iii. If any hardware modifications or special procedures are needed to perform the software update, describe the procedures for performing the update.
  4. All submitted software updates for the EIS must be accompanied by manufacturer-generated test data containing at least 74 total records for both ASM and Two-Speed Idle tests as shown in Table 1 below. BAR may require the completion of BAR supplied 'test scripts' instead of the tests listed below. BAR will determine if the 'test scripts' must be completed instead of the tests listed below prior to software submittal.

TABLE 1 - REQUIRED TEST RECORDS

TEST RECORDS	# OF RECORDS	
	ASM	TSI
PASS	5	5
FAIL (HC, CO, NO)	5	0
FAIL (HC, CO)	2	5
FAIL (HC, NO)	2	0
FAIL (CO, NO)	2	0
FAIL (ECS Visual)	2	4
FAIL (Functional)	2	4
FAIL GP (HC, CO, NO)	5	0
FAIL GP (HC)	3	4
FAIL GP (CO)	3	4
FAIL GP (NO)	3	0
FAIL GP (HC, CO) W/ REPAIRS	3	5
FAIL GP (HC, NO)	3	0
FAIL GP (CO, NO)	3	0
TAMPER (ECS Visual)	5	5
<b>TOTAL RECORDS</b>	<b>48</b>	<b>38</b>

- i. The manufacturer-generated test data shall also contain at least 20 complete calibration records - (10 complete three-day calibrations; 5 EIS gas calibration; 3 dynamometer calibration and 2 fuel cap tester calibration).
  - ii. The records must be generated by the EIS and should include all items required.
5. Depending on the type and number of changes contained in the proposed software update, the BAR may require testing at BAR-approved beta sites prior to release of the software. BAR will perform a preliminary review of the proposed software prior to releasing it for beta site testing.

- e) Pursuant to Health and Safety Code §44036, manufacturers are allowed six months from the date the BAR issues its proposed specifications for periodic software updates, to obtain approval that the updates meet the proposed specifications and to install the updates in all EIS subject to the updates. During the first 30 days of the six-month period, the manufacturers shall be permitted to review and to comment upon the proposed specifications. However, a shorter period of time may be required by the BAR upon finding that a previously-installed update did not meet the specification. A manufacturer's failure to furnish or install software updates as so specified is cause for the BAR to decertify the manufacturer's EIS Certification or to issue a citation and civil penalty up to \$1,000 per day that the manufacturer fails to furnish or install the software and hardware updates by the specified period. *(The BAR may allow additional time to review and comment and/or submit software updates if they are more complex.)*
- f) Software updates must correct all previously identified software problems.
- g) The software must be able to run on all certified BAR97 hardware configurations in the field for that manufacturer.

#### **3.2.4 Running Changes and Other Software Modifications**

Any changes to design characteristics, component specifications and any modifications to the software must be approved by BAR. It will be the manufacturer's responsibility to confirm that such changes have no detrimental effect on the performance of the EIS.

#### **3.2.5 Virus Detection Software**

Each EIS unit shall contain a virus detection program, subject to BAR approval, which shall verify the integrity (i.e. check for infection/corruption) of each update of the USB drive installation before it is applied to the EIS or allowed in memory.

Infected/corrupted software shall be blocked from installation.

In lieu of this requirement, the EIS manufacturer may submit for BAR's consideration written procedures clearly illustrating how the EIS manufacturer intends to meet the intent of the VIRUS PROTECTION PROGRAM requirement. These procedures shall demonstrate how the integrity of the EIS software and update software or decompressed file shall be protected under all circumstances.

#### **3.2.6 Directory and File Structure**

**(This information is confidential and may only be released with prior written consent from the BAR Engineering Section.)**

#### **3.2.7 Vehicle Look-Up Table (VLT)**

- a) The Vehicle Lookup Table is the BAR's version of the EPA/Sierra Lookup Table (ESLT). The VLT provides basic vehicle descriptions as well as ASM testing parameters, including single-axle dynamometer compatibility data. The VLT includes emission cutpoints exception information for some vehicles.

- b) The table will be periodically revised on a "by-record" basis, or by a complete table replacement. The EIS shall send the version date and the number of records in its VLT file to the VID during any "Begin-Test" or "Data-Refresh" communications session.
- c) The software must be able to store a minimum of five complete VLTs in addition to the active VLT. The manufacturer can determine how to load the additional VLTs onto the analyzer. The additional VLTs will follow the following naming convention: VLT1, VLT2, VLT3, etc. The files may be compressed if necessary. The software must not delete the additional VLT files if one of the files is copied into the active VLT file. The additional VLTs will be activated once the appropriate VLT update is received from the VID.
- d) When a "VLT Update" file is received from the VID, the EIS shall store the file to the hard drive until a period of relative inactivity (e.g. between Smog Check inspections). VLT.DAT file update strategies shall be proposed by each EIS manufacturer and be approved by BAR.
1. When a VLT update file is received from the VID that contains a VLT record where the data in the make = "VLTxxx" (the xxx will be a number so the make will be in the form of VLT1, VLT2, etc.) the software must process the VLT update as follows:

The software must replace the current VLT file loaded on the analyzer with the preloaded file that has the same name as data in the make column of the VLT record received from the VID. The software must update the REC\_LIST.DAT file with the appropriate version date and record count once the new VLT file has been loaded.

If the VID sends a VLT file (comprising a single row) that has data in the make column = "VLTxxx" (identifying a file name) and the software does not have a preloaded VLT file with that name, the software must ignore the VLT data sent by the VID and not attempt to perform any type of VLT update.

The software must ignore any trailing spaces in the VLT make data prior to searching for a matching preloaded VLT file.

When the make in the VLT record is not equal to "VLTxxx" the software must process the VLT update records as follows:

Each VLT update record will be preceded by a single character and shall be processed as follows:

"C" = replace record (same row ID),  
 "A" = append record (new row ID),  
 "D" = delete record (same row ID).

- e) The VLT Update file may appear to be corrupted if either of the following conditions exist:
1. The version date sent by the EIS does not match any dates stored in the "VLT Update History" table in the VID (second consecutive occurrence).
  2. The number of records in the EIS's VLT.DAT does not match the appropriate number of records for that version date (determined at the VID).

If possible corruption is detected by the VID, the VID will send a lockout to the EIS. The EIS, upon receiving the response bit, shall display the following prompt:

DISPLAY PROMPT:

**THE VLT DATABASE IS CORRUPT. CALL SERVICE.**

If the VLT is corrupt, a lockout shall be set. This lockout can only be cleared by the VID upon replacing the file and the VID has verified that the VLT data has been replaced.

### **3.2.8 Repair Action Information**

The EIS shall display a list of all repair categories and prompt the technician to select the category or categories of the system(s) which were repaired. The technician must be able to return to the list of major categories after each subcategory has been completed without having to hit more than two keys.

All repair actions shall be documented on the vehicle inspection report (VIR), and stored in the repair record. The technician shall be required to sign on the VIR to document the repairs that have been performed to reduce emissions. The tampered vehicle repair cost shall be printed on the VIR and recorded in the *Tampered Repairs (Parts and Labor) Cost* field of the repair record. If further repairs are needed, the estimated cost of the additional repairs shall be printed on the VIR and recorded in the *Estimated Cost of Additional Repairs* field of the repair record.

### **3.2.9 Display**

#### **a) Readability**

The display, when in the test mode, shall be readable at a minimum distance of eight feet in a building that meets OSHA lighting standards for a garage environment. Display contrast and brightness shall be adjustable.

#### **b) BAR Messages**

BAR messages shall be transmitted by the VID to the EIS during all communication sessions except during the network diagnostic routine (loopback). BAR messages will be in text file format. All new messages shall automatically display once immediately after the technician selects Smog Check√√ from the main menu. The messages shall default to print and the technician must press a function key to continue. The EIS shall save the most recent 100 messages and provide an option for later recall and print.

**c) Testing Messages**

During the emissions test, the EIS shall display the word TESTING on the screen. The EIS shall also display messages, if applicable, test mode, vehicle speed, dynamometer load deviation, test time, excessive exhaust dilution, low flow, driver acceleration violations, and engine RPM violations.

**d) Information Not Permitted During Testing**

The EIS shall not display the emission readings during the inspection. (However, during manual mode testing, the readings shall be displayed.)

**e) Print Screen Capability**

The EIS shall have a PRINT feature, which prints any current text or graph displayed on the screen, by depressing no more than three keys. The print feature shall always be active; however, there shall be no print capability during emissions testing.

**f) Engine RPM**

The EIS shall have the capability to display the engine speed up to four digits during the emissions test.

**3.2.10 Pretest/Training Mode**

The EIS shall have a PRETEST/TRAINING MODE feature that will allow technicians and trainees, respectively, go through a Pretest and/or a Training Mode inspection.

The Pretest feature shall allow technicians (trainees are restricted) to pre-screen vehicles for gross polluter status by performing an inspection without officially labeling the vehicle as a gross polluter. The Pretest is not an official test and therefore the EIS shall not issue certificates for passing vehicles. The Pretest shall be performed in the same manner as a Smog Check inspection except as noted. During Pretest, the EIS shall display a message on the screen that the inspection is a "PRETEST INSPECTION" and shall print "PRETEST" on the VIR. For additional VIR information, refer to Pretest sample VIRs.

If the "Invalid Station Type" response bit (bit 53) is received from the VID, the EIS shall display the following prompt, and allow the Pretest to continue.

**DISPLAY PROMPT:**

**THE PRETEST MAY CONTINUE, BUT THIS VEHICLE MUST BE REFERRED TO A REFEREE/STAR-CERTIFIED STATION FOR CERTIFICATION.**

During Pre-Test, the EIS shall not prompt for repair information in accordance with §3.6.20, 3.6.21 and 3.6.22 during Pre-Test.

The Training Mode capability will be used by the manufacturers for training purchasers of the EIS, by EIS owners to train new employees, or for schools to train students. The training mode shall not require the use of a technician's access code or allow access to secured areas of hardware or software and will not communicate to the VID. The display shall show a message throughout the inspection that this is a training exercise and not an official test (no certificates shall be issued). The EIS shall print TRAINING on the VIR.

The training mode test results shall be recorded and transmitted to the VID at the next required communication session (i.e. next Smog Check, data file refresh, etc.). Do not make an "end of test call" to the VID.

### **3.2.11 Inspection Cost Survey**

Once a month, the EIS shall query during an inspection for the cost of a smog check inspection. The EIS shall display the following prompt:

DISPLAY PROMPT:

**ENTER INSPECTION FEE CHARGED FOR THIS TEST (EXCLUDING CERTIFICATE).**

ASM: \_\_\_\_\_  
TSI: \_\_\_\_\_

#### Programming Criteria:

The EIS shall provide two five-character numeric fields (XX.XX) to enter the fees the station charges for the ASM and TSI inspections. The EIS shall store the inspection cost information in the inspection cost data file and transmit the file to the VID upon next VID communication transaction.

### **3.2.12 Configuration Information**

The EIS shall receive configuration information from the VID. The following items will be in the configuration information file:

- 1) Drive configuration information (Y/N). See §3.6.9 b).

Note: The EIS shall record the current status (Y/N) of the Drive Configuration to the Drive Configuration routine activated field of the test record.

- 2) Collect second-by-second information (Y/N). If "Y," then the EIS shall collect and send the secxsec data as per §3.6.12 c). If "N," then the EIS shall discontinue collecting and sending the secxsec data.
- 3) ASM activation (Y/N/B). [B = Basic area configuration]

If "Y," then all vehicles shall receive either an ASM or TSI inspection as per this specification.

If "N," then the EIS shall allow the technician to select an ASM or TSI test. The EIS shall display the ASM/TSI test selection prompt prior to any prompts related to dynamometer compatibility. Note: the software shall be able to perform a TSI test without a dynamometer or NO<sub>x</sub> measuring device installed in the EIS.

If "B", then the EIS either perform a TSI inspection or abort the test.

When the configuration is set to "B" the EIS shall perform a TSI test under the following conditions:

1. VID returns anything other than "A" in the *Required Test Type* field of the test record.
2. Off-line test.

When the configuration is set to "B" the EIS shall abort the test under the following conditions:

1. VID returns an "A" in the *Required Test Type* field of the test record.

If an "A" is received in the *Required Test Type* field of the test record the EIS shall display the following prompt then abort the test:

**DISPLAY PROMPT:**

**THE VEHICLE UNDER TEST MUST BE TESTED AT AN  
"ENHANCED AREA STATION," THE SMOG CHECK WILL BE  
ABORTED.**

Note: The EIS shall record the current status (Y/N/B) of the ASM activation to the ASM testing enabled field of the test record.

- 4) RPM limits (low/high, low/high). The EIS shall use the limits in the configuration file for all ASM tests. The order of the RPM limits shall be as follows. The first two numbers shall be the lower limit for engines less than or equal to 3.0L. The next two numbers shall be the upper limit for engines less than or equal to 3.0L. The next two numbers shall be the lower limit for engines greater than 3.0L. The last two numbers shall be the upper limit for engines greater than 3.0L. All limits shall be multiplied by 100 to determine the actual

limit. The lower limit applies to manual transmissions only; automatic transmissions shall use 100 RPM for the lower limit. See §3.6.12.a.12. Example: if the engine size = 5.0L then use the appropriate lower limit in the configuration file times 100 as the lower RPM limit and the appropriate upper limit in the configuration file times 100 as the upper RPM limit.

- 5) Dynamometer scale lockout percentage thresholds (low/high). The EIS shall use these limits to determine if the dynamometer scale is out of calibration. See §3.6.12.a.7.
- 6) Equivalent Test Weight percentage thresholds (low/high). See §3.6.12 a. 4.
- 7) Perform OBD II check (Y/N). If "N", then only perform the visual portion of the OBDII system check. If "Y", then perform the OBDII check as listed in section 3.6.19.4.3.

Note: The EIS shall record the current status (Y/N) of the Perform OBD II check to the Check OBD II field of the test record.

- 8) Fast Pass (Y/N). If 'Y', the EIS shall perform a 'fast pass' during the ASM test if all the 10-second average emission readings are simultaneously below the applicable standards. If 'N', the EIS shall use the final 10-second average emission readings for the overall emission results. The EIS shall default to 'N' if the *fast pass field* is not filled with 'Y' or 'N' in the configuration file. See §3.6.12.d & §3.6.12.e

Note: The EIS shall record the current status (Y/N) of the Fast Pass to the Fast Pass field of the test record.

### 3.2.13 VLT Exceptions

During the "begin test" communication to the VID, if there is a match with the VIN and license plate number, a Vehicle Specific VLT (which provides unique information for the vehicle under test) may be sent to the EIS from the VID. When sent, the information in the VSVLT shall be used instead of the information in the EIS resident VLT. The VSVLT will have the same layout as the VLT. The technician must enter vehicle information not received from the VSVLT.

In most cases, exception vehicles are vehicles that have been identified by the State Referee as having special features, such as an engine change. These vehicles are also identified with a Referee Label Number.

### 3.3 SOFTWARE MODULES

#### 3.3.1 Technician and Station License Numbers and Other Numbers

a) **General:**

The technician's license number and access code shall reside in both the EIS and the VID. The EIS shall determine the validity of the technician's access code, and the VID shall confirm its validity at initial contact.

In addition, the EIS shall not be allowed to go into the inspection mode unless valid entries have been made for station number, PEF value, calibration gas values, certificate numbers, and at least one licensed technician.

The EIS shall have the capacity to store at least 99 technician access codes and 99 corresponding technician license numbers. Only the VID can add, change or delete the technician's access code and corresponding license number. Station and technician license numbers begin with two alpha characters which are followed by six numeric characters.

b) **Technician Access Codes:**

The EIS shall require the technician to enter a special access code before an inspection can begin. The access code shall neither be displayed nor printed on the VIR. This special access code number shall be linked to the technician's license number.

c) **Technician License Numbers:**

A technician's license number reflects the type of license the technician possesses. The EIS shall automatically abort the inspection and display a message indicating that the technician has not obtained the proper license number and/or endorsement from the BAR.

The two alpha characters in the technician license will be one of the following: EA, EO, EB, EI or GU. A description of these licenses can be found in the test record layout.

BAR may require update training prior to performing certain test or repair related activities. A special identifier, not shown on the technician's badge or as part of the license number, will be referred to as an endorsement. Specific endorsements will be developed by the BAR as the need arises. Currently, only the "A" (ASM), "G" (Gaseous Fuel), "B" (Both ASM and Gaseous Fuel) and "N" (None) endorsements exist. Records of these endorsements will reside in the VID and the EIS.

d) **Station License Number:**

The station license number shall be entered into the EIS during initialization. Only valid station license prefixes may be entered into the EIS.

Station license prefixes beginning with an R and C indicate that the station is licensed to test and repair all classes of vehicles; therefore, the EIS must allow tests on light, medium- and heavy-duty vehicles.

Station license prefixes beginning with a T indicate that the station is licensed to test, but not repair, all classes of vehicles; therefore, the EIS must only allow tests on light, medium and heavy-duty vehicles.

Station license prefixes beginning with a D or F indicate that it is a fleet station and licensed to test and repair only those vehicles registered to their fleet.

Station license prefixes beginning with a G indicate that it is a government fleet station licensed to test and repair government fleet vehicles.

Station license numbers that begin with H or K are only licensed to test and repair vehicles over 8500 pounds.

Station license numbers that begin with P or V are only licensed to test vehicles over 8500 pounds.

Station license prefixes beginning with a S indicate that it is a training facility. Training facilities shall be blocked from performing official smog checks; however, training facilities are allowed to perform pretests, and training mode inspections.

Station license prefixes beginning with a Q, Y or Z shall be reserved for future expansion.

Valid entries for the second alpha character of the station license are A-N (A-Z for government fleet stations). The remaining 6 digits are numeric and unique to each station. The station license number shall be placed in the *Station License Number* field of the test record and on the VIR. This field must be populated in the test record for every valid test record sent to the VID.

#### Programming Criteria:

Government fleet stations with license numbers that begin with the alpha character G, shall only be required to make one front-end call to the VID. If the VID has a match, the VID shall transfer the vehicle data to the EIS. However, if a match is not found as a result of the front-end call to the VID, the EIS shall not require the technician to initiate a second call to the VID. The EIS shall allow the inspection to proceed without making a second initial call. The test will default to government fleet vehicle and a certificate will not be issued. (Note: Provisions regarding certificate numbers and certificates purchased as well as lockouts associated with certificates do not apply to government fleet stations.)

Provisions regarding certificate numbers and certificates purchased as well as lockouts associated with certificates do not apply to training facilities.

- e) **Test Record Number**

The EIS shall give each valid test a consecutive number. A valid test consists of a completed test with an overall pass or fail (including a tamper or gross polluter identification) test result that shall be transmitted to the VID. The record number shall be written to *Test Record Number* field of the test record. This field is numeric and has a length of 6 digits. When the number reaches 999999, the number shall be reset to 000001. This field must be populated in the test record for every valid test record sent to the VID.
- f) **EIS Number**

The EIS number shall be unique for each EIS unit in the state of California. The first two characters of the EIS number are alpha. These two characters shall be assigned to each manufacturer upon certification of that manufacturer's EIS unit. The following 6 digits shall be unique to each EIS made by a manufacturer. The EIS number shall be written to the *EIS Number* field of the test record. This field must be populated in the test record for every valid emissions test record sent to the VID. Print the EIS number on the VIR.
- g) **Loaded Software Version Number**

This field shall contain the version number of the software that is currently being used by the EIS. The loaded software version number shall be written to the *Loaded Software Version Number* field of the test record and printed on the VIR. This field must be populated in the test record for every valid test record sent to the VID.
- h) **Update Software Version Number**

This field shall contain the version number of the update software that is currently loaded but not being used by the EIS. *Update Software Version Number* field of the test record must be populated if the EIS has update software loaded. At a predetermined date, the update software shall become the loaded software version, and the old version shall be discarded. After the update software version turns into the loaded software version, the *Update Software Version Number* field shall be blank.
- i) **VID Identification**

The VID-ID is a record identifier generated by the VID. The VID shall assign an ID number to a test record which shall be transmitted to the EIS at the time of the begin test call. The ID will be written to the *VID-ID* field of the test record. The VID-ID shall not be modified by the EIS and shall be transmitted back to the VID during end-of-test contact.

**j) DMV ID Number**

When a certificate is issued, the DMV-ID number shall be printed on the VIR, and written to the *DMV-ID* field of the test record for every passing inspection.

**3.3.2 EIS Lockout Reasons**

The EIS shall be prohibited from performing an inspection for any of the following reasons:

- Clock Lockout
- Warm-up in progress
- Warm-up failure
- Dynamometer warm-up in progress (See Note 3)
- Dynamometer calibration required (See Note 3)
- Dynamometer calibration failure (See Note 3)
- Dynamometer failure (See Note 3)
- Gas calibration required
- Gas calibration failure
- Gas analyzer failure
- Fuel cap tester failure
- Fuel cap tester out of calibration
- Oxygen sensor out of calibration
- Dyno lift failure
- Leak check required
- Leak check failure
- EIS tampering
- Out of certificates (see Note 2)
- Hard disk is full
- USB Drive failure
- Hard disk or disk mechanism failure
- QA/State EIS lockout
- EIS initialization (data missing, incorrect or incomplete)
- No communication with VID in XXX days and XXX tests (see Note 1)
- Station license suspended
- Station license revoked
- Station license expired
- Failure to pay for certificate numbers purchased
- Failure to pay for communications services
- Certificate sequencing error (see Note 2)
- Calibration Gas Cylinder Violation
- State drive tampering
- VLT Corrupt
- Dynamometer scale failure (See note 3)
- Excessive Number of Aborts

**Notes:**

1. This lockout shall be set whenever (xxx inspection) fifty inspections (running total) have been performed by the EIS within five consecutive days without communicating to the VID. The VID sets the no contact limit and number of inspections allowed. The lockout can be cleared by QA/State personnel or by the VID HELP DESK in accordance with pre-established procedures.
2. When BAR commands the VID to send the EIS a no contact limit of “999” tests, the EIS shall require Internet connection to the VID when performing an inspection, both at the begin and end test communication. Also, any existing QA/State lockout shall be cleared by the VID, and a QA/State lockout shall no longer be set when the EIS fails to contact the VID. Anytime the EIS fails to establish communication with the VID, the EIS shall stop the inspection and prompt the user with the message below.

THE EIS MUST BE ONLINE TO PERFORM AN INSPECTION. DO YOU WISH TO RETRY? (Yes/No)

3. Not applicable for government fleet stations, or training facilities.
4. Dynamometer failures shall only prevent ASM inspections; two-speed idle inspections will be allowed to continue. See §3.9 a) for additional detail.

### 3.3.3 Fleet File Number

This field shall serve two purposes:

- a) To record the file or identification number of fleet or military personnel vehicles.
- b) When applicable, to identify a vehicle under test as a government fleet or military personnel vehicle, and as such, to prevent issuance of a certificate upon passage of the inspection.

This field shall contain the government fleet file number, PFR file number or military personnel identification number. The entry can be identified by the first character of the number. The data shall be recorded in the *File Number Storage* field of the test record.

### 3.3.4 Military Personnel Vehicle (Out-of-State)

Before transmitting the VIN/license plate number to the VID, if the vehicle has an out-of-state license plate, the EIS shall prompt the technician to ask if the consumer is seeking California DMV registration as follows:

DISPLAY PROMPT:

**IS THE CONSUMER SEEKING CALIFORNIA DMV REGISTRATION?  
(YES/NO)**

Programming Criteria:

- 1) If YES (consumer is seeking California DMV registration), continue the inspection.
- 2) If NO, determine if the consumer is in California on military assignment.

DISPLAY PROMPT:

**IS THE CONSUMER HERE ON MILITARY ASSIGNMENT? (YES/NO)**

- 3) If YES, the inspection shall continue and the EIS shall build a military personnel identification number and print it on the VIR. The EIS shall store this number in the *File Number Storage* field of the test record. The EIS shall not issue a certificate.

1. Military Personnel Identification Number

Character	Description
1	"M"
8	Last 7 characters of VIN

2. DISPLAY PROMPT:

**NO CERTIFICATE SHALL BE ISSUED FOR THIS VEHICLE.**

- 4) If NO, no inspection is required and the test shall be aborted.

### 3.3.5 Waiver and Hardship Extension

If a vehicle has a previous waiver or hardship extension on record, as indicated by the VID, then the technician shall be prompted to inform the consumer that no repair cost minimum applies if the vehicle fails the inspection. The EIS shall display the following message:

DISPLAY PROMPT:

**THIS VEHICLE HAS A PREVIOUS WAIVER OR HARDSHIP EXTENSION ON RECORD. THE VEHICLE IS NOT ELIGIBLE FOR ANOTHER WAIVER OR HARDSHIP EXTENSION. COST LIMITS DO NOT APPLY.**

If the vehicle has a previous waiver or hardship extension on the record, the EIS shall print the following appropriate message on the VIR:

**THIS VEHICLE HAS A PREVIOUS WAIVER ON RECORD.**

or

**THIS VEHICLE HAS A PREVIOUS HARDSHIP EXTENSION ON RECORD.**

**THE VEHICLE SHALL BE REFERRED TO THE REFEREE/STAR-CERTIFIED STATION FOR ISSUANCE OF A CERTIFICATE OF COMPLIANCE.**

In addition, the EIS shall write "W" for waiver or "H" for hardship to the *Previous Waiver/Hardship Extension Issued* field of the test record and the EIS shall also print the WAIVER/HARDSHIP EXTENSION ELIGIBILITY MESSAGE on the VIR. The EIS shall prohibit issuance of a certificate of compliance if the vehicle has a hardship extension even if the vehicle passes the inspection.

### **3.3.6 Emissions Recall Notice from DMV Records**

The EIS receives emissions-related recall registration block from the VID. This information shall be stored in the *Manufacturer Recall ID (DMV)* and *Manufacturer Date of Recall (DMV)* fields of the vehicle test record. If a repair record exists for the vehicle under inspection, the information shall also be written to the *Manufacturer Recall ID (DMV)* and *Manufacturer Date of Recall DMV)* fields of the repair record.

If information from the VID indicates that a DMV-installed emissions-related recall registration block exists on the test record, and no evidence was provided during the inspection to indicate compliance, then the EIS shall print the following message on the VIR:

**DMV HAS PLACED AN EMISSIONS-RELATED BLOCK ON YOUR VEHICLE REGISTRATION. THE EMISSIONS-RELATED RECALL NUMBER IS XXXXXXXXX (MFR'S RECALL ID). PLEASE CONTACT YOUR DEALERSHIP TO COMPLY WITH THE EMISSIONS RECALL REQUIREMENT.**

### **3.3.7 Applicable Model Years**

1. The EIS shall not accept any vehicle model year older than 1976, or newer than the current calendar year plus two. Any attempt to make such an entry shall cause the EIS to display one of the following prompts:

DISPLAY PROMPT:

**DO NOT TEST VEHICLES OLDER THAN 1976.**

**DO NOT TEST VEHICLES NEWER THAN THE CURRENT YEAR PLUS TWO.**

2. The EIS shall display the following prompt anytime the technician enters a model year that is six or less model-years old.

**VEHICLES LESS THAN SEVEN YEARS OLD ARE EXEMPT FROM BIENNIAL SMOG CHECKS, EXCEPT DIESELS. DO YOU WISH TO CONTINUE? (Yes/No)**

Programming Criteria:

1. If "YES", the EIS shall continue with the inspection. If "NO", the EIS shall abort the inspection. In either case (YES/NO), the EIS shall prompt as follows:

**ALL DIESEL-FUELED VEHICLES AND 2000 MODEL YEAR AND NEWER GASOLINE-FUELED VEHICLES THAT ARE OBDII EQUIPPED MUST BE TESTED USING THE OIS. DO YOU WISH TO CONTINUE? (Yes/No)**

Programming Criteria:

If "YES", the EIS shall continue with the inspection. If "NO", the EIS shall abort the inspection.

### **3.3.8 Vehicle Information Entry**

The full name of each vehicle make must be displayed and printed on the VIR, but only the first five characters of each make name shall be recorded on the test record. Based on the VIN, license plate number (and vehicle registration zip code), the VID (given a match) shall download the vehicle make, model name, model year, engine size, number of cylinders, transmission type, certification type, vehicle type, inspection reason, fuel type, vehicle test parameters and, if applicable, GVWR, fleet file number, referee label number, engine make and engine year. Since the VID does not always have complete information or the EIS to VID communication may have not been successful, the technician may have to enter some or all of this information manually. (See §3.6.6.g)

For each inspection the technician shall always enter the following information: odometer reading, and dual exhaust (if applicable).

### **3.3.9 Underhood Inspection**

The technician shall be required to make an entry for each of the items on the list provided in §3.6.18 before proceeding to the next item. However, if the technician fails to make an entry for every item on the list, then a message shall be displayed indicating that an error was made. Edit capability shall be provided for all entries prior to continuing the inspection. A HELP screen shall also be provided to advise the technician to refer to the vehicle's underhood emissions control system label as the primary source of information to determine what emission control devices are required on a particular vehicle or else use a current emissions control application guide.

### 3.3.10 Emission Standards

The emissions standards category (ESC) tables shall reside in the EIS and receive updates from the VID.

The EIS shall look into the VLT for emission cutpoints. If not available, the EIS shall use the ESC table.

The ESC tables shall also have a version number. Upon implementing the new ESC table, the old version shall be purged. Additional standards categories may be added at a future date.

Based on the vehicle information entered, the EIS shall determine the emissions test standards for the vehicle being tested. For all ASM tests that do not have emission standards in the VLT or VSVLT, the proper ESC category shall be determined as follows:

For vehicles that have a test weight (equivalent test weight, inertia weight class, measured test weight) less than or equal 3750 lbs. and the GVWR is less than 8501 pounds use the appropriate ESC record (based on model year, vehicle type, and GVWR) from TABLE1.DAT. If the vehicle test weight is greater than 3750 pounds, or the GVWR is greater than 8500 pounds use the appropriate ESC record from TABLE4.DAT. If the GVWR is not available select the appropriate table based on the vehicle test weight.

For each vehicle, the ESC will contain HC, CO, and NO Pass/Fail and Gross Polluter values and average emissions for non-polluting vehicles for ASM and two-speed idle tests. Print these emissions values on the VIR. The ESC tables also contain CO + CO<sub>2</sub> dilution thresholds, GVWR and engine speed limits. Emission standard category values and the criteria for selecting categories shall be designed in a manner that allows for easy modification or addition.

Minimum dilution limits shall be determined before the Dilution Correction Factor (DCF) is applied to the emission measurements. Dilution measurements shall be based on the sum of CO and CO<sub>2</sub>. The EIS shall prevent testing if the uncorrected CO + CO<sub>2</sub> value or the engine speed signal are outside the BAR specified thresholds. (Use the value on the ESC table for the minimum dilution limits, except that CNG- and LPG-powered vehicles shall use the table limits minus two. For example, if the minimum CO + CO<sub>2</sub> was 7, the minimum for CNG-powered vehicles would be 5.)

The ESC for the vehicle under test shall be taken from either the *Standard ASM ESC* column or the *Standard TSI ESC* column of the VLT and written to the *Emission Standards Category* field of the test record. The ESC Version number for the vehicle under test shall be left blank, as the *Version Date* column of the VLT is already written to the test record.

### 3.3.11 NO Humidity Correction Factor

Nitric oxide (NO) readings shall be multiplied by the following factor to correct for ambient humidity effects on NO generation in engine combustion.

$$K_h = e^{[0.004977*(H-75)-0.004447*(T-75)]}$$

Where:

$K_h$  = NO Humidity Correction Factor (Note cap HCF at 2.31; if greater than 2.31 use 2.31)

H = Absolute humidity, grains of water per pound of dry air,

T = Temperature degrees Fahrenheit

$$H = \frac{(43.478) \times R_a \times P_d}{P_B - \left( P_d \times \frac{R_a}{100} \right)}$$

$R_a$  = Relative humidity (RH) of the ambient air, percent

$P_d$  = Saturated vapor pressure, mm Hg, at the ambient dry bulb temperature.  $P_d$  vs. temperature data may be extracted from such sources as the Handbook of Chemistry & Physics (CRC Press).

$P_B$  = Barometric pressure, mm Hg

The following factors shall be written to the test record in the ATMOSPHERIC CONDITIONS section: *Relative Humidity, Ambient Temperature, Barometric Pressure, Humidity Correction Factor.*

### 3.3.12 Dilution Correction Factor

The EIS shall apply a DCF to the HC, CO, and NO inspection emissions results. The EIS shall look in the VLT for the minimum dilution threshold of CO + CO<sub>2</sub>. If the minimum dilution threshold does not exist in the VLT, the EIS shall default to 6%, except for vehicles running on CNG or LPG which shall default to 4%. This dilution correction accounts for any exhaust sample dilution, intentional or unintentional, occurring during inspection. The EIS shall calculate the DCF using the following procedure, and shall preselect the formula appropriate to the vehicle's fuel type. If the calculated DCF exceeds 3.0, a default value of 3.0 shall be used. If the DCF falls below 1.0, then a default value of 1.0 shall be used.

- a) Calculate "x" using the EIS measurements of CO and CO<sub>2</sub>:

$$x = \frac{[CO_2]_{meas.}}{[CO_2]_{meas.} + [CO]_{meas.}}$$

where  $[CO_2]_{meas.}$  and  $[CO]_{meas.}$  are the final readings of each mode of the inspection (for example, ASM 5015, ASM 2525, 2500 RPM and idle).

- b) Calculate the  $[CO_2]_{adj.}$  using the following formulas.

For Gasoline

$$[CO_2]_{adj.} = \left[ \frac{x}{4.644 + 1.88x} \right] 100$$

For Methanol or Ethanol:

$$[CO_2]_{adj.} = \left[ \frac{x}{4.73 + 1.88x} \right] 100$$

For Compressed Natural Gas (CNG):

$$[CO_2]_{adj.} = \left[ \frac{x}{6.64 + 1.88x} \right] 100$$

For Liquid Propane Gas (LPG):

$$[CO_2]_{adj.} = \left[ \frac{x}{5.39 + 1.88x} \right] 100$$

- c) Calculate the "Dilution Correction Factor" as follows:

$$Dilution\ Factor = \frac{[CO_2]_{adj.}}{[CO_2]_{meas.}}$$

Corrected HC = Observed HC x DCF

Corrected CO = Observed CO x DCF

Corrected NO = Humidity Corrected NO x DCF

The DCF shall NOT be applied to the CO<sub>2</sub> reading.

The EIS shall apply the DCF to the final emission readings of the inspection to calculate the dilution-adjusted values. The EIS shall then compare the dilution-adjusted values against the vehicle's emission standards to determine the pass/fail or gross polluter status of the vehicle. The dilution-adjusted values shall be the final emission readings for the test vehicle. They shall be printed on the VIR as AMOUNT MEASURED and shall be stored in the test record. The EIS shall record the DCFs on the *DCF - Dilution Correction Factor (ASM5015 or TSI-2500 RPM)* and *DCF - Dilution Correction Factor*

(*ASM2525 or TSI-Idle RPM*) fields on the test record. The values recorded shall be the calculated DCF values, not the default values.

### **3.3.13 Engine RPM Detection**

Based on the vehicle identification information entered by the technician, the EIS may assist the technician in determining which vehicles require a primary pick up, which require that an alternate counting algorithm be used, and which require the use of an auxiliary piece of equipment. Prompts may be provided to assist the technician in locating an RPM signal on vehicles equipped with distributorless ignition systems (DIS).

The EIS shall record the engine RPM simultaneously with the emissions readings. If the EIS does not read engine RPM in the proper range, the EIS shall prohibit continuation of the inspection until proper RPM range has been achieved. (Manufacturers may propose an error tolerance factor to be used when testing vehicles with unstable RPM.)

For 1996 and newer vehicles, the OBD-II SAE standardized connector link shall be capable of providing the tachometer signal. See §3.6.11 for "RPM Signal."

## **3.4 EIS ACCESSORY RECOGNITION**

### **3.4.1 Bar Code Scanner**

The EIS shall detect the presence of the bar code scanner automatically at POWER ON. During the inspection, if the bar code scanner cannot successfully scan, the technician's badge license number (after each attempt), the VIN (after each attempt), the VIN and license plate numbers from the DMV registration document, or the bar code labels from the calibration gas cylinders, a message shall be displayed advising the technician that the bar code is not readable and the technician shall have the option of trying again or entering the necessary information manually. To help ensure the accuracy of manual entry, all bar-coded information (VIN, license plate, etc.) must be entered twice (dual entry method in which entry is not displayed). Dual entry method shall be two-in-a-row correctly entered and both entries must match before the data is accepted. The EIS shall provide prompts on how to manually enter all bar-coded information.

## **3.5 SMOG CHECK MENUS**

The following menus are required. The BAR reserves the right to require modification of any menu if we feel it does not meet the minimum requirements.

### **3.5.1 Main Menu**

The main menu shall display the following options:

1. SMOG CHECK ✓✓

2. REPAIR-ONLY SOFTWARE FUNCTION
3. MANUAL TESTING MODE
4. EIS CALIBRATION MENU
5. STATUS PAGE
6. NETWORK COMMUNICATIONS DIAGNOSTICS
7. PRETEST or TRAINING MODE
8. RECALL PREVIOUS VEHICLE TESTS
9. QA FUNCTIONS
10. STATION MANAGER MENU
11. RECALL BAR MESSAGE

A detailed description of each menu item follows.

### 3.6 SMOG CHECK ✓✓

The EIS shall initiate, run and terminate the I/M inspection sequence in accordance with the BAR-97 EIS specifications.

#### 3.6.1 Technician License Number Entry

The license number shall be obtained by scanning the technician's badge. It must match a license number stored internally in the EIS. The EIS shall not allow license numbers from wall-mounted licenses. The technician's badge contains a bar-coded license expiration date. Whenever a technician scans the badge, the EIS shall verify the license expiration from the expiration date stored in the Technician Information Table. If the license has expired, the EIS shall prohibit the technician from performing an inspection. (If the expiration date in the Technician Information Table is blank, the EIS shall capture the expiration date from the technician's badge and write it to the appropriate location in the Technician Information Table.)

DISPLAY PROMPT:

**SCAN THE BAR CODE ON YOUR TECHNICIAN BADGE OR PRESS ---**  
(function key) **FOR MANUAL ENTRY.**

Programming Criteria:

- 1) If the expiration date from the bar code differs from the expiration date within the EIS, then the date within the EIS takes precedence. If a technician whose license number has expired initiates an inspection, the EIS shall not allow the inspection and shall display the following message:

DISPLAY PROMPT:

**THE TECHNICIAN LICENSE HAS EXPIRED. YOU CANNOT  
PERFORM AN INSPECTION OR REPAIR. CONTACT YOUR LOCAL  
BAR FIELD OFFICE.**

- 2) The validity of a technician's license number and access code will be verified by the VID at the time of initial contact with the VID. If a technician scans a bar-

coded technician license number that is not stored in the Technician Information Table, the EIS shall display the following message:

DISPLAY PROMPT:

**THE TECHNICIAN LICENSE NUMBER IS NOT IN THE EIS. CONTACT YOUR LOCAL BAR FIELD OFFICE.**

- 3) The VID shall install a lockout for licenses that have expired, been suspended or revoked. If the technician's license expiration date information doesn't reside on the EIS, the VID shall send this information to the EIS upon initial contact. If a technician that has an expired license, been suspended or revoked initiates an inspection, the EIS shall display the following message:

DISPLAY PROMPT:

**TECHNICIAN LICENSE HAS BEEN EXPIRED, SUSPENDED OR REVOKED. YOU CANNOT PERFORM SMOG CHECK TESTS OR REPAIRS. CONTACT YOUR LOCAL BAR FIELD OFFICE.**

- 4) In cases where the badge cannot be successfully scanned, the technician shall be given the option of manual entry via the following prompt:

DISPLAY PROMPT:

**ENTER YOUR TECHNICIAN LICENSE NUMBER.**

- 5) The bar code scanner shall be used whenever possible. To help ensure the accuracy of manual entry, the license number must be entered correctly twice (dual entry method). Both entries must match before proceeding with an inspection.

DISPLAY PROMPT:

**BOTH ENTRIES ARE NOT THE SAME - TRY AGAIN.**

- 6) After the technician's license number has been manually entered, the EIS shall display the following message:

DISPLAY PROMPT:

**YOU USED MANUAL ENTRY. IF YOUR BAR CODE SCANNER IS NOT WORKING, PLEASE GET IT REPAIRED. IF YOU DO NOT HAVE A TECHNICIAN BADGE LICENSE, PLEASE CONTACT YOUR LOCAL BAR FIELD OFFICE. BAR WILL INVESTIGATE FREQUENT USE OF MANUAL ENTRY.**

- 7) Technician license numbers shall be two alpha characters followed by six numeric characters. The following technicians are authorized to perform enhanced ASM inspections if they have an ASM update training certification and license

endorsement stored in the Technician Information Table. The initial two alpha characters are as follows (where nnnnnn represents the numeric portion):

EAnnnnnn	Advanced Emission Specialist
EOnnnnnn	Test-Only Technician

The EIS and VID shall also accept a license number that begins with a GU. This license number is only a placeholder for government fleet technicians. The government fleet technicians shall enter the number assigned to them by the BAR. Since bar code scanners are optional for government fleets, manual entry of GU license numbers must be allowed and the display prompt in Item 6) above should not be displayed. Government fleet technicians shall be allowed to perform tests only on government fleet vehicles. There will be no certificate issued to these vehicles. The format is as follows (where nnnnnn represents the technician's personal ID number):

GUnnnnnn	Government Unlimited Technician (Government fleet only)
----------	---

If accepted by the VID and/or EIS, the technician license number shall be written to the *Test Technician License Number* field of the test record.

If an ASM test is required and the technician does not have an ASM endorsement, the EIS shall display the following prompt:

DISPLAY PROMPT:

**TECHNICIAN IS NOT LICENSED TO PERFORM AN ASM INSPECTION. THE SMOG CHECK IS ABORTED.**

- 8) Technician license numbers with the following two alpha characters shall not be allowed to perform enhanced inspections.

EBnnnnnn	Basic Area Technician
EInnnnnn	Intern Technician

- 9) A technician who is licensed to perform inspections only in the Basic Area shall not be allowed to perform tests on Enhanced Area vehicles. In this case, upon connecting to the VID, the VID shall determine, based on the technician's license number and endorsement status, whether or not a technician is licensed to inspect vehicles in an Enhanced Area. If a technician is not licensed to inspect vehicles in an Enhanced Area, the VID shall return the appropriate response to the EIS. The EIS shall display the following message:

DISPLAY PROMPT:

**TECHNICIAN IS NOT LICENSED TO PERFORM AN INSPECTION ON AN "ENHANCED AREA VEHICLE" AND THE SMOG CHECK IS ABORTED.**

- 10) The VID shall transmit technician license numbers, expiration dates and

endorsements to the EIS. The EIS, upon receiving this information from the VID, shall read and store this information in the appropriate locations within the Technician Information Table. Print the technician's name and license number on the VIR.

- 11) In the case of bar code entry, the EIS shall store a B (bar code scanner) in the *Technician License Input Source* field of the test record; otherwise an M shall be stored to indicate manual entry. This field must be populated for every valid test record sent to the VID.
- 12) The EIS shall block intern technicians from performing Smog checks, and pretests. Intern technicians shall be allowed to enter repair data in the repair only software menu.

### 3.6.2 Technician Access Code Entry

After entry of the technician's license number, the EIS shall require manual entry of the technician's access code.

DISPLAY PROMPT:

**ENTER YOUR TECHNICIAN ACCESS CODE.**

Programming Criteria:

1. Do not display actual entries on the screen, instead use X's.
2. The access code must match the code stored internally in the Technician Information Table. The EIS shall allow three attempts to enter a valid access code. Following each of the first two attempts, the following message shall be displayed.

DISPLAY PROMPT:

**YOUR ACCESS CODE IS NOT VALID - TRY AGAIN.**

3. After the third unsuccessful attempt, the EIS shall display the following message:

DISPLAY PROMPT:

**THE ACCESS CODE ENTERED IS NOT VALID. CONTACT THE LOCAL BAR FIELD OFFICE. THE TEST IS ABORTED DUE TO ACCESS CODE FAILURE.**

### 3.6.3 Vehicle Identification Number (VIN) and License Plate Number Entry

The VIN and vehicle license plate number entry shall follow immediately after successfully entering technician access code (i.e., prior to any other data entry). The following display prompts can be displayed on one screen with the ability to scroll through the list and select the appropriate option.

DISPLAY PROMPT:

**SCAN THE BAR CODE ON THE DMV REGISTRATION DOCUMENT. PRESS**  
(function key) **IF NOT AVAILABLE.**

- a) If the technician scans the DMV bar-coded VIN and license plate (scanned entries cannot be edited), the EIS shall proceed to §3.6.3 g).
- b) If the (function key) is pressed, the EIS shall prompt the technician:

DISPLAY PROMPT:

**SCAN THE BAR CODE ON THE VEHICLE FOR THE VIN. IF THE BAR  
CODE IS NOT AVAILABLE, ENTER THE VIN MANUALLY.**

**IF THE VIN EXCEEDS 17 CHARACTERS ENTER THE LAST 17  
CHARACTERS ONLY.**

If manual entry is used, the VIN must be entered using dual manual entry to ensure accuracy. Both VIN entries must match before moving on to the license plate entry. The EIS shall automatically convert letter "I" to number "1" and letter "O" to number "0" as entered by the technician.

DISPLAY PROMPT:

**BOTH ENTRIES ARE NOT THE SAME - - TRY AGAIN.**

**INVALID CHARACTER ENTERED - - TRY AGAIN.**

If fewer than three characters are entered, the EIS shall display the following message:

DISPLAY PROMPT:

**AT LEAST THREE CHARACTERS MUST BE ENTERED - - TRY  
AGAIN.**

- c) After manual entry of the VIN, the EIS shall prompt the technician to manually enter (dual manual entry) the license plate number:

DISPLAY PROMPT:

**ENTER THE LICENSE PLATE NUMBER MANUALLY. DO NOT  
ENTER SYMBOLS OR SHAPES (I.E., DIAMONDS, HEXAGONS, ETC.)**

- d) If fewer than two (2) characters are entered, the EIS shall display the following message:

DISPLAY PROMPT:

**AT LEAST TWO CHARACTERS MUST BE ENTERED - - TRY AGAIN.**

The license plate number must be entered using dual manual entry to ensure accuracy. Both entries must match before proceeding to the next screen. If both entries are not the same, the EIS shall display the following message:

DISPLAY PROMPT:

**BOTH ENTRIES ARE NOT THE SAME - - TRY AGAIN.**

- e) If the vehicle has no license plate, the EIS shall allow the technician to enter NONE. The EIS shall store N in the *License Plate Number* field and print NONE on the VIR. If a repair record exists for this vehicle, the license number shall also be stored in the *License Plate Number* field of the repair record. In addition the EIS shall store XX (unknown) in the *License Plate Issuing State* field of the test record.

DISPLAY PROMPT:

**IF THE VEHICLE HAS NO LICENSE PLATE, ENTER "NONE" FOR THE LICENSE PLATE NUMBER.**Programming Criteria:

1. The bar code scanner shall be used whenever possible. To help ensure the accuracy of manual entry, the VIN and/or license plate number must be entered using dual manual entry.
2. If fewer than 17 characters are entered, the EIS shall display the following message:

DISPLAY PROMPT:

**THE VIN ENTERED HAS FEWER THAN 17 CHARACTERS.  
VERIFY THAT THE VIN ENTERED MATCHES THE VEHICLE'S  
ACTUAL VIN.**

3. The license plate number shall not contain special characters; valid characters are 0-9 and A-Z and shall be limited to 7 characters.
4. The data shall be written to the *VIN* and *License Plate Number* fields of the test record. If a repair record exists for this vehicle, the data shall also be written to the *VIN* and *License Plate Number* fields of the repair record. Print the VIN and license plate number on the VIR.
5. The VIN and license plate number entries are mandatory for every test record. If there is no entry, the EIS shall display the following message:

DISPLAY PROMPT:

**NO VALUE HAS BEEN ENTERED - - TRY AGAIN.**

6. The DMV bar-coded registration document (provided by the motorist) contains a bar code using either code 39 or 128 symbologies. The bar-code scanner must be able to automatically discriminate between the symbologies to ensure that the current information shall be automatically read.

The bar code format for the DMV registration document is defined.

- f) The EIS shall automatically store the source of entry for both VIN and license plate number in the test record as follows:

1. For VIN Input Source field:

D = Bar code on DMV registration document  
V = Bar code on vehicle  
M = Manual entry

This field must be populated in the test record for every valid test record sent to the VID. The EIS shall write the input source in the *VIN Input Source* field of the test record.

2. For License Plate Input Source field:

D = Bar code on DMV registration document  
M = Manual entry

This field must be populated for every valid test record sent to the VID. The EIS shall write the input source in the *License Plate Input Source* field of the test record.

- g) The EIS shall prompt the technician for the vehicle issuing state license plate:

DISPLAY PROMPT:

**SELECT THE LICENSE PLATE ISSUING STATE.**

Programming Criteria:

1. The EIS shall display a list containing the names and abbreviations of the 50 states, District of Columbia, Puerto Rico, Guam, American Samoa, Mexico, Canada, Armed Forces Plate and various locations.
2. The cursor shall default to California. However, under no circumstances

shall the "California" selection be entered into the test record automatically, it must be confirmed by the technician.

3. The technician shall be allowed (by scrolling through the list) to select the one that applies for the vehicle under test. The EIS shall display the following message:

DISPLAY PROMPT:

**SELECT AND ENTER THE "ISSUING STATE" OF THE LICENSE PLATE.**

4. If the vehicle issuing state is unknown, the EIS shall display the following message (on the same screen as the above prompt):

DISPLAY PROMPT:

**IF THE ISSUING STATE IS UNKNOWN, SELECT "XX" FOR UNKNOWN FROM THE LIST OF ISSUING STATES.**

Upon selecting XX, the EIS shall display the following message:

DISPLAY PROMPT:

**YOU HAVE SELECTED XX (UNKNOWN). IS THIS CORRECT? (YES/NO)**

If Y is selected, continue the inspection. If N is selected, display the issuing state list and message:

DISPLAY PROMPT:

**SELECT AND ENTER THE "ISSUING STATE" OF THE LICENSE PLATE.**

5. The EIS shall write the issuing state abbreviation in the *License Plate Issuing State* field of the test record. The issuing state field must be populated for every valid test record sent to the VID. The EIS shall print the full name of the issuing state on the VIR. If there is no license plate or the issuing state is unknown, then "Unknown" shall be entered on the VIR in place of the issuing state.

### 3.6.4 Network Communications

**(This information is confidential and may only be released with prior written consent from the BAR Engineering Section.)**

### **3.6.5 EIS Initiated Actions**

After connecting to the VID, the EIS shall transmit the following data:

- Technician information
- VIN, license plate number, and issuing state
- Test records, if applicable
- Repair records, if applicable
- Calibration records, if applicable
- Certificate purchase request, if applicable
- QA/State inspection records, if applicable
- Request current lockout status
- Inspection cost survey data, if applicable
- VLT version date and number of records

#### **a) Transmit VIN/License Plate**

After the VIN, vehicle license plate number and issuing state has been entered, the EIS shall display the following message:

DISPLAY PROMPT:

**SEARCHING FOR VEHICLE INFORMATION, PLEASE WAIT.**

Programming Criteria:

1. If a vehicle match is found, the VID shall transmit to the EIS applicable information for the vehicle under test, in addition to any other pending transactions.
2. Once a match has been made and the vehicle data or previously failed test data has been transferred from the VID to the EIS unit, the EIS shall not allow changes or corrections to either the VIN or license plate number or issuing state. If changes or corrections must be made to VIN, license and/or issuing state, the test shall be aborted.
3. If NO MATCH is found on the first attempt (note: attempts are counted by the EIS unit) for a California-licensed (non-government fleet vehicle or non-government "G" station) vehicle, then the EIS shall prompt the technician as follows:

DISPLAY PROMPT:

**NO VEHICLE MATCH HAS BEEN FOUND. VERIFY THAT THE VIN AND LICENSE PLATE HAVE BEEN ENTERED**

**CORRECTLY. RE-ENTER THE VIN AND LICENSE PLATE AND PRESS ----- (function key) TO PROCEED.**

4. The EIS shall allow the technician to completely re-scan or re-enter the VIN and/or vehicle license plate number. The EIS shall prompt the technician to press a function key to initiate a second call to the VID.
5. If no changes to the VIN or vehicle license plate number are required, the EIS shall prompt the technician to press a function key to initiate a second call to the VID. However, if the station is a government "G" station, the EIS shall continue WITHOUT making a second begin-test call to the VID.
6. If NO MATCH is found on the second attempt for a California-licensed vehicle, or on the first attempt for a vehicle with an out-of-state license plate number, then the EIS shall proceed with the inspection by prompting the technician to enter required information manually (see Item # 8). For a California-licensed vehicle, the EIS must be able to differentiate between the first and the second NO MATCH message. (A Government Fleet Station is not required to make a second call for a no match condition.)
7. The EIS shall display a message alerting the technicians of their responsibility to advise the consumer that NO MATCH was found with the DMV record or test was performed off-line and that the consumer should retain the VIR for reference during the registration process. This message shall also be printed on the VIR.

DISPLAY PROMPT:

**NO MATCH HAS BEEN FOUND OR TEST HAS BEEN PERFORMED OFF-LINE. THE CONSUMER IS RESPONSIBLE FOR RETAINING THE VIR FOR REFERENCE THROUGHOUT THE VEHICLE REGISTRATION PROCESS.**

8. If a NO MATCH message occurs, the EIS shall enable the technician to enter the test vehicle's description (year, make, model, engine size, etc.) according to §3.6.7.

**b) Transmit Test and/or Repair Records**

All records (inspection, hands-on, training, aborted) that the EIS has created in accordance with the test and/or repair record shall be transmitted to the VID.

DISPLAY PROMPT:

**TRANSMITTING DATA, PLEASE WAIT.**

Programming Criteria:

1. The first record transmitted will be the oldest. After successful transmission, each record shall be moved. The EIS shall retain a minimum of one thousand (1,000) of the most recent records by overwriting the oldest record.
2. If successful communications cannot be achieved (the EIS has not communicated with the VID), then the EIS shall display the following message.

DISPLAY PROMPT:

**CANNOT ACCESS NETWORK. PROCEED WITH THE INSPECTION.**

**c) Transmit Calibration Records**

All calibration records that the EIS has created pursuant to Calibration Test Data shall be transmitted to the VID.

DISPLAY PROMPT:

**TRANSMITTING DATA, PLEASE WAIT.**

Programming Criteria:

1. The EIS shall transmit all calibration records to the VID. The first record transmitted will be the oldest. After successful transmission, the EIS shall delete all of the calibration records from the calibration data file and each record shall append the historical calibration data file. The EIS shall retain a minimum of one hundred (100) of the most recent records by overwriting the oldest record.

**d) Transmit Certificate Numbers Purchase Request**

The EIS shall transmit certificate numbers purchase requests to the VID. The EIS shall allow the Station Manager or Owner through the Station Manager Menu to place a certificate numbers purchase order and transmit it to the VID.

### **3.6.6 Network Responses**

As the low level communication interface protocol makes contact with the VID and establishes a session, the VID will respond with stored transactions and messages (appropriate response bits) which are waiting for transmission to the EIS. These messages are:

- SYSTEM DATE/TIME UPDATE
- LOCKOUT STATUS
- TECHNICIAN(S) TO BE ADDED/CHANGED/DELETED
- PURCHASED SMOG CERTIFICATE NUMBERS
- BAR MESSAGES
- COMMUNICATIONS TRANSACTIONS

- VEHICLE DATA
- PREVIOUS FAILED TEST DATA
- PREVIOUS REPAIR INFORMATION
- VLT ROW ID NUMBER (no longer used)
- VLT UPDATE
- EMISSIONS-RELATED RECALL INFORMATION
- EMISSIONS-RELATED RECALL BLOCK (DMV)
- EMISSIONS-RELATED TSB INFORMATION
- EMISSIONS STANDARDS CATEGORY (ESC) TABLES (1,3 and 4) UPDATE
- PREVIOUS ODOMETER READING
- INSPECTION REASON
- REQUIRED TEST TYPE
- VEHICLE SPECIFIC VLT (VSVLT)
- CONFIGURATION UPDATE
- MESSAGE UPDATE
- ADVISE UPDATE
- EXTENDED PARAMETERS UPDATE (no longer used)

The automatic transaction and message updates will occur on every session initiated by the EIS except during communications diagnostic transactions. The communications interface will provide the EIS application with the appropriate status information to determine which transactions have occurred following VID session initiation.

**a) Receive SYSTEM DATE/TIME UPDATE**

The communication software shall reset the current EIS date/time settings each time contact is made with the VID (except during network diagnostics or loopback). The VID shall pass, via the communication software, the current date/time settings to the EIS. Upon receiving the date and time settings, the date and time received shall serve as the date stamp (date of test) and time stamp (test start time) for the inspection in progress. The EIS shall use the received date and time settings to update the EIS clock. (If the EIS uses other clocks, the EIS shall be required to update the appropriate system clock.) The inspection start date and time stamp for an inspection shall be set in the test record following the receipt of the System Date/Time Update by the EIS just after the initial VID contact. If communication attempts fail for the initial VID contact, the date and time stamp shall be set using the EIS clock.

The date of the test, test start-time and test-end time shall be recorded in the test record in the following fields, as appropriate: *Date of Test*, *Test Start Time* and *Test End Time*. Each of these fields must be populated in the test record for every valid test record. Print the date of the test and test end time on the VIR.

**b) Receive LOCKOUT/TAMPER STATUS**

The status (on/off) of the lockouts and/or tampers shall be transmitted by the VID to the EIS. If a lockout(s)/tamper(s) is set, then subsequent inspections shall be prohibited until the applicable lockout(s)/tamper(s) has been cleared. The VID shall return the state of the following lockout/tamper conditions to the EIS:

- QA/State EIS Lockout
- Cabinet Tampering (see Note 1)
- State Drive (see Note 1)
- Station License Expired
- Station License Suspended
- Station License Revoked
- Failure to Pay for Certificate Numbers Purchased
- Failure to Pay for Communication Services
- Certificate Sequencing Error
- Calibration Gas Cylinder Violation
- No communication with VID in XXX days and XXX tests
- Clock lockout
- VLT Corrupt (self-correcting - cleared upon VID verification of VLT data replacement)
- Excessive Number of Aborts
- Dynamometer scale failure

Note 1:

A tamper is set by the EIS and sent to the VID upon the next communication to the VID. Once the tamper condition has been received by the VID, it can only be cleared via the VID.

If a lockout/tamper has been set, the EIS shall display one or more of the messages shown below:

DISPLAY PROMPT:

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A QA/STATE INSTALLED LOCKOUT BEING SET. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A CABINET TAMPER. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A STATE DRIVE TAMPER. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED SINCE STATION LICENSE HAS EXPIRED. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED SINCE STATION LICENSE HAS BEEN REVOKED. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED SINCE STATION LICENSE HAS BEEN SUSPENDED. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A FAILURE TO PAY FOR CERTIFICATE NUMBERS PURCHASED. CONTACT BAR ACCOUNTING OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A FAILURE TO PAY FOR COMMUNICATION SERVICES. CONTACT MCI HELP DESK FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A CERTIFICATE OUT OF SEQUENCE ERROR. CONTACT MCI HELP DESK FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A CALIBRATION GAS CYLINDER LOCKOUT. CONTACT LOCAL BAR FIELD OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A LOCKOUT FOR TOO MANY SMOG INSPECTIONS WITHOUT VID CONTACT. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE VLT DATABASE IS CORRUPT. CALL FOR SERVICE.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A CLOCK FAILURE. CALL FOR SERVICE.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO EXCESSIVE NUMBER OF ABORTS. CONTACT LOCAL BAR OFFICE FOR FURTHER INSTRUCTIONS.**

**THE SMOG CHECK CANNOT BE PERFORMED DUE TO A DYNAMOMETER SCALE FAILURE. CALL FOR SERVICE.**

- c) **Receive TECHNICIAN(S) TO BE ADDED/CHANGED/DELETED**  
 The EIS shall receive the entire Technician Information File for the station (not individual technician file) from the VID. Technician(s) to be added, changed, or deleted shall be transmitted by the VID to the Technician Information File on the EIS. If the technician already exists (as determined by technician license number), the data received for said technician shall serve as an update. The EIS shall not allow changes to the Technician Information File from the EIS. Technician information can only be changed from the VID. Upon receiving the technician information from the VID, the EIS shall not be required to validate the technician information received from the VID.



e) **Receive BAR MESSAGES**

BAR messages shall be transmitted by the VID to the EIS during all communication sessions except during the network diagnostic routine. BAR messages will be in text file format. All new messages shall automatically display once immediately after the technician selects Smog Check√√ from the main menu. The messages shall default to print and the technician must press a function key to continue. The EIS shall save the most recent 100 messages and provide an option for later recall and print. If the message(s) is not displayed due to power interrupt, aborted test, printer jam, etc., the message(s) shall be displayed the next time the technician selects Smog Check √√ from the main menu. It is the responsibility of the EIS unit to verify that all BAR messages received are displayed AND given the option to print.

Prior to displaying a BAR message(s), the EIS shall display the following prompt:

DISPLAY PROMPT:

**BAR MESSAGES HAVE BEEN RECEIVED. BAR RECOMMENDS THAT THE MESSAGE BE PRINTED FOR FUTURE REFERENCE.**

f) **Receive COMMUNICATIONS TRANSACTION**

The communications data stream, as received from the VID, shall contain the command response status such as NO MATCH, PREVIOUS FAILED TEST RESULTS, REFEREE/STAR-CERTIFIED STATION (restriction), GROSS POLLUTER, ENHANCED AREA INSPECTION, etc.

Data that may be received by the EIS, in addition to the aforementioned, is defined in subsequent sections.

1. If, as a result of the VID response, the vehicle is identified as having a PREVIOUS FAILED TEST RESULT, the EIS shall alert the technician of the failed test results (see subsection (h) for display prompts).
2. If, as a result of the VID response, the vehicle is identified as requiring inspection at a REFEREE/STAR-CERTIFIED STATION (response bit 53), the EIS shall display the following message:

DISPLAY PROMPT:

**PLEASE REFER THIS VEHICLE TO A "REFEREE/ STAR-CERTIFIED STATION." THE SMOG CHECK WILL BE ABORTED.**

3. If, as a result of the VID response, the vehicle is identified as requiring inspection at a REFEREE/STAR-CERTIFIED STATION (response bit 71), the EIS shall display the following message:

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A REFEREE/STAR-CERTIFIED STATION.**

4. If, as a result of the VID response, the vehicle is identified as a GROSS POLLUTER, the EIS shall display the following message:

DISPLAY PROMPT:

**THE VEHICLE UNDER TEST HAS BEEN IDENTIFIED AS A GROSS POLLUTER.**

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A "REFEREE/STAR-CERTIFIED STATION."**

5. If, as a result of the VID response, the vehicle is identified as having been issued a previous waiver, the EIS shall display the following message:

DISPLAY PROMPT:

**THIS VEHICLE HAS A PREVIOUS WAIVER ON RECORD. THE VEHICLE IS NOT ELIGIBLE FOR ANOTHER WAIVER. COST LIMITS DO NOT APPLY.**

6. If, as a result of the VID response, the vehicle is identified as having been issued a previous hardship extension, the inspection can be performed but a certificate will not be issued and the EIS shall display the following message:

DISPLAY PROMPT:

**THIS VEHICLE HAS A PREVIOUS HARDSHIP EXTENSION ON RECORD. THE VEHICLE IS NOT ELIGIBLE FOR ANOTHER HARDSHIP EXTENSION. COST LIMITS DO NOT APPLY.**

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A "REFEREE/TEST-ONLY CENTER."**

7. If response bit 72 is received, display the text named 72\_NOCRT in MESSAGE .DAT and continue on with the test. When response bit 72 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.

8. If response bit 73 is received, display the text named 73\_NOCRT in MESSAGE .DAT and continue on with the test. When response bit 73 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.
9. If response bit 74 is received, display the text named 74\_NOCRT in MESSAGE .DAT and continue on with the test. When response bit 74 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.
10. If response bit 75 is received, display the text named 75\_INFOR in MESSAGE .DAT and continue on with the test. Response bit 75 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.
11. If response bit 76 is received, display the text named 76\_INFOR in MESSAGE .DAT and continue on with the test. Response bit 76 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.
12. If response bit 77 is received, display the text named 77\_INFOR in MESSAGE .DAT and continue on with the test. Response bit 77 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.
13. If a vehicle has been identified as having either a Gross Polluter, Previous Hardship extension, REFEREE/STAR- CERTIFIED STATION inspection, or response bit(s) 72-77 was received, the EIS shall save the information (VIN and restriction type as a minimum) to a file in the EIS before displaying the test restriction information to the technician. This file will contain the 50 most recent records. Prior to continuing with either an off-line or no-match inspection, the EIS shall search this file for a match. The match criteria are based on a match with the VIN. If a match is found, the EIS shall display the appropriate message (per section 3.6.7.a) and a certificate shall not be issued (except for response bits 75-77 which shall not block certificate issuance). In addition, the EIS will still need to search for matches in prior test records for any test restrictions.

**g) Receive VEHICLE DATA**

The following vehicle data in the proper test record format, if available, shall be sent from the VID to the EIS. The EIS shall allow this data set to be verified (if applicable) and confirmed/changed by the technician on a vehicle data review screen (items with an asterisk cannot be changed by the technician. If the "Edit bit" is set, items with a (+) cannot be changed.

- + Model year

- + Vehicle type
- Government fleet BAR file number (if applicable)
- PFR fleet BAR file number (if applicable)
- + GVWR (if applicable)
- + Vehicle make
- + Vehicle model name
- + Number of cylinders
- + Engine size (in liters)
- + Transmission type
- + Certification type
- Referee label number (if applicable)
- \* Registration due date (See Note 1)
- Emissions inspection type
- + Fuel type
- + Body Type (if applicable)
- + Engine make (if applicable)
- + Engine year (if applicable)
- + VLT Row ID Number (no longer used)
- \* Previous odometer reading (See Note 1)
- \* Previous failed test results (if applicable)
- \* Date of failed test (if applicable)
- \* "Gross Polluter" status (if applicable)
- \* "REFEREE/STAR-CERTIFIED STATION" (if applicable)
- \* Previous waiver (if applicable)
- \* Previous hardship extension (if applicable)
- \* Response bit 71-77

GENERAL NOTE: The following vehicle data shall be entered during each Smog Check by the technician, as applicable:

- Current Odometer Reading
- Exhaust Configuration

Note 1. Do not display.

Asterisk (\*) can never be modified by technician.

**h) Receive PREVIOUS FAILED TEST DATA**

Failed vehicle test results from the previous Smog Check inspection (in accordance with the test record) within the past 91 days, shall be sent from the VID to the EIS and shall be displayed to the technician. The EIS shall display the following test result information relative to a vehicle that has failed a previous Smog Check inspection on the screen, and shall provide an option to print.

- Date of Previous Test                      mmddyyyy
- Failed Visual Inspection                  Yes/No
- Failed Tailpipe Emissions                Yes/No

- Failed Functional Checks                      Yes/No

**i) Receive VLT ROW ID NUMBER (no longer used)**

**j) Receive EMISSIONS-RELATED RECALL INFORMATION**

Emissions related recall information, if available from the vehicle manufacturers, shall be sent to the EIS from the VID for use during the inspection. The EIS shall display, and provide the option to print, emission-related recall information in the following format:

Example:

**\*\*\* EMISSION-RELATED RECALL INFORMATION\*\*\***  
*Model Year:*            1982            *Engine Family:*        FAD1.6V6FBC2  
*Make:*                    AUDI            *Recall Initiated:*     06/01/90  
*Engine Size:*           1.6L            *Recall #:*                GL  
*Model:*                   4000            *Source:*                MFR/CARB  
*Class:*                    PC

*Affected Vehicles:*  
 ALL

*Defects:*  
 AIR/FUEL CHECKING PROCEDURES ON EMISSION LABEL ARE NOT  
 CONSISTENT WITH INSTRUCTIONS IN THE REPAIR MANUAL.

*Fix:*  
 REPLACE LABEL. NEW LABEL SHOULD BE WHITE WITH BLACK LETTERS  
 AND SHOULD NOT HAVE AIR/FUEL MIXTURE CHECKING PROCEDURE.

The EIS shall provide the option to scroll through multiple recall notices allowing the technician the option of printing either all of the recall notices or an individual recall by depressing no more than two keys.

The EIS shall also display a prompt to the technician as follows:

DISPLAY PROMPT:

**EMISSIONS-RELATED RECALL INFORMATION SHOULD ONLY BE  
 USED, IF APPLICABLE, ON VEHICLES THAT FAIL THE SMOG  
 CHECK INSPECTION AND ARE NOT REQUIRED TO BE PERFORMED  
 IN ORDER TO ISSUE A SMOG CHECK CERTIFICATE.**

**k) Receive EMISSIONS-RELATED RECALL BLOCK (Provided by DMV)**

If information from the VID indicates that a DMV emissions-related recall BLOCK exists on the vehicle test record (i.e. *Manufacturer Recall ID (DMV)* and *Manufacturer Date of Recall (DMV)* fields are populated), the VID shall transmit

the manufacturer's recall ID and the date of recall to the EIS. The technician shall check for evidence that the recall has been performed and shall enter recall compliance information into the EIS. After display of the Emissions-Related Recall Information and TSB Information (if any), the EIS shall display the following message:

DISPLAY PROMPT:

**HAS THE VEHICLE COMPLIED WITH RECALL REQUIREMENTS?**

If YES, the EIS shall prompt the technician to enter the following information into the EIS (if available) from the Recall Compliance Certificate or Emissions-Recall Underhood Identification Label:

DISPLAY PROMPT:

**ENTER RECALL COMPLIANCE CERTIFICATE NUMBER:**

**ENTER ISSUE DATE OF RECALL COMPLIANCE CERTIFICATE (MMDDYYYY):**

If YES and the required information is not available, the EIS shall allow the technician to press a function key to bypass this screen.

Programming Criteria:

1. Manufacturer's recall ID and recall compliance certificate number must be 1 to 8 alphanumeric characters.
2. The issue date of the recall compliance certificate number must be a valid date.
3. If available, the recall compliance certificate number and the issue date of the recall compliance certificate shall be stored in the *Recall Compliance Certificate Number* and *Issue Date of Recall Compliance Certificate* fields of the repair record. The repair record shall also be populated in the *Manufacturer Recall ID (DMV)* and *Manufacturer Date of Recall (DMV)* fields.
4. If no, then the EIS shall print the following message, including the manufacturer's recall ID, on the VIR:

**DMV HAS PLACED AN EMISSIONS-RELATED BLOCK ON YOUR VEHICLE REGISTRATION. THE EMISSIONS-RELATED RECALL NUMBER (MFR'S RECALL ID) IS XXXXXXXX. PLEASE CONTACT YOUR DEALERSHIP TO COMPLY WITH THE EMISSIONS RECALL REQUIREMENT(S).**

Note: This is not part of the Smog Check pass/fail determination.

**1) Receive EMISSIONS-RELATED TSB INFORMATION**

Emissions-related Technical Service Bulletin (TSB) information, if available, shall be sent from the VID to the EIS for use during an inspection. The TSB Information may contain multiple bulletins. The TSBs are provided as information to assist the technician during the inspection process and will also assist the technician if the vehicle subsequently fails the inspection.

Programming Criteria:

1. The TSB information shall be displayed as follows:
  - i. immediately following the display of Emissions-Related Recall Information (if applicable) or after the initial contact with the VID (if the recall information is not applicable), and
  - ii. prior to printing the VIR, if the vehicle subsequently fails the inspection.
2. If a match is confirmed by the VID, and a TSB is on record, the display prompt and TSB information shall be displayed as follows:  
DISPLAY PROMPT:

**TSB INFORMATION SHOULD ONLY BE USED, IF APPLICABLE, ON VEHICLES THAT FAIL THE SMOG CHECK INSPECTION AND ARE NOT REQUIRED TO BE PERFORMED IN ORDER TO ISSUE A SMOG CHECK CERTIFICATE.**

Example: \*\*\* *EMISSION-RELATED TSB INFORMATION* \*\*\*

*TSB #: 81-4 Make: AM*  
*Reference: Motor TSB Manual Model(s): Concord*  
*Edition: 1981-83 Domestic Model Year (range): 1981*  
*Page #: 23*

*Affected Vehicles:*

*ALL 1981 49-STATE HIGH ALTITUDE AMC CONCORDS WITH FOUR-CYLINDER ENGINE AND M/T.*

*Defects:*

*EGR VALVE CHANGED TO IMPROVE PERFORMANCE.*

*Fix:*

*INSTALL APPROPRIATE EGR VALVE AND FORWARD DELAY VALVE.*

3. The EIS shall provide the option to scroll through multiple TSBs allowing the technician the option of printing either all of the TSBs or an individual TSB by depressing no more than two keys.
- m) **Receive EMISSIONS STANDARDS CATEGORY (ESC) TABLES**  
The EIS shall receive ESC Table updates with version numbers from the VID. The EIS shall receive the entire ESC Tables (not individual categories) if applicable, from the VID. Refer to §3.3.10 .
- n) **Receive INSPECTION REASON**  
The inspection reason will be based on a vehicle's test date and registration due date. The VID will compare the two dates and, based on the difference of days, assign the appropriate inspection reason. The registration due date will be sent down from the VID and shall be recorded in the *Registration Due Date* field of the test record.

Programming Criteria:

1. Inspection reason shall be recorded in the *Inspection Reason* field to the test record and printed on the VIR. The valid entries are listed below:
  - B = Biennial: If the difference is  $\pm 60$  days or less.
  - C = Change of Ownership: If the difference is more than  $\pm 60$  days.
  - I = Initial Registration (Out of State): If the vehicle's license plate issuing state is other than California or unknown.
  - H = Hands-on Test: For use by QA, inspectors or BAR representatives. (The visual and functional inspection will be performed the same as a change of ownership "C").
  - E = Training Mode Test: For use in Training mode inspections. (The visual and functional inspection will be performed the same as a change of ownership "C").
  - Q = Pretest: For use in pre-screening vehicles for gross polluter status without officially labeling the vehicle as a gross polluter. (The visual and functional inspection will be performed the same as a change of ownership "C.")

Note: The inspection reasons listed in Table F (A-Z, and 0-9) will come from the VID and receive the same visual and functional inspection as a change of ownership "C", except reason "G", and "I" which will receive an initial inspection "I", and inspection reason "B" which will receive a biennial inspection.

Note: Inspection reasons Z, and 0 - 9 are for future use.

2. If the inspection reason is B (Biennial), the technician shall be prompted as follows:

DISPLAY PROMPT:

**WILL THE CERTIFICATE BE USED FOR DMV CHANGE-OF-OWNERSHIP TRANSACTION? (YES/NO)**

If NO, proceed with the smog check.

If YES, the EIS shall automatically change the inspection reason to C (change of ownership) and proceed with a change-of-ownership inspection.

3. The EIS shall automatically record the inspection reason as C (and follow inspection procedures for change of ownership inspections) for tests when there is no communication with the VID or no match.
4. If the vehicle has non-California issuing state license plate, the inspection reason shall be "I"; follow the change-of-ownership "C" inspection procedures.
5. If the inspection reason is H (hands-on test), follow special inspection procedures identified in §3.14.8 (Hands-on Test).
6. If the inspection reason is T (Training Mode) follow the special inspection procedures identified in §3.2.10 (Training Mode).

**o) Receive REQUIRED TEST TYPE**

The VID shall make the test type determination for all vehicles tested on-line when a MATCH is found. The required test type will be sent down from the VID in the test record. For vehicles with an appropriate ESC category in TABLE4, the default inspection shall be an ASM test when there is no contact with the VID or when NO MATCH is found.

However, all vehicles without an appropriate ESC category in TABLE4 shall receive a TSI inspection (with or without VID contact or a match).

**p) Receive PREVIOUS ODOMETER READING**

The odometer reading for a vehicle's previous inspection will be sent to the EIS from the VID in the proper test record format and shall follow the display prompt routine and programming criteria set forth in §3.6.7.n. The previous odometer reading shall not be displayed.

**3.6.7 Vehicle Specific Data Entry/Verification**

Vehicle specific data entry or verification is required for items listed below. For all inspections, the following vehicle specific data entry is required: odometer, exhaust configuration. Manual entry of all other vehicle specific data is required when the data is not received from the VID or the VLT.

- Vehicle Model Year

- Vehicle Type
- Vehicle Make
- Vehicle Model Name
- Body Type
- Gross Vehicle Weight Rating (GVWR)
- Certification Type
- Number of Cylinders
- Vehicle Engine Size
- Transmission Type
- Vehicle Odometer Reading
- Vehicle Fuel Type Code
- Dual Exhaust

*a) Off-line Testing: Special Features*

If there is no VID communication, the EIS shall query the test record files stored in the EIS, and the special test restriction file specified in §3.6.6.f.13. If there is a vehicle match, the EIS shall look for any test limitations placed on the vehicle. If the vehicle is required to be tested at a REFEREE/STAR- CERTIFIED STATION (i.e., identified as a gross polluter, previous hardship extension issued, or requires a REFEREE/STAR-CERTIFIED inspection), no certificate will be issued even if the vehicle passes the inspection.

If there is no vehicle match within the EIS, or the vehicle is not required to be tested at a REFEREE/STAR-CERTIFIED STATION (i.e., identified as a gross polluter, previous hardship extension issued, or requires a REFEREE/STAR-CERTIFIED inspection), the EIS shall prompt the technician as follows:

DISPLAY PROMPT:

**THERE IS NO COMMUNICATION WITH THE VID. YOU MAY PROCEED WITH THE INSPECTION, BUT ANY CERTIFICATE ISSUED TO A VEHICLE THAT IS REQUIRED TO BE TESTED AT A REFEREE/STAR-CERTIFIED STATION SHALL BE INVALID.**

**LOOK AT THE CONSUMER'S DMV REGISTRATION DOCUMENT FOR ANY INSPECTION LIMITATIONS (REFEREE/STAR-CERTIFIED STATION INSPECTION REQUIRED). ASK THE CONSUMER IF THE VEHICLE HAS BEEN PREVIOUSLY IDENTIFIED AS A GROSS POLLUTER VEHICLE AT ANOTHER STATION OR HAS BEEN ISSUED A HARDSHIP EXTENSION. IF SO, ADVISE THE CONSUMER THAT THE VEHICLE CAN ONLY BE CERTIFIED AT A REFEREE/STAR-CERTIFIED STATION.**

The following message shall also be printed on the VIR under the "Results Not Transmitted" message for passing inspections:

**IF THIS VEHICLE HAS BEEN IDENTIFIED AS A GROSS POLLUTER OR HAS BEEN ISSUED A HARDSHIP EXTENSION (OR FOR OTHER REASONS REQUIRING A REFEREE/STAR- CERTIFIED STATION INSPECTION), THE CERTIFICATE ISSUED AS A RESULT OF THIS INSPECTION SHALL BE INVALID.**

Programming Criteria:

1. If the vehicle is a previous gross polluter, the EIS shall display the following message.

DISPLAY PROMPT:

**THE VEHICLE UNDER TEST HAS BEEN IDENTIFIED AS A GROSS POLLUTER.**

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A "REFEREE/STAR-CERTIFIED STATION."**

2. If the vehicle has a previous hardship extension issued, the EIS shall display the following message:

DISPLAY PROMPT:

**THIS VEHICLE HAS A PREVIOUS HARDSHIP EXTENSION ON RECORD. THE VEHICLE IS NOT ELIGIBLE FOR ANOTHER HARDSHIP EXTENSION. COST LIMITS DO NOT APPLY.**

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A "REFEREE/TEST-ONLY CENTER."**

3. If the vehicle requires a referee/STAR-certified inspection (response bit 53), display the following prompt, and abort the test.

**PLEASE REFER THIS VEHICLE TO A "REFEREE/STAR-CERTIFIED". THE SMOG CHECK WILL BE ABORTED.**

-

4. If the vehicle requires a referee/STAR-certified inspection (response bit 71), display the following prompt, and continue on with the test.

**THE SMOG CHECK MAY CONTINUE, BUT NO CERTIFICATE WILL BE ISSUED. A CERTIFICATE CAN ONLY BE ISSUED AT A "REFEREE/STAR-CERTIFIED STATION."**

5. If response bit 72 was set, display the text named 72\_NOCRT in MESSAGE.DAT and continue on with the test. When response bit 72 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.
6. If response bit 73 was set, display the text named 73\_NOCRT in MESSAGE.DAT and continue on with the test. When response bit 73 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.
7. If response bit 74 was set, display the text named 74\_NOCRT in MESSAGE.DAT and continue on with the test. When response bit 74 is received, the EIS shall not issue a certificate if the vehicle passes the Smog Check.
8. If response bit 75 was set, display the text named 75\_INFOR in MESSAGE.DAT and continue on with the test. Response bit 75 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.
9. If response bit 76 was set, display the text named 76\_INFOR in MESSAGE.DAT and continue on with the test. Response bit 76 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.
10. If response bit 77 was set, display the text named 77\_INFOR in MESSAGE.DAT and continue on with the test. Response bit 77 is for information only, do not block certificate issuance for passing vehicles, or automatically abort the Smog Check.

***b) Vehicle Model Year***

DISPLAY PROMPT:

**ENTER THE MODEL YEAR.**

**ALL DIESEL-FUELED VEHICLES AND 2000 MODEL YEAR AND NEWER GASOLINE-FUELED VEHICLES THAT ARE OBDII**

**EQUIPPED AND UNDER 14,001 GVWR, MUST BE TESTED USING THE OIS. DO YOU WISH TO CONTINUE? (Yes/No)**

If "YES", the EIS shall continue with the inspection. If "NO", the EIS shall abort the inspection.

Programming Criteria:

1. Model year entries greater than "current calendar year plus two" shall not be allowed.
2. Requires two-character model year entry. The first two digits of the year (i.e., 19 or 20) shall be automated entry, based on whether the value of the number entered by the technician is less than 40 (e.g., technician enters 40, EIS picks 19 and displays 1940; if technician enters 39, EIS picks 20 and displays 2039). If the technician determines that the first two digits established by the EIS are incorrect, (s)he may backspace and re-enter the first two characters. Four-digit model year shall be recorded in the *Vehicle Model Year* field of the test record and printed on the VIR.

3. ERROR MESSAGES:

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**MODEL YEAR IS NOT VALID - TRY AGAIN**

4. The EIS shall display the following prompt anytime the technician enters a model year that is six or less model years old.

**VEHICLES LESS THAN SEVEN MODEL YEARS OLD ARE EXEMPT FROM BIENNIAL SMOG CHECKS, EXCEPT DIESELS. DO YOU WISH TO CONTINUE? (Yes/No)**

Programming Criteria:

If "YES", the EIS shall continue with the inspection. If "NO", the EIS shall abort the inspection.

c) ***Vehicle Type***

DISPLAY PROMPT:

**ENTER THE VEHICLE TYPE:**

**SELECT THE APPROPRIATE VEHICLE TYPE FROM THE LIST BELOW:**

<b><u>CODE</u></b>	<b><u>VEHICLE TYPE</u></b>
<b>P</b>	<b>PASSENGER CAR</b>
<b>T</b>	<b>TRUCK</b>
<b>M</b>	<b>MOTORHOME</b>
<b>G</b>	<b>GOVERNMENT FLEET VEHICLE</b>
<b>F</b>	<b>PFR (PERMANENT-FLEET-REGISTERED) VEHICLE</b>

Programming Criteria:

1. The EIS shall be designed so that only P, T, M, G or F can be entered for this field and if incorrect based on other vehicle data, an error message will be displayed:

ERROR MESSAGE:

**VEHICLE TYPE IS NOT VALID - TRY AGAIN**

2. If the technician indicates that a government fleet vehicle (type G) or PFR vehicle (type F) is being inspected, the EIS shall then ask for the type of fleet vehicle (P, T or M). The actual vehicle type (P, T or M) shall be written to the *Vehicle Type* field of the test record. Print the vehicle type on the VIR.

*i. Government Fleet Vehicle*

The EIS shall then prompt the technician to enter the government fleet file number. The inspection and testing shall be conducted in the usual manner except that no certificate shall be issued. There shall be the display prompt:

DISPLAY PROMPT:

**NO CERTIFICATE SHALL BE ISSUED FOR THIS VEHICLE.**

The EIS shall display a prompt to instruct the technician to enter the government fleet file number (2 alpha and 6 numeric) following entry of the vehicle type. This number shall be printed on the VIR and shall be recorded in the *File Number Storage* field of the test record for BAR data collection purposes. The technician must enter the full eight characters. All government fleet file numbers begin with G.

*ii. PFR Vehicle*

The EIS shall then prompt the technician to enter the PFR file number. The inspection and testing shall be conducted in the usual manner, including the issuance of a certificate upon passage of the inspection. The EIS shall display a prompt to instruct the technician to enter the PFR file number (2 alpha and 6 numeric) following entry of the vehicle type. This number shall be printed on the VIR and shall be recorded in the *File Number Storage* field of the test record for BAR data collection purposes. The technician must enter the full eight characters. All PFR file numbers begin with PF.

**d) *Vehicle Make***

Display prompt for passenger cars and light-, medium- and heavy-duty trucks:

**ENTER THE VEHICLE MAKE:**

**SELECT THE APPROPRIATE MAKE FROM THE LIST. IF THE MAKE IS NOT LISTED, TYPE IN THE FULL NAME OF THE MANUFACTURER. IF IT IS A KIT CAR OR SPECIALLY-CONSTRUCTED VEHICLE, ENTER "SPCN."**

Programming Criteria:

1. If the vehicle type is P or T, display all discrete vehicle makes found for the vehicle's model year in the *Make* field of the VLT, except "DF" (indicates a "default" record).. "Not Listed" and "SPCN" should be added to the end of the list as a selection, or as a separate function available on the screen. If "Not Listed" is selected, the following prompt shall be given:

DISPLAY PROMPT FOR P or T:

**ENTER THE NAME OF THE MANUFACTURER AS SHOWN ON THE DMV REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE WILL BE ENTERED LATER.)**

2. If the vehicle type is an M, the technician shall be advised to select the name of the manufacturer from the displayed list.

DISPLAY PROMPT FOR MOTORHOMES:

**ENTER THE NAME OF THE MANUFACTURER AS SHOWN ON THE DMV REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE WILL BE ENTERED LATER.)**

3. All vehicle make names shall be entered by a method (approved by the BAR) which maximizes user friendliness, preferably via direct cursor

selection or the first few letters of the name. For example, the technician should be able to enter the first letter of the vehicle make which would cause the cursor to go to the first make on the list which would also be highlighted. If that is the correct make, the ENTER key would be pressed. If it is not the correct make, the technician would at least be close and only have to move the cursor a short distance to the right one.

4. If SPCN is entered for the vehicle make, then "R" shall be automatically entered as certification type and the following message shall be displayed:

DISPLAY PROMPT:

**SPECIALY-CONSTRUCTED VEHICLES (KIT CARS) MUST BE REFERRED TO THE REFEREE UNLESS THEY ALREADY HAVE A BAR REFEREE LABEL.**

5. Only the first five characters of the make name shall be recorded on the test record in the *Vehicle Make* field; however, the full name shall be displayed and printed on the VIR.

*e) Vehicle Model Name*

DISPLAY PROMPT:

**SELECT OR ENTER VEHICLE MODEL NAME**

Programming Criteria:

1. If the vehicle type is P or T, display all discrete vehicle models found for the vehicle's make and model year in the *Model* field of the VLT, except "DEFAULT". "Not Listed" should be added to the end of the list as a selection, or as a separate function available on the screen. If "Not Listed" is selected, the following prompt shall be given:

DISPLAY PROMPT:

**ENTER THE NAME OF THE MODEL AS SHOWN ON THE DMV REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE WILL BE ENTERED LATER.)**

2. If the vehicle type is M or the make is SPCN, the EIS shall skip the "Model" entry, and leave the field in the test record blank.
3. The full model name shall be printed on the VIR and displayed on the screen; up to 23 characters shall be provided on the test record in the *Vehicle Model Name* field for vehicle model.

f) ***Gross Vehicle Weight Rating***

The technician shall be required to enter the GVWR only if the vehicle type is T or M, (i.e., not "P") so that emissions standards will be selected properly.

DISPLAY PROMPT:

**ENTER THE GROSS VEHICLE WEIGHT RATING (GVWR) IN LBS. IF GVWR RATING PLATE IS NOT ATTACHED TO THE VEHICLE AND DMV DOCUMENT IS NOT AVAILABLE, ENTER "NONE."**

Programming Criteria:

1. If the technician enters NONE, the EIS shall display:

DISPLAY PROMPT:

**IF THE VEHICLE IS A SMALL SIZE TRUCK, MINI-VAN, SPORT UTILITY OR IS CERTIFIED AS LIGHT-DUTY OR RATED AS A 1/2 TON (FOR EXAMPLE: GM 10 OR 1500 SERIES, DODGE 100 OR 1500 SERIES, OR FORD 100 OR 150 SERIES), ENTER 5999 FOR GVWR.**

**IF THE VEHICLE IS A MEDIUM-DUTY TRUCK OR FULL SIZE VAN OR IS CERTIFIED AS A MEDIUM-DUTY OR RATED AS A 3/4 TON (FOR EXAMPLE: GM 20 OR 25 SERIES OR FORD 250 SERIES), ENTER 8499 FOR GVWR.**

**IF THE VEHICLE IS RATED AS A 1 TON OR LARGER OR IS CERTIFIED AS A HEAVY-DUTY, ENTER 8501 FOR THE GVWR.<sup>1</sup>**

**IF THE VEHICLE IS RATED AS A 1 TON OR LARGER, BUT APPEARS TO HAVE A GVWR LESS THAN xxxx, ENTER 8501 FOR THE GVWR. IF THE VEHICLE APPEARS TO HAVE A GVWR GREATER THAN xxxx ENTER yyyy FOR THE GVWR.<sup>2</sup>**

- a) xxxx is the highest GVWR value in the *maximum GVWR field* in the appropriate ESC category in TABLE4 and yyyy = xxxx +1. Do not display the superscripts in the prompts. If the highest GVWR value in the *maximum GVWR field* in the appropriate ESC category in TABLE4 is less than 8501, do not display the prompt with a superscript of 2. If the highest GVWR value in the *maximum GVWR field* in the appropriate ESC category in TABLE4 is greater than 8501, do not display the prompt with a superscript of 1.
2. If an appropriate ESC category in TABLE4 is not available, the EIS shall prompt the technician to test the vehicle using the two-speed idle test, rather than the ASM test procedure.

DISPLAY PROMPT:

**USE THE TWO-SPEED IDLE TEST.**

3. ERROR MESSAGES:

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**TOO MANY CHARACTERS HAVE BEEN ENTERED - TRY AGAIN**

**GVWR MUST BE AT LEAST 2000 LBS - TRY AGAIN**

4. The GVWR must be printed on the VIR and recorded in the *GVWR* field of the test record.

g) *Certification Type*

DISPLAY PROMPT:

**CHECK UNDERHOOD LABEL FOR CERTIFICATION TYPE:**

**ENTER "C" FOR CALIFORNIA OR 50-STATE CERTIFIED.**

**ENTER "F" FOR FEDERAL-ONLY OR 49-STATE-ONLY CERTIFIED.**

**ENTER "R" FOR VEHICLE WITH BAR REFEREE LABEL.**

**IF THE UNDERHOOD LABEL IS MISSING, AND THE VEHICLE HAS NO BAR REFEREE LABEL, DETERMINE CERTIFICATION TYPE BASED ON THE APPLICABLE EMISSION CONTROL SYSTEMS PRESENT, AND ON MANUALS. IF THE EMISSION CONTROL SYSTEMS APPEAR TO BE IDENTICAL FOR BOTH FEDERAL AND CALIFORNIA CERTIFICATION TYPES, ENTER "C" FOR CERTIFICATION TYPE. IF CERTIFICATION TYPE CANNOT BE DETERMINED OR IF THE VEHICLE IS A GREY MARKET VEHICLE, REFER THE VEHICLE TO THE REFEREE CENTER.**

Programming Criteria:            (*vehicles other than motorhomes*)

1. The EIS shall be designed so that only a C, F or R can be entered by the technician for this field. The BAR/referee label number must be six characters if the first character is an A. The BAR/referee label number must be eight full characters if the first character is an N or I. The certification type and referee label number (if applicable) shall be recorded on the test record in the *Certification Type* and *Referee Label Number* fields. Print the certification type and referee label number (if applicable)

on the VIR. Valid referee label numbers only begin with the letters A, N or I.

2. If F is entered for Certification Type and vehicle is less than or equal to 3 years old, and has less than 7500 miles on the odometer, the EIS shall automatically add an "N" for Certificate of Noncompliance (refer to §3.6.24 for further information) as the last character of the certificate number. For all other circumstances, the EIS shall add a C as the last character of the certificate number.
3. If the technician enters R, the following prompt shall be displayed:

DISPLAY PROMPT:

**ENTER THE BAR REFEREE LABEL NUMBER. IF THERE IS NO LABEL NUMBER, ENTER "N" FOR NONE, PRESS** (function key for continue) **AND REFER THE MOTORIST TO THE REFEREE CENTER.**

The EIS shall be designed to automatically abort the test if the technician enters N and presses continue. However, if a valid BAR Referee Number is entered, the following prompt shall be displayed:

DISPLAY PROMPT:

**FROM THE BAR REFEREE LABEL, ENTER THE YEAR IN WHICH THE ENGINE WAS MANUFACTURED. IF NO YEAR IS LISTED ON THE LABEL, ABORT THE TEST AND REFER THE VEHICLE TO THE REFEREE CENTER**

**ENGINE YEAR: \_\_\_\_\_**

If the technician does not enter an engine year, the EIS shall abort the inspection. If the technician enters an engine year which is three or less years different than the vehicle model year (chassis year or DMV registration year), the EIS shall assume that the engine year is the same as the vehicle model year and shall select the emission standard category in the ESC table appropriate to the vehicle model year, and shall continue with the remainder of the inspection. The engine year will require a two-digit entry. However, the four-digit engine year shall be written to the *Engine Year* field of the test record. See §3.6.7 b) 3 for "year entry" programming criteria.

If the technician enters an engine year which is four or more years different than the vehicle model year (chassis year or DMV registration year), the EIS shall select the emission standard category in the ESC table appropriate to the engine year. If the engine is older than the earliest

applicable ESC, then the standard in earliest applicable ESC listed shall be selected to test the vehicle.

After the technician selects an engine year, the following prompt shall be displayed:

DISPLAY PROMPT:

**ENTER THE ENGINE MAKE FROM THE MFR. BLOCK ON THE BAR REFEREE LABEL.**

**SELECT THE APPROPRIATE MAKE FROM THE LIST BELOW. IF THE MAKE IS NOT LISTED, TYPE IN THE FULL NAME OF THE ENGINE MANUFACTURER.**

A list shall be displayed, based on a query of the Vehicle Make names in the VLT. The first five characters of the engine make shall be written to the *Engine Make* field of the test record.

**4. ERROR MESSAGES:**

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

Programming Criteria:      (*Motorhomes*)

1. If the vehicle being tested is a motorhome (Vehicle Type = M), and if the technician enters a C or an F, for Vehicle Certification Type, the prompt shall be as follows:

**IMPORTANT NOTICE**

**IF THE ENGINE HAS BEEN CHANGED AND THE VEHICLE DOES NOT HAVE A BAR REFEREE LABEL, ABORT THE TEST AND REFER THE MOTORIST TO THE REFEREE CENTER.**

**ENTER THE MAKE AND YEAR OF THE ORIGINAL CERTIFIED ENGINE/CHASSIS CONFIGURATION.**

**CERTIFIED ENGINE MAKE:** (Full Name)

**CERTIFIED ENGINE YEAR:** (4 digits)

2. If the engine year is more than 3 years different from the vehicle model year, the test may not be continued and the following prompt shall be displayed:

**THE ENGINE IN THIS VEHICLE HAS PROBABLY BEEN CHANGED. ABORT THE TEST AND REFER THE MOTORIST TO THE REFEREE CENTER.**

3. If an engine year no more than 3 years different from the model year has been entered, the EIS shall select the ESC appropriate to the engine year. If the engine is older than the earliest applicable ESC (i.e., older than 1966), then the standards in the earliest applicable ESC listed shall be selected to test the vehicle.
4. The technician may type in the full name of the engine make. However, the first five characters will be written to the *Engine Make* field of the test record. The technician shall enter the 2-digit engine year that will be written to the *Engine Year* field. Engine year entries greater than the current calendar year plus two shall not be allowed.
5. Error Messages:

**NO VALUE HAS BEEN ENTERED - - TRY AGAIN**

**ENGINE YEAR IS NOT VALID - - TRY AGAIN**

***h) Vehicle Specific Data for VLT***

The EIS shall refer to the EIS-resident VLT to select the appropriate test weight and load values for vehicles. To access the VLT, the EIS shall search for a match based on the vehicle year, make and model.

Programming Criteria:

1. **VLT Specific Record Selection:** If a match is found based on model-year, vehicle type, make, model, and certification type, the EIS shall display all possible vehicle configurations in a user-friendly manner. The technician shall select the configuration that best matches the vehicle to be tested. The BAR proposed display will include the VLT query inputs at the top of the screen:

MODEL YEAR  
MAKE (DIVISION)  
MODEL

The display is expected to contain the following information for each resultant listing, one-vehicle configuration per line:

BODY TYPE  
NUMBER OF CYLINDERS  
ENGINE SIZE (DISPLACEMENT)  
TRANSMISSION TYPE

## FUEL TYPE

The operator selects one of the records listed and those values are used for the inspection.

2. **VLT Default Record Selection:** If the operator determines that none of the listings match the vehicle being tested, the EIS shall prompt the technician to enter the following additional information: body type, number of cylinders, engine size, transmission type, and fuel type. Default records are identified in the VLT by “DF” in the make column.

For all non-diesel inspections (i.e., fuel type is NOT equal to D): The appropriate record should be selected from those default records that have no fuel type value provided, based on the model-year, body type and the number of cylinders. Default records will contain only “D” or blank values for fuel type..

For all diesel inspections (i.e., fuel type = D): When the fuel type is identified as “D” (diesel), then the model-year, certification type (populated in default records only for diesels), and vehicle type (P, T, or M) will be used to select the correct default record. Vehicle type = M will not be populated in the VLT default records. If “M” is entered, the software shall search for “T” in the vehicle type column, but shall print “M” to the test record. Default records for diesels do not exist for model-years prior to 1998. If a model-year prior to 1998 is being inspected and fuel type “D” is selected, display the following prompt and return to the model-year selection screen:

DISPLAY PROMPT:

**DIESELS OLDER THAN 1998 DO NOT REQUIRE INSPECTION.  
SELECT ANOTHER MODEL-YEAR OR FUEL TYPE, OR ABORT THE  
INSPECTION.**

3. After the correct VLT record has been established, it shall be checked against the appropriate records. If a match does exist, the *Pretest* field of the test record shall be filled with a Y (Yes), otherwise it shall default to N (No).

*i) Body Type*

DISPLAY PROMPT:

**SELECT THE BODY TYPE FROM THE LIST: (display pick list)**

Programming Criteria:

- 1) The EIS shall present a pick list of the vehicle body types to assist the technician in selecting the body type appropriate for the vehicle under test. The EIS shall store the selected body type in the *Body Type* field of the test record.
- 2) For Motorhomes, the "Body Shape" entry in the pick list will be the same as for Full Size Van.

*j) Number of Cylinders*

DISPLAY PROMPT:

**ENTER THE NUMBER OF CYLINDERS; FOR ROTARY ENGINES,  
ENTER AN "R."**

Programming Criteria:

1. The minimum number of cylinders is 1 and the maximum is 16. Any entries outside of 1-16 will be rejected by the system, except that for Rotary engines. For rotary engines the technician shall be prompted to enter an R and the EIS shall store R in the *Number of Cylinders* field of the test record. Print the Number of Cylinders value on the VIR.
2. If the technician enters a 1 or 2, the following message shall be displayed:

**VEHICLES POWERED BY ENGINES WITH 2 OR LESS  
CYLINDERS ARE EXEMPT FROM SMOG CHECK PROGRAM  
REQUIREMENTS.**

**3. ERROR MESSAGES:**

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**NUMBER OF CYLINDERS ENTERED IS NOT VALID - TRY  
AGAIN.**

*k) Vehicle Engine Size*

DISPLAY PROMPT:

**ENTER THE VEHICLE ENGINE SIZE:**

**ENTER THE ENGINE SIZE FOLLOWED BY ONE OF THE  
FOLLOWING CODES.**

<u>CODE</u>	<u>DESCRIPTION</u>
I	CUBIC INCHES
L	LITERS

## C CUBIC CENTIMETERS

### Programming Criteria:

1. The first five bytes shall be the engine size. The last byte shall be the unit used for the engine size, and shall be L for liters, I for cubic inches, or C for cubic centimeters. The EIS shall be designed so that only an I, L or C can be entered for the units. Liter size entries shall be in the format of XX.X. Although the internal storage on the test record in the *Vehicle Engine Size* field is to be automatically converted to liters, the display shall remain in the original units entered. Print the engine size in liters on the VIR.

To convert from cubic inches to liters, multiply by .016387. To convert from cubic centimeters to liters, divide by 1000. Products shall be rounded to the nearest 0.1L. For example, 1550 cubic centimeters shall be 1.6L; 1549 cubic centimeters shall be rounded down to 1.5L.

2. An error message shall be displayed if the technician enters an equivalent engine size greater than 17.0L or smaller than 0.5L. The technician shall be instructed to correct the entry or abort the test. If the vehicle under test is not in the VLT and the engine size entered by the technician is greater than 10.7L, the EIS shall display the prompt:

**ENGINE SIZE IS GREATER THAN 10.7 LITERS. ARE YOU SURE THIS IS CORRECT? (YES/NO)**

3. If yes, the EIS shall accept the entry and continue with the test. If no, the EIS shall revert to the Enter Engine Size screen.
4. The EIS shall make a validity check on the engine size entered by the technician for the particular year, make and model of vehicle being inspected. If the engine size is not found in the VLT, the technician shall be prompted to verify that the correct size was entered. The technician shall be allowed to change the entry or to continue after confirming that the entry is correct.

5. ERROR MESSAGES:

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**ENGINE SIZE OR ENTRY (I, L, OR C) IS NOT VALID FOR THIS YEAR, MAKE AND MODEL OF VEHICLE - TRY AGAIN.**

### *l) Transmission Type*

DISPLAY PROMPT:

**INDICATE THE TYPE OF TRANSMISSION:**

**ENTER "M" FOR MANUAL  
ENTER "A" FOR AUTOMATIC**

Programming Criteria:

1. Record in the *Transmission Type* field of the test record. Print the transmission type on the VIR.

2. **ERROR MESSAGES:**

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**m) *Vehicle Odometer Reading***

DISPLAY PROMPT:

**ENTER THE VEHICLE ODOMETER READING EXACTLY AS SHOWN.**

**DO NOT MAKE ADJUSTMENTS FOR ODOMETER ROLL-OVER.**

**A MINIMUM OF ONE NUMERIC ENTRY IS REQUIRED. DO NOT ENTER THE TENTH'S DIGIT.**

**IF NO ODOMETER READING, ENTER NONE.**

Programming Criteria:

1. If the vehicle has less than 7500 miles and is less than or equal to three years old, is not certified to meet California emission control regulations and the vehicle passes the inspection, the EIS shall cause the noncompliance indicator (consisting of an N) to be written to the last character of the *Certificate Number* field of the test record and printed on the VIR.

2. If the odometer reading is less than the reading received from the VID, display the following prompt:

DISPLAY PROMPT:

**PLEASE VERIFY THE ODOMETER READING.**

**IS THE ODOMETER READING CORRECT? (YES/NO)**

**IF NO, ENTER THE CORRECT ODOMETER READING.**

3. The EIS shall only accept an entry of all numbers or the word NONE in the odometer field. If the technician enters NONE, the EIS shall translate this to 000000 for the *Odometer Reading* field of the test record, display NONE and print NONE on the VIR.
4. If the technician enters an odometer reading higher than 99,000 miles for a vehicle five or less model years old, the following prompt shall be displayed:

**MILEAGE ENTERED IS HIGH FOR THE YEAR OF THE VEHICLE. CHECK THE MILEAGE AND RE-ENTER IF INCORRECT. DO NOT ENTER 1/10ths OF MILES.**

The technician shall be allowed to re-enter the mileage or use a function key to continue if the reading is correct. The EIS shall accept the second entry.

5. If the technician enters an odometer reading of less than 100,000 miles and the vehicle is 15 or more model years old, the following prompt shall be displayed:

**MILEAGE ENTERED IS LOW FOR THE AGE OF THE VEHICLE. CHECK THE MILEAGE AND RE-ENTER IF INCORRECT.**

The technician shall be allowed to re-enter the mileage or use a function key to continue. The EIS shall accept the second entry.

6. ERROR MESSAGES:

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**ODOMETER READING IS NOT VALID - TRY AGAIN**

n) *Vehicle Fuel Type Code*

DISPLAY PROMPT:

**ENTER THE VEHICLE FUEL TYPE CODE:**

**SELECT THE APPROPRIATE FUEL TYPE CODE FROM THE LIST BELOW.**

<b><u>CODE</u></b>	<b><u>FUEL TYPE</u></b>
<b>G</b>	<b>GASOLINE</b>

<b>D</b>	<b>DIESEL</b>
<b>P</b>	<b>LIQUID PROPANE GAS (LPG)</b>
<b>N</b>	<b>LIQUID/COMPRESSED NATURAL GAS (LNG/CNG)</b>
<b>M</b>	<b>METHANOL (greater than 20%)</b>
<b>E</b>	<b>ETHANOL (greater than 20%)</b>

Programming Criteria:

1. Entry of one of the above codes is required. The EIS shall be designed so that only a G, D, P, N, M or E can be entered by the technician for this prompt. The EIS shall default to gasoline.

2. If the technician selects either P or N, then the following prompt shall be displayed:

DISPLAY PROMPT:

**IF THE VEHICLE IS BI-FUELED, ENTER "Y" FOR YES OR "N" FOR NO.**

**IF YES, SELECT APPLICABLE FUEL INFO:**

**PG = LPG bi-fuel engine, operating on gasoline**

**PP = LPG bi-fuel engine, operating on propane**

**NG = LNG/CNG bi-fuel engine, operating on gasoline**

**NN = LNG/CNG bi-fuel engine, operating on LNG/CNG**

3. If NO, the EIS shall accept the vehicle as not bi-fueled (runs on either P or N). The EIS shall not require the fuel cap test to be performed during the manual functional checks.

4. The first character of the test record for this field shall be the fuel type entered. The second byte will be used for bi-fuel LPG, LNG and CNG vehicles. If the technician enters P for the fuel type and indicates that the vehicle is not bi-fuel, the test record would be P. Entries shall be written to the *Fuel Type* field of the test record. Print the fuel type on the VIR.

5. ERROR MESSAGES:

**NO VALUE HAS BEEN ENTERED - TRY AGAIN**

**INVALID ENTRY - TRY AGAIN**

6. If the technician selects either P or N, then the EIS shall look in the technician access data file for the gaseous fuel endorsement. If a B or G exists in the endorsement field, continue on with the inspection. If a B or

G does not exist in the endorsement field, then the EIS shall abort the test and display the following prompt:

DISPLAY PROMPT:

**YOUR LICENSE HAS NOT BEEN ENDORSED TO INSPECT ALTERNATIVE FUEL VEHICLES. THE TEST WILL BE ABORTED.**

7. The EIS shall apply the dilution correction factor for the fuel type selected (see §3.3.12) and shall provide a function key to switch the DCF on/off. (*This programming criterion only applies to manual testing mode.*)

*o) Dual Exhaust*

DISPLAY PROMPT:

**DOES THE VEHICLE HAVE DUAL EXHAUST? (YES/NO)**

Programming Criteria:

1. If the operator answers YES, then the EIS shall prompt the technician to attach the dual probe and hose assembly. Print whether the exhaust is dual or single on the VIR.

DISPLAY PROMPT:

**YOU HAVE SELECTED DUAL-EXHAUST. CONNECT DUAL PROBE AND ASSEMBLY NOW.**

2. If NO, continue the inspection.
3. ERROR MESSAGES:

**INVALID ENTRY - TRY AGAIN**

### 3.6.8 Review Screen

The EIS shall display a summary of all the entered vehicle information. At this point, the technician shall be prompted to verify the data and, if necessary, correct any incorrect entries. However, the information contained from the VLT or VSVLT cannot be edited if the "Edit bit" has been set. The EIS shall display the following prompt if the VLT Edit bit has not been set.

DISPLAY PROMPT:

**IS THIS DATA CORRECT? (YES/NO)**

Programming Criteria:

1. If the technician changes any vehicle data, the EIS shall automatically begin prompting the technician, as necessary, to repeat the vehicle data entry process. However, the VIN, License Plate and Issuing State entries cannot be changed.
2. If the "Edit bit" has been set, the EIS shall not allow any modification to the VLT or VSVLT information, or to the VIN, License Plate and issuing state. The EIS shall display the following prompt:

DISPLAY PROMPT:

**THE VEHICLE INFORMATION RECEIVED FROM THE VID CANNOT BE CHANGED FOR THE VEHICLE UNDER TEST.**

**3.6.9 Emission Test Selection****a) Emission Test Selection**

If fuel-type was identified as "D" (diesel), no tailpipe emissions test will be performed. Bypass ASM or TSI procedures entirely. If fuel-type is not "D", and an appropriate ESC category in TABLE4 is not available, the EIS shall automatically go to the two-speed idle test sequence. The default test in enhanced areas for all vehicles with an appropriate ESC category in TABLE4 shall be the ASM test. If a match was found, the test type to be used will be sent down by the VID. If the VID sends a TSI- requirement, the EIS shall perform a TSI test regardless of the vehicle type. The EIS shall not be able to override a TSI requirement from the VID. If the VID sends an ASM requirement, the EIS may override the ASM test based on the GVWR or drive train configuration (for example: an appropriate ESC category in TABLE4 is not available or nondisengagable all wheel drive.) Note: All inspections in enhanced area without communication to the VID shall default to ASM test except for vehicles without an appropriate ESC category in TABLE4. All inspections in basic area without communication to the VID shall default to TSI test (i.e. units configured without a dynamometer and NO<sub>x</sub> measuring device). See §3.6.6 o) for "Receive Required Test Type."

An entry shall be made in the *Test Cycle* field of the test record indicating test performed (A = ASM, T = two-speed idle, and N = emissions test not performed). The EIS shall display the following prompt:

DISPLAY PROMPT:

**PROCEED WITH (ASM or two-speed idle) TEST.**

Programming Criteria:

1. The EIS shall display the appropriate test information on the screen (test time, engine RPM, vehicle speed, etc.)
2. The technician should be able to abort the inspection by pressing the "Escape" key. If the technician presses the "Escape" key, the EIS shall display the following message:

DISPLAY PROMPT:

**ARE YOU SURE YOU WANT TO ABORT THIS TEST? (YES/NO)**

Programming Criteria:

1. If "NO", the EIS shall continue with the inspection.
2. If "YES", the EIS shall prompt the technician to enter one of the following abort codes prior to aborting the test. The abort code shall be stored in the *Abort Code* field of the test record. The EIS shall print the abort reason on the VIR. The overall test result shall be recorded as an "A" (aborted) and "A" shall be recorded in the Overall Test Result field of the test record.

DISPLAY PROMPT:

**ENTER THE CODE THAT BEST DESCRIBES THE REASON THE TEST WAS ABORTED:**

**ENTER THE APPROPRIATE ESCAPE CODE FROM THE LIST BELOW:**

- |           |   |
|-----------|---|
| <b>01</b> | <b>OIL SYSTEM LEAK OR THE WARNING LIGHT IS ON</b>     |
| <b>02</b> | <b>TRANSMISSION LEAK</b>                              |
| <b>03</b> | <b>COOLANT SYSTEM LEAK OR THE WARNING LIGHT IS ON</b> |
| <b>04</b> | <b>FUEL SYSTEM LEAK</b>                               |
| <b>05</b> | <b>EXCESSIVE EXHAUST SYSTEM LEAK</b>                  |
| <b>06</b> | <b>EXHAUST INACCESSIBLE</b>                           |
| <b>07</b> | <b>SAMPLE DILUTION</b>                                |
| <b>08</b> | <b>ENGINE RPM TOO HIGH</b>                            |

- 09 ENGINE RPM TOO LOW
- 10 EXCESSIVE ENGINE NOISE
- 11 MAINTENANCE WARNING LIGHT ON
- 12 SAFETY PROBLEMS ON VEHICLE
- 13 UNABLE TO KEEP VEHICLE ON THE DYNAMOMETER
- 14 UNABLE TO STABILIZE VEHICLE IN THE REQUIRED TIME
- 15 ACCELERATION VIOLATION
- 16 EXCESSIVE RESTARTS
- 17 BMW/PEUGEOT/VOLVO AUTO TRANSMISSION
- 18 VEHICLE SPEED VIOLATION
- 19 INVALID HUMIDITY
- 20 OTHER
- 21 LPFET ABORT

3. From this point onward, the EIS shall allow the technician to abort the inspection anytime before the overall "Pass/Fail" determination has been made. However, the EIS shall create a record and store test data up to the point where the "Escape" key has been pressed and shall transmit the test record to the VID during the next required communication session (i.e. next Smog Check, data file refresh, etc.). Do not make an "end of test call" to the VID. If the inspection is aborted during the tailpipe emissions testing, the EIS shall print "Invalid" next to the emission readings (HC, CO, NO) on the VIR and record "A" in the *Overall Test Result* field of the test record.

**b) Drive Configuration Routine**

The EIS shall have a drive configuration routine that can be activated/deactivated by the VID.

When deactivated, AWD vehicles (including full-time 4WD and non-disengageable traction control) shall receive an ASM inspection except in the case of an "M" (maybe) VLT entry. In this case abort the ASM test. (see §3.6.12.2).

When activated, the EIS shall use the VLT to determine test type, and if applicable, the previous test record). The VLT entry for *Single Axle Dyno Capability* field will be N for AWD, Y for two-wheel drive, and M for maybe. The following table shows how test type shall be determined by the EIS based on the VLT entry:

VLT Entry:	Y (Yes) = 2WD	N (No) =AWD	M (Maybe)
Inspection Type:	ASM	TSI	Display Prompt

1. If the VLT entry is M, the EIS shall display the following prompt:

DISPLAY PROMPT:

**CAN THE VEHICLE BE TESTED ON A TWO-WHEEL DRIVE DYNAMOMETER? (Yes/No)**

If yes, the EIS shall perform an ASM test.

If no, the EIS shall select TSI and display the following prompt:

DISPLAY PROMPT:

**SELECT THE APPLICABLE DRIVE CONFIGURATION.**

- A. ALL-WHEEL-DRIVE OR FULL-TIME FOUR-WHEEL-DRIVE WITHOUT TRACTION CONTROL**
- B. ALL-WHEEL-DRIVE OR FULL-TIME FOUR-WHEEL-DRIVE WITH TRACTION CONTROL**
- C. NON-DISENGAGEABLE TRACTION CONTROL**
- D. VEHICLE DOES NOT FIT ON THE DYNAMOMETER**
- E. VEHICLE IS TOO HEAVY FOR THE DYNAMOMETER**

Programming Criteria:

- i. The EIS shall require the selection of one item before proceeding.
  - ii. The EIS shall store the appropriate letter (A, B, C, D, or E) to the *Drive Configuration* field of the test record.
2. If the VLT entry is M, and the vehicle has had a previous ASM test on a 2WD dyno (based on *test cycle field* and *dyno configuration field* of the

test record from the previous test record), the EIS shall display the following prompts:

DISPLAY PROMPT:

**PERFORM AN ASM TEST. BE SURE TO DISABLE THE TRACTION CONTROL IF NECESSARY. PRESS (function key) TO CONTINUE.**

**YOU WILL BE PERFORMING AN ASM TEST, IF THE VEHICLE IS NOT COMPATIBLE WITH A 2WD DYNAMOMETER, ABORT THE TEST.**

Programming Criteria:

- i. The EIS shall require the technician to press a function key to continue.
- ii. The EIS shall perform an ASM inspection. The EIS shall store the dyno type (2WD or 4WD) based on the current test in the *Dyno Configuration* field of the test record.
- iii. If the vehicle has not been previously tested ASM on a 2WD dyno, then the EIS shall go to §3.6.9 b.1.

### 3.6.10 Sample System Readiness

- a) The EIS shall be zeroed in accordance with §4.5 a) and b).
- b) The HC hangup check will be done immediately after the EIS is zeroed and the ambient air is sampled. The zeroing is initiated after a smog check has been initiated and the initial VID contact sequence has been successfully or unsuccessfully completed. The whole zero-ambient air-HC hangup sequence runs in background while the technician is entering vehicle information. If the hangup check is not completed before the technician is ready to start the tailpipe test, the EIS shall display the following message:

DISPLAY PROMPT:

**HC HANGUP CHECK IN PROGRESS.**

If the hangup check is not successfully completed in 150 seconds from the start of the hangup check, the EIS shall display the following message:

DISPLAY PROMPT:

**POSSIBLE DIRTY PROBE, HOSE OR FILTER.**

- c) The EIS shall not allow the inspection to continue before the system passes the HC hangup check.

### **3.6.11 RPM Signal**

The EIS shall prompt the technician to select the RPM pick-up type to be used while performing the emissions test (either ASM or two-speed idle). See §3.3.13 for "Engine RPM Detection."

DISPLAY PROMPT:

**SELECT RPM PICK-UP DEVICE:**

- 1. CONTACT**
- 2. NON-CONTACT**
- 3. OBD II PORT**
- 4. OTHER**

Programming Criteria:

- 1) The EIS may provide additional prompts or submenus to guide the technician for proper RPM pickup connection.
- 2) Beginning with the 1996 model year vehicles, the EIS shall be prompted to detect engine RPM via the OBD port.
- 3) The technician shall be given the opportunity to select another RPM pick-up device and continue with the current inspection (without causing test to abort), if the engine RPM is not detected.
- 4) RPM shall be displayed during the emissions test. Instability shall be immediately detected and displayed on the screen.

DISPLAY PROMPT:

**UNSTABLE RPM SIGNAL - - CHECK OR CHANGE PICK UP**

- 5) A stable RPM signal is required to complete the emissions test. Manufacturers may propose an error tolerance factor to be used when testing vehicles with unstable RPM signal.
- 6) For other RPM pick-up device, the EIS manufacturer may develop a unique engine RPM pick-up. If the EIS manufacturer provides this option, a written explanation/procedure regarding this option must be submitted to BAR for approval.

### **3.6.12 ASM (Loaded-Mode) Emissions Testing Sequence**

a) **General Procedure for Both ASM5015 and 2525 Test Modes:**

1. **Safety Checks:** The EIS shall prompt the technician to perform any equipment manufacturer-required safety checks.
2. **Auxiliary Rolls:** The EIS shall prompt the technician to determine if the vehicle being tested requires auxiliary rolls.

DISPLAY PROMPT:

**IS THE VEHICLE EQUIPPED WITH AWD OR FULL-TIME 4-WHEEL DRIVE OR NON-DISENGAGEABLE TRACTION CONTROL? (YES/NO)**

Programming Criteria:

- 1) If YES and according to the information stored in the station information that the emissions inspection system is not equipped with an AWD dynamometer, then the prompt shall read:
 

**DO NOT INSPECT -- REFER THE VEHICLE TO A STATION WITH AN AWD DYNO.**
  - 2) If YES and the dynamometer is an AWD dynamometer, then the EIS shall engage, or if manual, prompt the technician to engage the auxiliary rolls.
  - 3) If NO, the EIS shall proceed with a 2WD dyno configuration.
3. **Drive Axle Weight Measurement and Vehicle Alignment:** The measured drive axle weight will be used to calculate the vehicle loading (the effect of tire loss and the amount of horsepower to be applied based on vehicle test weight) and to determine the appropriate emission standard category. The EIS shall prompt the technician to capture the drive axle weight of the test vehicle and shall display the following message:

**MEASURE THE DRIVE AXLE WEIGHT OF THE TEST VEHICLE.**

Programming Criteria:

- 1) If the drive axle weight is not measured with the vehicle on the dynamometer, prompt the driver to measure the drive axle weight. (This information shall be electronically transferred from the weighing device to the EIS.)

- 2) Prior to measuring an axle, the EIS must see less than 100 pounds before taking the weight measurement.
  - 3) If the drive axle weight is measured on the dynamometer, prompt the driver to:
    - a. Drive the vehicle onto the dynamometer,
    - b. Squarely center the tires on the scale.
    - c. For scales integrated with the vehicle lift, slowly spin wheels to center vehicle on dynamometer.
    - d. Measure and record the drive axle weight.
    - e. Laterally stabilize, restrain, and chock the vehicle.
  - 4) If the vehicle is to be measured on a four-wheel drive dynamometer, both axles must be weighed.
  - 5) When the drive axle or non-drive axle is measured, the EIS must see a minimum of 500 pounds before continuing on with the inspection.
4. **Vehicle Test Weight (VTW) Selection:** Select a test weight based upon the following criteria:

Programming Criteria:

1. Use the ETW value in the VLT when available. If the ETW is not available, use the inertia weight class value (IWC) in the VLT, the vehicle's measured drive axle weight, or the appropriate default weight. See below for specific test weight determination when the ETW is not available.
2. If the ETW is not available in the VLT and the GVWR is less than 8501 pounds, the EIS shall determine the correct Vehicle Test Weight based on one of the following formulas.
  - a. If  $ABS(ADAXWT - MDAXWT) \leq (XX * ADAXWT)$

where:

ADAXWT = Average Drive Axle Weight taken from the appropriate VLT record.

MDAXWT = Measured Drive Axle Weight from the EIS scale.

ABS = Absolute Value

XX = 10% until updated by the Low % Threshold field of the configuration information record.

If yes, then use the IWC in the appropriate VLT record. If no, proceed with step b.

- b. If  $ABS(ADAXWT - MDAXWT) > (XX * ADAXWT)$

Query the technician to determine if the vehicle is carrying an excess load.

DISPLAY PROMPT:

**DOES THE VEHICLE APPEAR TO HAVE AN EXCESS LOAD GREATER THAN 500 POUNDS? (YES/NO) (e.g., load of bricks or camper)**

- 1) If the technician answers "YES," then the IWC from the appropriate VLT record will be assumed to be correct since weighing the whole vehicle will produce inaccurate results.
- 2) If the technician answers "NO" and:

$$ABS(ADAXWT - MDAXWT) \leq (YY * ADAXWT)$$

where:

YY = 30% until updated by the High % Threshold field of the configuration information record.

then the technician shall be prompted to validate the vehicle weight.

DISPLAY PROMPT:

**BASED UPON THE DRIVE AXLE WEIGHT OF THIS VEHICLE, THE TOTAL VEHICLE INERTIA IS ASSUMED TO BE [IWC]. IS THIS WEIGHT CORRECT? (YES/NO)**

- i). If the technician answers "YES" then use the IWC from the appropriate VLT record.
- ii). If the technician answers "NO" then prompt the technician to measure the non-drive axle weight.

$$VTW = [MDAXWT] + [\text{Measured Non-Drive Axle Weight}]$$

- 3)  $ABS(ADAXWT - MDAXWT) > (YY * ADAXWT)$

then the IWC in the applicable VLT record is incorrect. To determine the correct VTW, prompt the technician to measure the non-drive axle weight.

$$VTW = [MDAXWT] + [Measured\ Non-Drive\ Axle\ Weight]$$

- 4) If the ETW, IWC or the measured VTW is less than 2000lbs., the EIS shall use 2000lbs. for the VTW.
3. If an ETW is unavailable and the GVWR is greater than 8500 lbs. the EIS shall use 6000 lbs. for the VTW.

5. **Vehicle Test Weight Data Source:** The EIS shall automatically record the source of entry for the vehicle test weight data in the *Vehicle Test Weight Input Source* field. The entries are as follows:

V = VLT Match (VLT *Equivalent Test Weight*)

D = VLT Default (VLT *Inertia Weight Class*)

M = Measured Weight

F = 2000 lb. default (when the vehicle test weight is less than 2000 lb.)

G = 6000 lb. default (when an ETW is not available and the GVWR is greater than 8500 lbs.)

6. **Restrain the Vehicle:**

DISPLAY PROMPT:

**IS THE VEHICLE A FRONT-WHEEL DRIVE? (YES/NO)**

Programming Criteria:

- 1) If Yes (the vehicle is a front-wheel drive vehicle) or the vehicle is being tested on a four-wheel drive dynamometer, the EIS shall:
- a. Prompt the driver to laterally stabilize, restrain and chock the vehicle on the dynamometer if it has not already been done.

DISPLAY PROMPT:

**FRONT-WHEEL DRIVE VEHICLE: LATERALLY STABILIZE, RESTRAIN AND CHOCK.**

- b. Verify that the restraints are engaged prior to proceeding to the next step.

Note: Provisions must be made to ensure that restraints which control side-to-side movement are used on all front-wheel drive vehicles and that the vehicles are not just tied to some fixed object. If the restraint system does not control forward to backward movement, the EIS must prompt the technician to place wheel chocks or equivalent.

- 2) If No (the vehicle is a rear-wheel drive vehicle), prompt the driver to restrain the vehicle.

DISPLAY PROMPT:

**REAR-WHEEL DRIVE VEHICLE: RESTRAIN**

#### 7. **Axle weight scale calibration verification.**

Each time the EIS measures a drive axle weight, the EIS shall determine if the axle weight is directly comparable to the axle weight listed in the VLT. An axle weight is directly comparable to the VLT axle weight if the vehicle has an ETW listed in the appropriate VLT record.

For each directly comparable drive axle weight (CDAX), the EIS shall determine the measured weight error (DAXERR) according to the following equation:

$$DAXERR = \frac{CDAX - ADAXWT}{ADAXWT} * 100$$

where ADAXWT is the drive axle weight taken from the appropriate VLT record.

The EIS shall maintain a record of the last 30 DAXERRs in the file DAXERR.DAT. If the average of these 30 DAXERRs is greater than XX or less than YY (where YY is assumed to be a negative number), then the EIS shall lock out for inspection until the axle weight scale calibration can be verified by a field service representative. If DAXERR.DAT does not contain 30 records (new EIS or the record was recently cleared), the EIS shall not lock out for drive axle weight scale calibration. The dynamometer scale lockout can be cleared in the service menu, or by the VID. Anytime the dynamometer scale lockout is cleared the EIS shall clear the DAXERR.DAT file.

The field service representative shall, in the process of calibrating the

drive axle weight scale, clear out the DAXERR records.

Note: CONFIG.DAT contains the values for XX, and YY.

Anytime the DAXERR is within 80% of the lockout limits (XX, and YY), the EIS shall display the following warning prompt:

DISPLAY PROMPT:

**THE AXLE SCALE APPEARS TO BE OUT OF CALIBRATION.  
IF THE PROBLEM PERSISTS THE EIS WILL BE LOCKED OUT.**

Note: Prior to displaying the above prompt, the DAXERR file must have 30 records in it

8. **Horsepower Applied During the ASM Cycle:** During the ASM test, the torque will remain constant during each mode of the test. The torque to apply will be derived from the dynamometer-applied horsepower for both the 5015 and the 2525 portions of the test using the following equation:

$$\text{Torque} = 5252 \times [\text{applied hp @ 15 mph}] / [\text{roll RPM}]$$

$$\text{Torque} = 5252 \times [\text{applied hp @ 25 mph}] / [\text{roll RPM}]$$

Dynamometer-applied horsepower for each mode of the ASM loaded-mode test must be calculated using measured vehicle weights if the drive axle weight differs by more than 10% from the value listed in the *Average Drive Axle Weight* field of the VLT. Otherwise, calculate the loading using the appropriate weights located in the VLT.

## 9. Structured Test Drive and Free-Form Test Drive Calculation for Power Applied

$$\text{PAU POWER}_{@ \text{OBS MPH}} = \text{ACC POWER}_{@ \text{OBS MPH/S}} + \text{TRLHP}_{@ \text{OBS MPH}} - \text{GTRL}_{@ \text{OBS MPH}} - \text{LHP}_{@ \text{OBS MPH}}$$

where:

PAU POWER<sub>@ OBS MPH</sub> = Power applied by the PAU to accurately simulate a vehicle during a transient cycle

ACC POWER<sub>@ OBS MPH/S</sub> = Power required to accelerate or decelerate vehicle inertia in excess of dynamometer base inertia = Obsmph \* 5280 / 3600 \* ACC FORCE / 550

Where:

ACC FORCE = E MASS \* ACCELERATION (MPH/SEC) \* 5280 / 3600

Obsmph = Observed vehicle speed

E MASS = The portion of the vehicle mass that must be simulated electrically

E MASS = (VEHICLE WEIGHT - BASE INERTIA) / 32.2

Multiply vehicle weight by 1.015 if two-wheel drive vehicle (for non-drive wheel rotating inertia)

$$\text{TRLHP}_{\text{@OBS MPH}} = \text{Power absorbed by drag on the vehicle} = \text{AV} * (\text{Obsmph}) + \text{BV} * (\text{Obsmph})^2 + \text{CV} * (\text{Obsmph})^3$$

Where:

$$\text{AV} = (\text{AVPF} / 50) * \text{TRLHP}@50$$

$$\text{BV} = (\text{BVPF} / 2500) * \text{TRLHP}@50$$

$$\text{CV} = (\text{CVPF} / 125000) * \text{TRLHP}@50$$

Where:

TRLHP@50 = Track road load horsepower at 50 mph

AVPF = 0.35

BVPF = 0.1

CVPF = 0.55

$$\text{GTRL}_{\text{@OBS MPH}} = \text{Power absorbed at the tire/dyno roll interface} = \text{At} * (\text{Obsmph}) + \text{Bt} * (\text{Obsmph})^2 + \text{Ct} * (\text{Obsmph})^3$$

PLHP<sub>@OBS MPH</sub> = Dynamometer parasitic loss horsepower

#### Programming Criteria:

- 1) If the applied dynamometer horsepower must be calculated, use the following procedure:

Calculate the curve coefficients necessary to properly characterize the tire/roll interface losses.

$A_t = (0.xx/50) \times (\text{GTRL}@50\text{mph})$
$B_t = (0.yy/2500) \times (\text{GTRL}@50\text{mph})$
$C_t = (0.zz/125000) \times (\text{GTRL}@50\text{mph})$
$A_{t8} = (0.76/50) \times (-.378193 + (0.0033207 \times \text{DAXWT}))$
$B_{t8} = (0.33/2500) \times (-.378193 + (0.0033207 \times \text{DAXWT}))$
$C_{t8} = (-0.09/125000) \times (-.378193 + (0.0033207 \times \text{DAXWT}))$
$A_{t20} = (0.65/50) \times (.241645 + (.0020844 \times \text{DAXWT}))$
$B_{t20} = (0.48/2500) \times (.241645 + (.0020844 \times \text{DAXWT}))$
$C_{t20} = (-0.13/125000) \times (.241645 + (.0020844 \times \text{DAXWT}))$

Where:

- $A_t$ ,  $B_t$ ,  $C_t$  are curve coefficients necessary to properly characterize the tire/roll interface losses.
- $A_{t8}$ ,  $B_{t8}$ , and  $C_{t8}$  are curve coefficients when using twin 8.625-inch diameter rolls.

- $A_{t20}$ ,  $B_{t20}$ , and  $C_{t20}$  are curve coefficients when using twin 20-inch diameter rolls.
- DAXWT is the measured drive axle weight.

Coefficients for other roll diameters shall be supplied by dynamometer manufacturers and submitted to BAR for approval.

- 2) Using the curve coefficients established above, determine the GTRL for 15 mph and 25 mph using the following equation:

$$\text{GTRL}_{@Obmph} = (A_t \times (\text{Obmph})) + (B_t \times (\text{Obmph})^2) + (C_t \times (\text{Obmph})^3)$$

Where:

GTRL@Obmph = Generic Tire/Roll Interface losses at the observed mph

- 3) Using the measured drive axle weight (MDAXWT), calculate the applied horsepower as follows:

- a. For 8.65" diameter rolls:

$$\text{THP5015} = \text{VTW}/227$$

$$\text{THP2525} = \text{VTW}/248$$

$$\text{HP50158} = \text{THP5015} - \text{GTRL}_{@ \text{ for 8.65 rolls}}$$

$$\text{HP25258} = \text{THP2525} - \text{GTRL}_{@ \text{ for 8.65 rolls}}$$

- b. For 20" diameter rolls:

$$\text{THP 5015} = \text{ETW}/227 + \text{GTRL}_{@15 \text{ for 8.65" rolls}} - \text{GTRL}_{@15 \text{ for 20" rolls}}$$

$$\text{THP 2525} = \text{ETW}/248 + \text{GTRL}_{@25 \text{ for 8.65" rolls}} - \text{GTRL}_{@25 \text{ for 20" rolls}}$$

10. **Cooling Fan:** The EIS shall prompt the technician to turn on the fan and to place it in position if the ambient temperature is above 72°F. (The EIS may provide the option of automatically turning on the fan from a remote location.)
11. **Probe and Tachometer Hookups:** The EIS shall prompt the technician to insert the sample probe into the tailpipe and attach the selected RPM pick up device pursuant to §3.6.11.
12. **Gear Selection:** The technician shall be prompted, as appropriate, on transmission type:
- i. Automatic Transmissions

DISPLAY PROMPT:

**PLACE THE TRANSMISSION IN DRIVE. IF THE ENGINE RPM EXCEEDS\_\_\_\_\_, PLACE THE TRANSMISSION IN OVERDRIVE.**

Programming Criteria:

The EIS shall prompt the technician to place the transmission in drive. Engine RPM during the test mode shall not exceed the following:

- a. Engine size less than or equal to 3.0L: RPM may not exceed the appropriate upper limit (times 100) in the configuration file (CONFIG.DAT). If the RPM limit in the configuration file is empty, the EIS shall default to 3000 RPM.
  - b. Engine size greater than 3.0L: RPM may not exceed the appropriate upper limit (times 100) in the configuration file (CONFIG.DAT). If the RPM limit in the configuration file is empty, the EIS shall default to 2500 RPM.
- ii. Manual Transmissions

DISPLAY PROMPT:

**PLACE THE TRANSMISSION IN SECOND GEAR.**

**KEEP ENGINE RPM BETWEEN\_\_\_\_AND\_\_\_\_\_.**

Programming Criteria:

The EIS shall prompt the technician to test the vehicle in second gear unless the following criteria cannot be met, then select a gear that will maintain the following engine speeds.

- a. Engine size less than or equal to 3.0L: Greater than or equal to the appropriate lower limit (times 100) in the configuration file, less than or equal the appropriate upper limit (times 100) in the configuration file. If the RPM limit in the configuration file is empty, the EIS shall default to 3000 RPM for the upper limit, and 1500 RPM for the lower limit.
- b. Engine size larger than 3.0L: Greater than or equal to the appropriate lower limit (times 100) in the configuration file, less than or equal to the appropriate upper limit (times

100) in the configuration file. If the RPM limit in the configuration file is empty, the EIS shall default to 2500 RPM for the upper limit, and 1250 RPM for the lower limit.

13. **Tire Drying:** The EIS shall prompt the technician as follows:

DISPLAY PROMPT:

**DO THE TIRES NEED DRYING? (YES/NO)**

Programming Criteria:

- 1) If YES, the EIS shall allow the technician to run the vehicle at any speed below 30 mph after selection of the transmission gear (engine speed may not exceed 3000 RPM). When the roll speed exceeds 1 mph, the screen shall display the following delay message which shall include the seconds that must be waited until the test mode can begin.

DISPLAY PROMPT:

**ONCE THE TIRES ARE DRY, YOU MUST WAIT \_\_\_\_\_ SECONDS PRIOR TO BEGINNING THE 5015 TEST MODE.**

The EIS shall increment the above second timer one second at a time until the rolls are brought to a stop (speed reaches 1 mph or less). If the vehicle speed exceeds 30 mph or the engine exceeds 3000 RPM during tire drying, the timer shall increment twice a second until the speed is brought below 30 mph or the engine speed below 3000 RPM. When the rolls come to a stop, the above timer shall decrement once every second until the time reads zero before the EIS allows the driver to start the 5015 mode.

- 2) If NO, the EIS shall proceed to the next step in the testing procedure.
- 3) The response (Y=Yes, N=No) shall be written to the *Tire Drying* field of the test record. This field shall be filled for all ASM test records. (For two-speed test records, the field shall remain blank.)

**b) ASM Pre-Emissions Test Conditions**

The following conditions must be present before the EIS begins the test sequence:

Programming Criteria:

1. The dilution threshold is within the limits.
2. The EIS does not detect a "low-flow" condition.
3. The engine idle speed is between 400 and 1250 RPM.
4. The dynamometer rolls are not turning (speed <1 mph). If the roll speed exceeds this limit, or the engine speed exceeds 1250 RPM, display the following delay message and increment the displayed seconds by two times the number of seconds the roll or engine speed are outside limits.

DISPLAY PROMPT:

**DELAY TESTING, YOU MUST WAIT \_\_\_\_ SECONDS.**

5. Once the roll or engine speed are within the limits, decrement the time by one second at a time until the number of seconds reaches zero. In addition, the EIS shall not start the test sequence until the dynamometer remains stopped for twice the time that the rolls were turning.
6. Once all conditions have been met, display the following prompt:

DISPLAY PROMPT:

**TESTING CAN BEGIN.**

**c) ASM (Loaded Mode) Emissions Testing Sequence**

Second-by-second data recording shall start from the time the roll speed exceeds 1 mph during the acceleration into the ASM 5015 mode (Mode 1) until the roll speed decelerates to 1 mph at the conclusion of the ASM 2525 mode (Mode 2). This data will be collected, based on the data in CONFIG.DAT. If the test is restarted at any time during the test sequence, the previously stored second-by-second record shall be deleted. The second-by-second data shall be written to the second-by-second data record. The emission levels, without the DCF adjustment, shall be recorded in the second-by-second data record.

The emissions data (HC, CO, CO<sub>2</sub>, NO and O<sub>2</sub> second-by-second readings) for both the ASM 5015 and ASM 2525 modes shall be time-aligned with the vehicle speed readings to account for the delay caused by the transport time needed to get the exhaust gas from the vehicle's tailpipe to the analyzers/sensors. This transport time may be different from the probe to the optical bench and from the probe to the NO and O<sub>2</sub> sensors, and shall be accounted for. The transport times shall be determined by the EIS manufacturer by measuring the transport times of at least thirty EIS's in their final production configuration. These times shall be averaged and used as fixed numbers to be added to the figures based on the response times. Time-alignment shall be done before any corrections (e.g., DCF) are applied. The time-alignment shall be based on the average of the three most recent calibration

records'  $T_{90}$  times for the appropriate gas. Do not use a fixed response time for the various sensors' response times.

**d) 5015 Test Mode (ASM Test Mode 1)**

The EIS shall prompt the technician to accelerate the vehicle to 15 miles per hour. The EIS shall display the 5015 test speed with applicable speed limits (or drive trace graphical display), test time, engine RPM, and other appropriate test mode information. The dynamometer shall smoothly apply the load once the vehicle speed exceeds 10 mph.

The maximum duration for the 5015 test mode is 100 seconds. The beginning of the mode is defined as the time that the vehicle accelerates from rest to  $>1$  mph. The emissions averaging portion of the test shall not begin unless:

- Roll speed is at  $15 \pm 1$  mph for two consecutive seconds.
- Engine speed is within required engine RPM range. The required engine RPM limits are found in the configuration file. If the limits are not in the configuration file, use the following default ranges: 100 - 2500 or 100 - 3000 for automatic transmissions depending on engine size; 1250 - 2500 or 1500 - 3000 for manual transmission depending on engine, refer to §3.6.12 .
- Load and dilution ( $\text{CO} + \text{CO}_2$ ) fall within specifications. (If dyno horsepower loading and dilution remain out of specification for more than two seconds, restart test according to the restart procedures listed in 3.6.12.h.)

The emissions averaging portion may last up to 90 seconds. However, the moving 10-second emissions averaging shall extend to 90 seconds (+ EIS system response time).

If the vehicle has not stabilized in accordance with the above criteria within 25 seconds, the EIS shall prompt the technician to restart the test according to the restart procedures listed later. If the vehicle stabilizes in more than ten seconds and less than 25, the corresponding amount of time beyond 10 seconds shall be subtracted from the 90 seconds emissions-averaging portion of the test.

If the instantaneous dynamometer loading, as measured by the dynamometer load cell, differs from the command load by more than  $\pm 0.25$  hp or  $\pm 2\%$  for more than two consecutive seconds during the emissions averaging portion of the ASM test, the EIS shall set a dynamometer loading error. This shall cause the test mode to restart according to the restart procedures.

If, at any time during the emissions-averaging portion of the test mode, the above criteria fall outside the acceptable ranges, the EIS shall display one of the following appropriate messages to prompt the driver to correct the problem. In

the event of a RPM range violation, the RPM must be monitored as follows: If the engine RPM is above the upper limit or below limit but above 100 RPM for more than five seconds, the test shall restart. If the engine RPM is below 100 RPM for more than 2 seconds, the test shall restart.

DISPLAY PROMPT:

### **OUTSIDE TEST SPEED LIMIT**

### **OUTSIDE ENGINE RPM RANGE**

### **DYNO LOADING ERROR**

### **OUTSIDE DILUTION SPECIFICATION**

As soon as the emission averaging portion of the test mode has begun, start monitoring the vehicle's acceleration every 0.5 seconds. If at any time the acceleration exceeds the limits in the VLT, *Acceleration Excursion Limit* field, the EIS shall display the following message to prompt the driver that the acceleration is out of range:

DISPLAY PROMPT:

### **OUTSIDE THE MAXIMUM ACCELERATION LIMIT**

Emissions resulting from transient throttle shall not be included in the 10-second averaging data. In addition, if an acceleration violation occurs, that time-aligned data must not be used for emissions averaging. Instead, the emissions averaging will continue five seconds after the time aligned acceleration violation ceased. (Time alignment is determined by subtracting EIS response time and transport time.) If this event occurs near the end of the test (meaning another 10-second average cannot be completed), the last full 10-second average will be the ending result for the mode.

When ten seconds have passed since the emissions-averaging portion of the test mode began, the EIS shall keep track of the number of acceleration excursions. The data shall be recorded in the *Acceleration Violations ASM Mode 1* field of the test record. If the number of acceleration excursions exceeds five or the cumulative time exceeds five seconds, then the EIS shall prompt the technician to restart the test according to the restart procedures listed in 3.6.12.h.. Each violation, regardless of the length, is considered one unique violation. If, at any time during the emissions averaging portion of the test mode, the vehicle speed deviates by more than one mph from the target speed for more than five seconds at any one time, the test shall terminate.

If the *fast pass field* in the configuration file is set to 'Y' the vehicle shall pass the 5015 test mode when the 10-second average readings for HC, CO and NO are all

below the applicable standards for the vehicle. Once passing readings have been achieved for all three gases, the 5015 mode shall terminate and the EIS shall proceed to the next phase of the test. If the *fast pass field* in the configuration file is set 'N', the EIS shall use the final 10-second average readings for HC, CO, and NO to determine pass or fail for the mode. However, emissions resulting from transient throttle shall not be included in the 10-second averaging data. In the event an acceleration violation occurs during the final 10 second average, the last full 10-second average will be the end result for the mode.

For a 5015 test, 25 valid 10 second moving averages are required for a failing test. For a 2525 test, 15 valid 10 second averages are required for a failing test. If the vehicle has passing emissions, only one valid 10-second average is required. Therefore, the minimum test time in either mode for a vehicle that has passing emissions is 2 sec + 10 sec AVE + EIS response time. Otherwise, the test shall be restarted according to the restart procedures listed in 3.6.12.h.

The emissions reading used to make the pass/fail or gross polluter determination shall be recorded in the test record and on the VIR.

e) **2525 Test Mode (ASM Test Mode 2)**

At the conclusion of the 5015 test mode, the EIS shall prompt the driver to accelerate the vehicle to 25 mph. The EIS shall display the 2525 test speed with applicable speed limits (or drive trace graphical display), test time, engine RPM and other appropriate test mode information. The dynamometer shall change to the 2525 test mode settings as soon as the 5015 test mode has been completed.

The 2525 test mode procedures are the same as those for the 5015 test mode, except for the following:

1. Maximum test duration equals 75 seconds.
2. Vehicle speed is stabilized at 25 mph  $\pm$ 1 mph for two consecutive seconds.
3. Vehicle speed stabilization must be achieved within 20 seconds.
4. Maximum emissions-averaging duration is 65 seconds.
5. Fifteen valid 10-second moving averages constitutes a valid test.

The number of acceleration excursions shall be recorded in the *Acceleration Excursion Violations ASM Mode 2* field of the test record.

If the *fast pass field* in the configuration file is set to 'Y' the vehicle shall pass the 2525 test mode when the 10-second average readings for HC, CO and NO are all below the applicable standards for the vehicle. Once passing readings have been achieved for all three gases, the 2525 mode shall terminate and the EIS shall proceed to the next phase of the test. If the *fast pass field* in the configuration file is set 'N', the EIS shall use the final 10-second average readings for HC, CO, and NO to determine pass or fail for the mode. However, emissions resulting from transient throttle shall not be included in the 10-second averaging data. In the

event an acceleration violation occurs during the final 10 second average, the last full 10-second average will be the end result for the mode.

For a 5015 test, 25 valid 10 second moving averages are required for a failing test. For a 2525 test, 15 valid 10 second averages are required for a failing test. If the vehicle has passing emissions, only one valid 10-second average is required. Therefore, the minimum test time in either mode for a vehicle that has passing emissions is 2 sec + 10 sec AVE + EIS response time. Otherwise, the test shall be restarted according to the restart procedures listed in 3.6.12.h..

The emissions reading used to make the pass/fail or gross polluter determination shall be recorded in the test record and on the VIR.

**f) Fast Pass/Fast Fail**

An algorithm may be included at a later date for both modes.

**g) Augmented Braking**

Augmented braking shall be “ON” and operational during the ASM test mode. The EIS is not required to provide a method to disengage the augmented braking during the ASM testing mode. Augmented braking for the ASM test consists of applying the maximum safe load with the dynamometer to bring the rolls to a complete stop. Augmented braking shall automatically occur when any of the following conditions are met:

1. The conclusion of the 2525 mode
2. The test mode meets conditions for restart
3. The test mode meets conditions for abort

The EIS shall include a way to disengage the augmented braking if the technician chooses. The augmented braking shall default to the engaged position.

**h) Restart Procedures**

Bring the rollers to a full stop. Record the time that had elapsed since the beginning of the 5015 mode (when wheels started turning). Reset the test timer to zero. The EIS shall prohibit the restart of the test until the vehicle has idled (speed <1250) twice the original elapsed time from the start of the ASM 5015 (roller speed >1 mph). Upon restart, the previously captured second-by-second data shall be deleted and new second-by-second data collected.

DISPLAY PROMPT:

**TEST MODE MUST BE RESTARTED BECAUSE:**

1. Conditions Causing Test Mode Restart (both modes):
  - i. Vehicle and/or equipment unable to stabilize with required stabilization time

- ii. Acceleration violation according to the requirements stated in the test sequence
- iii. Dynamometer load outside of specification for at least two consecutive seconds
- iv. Sample dilution
- v. Engine speed below 100 RPM for more than two seconds.
- vi. Engine speed outside of range more than five seconds during one excursion.
- vii. Inadequate number of valid ten-second average readings.
- viii. “Low Flow” displayed on the screen for more than three seconds.

The EIS shall count the number of restarts during the test procedure. The count shall be written to the *ASM Restart Counter* field of the test record. The maximum number of restarts is two, otherwise the test will be aborted. ASM tests with no restarts will record zero in the appropriate field, two-speed idle tests will leave the field blank. Conditions for restart:

- a) the dyno roll speed is < 1mph
- b) the engine is idling between 400-1250 RPM
- c) the EIS must wait twice the elapsed test time

Note: If the technician violates criteria a ) and/or b) during the “wait time” the EIS will add the remaining “wait time” to the duration of the new violation “wait time”.

2. Conditions Causing Test Mode Abort (both modes):

- i. Safety-related issues
- ii. Equipment failure
- iii. Power loss
- iv. Any of the restart conditions listed above occurring more than twice
- v. Technician violates the speed tolerance for more than five seconds

Anytime the test is aborted, the EIS shall display the following prompt:

DISPLAY PROMPT:

**TEST MODE ABORTED DUE TO:** Display the appropriate abort reason.

**i) End of ASM Emissions Test Mode**

At the completion or termination of the ASM two-mode inspection, the EIS shall display the following message:

DISPLAY PROMPT:

**END OF ASM EMISSIONS TEST**

The following values shall be stored in the test record for all emissions tests: Dynamometer Manufacturer, Gas Bench Manufacturer and Acceleration/Excursion Limit.

**j) Optional ASM Testing Sequences**

Based on information in the *Optional ASM Test Sequence* field of the VLT, one of the following test sequences may be performed instead of the standard ASM test (ASM Test Sequence #1). Store the ASM test sequence identifier to the *Test Sequence* field of the test record.

**Optional ASM Test Sequence #2**

If the VLT reference for the vehicle being tested has a "2" in the *Optional ASM Test Sequence* field, the EIS shall perform a standard ASM with the following exceptions:

- If the vehicle still fails emissions testing after 100 seconds (5015 mode), increase speed to 20 mph, then reduce speed to 10 mph, and then increase speed to 15 mph. The technician will have 10 seconds to start the speed deviation cycle (the vehicle must pass 16 mph within 10 seconds), or the test must be restarted per the restart conditions (see §3.6.12.h). Maximum duration of the speed deviation procedure is 20 seconds (the 20-second counter will start once the vehicle passes 16 mph). If the speed deviation cycle is not completed within 20 seconds, the test must restart per the restart conditions. Make the next pass/fail decision based on average emissions over a 10-second averaging period that begins 12 seconds after roll speed has returned to the 15-mph window. Store the final emission readings to the test record.
- Maximum duration for the 5015 mode is 180 seconds (without restarts).
- The standard ASM 2525 mode follows the modified 5015 mode with no modifications to the 2525 mode.

**k) Special Test Sequence Prompt**

Prior to displaying any messages about dynamometer compatibility, the EIS shall look to the Advice Code field of the VLT. When the VLT Advice Code field is filled with a number other than zero, the EIS shall go to ADVICE.DAT file and display the appropriate message (i.e. if the Advice Code field is filled with 12, display record number 12 of ADVICE.DAT prior to displaying any messages about dynamometer compatibility). If the Advice Code field of the VLT is zero filled, do not display any message from ADVICE.DAT prior to any dynamometer related prompts.

**l) Extended Parameters (no longer used)**

**3.6.13 Commencement of the Emissions Sampling Period For Two-Speed Idle Test Only**

Immediately before starting the two-speed idle emissions test, the EIS shall require the operator to verify that the type of ignition system entered is correct and allow the technician to change it if it is incorrect.

- a) The sampling period shall commence as soon as stability is achieved. Stability is achieved when all of the following conditions are satisfied:
  1. Averaged reading for CO+CO<sub>2</sub> over a period of two seconds meet the dilution threshold.
  2. Engine RPM has been within specified thresholds for at least one second.
  3. Sample flow rate is adequate to prevent triggering the low flow lockout.
  
- b) After stability has been achieved and sampling has been initiated, if any of the following conditions occur, the test mode must be restarted:
  1. The dilution level is below the specified threshold.
  2. Engine RPM is outside the specified thresholds.
  3. Sample flow rate is not adequate to prevent triggering the low flow lockout.
  
- c) Exceeding the RPM limits, not reaching the dilution threshold or a low flow rate during a testing period shall automatically cause the testing period to restart for that mode. The EIS shall allow the technician three attempts before displaying a message asking the technician if he/she wants to abort the test. The same message shall be displayed after each subsequent unsuccessful attempt.

### 3.6.14 Two-Speed Idle Testing Sequence

- a) The following testing/sampling sequences shall be available in the EIS at the time of certification:

#### SEQUENCE #1:

Testing period: 30 seconds for each stage  
 First stage: 2500 RPM ( $\pm 10\%$ )  
 Second stage: Idle RPM  
 Basis for test results: Average of last 5 seconds of each sampling period.  
 Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>.

Test Sequence # 1 shall be used to test all vehicles except those mentioned under the test sequences below.

SEQUENCE #2:

Testing period: 30 seconds for each stage

Note: Prior to initiating the test, the technician shall be informed that the vehicle they will be testing will require special test procedures and that it is important to follow directions carefully. The technician shall then be prompted to turn the key off for 10 seconds. At the end of 10 seconds, the EIS shall prompt the technician to restart the engine and begin the 2500-RPM test. The EIS shall ensure that there is no RPM signal for 10 seconds prior to starting the 2500-RPM test.

First stage: 2500 RPM ( $\pm 10\%$ )

Note: Between the test stages, the technician shall be prompted to turn the ignition off for 10 seconds. The EIS shall ensure that there is no engine RPM signal for at least 10 seconds. At the end of 10 seconds, the EIS shall prompt the technician to restart the engine and begin the idle test.

Second stage: Idle RPM (see standards for maximum)

Basis for test results: After the first 15 seconds of each stage, any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.

Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

Test sequence #2 could take as little as 20 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 15-second period), the test shall run the full 30 seconds.

All 1981-1984 Ford passenger cars with 5.8L (351 CID) engines shall be tested using Sequence # 2.

SEQUENCE #3:

Testing period: 30 seconds for each stage

Note: Before the 2500 RPM test starts, the EIS shall display a message to the technician indicating that the engine RPM cannot exceed 2650 for this vehicle.

First stage: 2500 RPM (+ 6 %, - 10 %)

Second stage: Idle RPM (see standards for maximum)

Basis for test results: Average of the last 5 seconds of each sampling period.

Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

All 1984 Jeeps with a 2.5L (150 CID) light-duty trucks shall be tested using test Sequence # 3.

SEQUENCE #4:

Testing period: 30 seconds for each stage  
 First stage: 2500 RPM ( $\pm 10\%$ )

Note: A message shall be displayed to the technician indicating that the vehicle being tested will require special test procedures and that it is important that they follow directions carefully. The EIS shall display the following prompt:

DISPLAY PROMPT:

**IS THE VEHICLE FUEL INJECTED? (YES/NO)**

Programming Criteria:

1. If YES, perform test sequence # 4.
2. If NO, follow inspection sequence # 1.

The technician shall be prompted to set the parking brake, press the brake pedal and run the IDLE test with the transmission in DRIVE. When the idle test is complete, the technician shall be prompted to return the transmission to PARK.

Second stage: Idle RPM (see standards for max.)  
 Basis for test results: Average of last 5 seconds of each sampling period.  
 Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

All 1984 Chrysler/Dodge/Plymouth passenger cars having a 2.2L, fuel-injected engines with automatic transmissions shall be tested using Sequence # 4.

SEQUENCE #5:

Given the problems with the ZF automatic transmission, the BAR prefers that the affected vehicles be tested at their dealerships. Accordingly, if the technician enters an A (for automatic) for the transmission type, and if the vehicle make, model and model year match BMW/Peugeot/Volvo criteria, the EIS shall display the following message:

**BECAUSE OF THE POSSIBILITY OF TRANSMISSION DAMAGE TO THIS VEHICLE, THE BAR PREFERS THAT IT BE INSPECTED AT ITS DEALERSHIP. IF YOU STILL WISH TO PERFORM THE INSPECTION, YOU MAY DO SO AT YOUR OWN RISK OR YOU MAY ABORT THE TEST.**

Note: If the technician chooses to continue testing this vehicle, display the following message before beginning the test sequence.

**BEFORE BEGINNING THE EMISSIONS TEST, MAKE SURE THE ENGINE IS AT NORMAL OPERATING TEMPERATURE. IF NOT, THE VEHICLE SHOULD BE DRIVEN UNTIL IT IS. DO NOT WARM THE ENGINE BY RAISING THE RPM ABOVE IDLE WHILE THE TRANSMISSION IS IN PARK OR NEUTRAL.**

Perform idle test only (delete first stage).

Testing period: 30 seconds for idle stage  
 Engine Speed: Idle RPM [Note: One stage only.]  
 Basis for test results: Average of the last 5 seconds of the sampling period.  
 Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and CO<sub>2</sub>

**Note:** All 1984-1987 BMWs with automatic transmission, 1985-1988 Volvo 740s with automatic transmission, and 1986-1987 Peugeot 505s with automatic transmission shall be tested using test Sequence #5. If the engine has been changed to a different year, the special test sequence shall follow the year of the vehicle.

Example:

- \* 1985 BMW with a ZF transmission and original engine uses test sequence #5 and the emission standards for 1985.
- \* 1985 BMW with a ZF transmission and a 1990 engine uses test sequence #5 and emission standards for 1990.

#### SEQUENCE #6:

Testing period: 30 seconds for each stage  
 First stage: 2500 RPM ( $\pm 10\%$ )  
 Second stage: Idle RPM  
 Basis for test results:  
     Stage 1: Average of last 5 seconds of sampling period.  
     Stage 2: Same as stage 1; however, if the emissions are not within the standards and the idle RPM was below 900, then the technician shall be prompted to rev the engine so that the idle speed is a minimum of 900 RPM (but not to exceed the manufacturer's specifications), and to continue the test for another 30-second Second-Stage Idle Test. After the first 15 seconds of the repeated second stage, any passing reading (averaged over 5 consecutive seconds) collected during the sampling period, or, if none,

the average reading over the last 5 seconds of the stage.  
 Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

All 1985 Ford Ranger 2.3L (140 CID) light duty trucks and 1986 Ford Ranger and Aerostar 2.3L (140 CID) light duty trucks shall be tested using test sequence #6.

SEQUENCE #7:

Testing period: 25 seconds for each stage

Note: Prior to beginning the first stage, the technician shall be informed that the vehicle he/she will be testing will require special test procedures and that it is important to follow directions carefully (this information shall not be displayed prior to the "second-chance" test if preconditioning is required). The technician shall then be prompted to ensure the tachometer lead is connected, start the vehicle and allow it to idle. At the end of 156 seconds, the EIS shall prompt the technician to insert the probe and begin the 2500 RPM test. The EIS shall ensure that there is an RPM signal for 156 seconds prior to starting the 2500 RPM test. This 156-second warm-up shall not be required prior to the "second-chance" test if preconditioning is required.

First stage: 2500 RPM ( $\pm 10\%$ )  
 Second stage: Idle RPM (see standards for maximum)  
 Basis for test results: After the first 10 seconds of each stage, averaging shall begin. Any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.  
 Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

Test Sequence #7 could take as little as 15 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 15-second period), the test shall run the 25 seconds.

All 1985-1986 GM passenger cars with 5.0L engine and VIN-Y ("Y" in eighth position of the VIN) engines shall be tested using Sequence # 7.

- b) Accommodations shall be made to allow for additional test sequences and sampling periods, which can be added at a later date. Based on information in the *TSI Test Sequence* field of the VLT, the following test sequence may be performed instead of the standard ASM test sequences listed above.

SEQUENCE #8:

Testing period: 25 seconds for each stage

Note: Prior to initiating the test, the technician shall be informed that the vehicle they will be testing should be at normal operating temperature prior to starting the test. The technician shall then be prompted to start the vehicle, snap the throttle and allow the throttle plate to snap closed. The EIS shall prompt the technician to insert the probe and begin the 2500-RPM test.

First stage: 2500 RPM ( $\pm 10\%$ )

Second stage: Idle RPM (see standards for maximum)

Basis for test results: After the first 10 seconds of each stage, averaging shall begin. Any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.

Units of test results: Concentration measurements: PPM HC, % CO, % O<sub>2</sub> and % CO<sub>2</sub>

Test Sequence #8 could take as little as 15 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 10-second period), the test shall run the 25 seconds.

All vehicles designated in the VLT with an "8" in the *TSI Test Sequence* field shall be tested using Sequence # 8.

- c) The different test sequences are designed to make the Smog Check test procedure correlate better with the Federal Test Procedure. Most of the different test sequences will be designed to prevent incorrectly failing pattern failures (errors of commission). Therefore, the BAR will provide information to the manufacturers regarding which procedure should be used with which engine families. The EIS should be designed to automatically run the appropriate test sequence after vehicle identification information is entered. Additional test sequences selected by the BAR will be provided to the manufacturers as soon as they become available. The test sequence number shall be documented in the *Test Sequence* field of the test record and the VIR.
- d) When the vehicle has met RPM, flow rate and dilution conditions, the emissions test sequence shall begin and the display shall show the word TESTING and time remaining in the test sequence. The EIS shall record the emission readings at the end of the TESTING period, for each test mode.
- e) For vehicles that have had engine changes, special test sequences shall follow the year of the engine, except special test sequence #5.

Example:

A 1980 Ranger with a 1985 2.3L engine uses special test sequence #6 and emission standards for 1985.

### **3.6.15 Vehicle Preconditioning Sequence For Two-Speed Idle Test**

If a vehicle fails any of the TSI emission tests, the EIS shall instruct the technician to precondition the vehicle and run a second chance test. The EIS shall also use special test sequences for the second chance test if they were used for the first test. For example: if the EIS uses special test sequence #2 and the vehicle requires preconditioning, the EIS shall use special test sequence #2 for the second chance test. The EIS shall also follow any RPM restrictions that the special test sequence may require, i.e., a 1985 BMW with a ZF transmission shall NOT be preconditioned at high RPM. Based on the surveys conducted for the BAR, and on studies conducted on suspected pattern failures by the EPA, all model vehicles failing an initial test shall be preconditioned in the following manner, and retested:

DISPLAY PROMPT:

**REMOVE THE EXHAUST PROBE FROM THE TAILPIPE.**

**PROCEDURE #1: For All Vehicles Except Those Covered by Procedures 2 and 3**

**OPERATE THE VEHICLE AT 2500 ±300 RPM FOR THREE MINUTES WITH THE TRANSMISSION IN "PARK" OR "NEUTRAL."**

**AT THE END OF THE THREE-MINUTE PERIOD, ALLOW THE VEHICLE TO RETURN TO IDLE AND STABILIZE FOR 10 SECONDS, BUT DO NOT TURN THE IGNITION SWITCH OFF.**

**INSERT THE PROBE INTO THE TAILPIPE.**

**AT THE END OF THE 10-SECOND PERIOD, IMMEDIATELY BEGIN THE EMISSIONS TEST.**

#### Programming Criteria For Procedure # 1

The EIS shall detect a signal in the proper range for 3 minutes within a 3-minute and 15-second period, with no single excursion exceeding 5 seconds. A message shall be displayed instructing the technician to adjust the engine RPM, restart the test or abort the test as appropriate if the RPM is outside of the specified limits. The preconditioning period shall begin as soon as the engine RPM is stable (for a period of 1 second) and in the proper range. To avoid loading the sample system with vehicle exhaust during the preconditioning process, the EIS shall either back purge during the preconditioning sequence or prevent preconditioning if the probe is in the tailpipe. Preconditioning prevention could be determined by checking for emissions prior to or during the preconditioning sequence.

When the preconditioning period is complete, the technician shall be instructed to allow the vehicle to return to idle and the EIS shall ensure that the engine speed is reduced for at least 10 seconds, but no more than 30 seconds. If the engine speed is reduced for less than 10 seconds or more than 30 seconds, a message shall be displayed instructing the technician to either restart the preconditioning procedure or abort the test. Messages indicating the retest instructions shall be displayed at the end of the 10-second idle period.

**PROCEDURE #2: For 1981-1986 Fords and 1984-1985 Honda Preludes**

**OPERATE THE VEHICLE AT 2500  $\pm$ 300 RPM FOR 3 MINUTES WITH THE TRANSMISSION IN "PARK" OR "NEUTRAL."  
AT THE END OF THE 3-MINUTE PERIOD, ALLOW THE VEHICLE TO RETURN TO IDLE AND IMMEDIATELY TURN THE IGNITION KEY OFF.**

**INSERT THE PROBE INTO THE TAILPIPE.**

**LEAVE THE IGNITION OFF FOR 10 SECONDS THEN RESTART THE ENGINE AND PROCEED IMMEDIATELY WITH THE EMISSIONS TEST.**

Programming Criteria For Procedure # 2

Within 30 seconds of having completed the three-minute portion of the preconditioning sequence, the technician shall release the throttle, turn off the ignition for at least 10 seconds and insert the probe and return the engine to 2500 ( $\pm$ 250) RPM\*. The 30-second time period shall begin when the engine RPM drops below 2200. The EIS shall provide prompts indicating when the technician should release the throttle, turn the ignition key off, insert the probe, and to restart the engine and immediately increase the engine RPM to the appropriate range as specified. The emissions test shall begin as soon as the engine RPM reaches the appropriate range. The EIS shall display the time remaining before the preconditioning period will have to be restarted or the test aborted.

**PROCEDURE #3: For "ZF" Automatic Transmission**

Given the problems with the ZF automatic transmission, the BAR prefers that the affected vehicles be tested at their dealerships. Accordingly, if the technician enters an A (for automatic) for the transmission type, and if the vehicle make, model and model year match BMW/Peugeot/Volvo criteria, the EIS shall display the following message:

**BECAUSE OF THE POSSIBILITY OF TRANSMISSION DAMAGE TO THIS VEHICLE, THE BAR PREFERS THAT IT BE INSPECTED AT ITS DEALERSHIP. IF YOU STILL WISH TO PERFORM THE INSPECTION, YOU**

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\*Emissions test RPM requirements may vary depending upon the test sequences.

**MAY DO SO AT YOUR OWN RISK. PRESS "ENTER" TO CONTINUE. IF NOT, PRESS "ESC" TO ABORT THE TEST.**

For all 1984-1987 BMWs with automatic, 1986-1987 Peugeot 505s with automatic, and 1985-1988 Volvo 740s with automatic transmission.

If these vehicles fail the first chance, display the following message:

**DUE TO POSSIBLE SERIOUS TRANSMISSION DAMAGE, DO NOT RAISE THE ENGINE SPEED ABOVE IDLE RPM WHILE THE TRANSMISSION IS IN NEUTRAL OR PARK. IF THE VEHICLE NEEDS TO BE PRECONDITIONED, DRIVE IT UNTIL IT HAS REACHED OPERATING TEMPERATURE.**

The EIS shall start the second chance test as soon as the EIS detects engine RPM within the idle RPM range. The EIS shall perform the emissions measurement at idle for 30 seconds. After the second chance, the EIS shall allow the technician to continue with the remainder of the inspection.

Programming Criteria For All Procedures:

The manufacturer shall provide for the capability to utilize as many different preconditioning procedures as can be contained in the EIS. The preconditioning procedure number shall be recorded on the test record in the *Preconditioning Procedure* field.

- 1) **For all procedures** - The EIS shall automatically instruct the technician to initiate the preconditioning procedure whenever a vehicle fails the emissions test before the test can proceed. The EIS shall select and display only the appropriate preconditioning procedure based on the vehicle make and model year information entered by the technician.
- 2) **For procedure # 1** - A message shall be displayed instructing the technician to remove the exhaust probe, increase the engine RPM to 2500 ( $\pm 300$ ) and hold it there for 3 minutes. The EIS shall detect a signal in the proper range for 3 minutes within a 3-minute and 15-second period, with no single excursion exceeding 5 seconds. A message shall be displayed instructing the technician to adjust the engine RPM, restart the test or abort the test as appropriate if the RPM is outside of the specified limits. The preconditioning period shall begin as soon as the engine RPM is stable (for a period of 1 second) and in the proper range. To avoid loading the sample system with vehicle exhaust during the preconditioning process, the EIS shall either back purge during the preconditioning sequence or prevent preconditioning if the probe is in the tailpipe. Preconditioning prevention could be determined by checking for emissions prior to or during the preconditioning sequence.

When the preconditioning period is complete, the technician shall be instructed to allow the vehicle to return to idle and the EIS shall ensure that the engine speed is

reduced for at least 10 seconds, but no more than 30 seconds. If the engine speed is reduced for less than 10 seconds or more than 30 seconds, a message shall be displayed instructing the technician to either restart the preconditioning procedure or abort the test. Messages indicating the appropriate ignition key on/off and retest instructions shall be displayed at the end of the 10-second idle period. The technician shall be instructed to strike the ENTER key as soon as possible after 10 seconds of idling has occurred.

- 3) **For all procedures** - The EIS shall display the engine speed and the time remaining during each stage of the preconditioning sequence. The number of the preconditioning procedure shall be recorded on the test record automatically by the EIS. If no preconditioning procedure was used (vehicle passed the emissions portion of the test the first time), the *preconditioning procedure* field shall be filled with a space.

- 4) ERROR MESSAGES:

**(For all procedures)**

**NO RPM SIGNAL - MAKE SURE THE TACH LEAD IS CONNECTED.**

**(For procedures 1 & 2)**

**ENGINE RPM DROPPED BELOW 2250-RPM -RAISE THE ENGINE SPEED TO 2500 ( $\pm 250$ ) RPM AND HOLD IT THERE FOR 3 MINUTES.**

**(For procedures 1 & 2)**

**ENGINE RPM INCREASED ABOVE 2750 RPM-REDUCE THE ENGINE SPEED TO 2500 ( $\pm 250$ ) RPM AND HOLD IT THERE FOR 3 MINUTES.**

- 5) **For all procedures** - If a vehicle subject to preconditioning receives a second-chance test, the emissions results of both tests shall be stored in the test record. The results for either or both tests shall not be written to the test record until the pass/fail decision has been made by the EIS.

The emission values from the first test should be written to a "scratch" file on the EIS hard drive until a pass/fail decision on the emissions values has been determined. If the emissions indicate a pass, the values from the first test shall be written to the *Emissions Test Results: Final Values* fields of the test record, and the *Emissions Test Results: Before Preconditioning/ASM Test Sequence #3* fields shall remain blank.

Note: For the two-speed emissions test, NO is not measured. When two-speed emissions data is inserted into the *Emissions Test Results: Final Values* fields of the test record, the NO field should remain blank.

If preconditioning and a second chance emissions test is given, the second chance emissions values shall be written to the *Emissions Test Results: Final Values* fields of the test record. The results of the first test, which are in the "scratch"

file, shall be written to the *Emissions Test Results: Before Preconditioning/ASM Test Sequence #3* fields of the test record.

DESCRIPTION	LAYOUT
<b>TWO-SPEED IDLE AT 2500 RPM</b>	
DCF	N.NN
RPM	NNNN
AIR/FUEL RATIO	NN.N
CATALYST EFFICIENCY	X
DCF HC	NNNN
DCF CO	NN.NN
DCF CO <sub>2</sub>	NN.N
O <sub>2</sub>	NN.N
<b>TWO-SPEED IDLE AT IDLE RPM</b>	
DCF	N.NN
RPM	NNNN
AIR/FUEL RATIO	NN.N
CATALYST EFFICIENCY	X
DCF HC	NNNN
DCF CO	NN.NN
DCF CO <sub>2</sub>	NN.N
O <sub>2</sub>	NN.N

### 3.6.16 Air/Fuel Ratio Calculation

The average air/fuel ratio shall be calculated during all emissions test modes (ASM 5015, ASM 2525, and two-speed idle test). The ratio shall be stored in the *Average Air/Fuel Ratio-ASM 5015 or TSI-2500 RPM* and *Average Air/Fuel Ratio-ASM 2525 or TSI-Idle RPM* fields of the test record.

The average air/fuel ratio shall be calculated during the pass/fail determination window using the DCF values in the following formula:

**Air-to-Fuel Ratio (Based on Oxygen Balance)**

This equation is an extension of the Spindt formula. It adds an oxygen-to-carbon ratio, needed to properly calculate A/F for oxygenated gasolines and alcohol-based fuels.

$$A/F_o = \frac{138.1918}{M_F} \left( \frac{CO_2 + \frac{CO}{2} + \frac{R_{OC}}{2} HC + \frac{H_2O}{2} + \frac{NO}{2} + O_2}{CO_2 + CO + HC} - \frac{R_{OC}}{2} \right)$$

where

A/F <sub>o</sub>	=	Oxygen-balanced air-to-fuel ratio
R <sub>OC</sub>	=	Oxygen-to-carbon ratio of fuel
M <sub>F</sub>	=	Gram-molecular weight of fuel, = 12.0115 + (1.00797*R <sub>HC</sub> ) + (15.9994*R <sub>OC</sub> )
HC	=	Hydrocarbon concentration in exhaust, %C, = 6*(HC, ppm hexane)/10,000
CO	=	Carbon monoxide concentration in exhaust, %
NO	=	Nitric oxide concentration in exhaust, %, = (NO, ppm)/10,000
CO <sub>2</sub>	=	Carbon dioxide concentration in exhaust, %
O <sub>2</sub>	=	Oxygen concentration in exhaust, %

$$138.1918 = M_A * [100/(\% \{O_2\}_A)]$$

M <sub>A</sub>	=	Gram-molecular weight of air, = 28.965
% {O <sub>2</sub> } <sub>A</sub>	=	Percent of oxygen in the air, = 20.9

H<sub>2</sub>O = Water formation during combustion, expressed by the following

$$H_2O = \frac{[CO + CO_2] \frac{R_{HC}}{2}}{\left[ \frac{CO}{WC * CO_2} \right] + 1.0} = \frac{1.75 CO_2 (CO + CO_2) R_{HC}}{CO + 3.5 CO_2}$$

equation:

WC	=	Water gas constant, = 3.5
R <sub>HC</sub>	=	Hydrogen-to-carbon ratio of fuel

**Hydrogen To Carbon and Oxygen to Carbon Ratios for Various Fuels**

<b>Fuel</b>	<b>Formula</b>	<b>R<sub>HC</sub></b>	<b>R<sub>OC</sub></b>
*CA Phase 2 Reformulated Gasoline	C <sub>7</sub> H <sub>13.89</sub> O <sub>0.12</sub>	1.980	0.017
Compressed Natural Gas (CNG)	CH <sub>4</sub>	4.000	0
E85 (Ethanol)	C <sub>2</sub> H <sub>5</sub> OH (85%) + **gasoline (15%)	2.831	0.425
M85 (Methanol)	CH <sub>3</sub> OH (85%) + **gasoline (15%)	3.681	0.850
Propane	C <sub>3</sub> H <sub>8</sub>	2.667	0

\* Note: The formula is an empirical average, based on the following mass percentages:  
C: 84.17%, H: 13.89%, O: 1.94%.

\*\*Note: Gasoline blended with ethanol or methanol is assumed to have an empirical formula of C<sub>8</sub>H<sub>15</sub>, R<sub>HC</sub> of 1.875, and R<sub>OC</sub> of 0.0.

### **3.6.17 Catalytic Converter Efficiency Determination**

The catalytic converter efficiency determination shall be performed on all vehicles that fail the emissions portion of the Smog Check. The EIS shall analyze the final emission test results to determine catalytic converter efficiency based on the following criteria:

A catalyst is presumed to be defective if the final ten-second average CO concentration is >0.3% for either the ASM 5015 or the ASM 2525 test mode (use the final five second average periods for TSI, either the 2500 rpm or idle tailpipe test), and the corresponding ten-second average O<sub>2</sub> concentration is ≥0.4% AND the corresponding ten-second CO<sub>2</sub> concentration is less than 14%. The values used for the five second average for TSI, or ten second average for ASM shall be DCF corrected, except for CO<sub>2</sub> and O<sub>2</sub>.

#### Programming Criteria:

- 1) The EIS shall automatically determine the efficiency of the catalytic converter if the vehicle fails the emissions portion of the test. The determination shall be made immediately after the end of the ASM 2525 test (or at the end of the idle test for TSI). The data (pass or fail) shall be stored in the *Catalyst Efficiency Test Result (ASM 5015 or TSI-2500 rpm)* and *Catalyst Efficiency Test Result (ASM 2525 or TSI-Idle rpm)* fields of the test record but shall not be displayed on the screen or printed on the VIR.
- 2) If the vehicle does not require the catalytic converter efficiency test, N (not applicable) shall be written to the *Catalyst Efficiency Test Result (ASM 5015 or*

*TSI-2500 rpm*) and *Catalyst Efficiency Test Result (ASM 2525 or TSI Idle rpm)* fields of the test record.

### 3.6.18 Emission Control Systems Visual Inspection

#### a) Visual Inspection Procedures

All vehicles, regardless of test type or inspection reason, shall receive a visual inspection.

DISPLAY PROMPT:

#### EMISSION CONTROL SYSTEMS VISUAL INSPECTION

ENTER ONE OF THE FOLLOWING CODES FOR EACH EMISSION CONTROL SYSTEM:

<u>CODE</u>	<u>DESCRIPTION</u>
P	PASS
D	DISCONNECTED
M	MODIFIED
S	MISSING
N	NOT APPLICABLE
F	DEFECTIVE

#### EMISSION CONTROL SYSTEM

- PCV System
- Thermostatic Air Cleaner
- Fuel Evaporative Controls
- Catalyst
- Exhaust Gas Recirculation
- Ignition Spark Controls
- Carburetor
- Fuel Injection
- Air Injection
  - Pump air injection (display if yes is entered at the air injection prompt)
  - Pulse air injection (display if yes is entered at the air injection prompt)

- **O<sub>2</sub> Sensor And Connectors**
- **Wiring of Other Sensors/Switches/Computer**
- **Vacuum Line Connections to Sensors/Switches**
- **Other Emission Related**  
 Components Add-on emission-related components  
 NOx retrofit devices  
 Retrofit crankcase emission control devices
- **Liquid Fuel Leaks**
- **Fuel Tank Cap**  
 Fuel tank cap (see functional test to see how visual test and functional test prompts are to be displayed).

Programming Criteria:            (*Visual Inspection*)

1. The EIS shall prevent the entry of either Pass or Missing, Modified or Disconnected results code for both the Carburetor and Fuel Injection. A vehicle has only one type of fuel induction system and therefore an N (not applicable) must not be entered for both.
2. The EIS will display each emission control system. The EIS will require the technician to enter a single code for each emission control system.
3. The Fuel Tank Cap visual inspection will be prompted separately rather than being included with the Fuel Evaporative Control's visual.
4. The EIS shall prompt YES or NO for "**Air Injection.**" The response "Y" for YES or "N" for NO shall be recorded in the *Air Injection* field of the test record. If NO, the EIS shall automatically enter "N" in the *Pulse Air* field and *Air Pump* field of the test record. If YES, the EIS shall prompt the technician to select either "Pump Air Injection" or "Pulse Air Injection" system. The EIS shall require the entry of P, D, M, S, N, or F for air pump or pulse air injection if a yes was entered for the air injection. The EIS shall allow only one type of air injection, therefore "N" must be entered for one of the air injection sub menus. The EIS shall enter the appropriate letter (P, D, M, S, N, or F) to the *Air Pump* field and *Pulse Air* field of the test record, and print the appropriate type and result to the VIR.

**a) Test Record Entries:**

A single entry is mandatory for each byte. The EIS shall be designed so that only a P, D, M, S, N or F can be entered by the technician for this field, except for the

*Liquid Fuel Leaks field* which shall only accept P, F, or N. The entries must be made in sequence, but technicians may be allowed to edit previous entries. The technician shall make a positive entry for each ECS. The EIS shall have no built in defaults for the visual inspection.

The entries shall be recorded in the appropriate field in the test record. If any entries of D, M or S, are made into any fields in the visual inspection results portion of the test record, then a T will be entered in the *Visual Inspection Result* field of the test record. If no entries of D, M or S and any entries of F are made into these fields, then an F will be entered in the *Visual Inspection Result* field of the test record. If all entries in any fields in the visual inspection results portion of the test record are either P or N, then a P will be entered into the *Visual Inspection Result* field of the test record. The results shall be printed on the VIR.

### 3.6.19 Functional Checks

The following functional checks will be performed on all non-diesel vehicles tested (ASM and two-speed idle) regardless of inspection reason, except as indicated.

DISPLAY PROMPT:

#### THE FUNCTIONAL INSPECTION

ENTER ONE OF THE FOLLOWING CODES FOR EACH OF THE FUNCTIONAL CHECKS:

<u>CODE</u>	<u>DESCRIPTION</u>
P	PASS
F	FAIL
N	NOT APPLICABLE

**Note: Print visual or functional, whichever applies, next to the EGR and fuel cap results on the VIR.**

#### Manual Functional Checks

- **Exhaust Gas Recirculation System** (display for two-speed idle testing only)
- **Ignition Timing**
- **Malfunction Indicator Light (MIL)/Check Engine Light**
- **Fuel Cap Integrity Test**

#### Programming Criteria:

- 1) General: The EIS shall prompt the technician to perform the indicated functional inspection and enter P, F or N results. The fillpipe restrictor field of the test record shall be populated with N. If all of the fields in the Functional Check Results portion of the test record (except for the *Fuel Cap Provided* field) contain either a P or N, then P will be entered in *Functional Test Result* field of the test record. If any of

these fields contain an F, then F will be entered into *Functional Test Result* field of the test record. The results will be printed on the VIR.

If a functional check is not required for any item, the EIS shall automatically populate the field with an "N" indicating that a function check of the item was not applicable.

- 2) Exhaust Gas Recirculation: The functional inspection of the EGR applies only to vehicles subject to the two-speed idle test; the EGR functional test does not apply to vehicles subject to an ASM test. In addition, since diesel vehicles will not receive any tailpipe emissions test, the EGR functional test will not apply to diesels. For ASM or Diesel tests, the *Exhaust Gas Recirculation System (Functional)* field of the test record shall be filled with an "N".

DISPLAY PROMPT:

**CHECK EGR ACCORDING TO THE MANUFACTURER'S EGR CHECK PROCEDURES AND ENTER P, F OR N.**

- 3) Ignition Timing: Ignition timing shall be performed on all vehicles, except for diesel vehicles and vehicles with non adjustable timing.

Programming Criteria:            (*Ignition Timing Check*)

1. If fuel-type = D, the ignition timing functional check procedure should be bypassed. Otherwise, the EIS shall prompt the technician to prepare the vehicle for the ignition timing check in accordance with the vehicle's underhood specification and manufacturer's prescribed check procedures. The EIS shall display the following message:

DISPLAY PROMPT:

**SEE VEHICLE'S UNDERHOOD LABEL AND  
MANUFACTURER'S TIMING CHECK PROCEDURES.**

2. The EIS shall prompt the technician to verify that the vehicle's engine speed for the ignition timing check is within the manufacturer's tolerance, if applicable.

DISPLAY PROMPT:

**IS THE VEHICLE ENGINE RPM OUT OF MANUFACTURER'S  
RECOMMENDED TOLERANCE? (YES/NO)**

If the technician enters NO, the EIS shall prompt the technician to proceed with the ignition timing check. If the technician enters YES, the EIS shall record a "U" for Engine Speed Failure in the *Ignition Timing* field of the vehicle test record and print the following message on the VIR.

**THIS VEHICLE FAILED THE IGNITION TIMING CHECK DUE TO ENGINE RPM BEING OUT OF TOLERANCE.**

3. The technician shall be prompted to enter the results of the ignition timing check. If the technician enters a P or an F for ignition timing, the EIS shall prompt the technician to enter the vehicle's engine ignition timing in degrees followed by a B for before top dead center or an A for after top dead center. If the technician enters 0 degrees timing, no entry (A or B) is required. If the ignition timing cannot be checked due to slipped damper, non-visible timing mark or other mechanical problems, the EIS shall prompt the technician to enter M (Mechanical Problem) and proceed with the inspection. M shall also be recorded in the test record. For non-adjustable computer-controlled vehicles, the software shall allow entry of Not Applicable (N) for the timing check, and shall store this in the *Ignition Timing* field of the vehicle test record. If the timing functional check is bypassed because fuel type = D, the software shall automatically enter "N" for the timing check. Entries of F, M or U shall all be considered a failure of the ignition timing check.

DISPLAY PROMPT:

**ENTER RESULT OF IGNITION TIMING CHECK:**

**P = PASS**

**F = FAIL**

**M = MECHANICAL PROBLEM PROHIBITS TIMING CHECK**

**N = NON ADJUSTABLE TIMING**

DISPLAY PROMPT: (FOR PASS/FAIL ENTRIES)

**ENTER DEGREES.**

- 4) Malfunction Indicator Light (MIL)/Check Engine Light: This functional check shall be performed during all inspections, including inspections when fuel-type = D (diesel).

The technician shall be prompted to perform the MIL/Check Engine Light functional test and to enter the results of the test. Acceptable responses are "P" for Pass, "F" for Fail or "N" for non-applicable.

DISPLAY PROMPT:

**PERFORM THE MIL/CHECK ENGINE LIGHT FUNCTIONAL TEST.****ENTER RESULTS OF MIL/CHECK ENGINE LIGHT FUNCTIONAL TEST (P, F, OR N)**

Programming Criteria: (MIL/Check Engine Light)

## A) OBD (MIL and bulb check only)

P, N or F shall be recorded in the *Malfunction Indicator Light (MIL)/Check Engine Light* field of the test record (P= pass, F= fail, N= Not applicable).

## B) OBD and OBD II

The OBDII test consists of two parts, a visual check of the MIL/check engine light (as above), and automated OBD status and fault code retrieval through the vehicle's Diagnostic Link Connector (DLC). The EIS shall perform OBDII check as follows:

- a. If there is an "N" in the OBDII Check field of the configuration file, only prompt the technician to enter "P", "F", or "N" for the MIL/check engine light. If there is a "Y" in the OBDII Check field of the configuration file, perform the OBDII check as listed below.
- b. For 1996 and newer, non-diesel passenger cars and light duty vehicles (trucks and motor homes less than 14,001 lbs.), and for 1998 and newer, diesel passenger cars, trucks, and motor homes less than 14,000 lbs. display the following prompt:

**IS THIS VEHICLE SUPPOSED TO GET AN OBDII FUNCTIONAL CHECK? (YES/NO)**

If yes, prompt the technician to visually inspect the MIL/check engine light, and enter "P" or "F" for the light. Once "P" or "F" has been entered, the EIS shall prompt the technician to hook up the EIS's OBDII connector. Then the EIS shall prompt the technician to start the vehicle, and allow the vehicle to idle. Next, the EIS shall access the OBD system and check for readiness indicators and fault codes.

If no, only prompt the technician to enter "P", "F", or "N" for the MIL/check engine light.

- c. If there is an "N" in the OBDII field of the VLT, do not prompt the technician to hook up the OBDII connector. For vehicles with an "N" in the OBDII field of the VLT, prompt the technician to enter

“P”, “F”, or “N” for the MIL/check engine light. The “N” in the OBDII field overrides the criteria listed in item b above.

1. The EIS shall determine the pass/fail status of the OBD systems as follows:

Pass (P) No emission related faults (or emission related faults detected, but the MIL was not commanded on), readiness indicators turned on, and “P” was entered for the MIL/check engine light visual test.

Note: Only use the readiness indicators for pass/fail criteria if there is a match with the vehicle’s readiness indicator(s) that is not turned on and the readiness indicators in the VLT, or OBD\_RED.DAT. In addition to looking for a match between the vehicle’s readiness indicators, the EIS shall use a count supplied in the VLT or OBD\_RED.DAT to determine the maximum number of monitors that can not be turned on and still pass.

If a monitor is not supported by a vehicle’s OBDII system, ignore the monitor.

Fail (F) Faults detected (emission related codes) with the MIL commanded on, or “F” was entered for the MIL/check engine light.

Note: Only fail the OBDII system for emission related fault codes (Functional check) when the MIL is commanded on.

Not Ready (R) = (F) Vehicle has not been operated long enough since faults were cleared (readiness indicators not turned on, or too many readiness indicators have not been turned on). The vehicle fails the test.

Note: Only use the readiness indicators for pass/fail criteria if there is a match with the vehicle’s readiness indicator(s) that is not turned on and the readiness indicators in the VLT, or OBD\_RED.DAT. In addition to looking for a match between the vehicle’s readiness indicators, the EIS shall use a count supplied in the VLT or OBD\_RED.DAT to determine if too many readiness indicators have not been turned on. If too

many readiness indicators have not been turned on, the vehicle fails.

If a monitor is not supported by a vehicle's OBDII system, ignore the monitor.

No Communication (U) = (F) Unable to communicate with OBD system. The vehicle fails the test.

If there is failed communication, prompt the technician to recheck the OBDII hookup and try again. If failed communication occurs again, store U to the fault codes field of the test record, and print the following message on the VIR:

**THIS VEHICLE FAILED THE MIL/CHECK ENGINE LIGHT DUE TO OBD COMMUNICATION FAILURE.**

If the readiness indicators are not turned on, store the appropriate readiness indicator codes (see item 3 below for readiness indicator codes to store in the test record) to the *readiness indicators* field of the test record, and print the following message on the VIR: (Only print the following message when the readiness indicator(s) is used for the pass/fail criteria.)

**THIS VEHICLE FAILED THE MIL/CHECK ENGINE LIGHT DUE TO FAILURE TO SUCCESSFULLY COMPLETE ALL OBD SELF TESTS.**

The standard emission related fault codes and corresponding description shall be displayed, printed on the VIR and stored in the test record (only print and display emission related fault codes when the MIL is commanded on, store all emission related fault codes, up to eleven codes). If the failure was due to the MIL/check engine light visual inspection, store L to the fault codes field of the test record, and print the following message on the VIR:

**THIS VEHICLE FAILED MIL/CHECK ENGINE LIGHT DUE TO A WARNING LAMP FAILURE.**

A list of emission related fault codes along with their corresponding description shall be in OBDII.DAT. A list of readiness indicators

and the number of indicators that must be turned on shall be in the VLT or OBD\_RED.DAT. The EIS shall first look to the VLT for the readiness indicators and count. If the misfire monitor status field in the VLT is filled with a 'Y' or 'N', all readiness indicator information will be contained in the VLT. If the misfire monitor status field in the VLT is filled with a space, all the readiness indicator information will be contained in OBD\_RED.DAT. The EIS shall compare all readiness indicators that are not turned on against those in the VLT, or OBD\_RED.DAT. If there is a match between the readiness indicators that are not turned on, and too many of the vehicle's readiness indicators are not turned on, the vehicle fails.

Examples:

OBDII is enabled in CONFIG.DAT

OBDII required field in the VLT is space filled

1996 passenger vehicle, technician states vehicle is supposed to get an OBDII check

VLT fields filled as follows:		OBD_RED.DAT filled as follows:		Vehicle's OBDII system filled as follows: (On = Ready Off = Not Ready)	
Misfire	N	Misfire	Y	Misfire	On
Fuel System	N	Fuel System	Y	Fuel System	On
Comprehensive component	Y	Comprehensive component	Y	Comprehensive component	On
Catalyst	Y	Catalyst	Y	Catalyst	On
Heated catalyst	Y	Heated catalyst	Y	Heated catalyst	Off
Evaporative system	Y	Evaporative system	Y	Evaporative system	On
Secondary air system	Y	Secondary air system	Y	Secondary air system	Not supported
A/C system refrigerant	N	A/C system refrigerant	Y	A/C system refrigerant	On
Oxygen sensor	N	Oxygen sensor	Y	Oxygen sensor	On
Oxygen sensor heater	N	Oxygen sensor heater	Y	Oxygen sensor heater	On
EGR system	N	EGR system	Y	EGR system	On
No match	N	No match	N		
Count	2	Count	5		

The EIS shall use the readiness indicator information from the VLT. To pass the readiness indicator portion of the OBDII check, the vehicle cannot have two or more of the following readiness indicators not set and still pass the readiness indicators check:

Comprehensive component  
Catalyst  
Heated catalyst  
Evaporative system  
Secondary air system

The above vehicle passes the readiness indicators check.

Example #2:

OBDII is enabled in CONFIG.DAT

OBDII required field in the VLT is space filled

1998 passenger vehicle, technician states vehicle is supposed to get an OBDII check

VLT fields filled as follows:		OBD_RED.DAT filled as follows:		Vehicle's OBDII system filled as follows: (On = Ready Off = Not Ready)	
Misfire		Misfire	Y	Misfire	On
Fuel System		Fuel System	Y	Fuel System	On
Comprehensive component		Comprehensive component	Y	Comprehensive component	Off
Catalyst		Catalyst	Y	Catalyst	Off
Heated catalyst		Heated catalyst	Y	Heated catalyst	Off
Evaporative system		Evaporative system	Y	Evaporative system	Off
Secondary air system		Secondary air system	Y	Secondary air system	Off
A/C system refrigerant		A/C system refrigerant	Y	A/C system refrigerant	Off
Oxygen sensor		Oxygen sensor	Y	Oxygen sensor	Off
Oxygen sensor heater		Oxygen sensor heater	Y	Oxygen sensor heater	On
EGR system		EGR system	Y	EGR system	Not supported
No match		No match	N		
Count		Count	8		

The EIS shall use the readiness indicator information from OBD\_RED.DAT because the misfire monitor field in the VLT is space filled. To pass the readiness indicator portion of the OBDII check, the vehicle must not have eight or more of the following readiness indicators not set:

Misfire  
Fuel System  
Comprehensive component  
Catalyst  
Heated catalyst  
Evaporative system

Secondary air system  
 A/C system refrigerant  
 Oxygen sensor  
 Oxygen sensor heater  
 EGR system

The above vehicle passes the readiness indicators check.

Example #3:

OBDII is enabled in CONFIG.DAT

OBDII required field in the VLT is space filled

1998 passenger vehicle, technician states vehicle is supposed to get an OBDII check

VLT fields filled as follows:		OBD_RED.DAT filled as follows:		Vehicle's OBDII system filled as follows: (On = Ready Off = Not Ready)	
Misfire		Misfire	Y	Misfire	On
Fuel System		Fuel System	Y	Fuel System	On
Comprehensive component		Comprehensive component	Y	Comprehensive component	Off
Catalyst		Catalyst	Y	Catalyst	Off
Heated catalyst		Heated catalyst	Y	Heated catalyst	Off
Evaporative system		Evaporative system	Y	Evaporative system	Off
Secondary air system		Secondary air system	Y	Secondary air system	Off
A/C system refrigerant		A/C system refrigerant	Y	A/C system refrigerant	Off
Oxygen sensor		Oxygen sensor	Y	Oxygen sensor	Off
Oxygen sensor heater		Oxygen sensor heater	Y	Oxygen sensor heater	On
EGR system		EGR system	Y	EGR system	Off
No match		No match	N		
Count		Count	8		

The EIS shall use the readiness indicator information from OBD\_RED.DAT because the misfire monitor field in the VLT is space filled. To pass the readiness indicator portion of the OBDII check, the vehicle must not have eight or more of the following readiness indicators not set:

Misfire  
 Fuel System  
 Comprehensive component  
 Catalyst  
 Heated catalyst  
 Evaporative system  
 Secondary air system  
 A/C system refrigerant

Oxygen sensor  
 Oxygen sensor heater  
 EGR system

The above vehicle fails the readiness indicator check.

Note: whenever the OBD II functional check is performed, store the MIL status to the *MIL Status* field of the test record.

Whenever a readiness indicator(s) is not turned on, store the appropriate letter(s) to the readiness indicators field of the test record. Example: if the catalyst monitoring readiness indicator is not set, store “D” to the *readiness indicators* field of the test record.

A	Misfire monitor status
B	Fuel system monitor status
C	Comprehensive component monitoring status
D	Catalyst monitoring
E	Heated catalyst monitoring
F	Evaporative system monitoring
G	Secondary air system monitoring
H	A/C system refrigerant monitoring
I	Oxygen sensor monitoring
J	Oxygen sensor heater monitoring
K	EGR system monitoring
L	No Match

- 5) Fuel Cap Integrity Test: For 1995 and older model year vehicles, except for vehicles with fuel type D, or fuel type codes P or N that are not bi-fueled, equipped with evaporative control systems, there shall be a two-part test. The first part shall be a visual inspection checking for the presence of the cap and the second part shall be a functional test. For vehicles not equipped with evaporative control systems, this test will consist of only a visual inspection of the fuel cap.

Programming Criteria:

- a) Visual Fuel Cap Integrity Test

DISPLAY PROMPT:

**INSPECT FUEL CAP(S) FOR PROPER FIT AND  
 INSTALLATION. ENTER INSPECTION RESULT:**

**P = PASS**

**F = FAIL**

**S = MISSING**

If P, record a P in the *Fuel Cap Visual* field of the test record and proceed with functional inspection, if applicable.

If F or S, the vehicle fails the visual portion of the Fuel Cap Integrity Test and also automatically fails the functional portion of the test. The F or S shall be recorded in the *Fuel Cap Visual Test* field of the test record and on the VIR.

In addition, if the visual test result was F, an F (Fail) shall be recorded in the *Fuel Cap Leak-down Test* field of the test record and on the VIR; if the visual test result was S, an N (Not Applicable) shall be recorded in the *Fuel Cap Leak-down Test* field of the test record and on the VIR.

i.) DISPLAY PROMPT:

***SELECT A FUEL CAP ADAPTER FROM THE LIST.***

***GRAY  
BLUE  
BLACK  
BROWN  
RED  
YELLOW  
LIGHT BLUE  
ORANGE  
GREEN  
WHITE  
VIOLET  
THREADED  
NO ADAPTER AVAILABLE  
OTHER***

The EIS shall record the appropriate fuel cap adapter code to the *Fuel cap adapter* field of the test record. Entering "No Adapter Available" will complete the fuel cap functional test. Note that an entry of "No Adapter Available" entry will not cause the vehicle to fail the Fuel Cap Leak-down Test.

Fuel cap adapter codes are as follows:

GY = Gray  
BL = Blue  
BK = Black  
BR = Brown  
RD = Red  
YW = Yellow  
LB = Light Blue

OR = Orange  
 GR = Green  
 WH = White  
 VI = Violet  
 TH = Threaded  
 NN = No Adapter  
 OT = Other

- ii.) DISPLAY PROMPT:

***SELECT THE MANUFACTURER OF THE FUEL CAP ADAPTER.***

***STANT  
 WAEKON  
 OTHER***

The EIS shall record appropriate manufacturer to the *Fuel Cap Manufacturer* field of the test record.

Fuel cap manufacturer codes are as follows:

S = Stant  
 W = Waekon  
 O = Other

- iii.) DISPLAY PROMPT:

**PRESS (FUNCTION KEY) TO BEGIN FUEL CAP LEAK DOWN TEST.**

- iv.) If a pass is sent to the EIS, the data will be recorded on the VIR and the test record. After every pass or fail result for the functional fuel cap test, the EIS shall prompt the technician as follows:

DISPLAY PROMPT:

**IS THERE ANOTHER FUEL CAP TO BE FUNCTIONALLY TESTED? (Y OR N)**

If Y, repeat the functional test prompts provided above until an N response is given.

- v.) If a fail is sent to the EIS, the EIS shall display the following prompt.

DISPLAY PROMPT:

**THE FUEL CAP HAS FAILED. DO YOU WISH TO REPLACE THE GAS CAP AND TRY AGAIN? (Yes/No)**

If the technician enters yes, the EIS shall store a "Y" to the *Fuel Cap provided* field of the test record, and prompt the technician to perform a leak down check on the new gas cap. If the new fuel cap fails store an "F" in the *Fuel Cap Leak-down Test* field of the test record. If the new fuel cap passes, the result for this set of gas caps shall be "P".

If the technician does not replace the gas cap, the EIS shall display the following prompt:

**REMOVE THE FUEL CAP AND INSPECT.**

**TIGHTLY INSTALL THE FUEL CAP ON THE FUEL CAP TESTER AND PRESS (FUNCTION KEY) TO BEGIN FUEL CAP LEAK-DOWN CHECK OR PRESS (*function key*) TO FAIL THE FUEL CAP.**

If the functional test has indicated a failure again, the data shall be recorded in the *Fuel Cap Leak-down Test* field of the test record.

- 6) The EIS shall prompt for an LPFET functional test EXCEPT when any of the following conditions are true:
- a) LPFET tester has not been enabled in Station Manager Menu (whether the EVAP tester device is available or not). Vehicle model year is 1996 or newer.
  - b) Vehicle has fuel type code D.
  - c) Vehicle has fuel type code P or N and is not bi-fueled.
  - d) Vehicle has fuel type code P or N and is bi-fueled but is not operating on gasoline.
  - e) Vehicle does not have evaporative control systems.
- A. If the LPFET test is automatically bypassed for one of the reasons above, "1" will be written to the *EVAP Test Bypass* field of the EIS test record and "B" will be written to the *Fuel EVAP Test* (EVAP Pass/Fail Result overall) field of the EIS test record.
- B. For vehicles that did not automatically bypass the LPFET functional check, display the following prompt:

DISPLAY PROMPT:

**NOTE:**

**THE LPFET FUNCTIONAL TEST MUST BE PERFORMED WITHIN 20 MINUTES OF THE START OF THE SMOG CHECK.**

**CAN A LPFET FUNCTIONAL CHECK BE PERFORMED ON THIS VEHICLE? (YES/NO)  
IF YES, CONNECT LPFET TO VEHICLE.**

1. If the technician selects “No”, write “N” to the *Fuel Evap Test* (EVAP Pass/Fail Result overall) field of the EIS test record, and write a “2” to *EVAP Test Bypass* field of the test record. Bypass the rest of the EVAP test and continue with the rest of the Smog Check.
2. If the technician selects “Yes”, the EIS shall determine if the current time is more than 20 minutes from the Smog Check inspection start time (*Test Start Time* field of the EIS test record). If so then display the following prompt.

DISPLAY PROMPT:

**TOO MUCH TIME HAS ELAPSED FROM THE START OF THE SMOG CHECK. THE TEST MUST BE ABORTED.**

The EIS shall abort the Smog Check.

3. If the EIS determines that the current time is within the time window, write a “3” to *EVAP Test Bypass* field of the test record to indicate LPFET test performed and then display the following prompt.

DISPLAY PROMPT:

**MAKE SURE EVAP TESTER IS CONNECTED TO THE EIS. SELECT “CONTINUE” WHEN DONE.**

4. The EIS shall purge all test records from the LPFET.

DISPLAY PROMPT:

**PURGING DATA, PLEASE WAIT.**

If the purge is unsuccessful, the EIS shall display the following prompt:

DISPLAY PROMPT:

**LPFET DATA PURGE FAILED. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If the technician selects “Yes”, the EIS shall go back to 6) B. 3. Allow the technician to retry as many times as desired.

If “No”, the EIS shall abort the Smog Check.

5. If LPFET data purge is successful, the EIS shall synchronize the LPFET date and time with the EIS date and time (using the “Time Sync” LPFET command) and then prompt as follows:

DISPLAY PROMPT:

**INITIALIZING LPFET.**

If date and time synchronization is unsuccessful, the EIS shall display the following prompt:

DISPLAY PROMPT:

**LPFET INITIALIZATION FAILED. THERE IS A COMMUNICATION ERROR BETWEEN THE EIS AND THE EVAP TESTER. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If “Yes”, the EIS shall go back to 6) B. 5. Allow the technician to retry as many times as desired.

If “No”, the EIS shall abort the Smog Check.

6. If the data and time synchronization is successful, the EIS shall prompt the technician as follows:

DISPLAY PROMPT:

**STARTING LPFET TEST.**

If starting the LPFET test is unsuccessful, the EIS shall display the following prompt:

DISPLAY PROMPT:

**LPFET TEST FAILED TO START. THERE IS A COMMUNICATION ERROR BETWEEN THE EIS AND THE LPFET TESTER. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If the technician selects “Yes”, the EIS shall go back to 6) B. 6. Allow the technician to retry as many times as desired.

If the technician selects “No”, the EIS shall abort the Smog Check.

7. Wait for confirmation of LPFET test completion, the EIS shall prompt as follows:

DISPLAY PROMPT:

**PERFORMING EVAP FUNCTIONAL TEST, PLEASE WAIT.**

If successful communication cannot be achieved between the EIS and the LPFET tester, the EIS shall display the following prompt:

DISPLAY PROMPT:

**THERE IS A COMMUNICATION ERROR BETWEEN THE EIS AND THE EVAP TESTER. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If the technician selects “Yes”, the EIS shall go back to 6) B. 6. Allow the technician to retry as many times as desired.

If the technician selects “No”, the EIS shall abort the Smog Check.

8. Upload the test record from the tester (using the “Upload Test Record” LPFET command). The record will be stored in C:\EISDATA\EVAP\_REC.DAT (this is a single record file that would contain the most recent LPFET record).

DISPLAY PROMPT:

**UPLOADING TEST DATA, PLEASE WAIT.**

If the upload is unsuccessful, the EIS shall display the following prompt:

DISPLAY PROMPT:

**THE LPFET DATA COULD NOT BE UPLOADED. THERE IS A COMMUNICATION ERROR BETWEEN THE EIS AND THE LPFET TESTER. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If the technician selects “Yes”, the EIS shall go back to 6) B. 8. Allow the technician to retry as many times as desired.

If the technician selects “No”, the EIS shall abort the Smog Check.

9. If no matching record (if the last four LPFET VIN does not match the EIS VIN) was found, the EIS shall display the following prompt:

DISPLAY PROMPT:

**NO TEST DATA FOUND FOR THE VEHICLE UNDER TEST. DO YOU WISH TO TRY AGAIN? (YES/NO)**

If the technician selects “Yes”, the EIS will go back to 6) B. 6. above.

If the technician selects “No”, the EIS shall abort the Smog Check.

If a single record is found and if the LPFET test time is within 20 minutes of the inspection start (*Test Start Time* field of the EIS test record), and if the last four LPFET VIN match the EIS VIN, then LPFET overall test result and other data would be extracted from EVAP\_REC.DAT and written to the EIS inspection record for the current Smog Check.

If LPFET test time exceeded 20 minutes of inspection start, then technician is notified that the time to perform LPFET has been exceeded and the Smog Check must be aborted.

If the Smog Check is aborted at any time during the EVAP test, the EIS shall write the following, and any other test data obtained up to this point of the test (i.e. vehicle data, visual/functional results, etc.), to the EIS test record:

- “20” “LPFET Abort” to the *Abort Code* field
- “A” to the *Overall Test Result* field
- “A” to the *Fuel EVAP Test* (EVAP Pass/Fail result) field.

If the LPFET test is successfully completed, the EIS shall write the following from EVAP\_REC.DAT to the EIS test record:

- *Pass/ Fail Result* field 11 of the LPFET test record to the *Fuel EVAP Test* (EVAP Pass/Fail result) field of the EIS test record.
- *Air/N2 Added field* 15 of the LPFET test record to the *LPFET Nitrogen Added* field of the EIS test record.

### 3.6.20 Repairs Performed Before Test

At the conclusion of functional testing, the EIS shall prompt the technician to determine if any repairs were made to the vehicle prior to the start of the inspection. The response will be Yes/No. The response shall be recorded in the *Repairs Performed Before Test* field of the test record.

- 1) The EIS shall display the following prompt:

DISPLAY PROMPT:

**WERE ANY EMISSIONS-RELATED REPAIRS PERFORMED PRIOR TO THE START OF THE INSPECTION? (YES/NO)**

Programming Criteria:

1. If the technician enters Y, the EIS shall go to the next prompt under Subsection 2) (Were the repairs performed at your shop?).
2. If the technician enters N, the EIS shall proceed with the inspection

process (go to §3.6.23). The EIS shall store N in the *Repairs Performed Before Test* field of the test record.

- 2) The EIS shall display the following prompt:

DISPLAY PROMPT:

**WERE THE REPAIRS PERFORMED AT YOUR SHOP? (YES/NO)**

The response (yes or no) shall be recorded in the *Repairs Performed* field of the test record.

Programming Criteria:

1. If the technician enters Y, the EIS shall prompt as follows:

DISPLAY PROMPT:

**DID YOU PERFORM THE REPAIRS? (YES/NO)**

- a) If the technician selects "Y" (for YES), then the EIS shall automatically store the technician's license number in the *Repair Technician License Number* field of the repair record and continue with the repair information entry process.
- b) If the technician selects "N" (for NO), then the EIS shall display the list of technicians (Names and License Numbers only) that are stored in the Technician Information File (see §3.14.5) and shall allow to scroll up or down in this list and select the technician that has performed the repairs. The EIS shall store the technician's license number in the *Repair Technician License Number* field of the repair record and shall display the following prompt:

**DISPLAY PROMPT:**

**WERE ANY OF THE "REPAIRS PERFORMED AT YOUR SHOP" THE RESULT OF A TAMPERED EMISSION SYSTEM? (YES/NO)**

- i. If the technician enters Y, the *Repairs Performed Before Test* field of the test record shall be overwritten with a "T." A "Y" entry shall require the following statement to be printed on the VIR in the technician's signature block.

**ALL REPAIRS WERE MADE IN ACCORDANCE WITH BAR GUIDELINES.**

- ii. If the technician enters N, there will be no modification to the test record. An N entry shall require the following statement to be printed on the VIR in the technician's

signature block.

**PRETEST REPAIRS PERFORMED ON THIS  
VEHICLE WERE NOT TAMPER RELATED.**

2. If the technician enters N to the prompt "Were there repairs performed at your shop," the EIS shall proceed with the inspection process (go to §3.6.23)

### 3.6.21 Repair Action Categories

The EIS shall display the Repair Action Categories (underlined) if Y was entered in response to the question "WERE THERE REPAIRS PERFORMED AT YOUR SHOP?" All repair-related information shall be stored in the repair record. Upon selection of a Repair Action Category, the EIS shall display the appropriate Menu items, indicated by the bullet (◆). If a "◆" Menu is not required, the appropriate sub-menu items will be displayed after the Repair Action Category. When the sub-menu items are displayed (under either the selected Repair Action Category or "◆" Menu), the EIS shall display the following message:

DISPLAY PROMPT:

**ENTER ONE OF THE FOLLOWING CODES FOR EACH OF THE  
EMISSION-RELATED SYSTEM ITEMS THAT HAVE BEEN  
DIAGNOSED AND/OR REPAIRED.**

**T - TAMPERED SYSTEMS REPAIRED/RESTORED**

**R - EMISSIONS-RELATED REPAIRS (OR REPLACEMENTS OR  
ADJUSTMENTS) - REPAIRS THAT WERE PAID BY THE CONSUMER**

**D - DIAGNOSED - SYSTEM OK (NO PROBLEM) - DIAGNOSIS THAT WAS  
PAID BY THE CONSUMER**

**E - ESTIMATED ADDITIONAL REPAIRS NEEDED**

**L - EMISSIONS-RELATED REPAIRS (OR REPLACEMENTS OR  
ADJUSTMENTS) - REPAIRS THAT WERE PAID BY LIRAP**

**C - DIAGNOSED - SYSTEM OK (NO PROBLEM) - DIAGNOSIS THAT WAS  
PAID BY LIRAP**

or **PRESS (FUNCTION KEY) TO BACK-UP ONE SCREEN**

### **REPAIR ACTION CATEGORIES**

#### **Emissions Control Systems**

##### **◆ Positive Crankcase Ventilation**

**PCV Valve**

**PCV Hose**

##### **◆ Thermostatic Air Cleaner**

**Pre Heat Tube**

**Vacuum Motor**

**Thermostatic Bulb**

**Control Valve**

- ◆ **Air Injection System**
  - Air Pump
  - Pulse Valve
  - Pump Belt
  - Diverter Valve
  - Plumbing
  - Check Valve
- ◆ **Exhaust Gas Recirculation**
  - Vacuum Routing
  - EGR Valve
  - Passages Cleaned
  - Controls (non computer)
- ◆ **Evaporative Emission Control**
  - Vacuum Routing
  - Purge Valve (non-computer)
  - Fuel Cap
  - Vapor Lines
  - Charcoal Canister
  - Other
- ◆ **Exhaust**
  - Catalytic converter
  - Thermal Reactor

### **Ignition System**

- ◆ **Primary**
  - Ignition Module
  - Distributor
  - Spark Control
- ◆ **Secondary**
  - Spark Plugs
  - Ignition Wires
  - Cap/Rotor
  - Initial Timing
  - Ignition Coil
  - Other

### **Fuel System**

- ◆ **Carburetor**
  - Fuel Filter
  - Air Filter
  - Adjustment
  - Rebuild/Replace
- ◆ **Fuel Injection**
  - Fuel Filter
  - Air Filter
  - Pressure Regulator
  - Throttle Body
  - Fuel Distributor
  - Fuel Injectors
  - Cold Start Valve

**Other****Engine Mechanical**

**Vacuum Leaks**  
**Cylinder Heads**  
**Top Engine Cleaning**  
**Valve Train**  
**Valve Adjustment**  
**Lower End (Pistons, rings, etc.)**  
**Intake Manifold**  
**Turbo/Supercharger**  
**Other**

**Computer System****◆ Inputs**

**Coolant Temperature Sensor**  
**Air Temperature Sensor**  
**Throttle Position Sensor**  
**Oxygen Sensor**  
**MAP Sensor**  
**BARO Sensor**  
**EGR Valve Position Sensor**  
**Engine Speed Sensor**  
**Vehicle Speed Sensor**  
**Mass Air Flow Sensor**  
**Crankshaft Position Sensor**  
**Camshaft Position Sensor**  
**Other**

**◆ Outputs**

**M/C Solenoid**  
**Spark Control**  
**Canister Purge Solenoid**  
**Idle Speed Control**  
**EGR Solenoid**  
**Diverter Solenoid**  
**Other**

**◆ Controls**

**ECM**  
**PROM**

**Programming Criteria:**

1. The EIS shall only allow the letters T, R, L, C, D or E to be entered for each applicable menu item. The technician shall be able to go directly to the repair action category(ies) of choice, without having to scroll through all of the menu items or back up one screen at a time. If an item is not selected, a blank space shall be recorded in the corresponding field of the repair record. Similarly, if a menu item is chosen and no value is entered, a blank space (indicating no action taken) shall be recorded to the repair record. The EIS may display the following error messages:

ERROR MESSAGES:

**THE REPAIR ACTION CODE IS NOT VALID - TRY AGAIN.**

- 2) The EIS shall not allow the inspection to proceed without entering an appropriate repair code for at least one repair action category item. If there is no entry made for at least one repair action category item, the EIS shall display the following message.

DISPLAY PROMPT:

**WERE REPAIRS PERFORMED AT YOUR SHOP? (Y or N)**

**IF YES, A REPAIR ACTION CODE ENTRY IS REQUIRED!**

If Y, continue with repair action category function. If N, change the entry recorded in the *Repairs Performed* field of the test record from Y to N; do not write to the repair record.

- 3) The EIS shall provide a review screen option to assist the technician to view all repair category actions that have been entered.

**3.6.22 Repair Cost Information**

After the appropriate repair action codes have been entered, the EIS shall require entry of the repair cost information. The EIS shall display the following message:

DISPLAY PROMPT:

- a) **ENTER THE AMOUNT OF LABOR TIME IT TOOK TO REPAIR THE VEHICLE (ROUND TO THE NEAREST TENTH OF AN HOUR):**

**TOTAL REPAIR TIME, HH.H HOURS** \_\_\_\_\_

- b) **ENTER THE TOTAL AMOUNT CHARGED FOR PARTS AND LABOR TO PERFORM EMISSION-RELATED REPAIRS. ENTER THE DOLLAR AMOUNT ONLY (ROUND TO THE NEAREST WHOLE DOLLAR). DO NOT INCLUDE ANY WARRANTY REPAIRS (EMISSION-RELATED OR NOT) AND/OR TAMPER REPAIRS.**

**EMISSION-RELATED REPAIRS (charged to the consumer): PARTS COST \$** \_\_\_\_\_  
**EMISSION-RELATED REPAIRS (charged to the consumer): LABOR COST \$** \_\_\_\_\_  
**EMISSION-RELATED REPAIRS (charged to CAP): PARTS COST \$** \_\_\_\_\_  
**EMISSION-RELATED REPAIRS (charged to CAP): LABOR COST \$** \_\_\_\_\_

- c) **ENTER THE TAMPERED REPAIRS TOTAL PARTS AND LABOR COST WHICH INCLUDES REPAIRS TO GROSS POLLUTERS (ROUND TO THE NEAREST WHOLE DOLLAR):**

**TAMPER REPAIRS (PARTS AND LABOR) COST** \$ \_\_\_\_\_

- d) **ENTER THE ESTIMATED COST OF ADDITIONAL REPAIRS NOT PERFORMED (ROUND TO THE NEAREST WHOLE DOLLAR):**

**ESTIMATED COST OF ADDITIONAL REPAIRS** \$ \_\_\_\_\_

- e) **ENTER THE STATION HOURLY LABOR RATE (ROUND TO THE NEAREST WHOLE DOLLAR):**

**HOURLY LABOR RATE** \$ \_\_\_\_\_

Programming Criteria:

- 1) The EIS shall display the technician's entries, but shall disregard any portion less than a whole dollar amount for the repair record.
- 2) The EIS shall provide a summary screen for the technician to review the repair and diagnostic data entries. In addition, the EIS shall print the information on the VIR.

DISPLAY PROMPT:

**IS THE INFORMATION CORRECT? (YES/NO)**

- 3) If the information is incorrect, the EIS shall allow the technician to make changes.
- 4) The EIS shall recall and display the hourly labor rate from the previous test and write the same rate to the *Hourly Labor Rate* field unless changed by the technician. Then the new hourly labor rate shall be stored in the repair record.
- 5) If the information is correct, the EIS shall store the data in the repair record as follows:

<b>DESCRIPTION</b>	<b>LAYOUT</b>
REPAIR TIME	HH.H
EMISSION-RELATED PARTS COST ( <i>charged to the consumer</i> )	\$\$\$\$
EMISSION-RELATED LABOR COST ( <i>charged to the consumer</i> )	\$\$\$\$
<i>EMISSION-RELATED PARTS COST (charged to</i>	\$\$\$\$

<i>LIRAP)</i>	
<i>EMISSION-RELATED LABOR COST (charged to LIRAP)</i>	\$\$\$\$
TAMPERED REPAIRS (PARTS & LABOR) COST	\$\$\$\$
ESTIMATED COST OF ADDITIONAL REPAIRS	\$\$\$\$
HOURLY LABOR RATE	\$\$\$\$

**3.6.23 Pass/Fail Determination**

The final inspection results shall be determined as follows:

- a) If the *Overall Emissions Test Result*, *Visual Inspection Result* and *Functional Check Result* fields of the test record all contain P entries, then a P shall be entered into the *Overall Test Result* field of the test record. For diesel vehicles, if the *Visual Inspection Result* and *Functional Check Result* fields of the test record both contain P entries, then a P shall be entered into the *Overall Test Result* field of the test record. The vehicle shall pass the inspection and the EIS shall issue a certificate subject to the conditions listed in §3.6.24.
- b) If any of the fields indicated in Item a) contain an F, but not a T or G, then F shall be entered in the *Overall Test Result* field. The vehicle shall fail the inspection and the EIS shall not issue a certificate.
- c) If any of the fields indicated in Item a) contain a T but not a G, then a T shall be entered in the *Overall Test Result* field. The vehicle shall fail the inspection as a ‘tamper’ and a certificate is not issued.
- d) If any of the fields indicated in Item a) contain a G, then G will be entered in the *Overall Test Result* field. The vehicle shall fail the inspection as a ‘gross polluter’ and a certificate is not issued.
- e) Once the Pass/Fail determination has been made, the test cannot be aborted. The test data cannot be changed and the EIS shall store the final test data in the test record and transmitted to the VID.
- f) When the pass/fail determination has been made, the EIS shall record the time to the *Test End Time* field of the test record.

**3.6.24 Electronic Certificate of Compliance or Noncompliance**

The EIS shall issue an electronic certificate of compliance or noncompliance for vehicles that pass all applicable portions of the Smog Check inspection. The certificate number shall be printed on the VIR and shall be transmitted during the END-OF-TEST network contact to the VID along with the final vehicle test results. The EIS shall attempt END-OF-TEST network contact to the VID immediately following the issuance of electronic certificate.

Under the following conditions, even if the vehicle passes the Smog Check, the EIS shall not issue an electronic certificate.

- GROSS POLLUTER as indicated by the VID or previous EIS record.
- Government fleet vehicle.
- Motorist on military assignment and is not seeking California DMV registration for a vehicle
- TRAINING mode
- HANDS-ON-TEST mode

- Government Facility
- Hardship Extension within last 12 months

The EIS shall keep track of the number of remaining certificates based on the total number purchased from the VID.

The certificate number shall be put in the *Certificate Number* field of the test record. The first two characters of this entry are alpha characters, the next 6 digits shall be used sequentially for each emissions test requiring a certificate number. The last character shall be alpha, as specified in the test record.

If F is entered for Certification Type and vehicle is less than or equal to 3 years old, and has less than 7500 miles on the odometer, the EIS shall automatically issue a Certificate of Noncompliance, and add an N as the last character of the certificate number. The EIS shall print a Certificate of Noncompliance number on the VIR. For all other circumstances, the EIS shall add a C as the last character of the certificate number.

When the EIS issues a Certificate of Noncompliance, it shall print a "Notification of Noncompliance" form.

### 3.6.25 Transmission Date and Time

The EIS shall initiate the "End-of-Test" contact to the VID. If successful, the date and time the test record was transmitted to the VID shall be recorded in the *Date of Record Transmission* and *Time of Record Transmission* fields of the test record. These fields shall be populated by the VID at the time that the record is received by the VID.

### 3.6.26 Display of Final Inspection Test Results

Following successful or unsuccessful END-OF-TEST network contact to the VID, the EIS shall display the final inspection test results. As a minimum, the words PASS, FAIL, GROSS POLLUTER or TAMPERED shall be written beside each inspection result as shown in the table below (visual, functional and emissions) except for CO<sub>2</sub> and O<sub>2</sub>. Manufacturer may display only the last three rows (visual test result, functional test result, overall test result) when fuel-type = D (diesel).

HC: (ASM 5015 or TSI 2500 rpm)	XXXX PPM	PASS or FAIL or GROSS POLLUTER
CO: (ASM 5015 or TSI 2500 rpm)	XX.XX %	PASS or FAIL or GROSS POLLUTER
CO <sub>2</sub> : (ASM 5015 or TSI 2500 rpm)	XX.X %	blank
O <sub>2</sub> : (ASM 5015 or TSI 2500 rpm)	XX.X %	blank
NO: (ASM 5015)	XXXX PPM	PASS or FAIL or GROSS POLLUTER
HC: (ASM 2525 or TSI - Idle rpm)	XXXX PPM	PASS or FAIL or GROSS POLLUTER
CO: (ASM 2525 or TSI - Idle rpm)	XX.XX %	PASS or FAIL or GROSS POLLUTER

CO <sub>2</sub> : (ASM 2525 or TSI - Idle rpm)	XX.X %	blank
O <sub>2</sub> : (ASM 2525 or TSI - Idle rpm)	XX.X %	blank
NO: (ASM 2525)	XXXX PPM	PASS or FAIL or GROSS POLLUTER
AIR/FUEL RATIO:	XX.X	blank
VISUAL TEST	blank	PASS or FAIL or TAMPERED
FUNCTIONAL TEST	blank	PASS or FAIL or TAMPERED
OVERALL TEST RESULT	blank	PASS or FAIL or GROSS POLLUTER or TAMPERED

### 3.6.27 Vehicle Inspection Report (VIR)

After display and review of the final test results, and after END-OF-TEST contact attempt with the VID, the EIS shall print the VIR. If contact was not made with the VID, it shall be indicated on the VIR.

If a Smog Check certificate is issued and no contact was made with the VID, print the following message on the VIR:

**YOUR SMOG CHECK CERTIFICATE WILL BE  
ELECTRONICALLY TRANSMITTED TO DMV.**

If a Smog Check certificate is issued and contact was made with the VID, print the following message on the VIR:

**YOUR SMOG CHECK CERTIFICATE HAS BEEN  
ELECTRONICALLY TRANSMITTED TO DMV.**

The following messages shall be sent from the VID to the EIS in a text file. The EIS shall print the appropriate message on the VIR

For vehicles that pass the smog check inspection and a certificate is not issued due to a certificate restriction which includes previous gross polluter, previous hardship extension, and response bits 71 -74, print the message named VIR\_NCRT from MESSAGE.DAT on the VIR. If VIR\_NCRT is printed on the VIR, do not print VIR\_RPAS, or VIR\_PASS on the VIR.

If the vehicle is a military fleet vehicle, or a government fleet vehicle, do not print VIR\_NCRT on the VIR, only use the messages named VIR\_PASS, VIR\_RPAS, VIR\_FAIL, or VIR\_REPR when applicable.

The current message named VIR\_NCRT is the following:

**HOWEVER, ONLY A REFEREE/STAR-CERTIFIED STATION IS  
AUTHORIZED BY LAW TO ISSUE A CERTIFICATE OF**

**COMPLIANCE AFTER REPAIRS HAVE BEEN MADE TO A VEHICLE IDENTIFIED AS A GROSS POLLUTER.**

For vehicles that pass the smog check inspection and have been repaired, print the message named VIR\_RPAS from MESSAGE.DAT on the VIR. The current message named VIR\_RPAS is the following:

**THANK YOU FOR PERFORMING THE NEEDED EMISSIONS-RELATED REPAIRS TO YOUR VEHICLE. THESE REPAIRS HELP CALIFORNIA REACH ITS GOAL OF REMOVING AN EXTRA 100 TONS OF SMOG-FORMING EMISSIONS FROM THE AIR EVERY DAY.**

For vehicles that pass the smog check inspection and have not been repaired, print the message named VIR\_PASS from MESSAGE.DAT on the VIR. The current message named VIR\_PASS is the following:

**BY KEEPING YOUR VEHICLE WELL-MAINTAINED, YOU'VE PASSED YOUR ENHANCED SMOG CHECK AND ARE HELPING CALIFORNIA REACH ITS GOAL OF REMOVING AN EXTRA 100 TONS OF SMOG-FORMING EMISSIONS FROM THE AIR EVERY DAY.**

For vehicles that fail the smog check inspection the message named VIR\_REPR from MESSAGE.DAT on the VIR. The current message named VIR\_REPR is the following:

**REPAIRING YOUR VEHICLE IS NECESSARY TO HELP CALIFORNIA REACH ITS GOAL OF REMOVING AN EXTRA 100 TONS OF SMOG-FORMING EMISSIONS FROM THE AIR EVERY DAY. THE STATE OFFERS A LOW-INCOME EMISSION REPAIR ASSISTANCE PROGRAM AND A VOLUNTARY RETIREMENT PROGRAM FOR POLLUTING VEHICLES. ASK YOUR TECHNICIAN FOR THE OFFICIAL PROGRAM INFORMATION PAMPHLETS OR CALL 1-800-952-5210. YOU CAN ALSO GET INFORMATION ABOUT ALL SMOG CHECK PROGRAMS AT <WWW.SMOGCHECK.ORG>**

For vehicles that fail the smog check inspection, bold all results that are shown as a "Fail" on the VIR.

For vehicles that fail the inspection for any reason, the EIS shall print the message named VIR\_FAIL from MESSAGE.DAT on the VIR. The current message named VIR\_FAIL is the following:

**VEHICLES FAILING SMOG CHECK MUST HAVE NECESSARY REPAIRS MADE TO REDUCE VEHICLE'S EMISSIONS TO REQUIRED LEVELS. IF YOU HAVE SPENT MORE THAN THE REQUIRED COST EXPENDITURE FOR APPROPRIATE EMISSION-RELATED REPAIRS (EXCLUDING WARRANTY REPAIRS AND REPAIRS TO MISSING, MODIFIED OR**

**DISCONNECTED EMISSION CONTROL SYSTEM) AT A LICENSED SMOG CHECK REPAIR FACILITY, YOU MAY BE ELIGIBLE FOR A ONE TIME WAIVER. YOU MAY ALSO BE ELIGIBLE FOR A ONE-TIME ECONOMIC HARDSHIP EXTENSION.**

**REPAIR WAIVERS WILL NOT BE ISSUED FOR VEHICLES WITH MISSING, MODIFIED OR DISCONNECTED EMISSIONS CONTROL EQUIPMENT REGARDLESS OF COST TO MAKE REPAIRS; VEHICLES IDENTIFIED AS "GROSS POLLUTERS," (VEHICLES WHICH HAVE MUCH HIGHER EMISSIONS THAN PROPERLY MAINTAINED VEHICLES IN THEIR CLASS); VEHICLES THAT WERE ISSUED A HARDSHIP EXTENSION; OR VEHICLES THAT OBTAINED A REPAIR COST WAIVER IN THEIR MOST RECENT SMOG CHECK. TWO CONSECUTIVE REPAIR WAIVERS WILL NOT BE ISSUED.**

**FOR QUESTIONS, ASK THE SMOG CHECK TECHNICIAN OR SMOG CHECK STATION REPRESENTATIVE. IF THE SMOG CHECK TECHNICIAN OR SMOG CHECK STATION REPRESENTATIVE IS UNABLE TO ANSWER YOUR QUESTIONS, PLEASE CALL THE BUREAU OF AUTOMOTIVE REPAIR AT (800) 952-5210.**

### **3.7 REPAIR-ONLY SOFTWARE FUNCTIONS**

The Repair-Only Software function shall display the following options:

1. Recall Repair Records
2. Create New Repair Records

- 1) Recall Repair Records  
 Recall Repair Records/Check for Low Income Repair Assistance  
 When this function is selected, the EIS shall prompt the technician to enter the VIN and license plate number of the vehicle. Upon transmission of VIN/license plate number to the VID, if records are found, the VID will transmit up to 10 of the most recent repair records. The EIS shall allow the technician to only view and/or print a user-selectable number of records. If the Low Income Repair field in the repair record is filled with a "Y", the EIS shall display the following message prior to exiting the repair only software functions.

**THIS VEHICLE QUALIFIES FOR LOW INCOME REPAIR ASSISTANCE.**

If the *Low Income Repair* field in the repair record is filled with an "N", the EIS shall display the following message prior to exiting the repair only software functions.

**THIS VEHICLE DOES NOT QUALIFY FOR LOW INCOME REPAIR ASSISTANCE.**

- 2) **Create New Repair Records**  
When this menu item is selected, the EIS shall prompt the technician to enter his/her technician license number and access code per §3.6.2 and 3.6.3. Next, the EIS will prompt the technician for the VIN and license plate number, and then will display the Repair Category per §3.6.21 and 3.6.22. After the repairs have been entered, the EIS will send the record to the VID.

### **3.8 MANUAL TESTING MODE**

When the technician selects manual testing mode, the EIS shall display the following prompt:

DISPLAY PROMPT:

#### **ENTER THE VEHICLE FUEL TYPE CODE:**

Select the appropriate fuel type in accordance with §3.6.7.n) - Vehicle Fuel Type Code.

After the technician has selected the fuel type, the EIS shall display the following menu items:

DISPLAY PROMPT:

#### **ENTER CHOICE FOR MANUAL MODE TESTING:**

- 1) **NO-LOAD EMISSIONS MEASUREMENT**
- 2) **TECHNICIAN SELECTED STEADY LOAD**
- 3) **ASM DIAGNOSTIC TEST**
- 4) **STRUCTURED TEST DRIVE**
- 5) **FREE-FORM TEST DRIVE**

At the conclusion of any of the above modes, the EIS shall, if the technician chooses, be able to display or print a time-aligned second-by-second emissions and wheel speed (if applicable) plot for each gas (HC, CO, NO, O<sub>2</sub> and CO<sub>2</sub>) for up to the last 180 seconds of any of the manual test modes. The gas values shall default to dilution corrected readings and as an option may be set to uncorrected for dilution as toggled by the technician except for the Structured Test Drive and the Free-Form Test Drive, where only uncorrected values shall be displayed. The EIS shall display the emission readings of (HC, CO, NO, O<sub>2</sub> and CO<sub>2</sub>). However, the manufacturer may provide an option to toggle off the display. The rules for applying the DCF during the manual mode shall be the same as the inspection mode.

Each of the above tests, aside from the No-Load Emissions Measurement, must be preceded by the EIS manufacturer's recommended pretest procedures.

- a) **No-Load Emissions Measurement**  
When the operator selects the No-Load Emissions Measurement, the EIS shall start sampling HC, CO, O<sub>2</sub> and CO<sub>2</sub> gases. The EIS shall display these gas values

along with the engine speed on the screen until the operator leaves the No-Load Emissions Measurement.

**b) Technician Selected Steady Load**

When the operator selects the Technician Selected Steady Load, the driver shall be prompted to enter a horsepower load for the dynamometer to simulate. The EIS shall simulate tire losses, and the technician shall be warned accordingly. However, the manufacturer may provide an option to toggle off the tire losses and warning message. This horsepower should be accurate at or above 14 mph and should not exceed safe limits established by the EIS manufacturer. The dynamometer shall smoothly apply the load above 10 mph. Once the power setting is selected, the EIS shall start sampling and the following values shall be displayed on the screen: gas readings for HC, CO, NO, O<sub>2</sub> and CO<sub>2</sub>, engine speed, wheel speed, and a reference time clock (displaying seconds).

**c) ASM Diagnostic Test**

To be able to conduct an ASM Diagnostic Test, the vehicle information must be known. If the information for the vehicle has not been entered already, the EIS must prompt the technician to enter all vehicle data required to correctly determine dynamometer loading information for both modes of the ASM test.

Once the vehicle information is entered, the technician shall be given the option to simulate either the 5015 mode, the 2525 mode, or both as in an actual ASM inspection test. Once a mode is selected, the gas EIS shall start sampling and the screen shall display all of the same values as the Technician Selected Steady Load test in addition to the driver trace appropriate to the mode selected. In either case, the dynamometer shall not apply load below 10 mph for the ASM 5015 and 20 mph for the ASM 2525 mode to aid in bringing the vehicle up to speed.

Once the vehicle information is entered, the EIS shall display HC, CO, NO, O<sub>2</sub>, CO<sub>2</sub>, engine speed, wheel speed, and time while the gas EIS starts taking samples.

Whenever the ASM Diagnostic Test is run on a different vehicle, the *Row ID Number* field of the VLT shall be recorded along with the date and time in a separate file. Only the 25 most recent vehicles must be kept in this file. This information will be used elsewhere in the EIS to create vehicle pretest statistics.

**d) Structured Test Drive**

To assist in the repair of vehicles, the EIS must be capable of providing a repeatable test drive for the vehicle to follow, in this case, the BAR-31 simulation trace. As with the ASM Diagnostic Test, the vehicle information must be known prior to conducting structured test drive. If the information for the vehicle has not been entered already, the EIS must prompt the technician to enter all vehicle data required to correctly access the VLT. This information will be used to determine the appropriate vehicle loading from the VLT. The load shall be applied according to the requirements in §2.5.5.2. a), Diagnostic Level Simulation.

Once the vehicle information is entered, the EIS shall display HC, CO, NO, O<sub>2</sub> and CO<sub>2</sub> gases, engine speed, and wheel speed while the gas EIS starts taking samples. The test shall start once the operator presses START.

e) **Free-Form Test Drive**

To assist in the repair of vehicles, the EIS must be capable of providing a free-form test drive. This will allow the vehicle to be test driven on the dynamometer as it would be test driven on the actual road. As with the ASM Diagnostic Test, the vehicle information must be known prior to conducting the free-form test drive. If the information for the vehicle has not been entered already, the EIS must prompt the technician to enter all vehicle data required to correctly access the VLT. This information will be used to determine the appropriate vehicle loading from the VLT. The load shall be applied according to the requirements in §2.5.5.2 a), Diagnostic Level Simulation.

Once the vehicle information is entered, the EIS shall display HC, CO, NO, O<sub>2</sub> and CO<sub>2</sub> gases, engine speed, and wheel speed while the gas EIS starts taking samples. The test shall start once the operator presses START.

### 3.9 EIS CALIBRATION MENU

When the technician selects the EIS CALIBRATION MENU, the EIS shall display the following menu items:

ENTER CHOICE:

- 1) 3-DAY CALIBRATION, LEAK CHECK & SYSTEMS CHECK
- 2) ANALYZER GAS CALIBRATION
- 3) ANALYZER SAMPLE SYSTEM LEAK CHECK
- 4) DYNAMOMETER CALIBRATION
- 5) FUEL CAP TESTER CALIBRATION WITH MASTER CAPS
- 6) USB DRIVE CHECK

The procedures shall be user-friendly and shall prompt the technician through every step needed to properly perform the required calibration/system check (including, for example, when to turn the gas cylinder valve on and off). Results of all calibrations and checks shall be displayed and recorded in the calibration record. All cylinder bar code data shall be stored in the calibration record.

a) **Three-Day Calibration, Leak Check and Systems Check**

The system shall preclude I/M testing after 72 hours if a full EIS calibration & leak/systems check (CLSC) is not performed and passed. However, if the dynamometer fails the dynamometer calibration, the EIS shall not be locked out of two-speed idle testing. If the EIS fails any portion of the three-day CLSC, a message shall be displayed indicating the failure and suggesting possible technician-fixable causes for the failure; e.g., CHECK GAS CYLINDERS

SHUT/EMPTY/CONNECTED TO WRONG PORTS. TRY AGAIN. IF NONE OF THESE, CALL SERVICE. If a Smog Check is initiated, and the dynamometer calibration has failed, the EIS shall display the following prompt:

DISPLAY PROMPT:

**THE DYNAMOMETER HAS FAILED CALIBRATION. PRESS *(function key)* TO CONTINUE WITH TWO-SPEED IDLE TEST OR [ESC] TO ABORT.**

If the technician presses the escape key [ESC], the Smog Check will abort. If the technician presses the appropriate function key to continue, the technician will be allowed to continue. However, once the test is determined (ASM or TSI) by the VID or from the vehicle information entered, the inspection will abort if the vehicle requires an ASM inspection.

The Three-Day CLSC selection shall perform automatically, in sequence, all the other items in the Calibration Menu, prompting the technician to perform tasks as required. The calibrations and checks shall be performed in the same order as the Calibration Menu list. Since the Three-Day CLSC procedure is a sequence of other procedures, its details will be delineated in Items b) through f), below.

The Dilution Correction Factor and the NO Humidity Correction Factor (HCF) shall be disabled during Three-day Gas Calibration and Gas Audit.

The O<sub>2</sub> sensor shall be calibrated, not just checked during gas calibration. If the O<sub>2</sub> sensor does not pass calibration, the EIS shall display the following message:

**THE O<sub>2</sub> SENSOR FAILED CALIBRATION. CALL FOR SERVICE TO AVOID LOCKOUT.**

The EIS shall not be prevented from performing a Smog Check if oxygen is the only channel to fail gas calibration. However, if the O<sub>2</sub> sensor does not pass calibration within seven days, the EIS shall be locked out and the following prompt shall be displayed:

DISPLAY PROMPT:

**THE O<sub>2</sub> SENSOR IS OUT OF CALIBRATION. EIS IS LOCKED OUT. CALL FOR SERVICE.**

**b) Analyzer Precalibration Audit and Gas Calibration**

The gas analyzer shall be calibrated every 72 hours, or more frequently if required by the system's self-diagnostics..

When this menu item is selected, the EIS shall disable the Dilution Correction Factor (DCF) and the NO Humidity Correction Factor (HCF), and shall display the following prompt:

## 1. DISPLAY PROMPT:

**SCAN THE HIGH RANGE CYLINDER'S THREE BAR CODES IN SEQUENCE (1, THEN 2, THEN 3), OR PRESS [function key] FOR MANUAL ENTRY.**

- i. If the technician presses the [function key], the EIS shall display a manual entry Gas Cylinder Data Screen, prompting the technician to enter the following information manually via the keyboard:

- BAR Label Number
- HC Cyl. Value, ppm
- CO<sub>2</sub> Cyl. Value, %
- O<sub>2</sub> Cyl. Value, %
- Cylinder Expiration Date
- Gas Blend Code
- CO Cyl. Value, %
- NO Cyl. Value, ppm
- Cylinder Lot Number

The BAR Label Number must contain 2 Alpha characters followed by 8 numeric characters. Any deviation from this shall cause the EIS to display the prompt:

**INVALID BAR LABEL NUMBER**

The calibration sequence shall stop until a proper BAR Label Number is entered.

The EIS shall check the cylinders' expiration dates to see that none of the gas blends have expired. (NOTE: Zero air generators do not have an expiration date.) If any expiration date has been exceeded, the EIS shall display the prompt:

***GAS EXPIRATION DATE HAS PASSED.***

*The calibration sequence shall stop until the expired cylinder has been replaced.*

*The EIS shall check the label concentrations of each of the gases in each cylinder to ensure that they are within  $\pm 2\%$  of the nominal concentrations listed in §2.4.5.c) 3 of this specification. (E.g., the nominal concentration of propane in the low range calibration gas is 200 ppm. The allowable concentrations scanned in from the cylinder's label are between 196 –204 ppm ( $\pm 2\%$  of 200 is  $\pm 4$  ppm))*

*If any gas label concentration is outside the  $\pm 2\%$  tolerance, the EIS shall display the prompt:*

**GAS VALUE EXCEEDS TOLERANCE.**

The calibration sequence shall stop until the faulty cylinder has been replaced.

After the technician has successfully scanned the bar codes on the high range cylinder, or entered the required data manually, the software shall prompt him to

DISPLAY PROMPT:

**SCAN THE LOW RANGE CYLINDER'S THREE BAR CODES IN SEQUENCE (1, THEN 2, THEN 3), OR PRESS [function key] FOR MANUAL ENTRY.**

The software shall follow the same procedure as in Step 1.i above.

After the technician has successfully scanned the bar codes on the low range cylinder, or entered the required data manually, the software shall prompt him to

DISPLAY PROMPT:

**SCAN THE THREE BAR CODES IN SEQUENCE (1, THEN 2, THEN 3) ON THE ZERO AIR CYLINDER OR ZERO AIR GENERATOR, OR PRESS [function key] FOR MANUAL ENTRY.**

The software shall follow the same procedure as in Step 1.i above.

2. After the technician has successfully scanned the bar codes on the zero air source, or entered the required data manually, the software shall begin the precalibration audit and calibration routines, displaying prompts for technician actions and inputs, and the status of the calibration procedure as it progresses.
3. The EIS manufacturers, in consultation with their analyzer bench/sensor providers, shall determine whether single-point or two-point calibration, as described below, will result in greater and more consistent accuracy and dependability in their particular systems. The EIS manufacturers shall incorporate the better calibration method in their systems. The two calibration methods, along with their associated precal audits, are performed as follows:
4. Single-Point Calibration

DISPLAY PROMPT:

**OPEN CAL GAS CYLINDERS AND ZERO AIR. PRESS [function key] TO CONTINUE.**

- i. After the technician presses the function key, the software shall cause zero air to flow through the analyzer. (It is permissible to

flush the system with ambient air before flowing zero air; however, sufficient zero air must flow to flush the ambient air before zeroing.) The EIS manufacturer shall determine how long the flow must be maintained. The EIS shall record each channel's precal zero reading (span reading for O<sub>2</sub>).

- ii. The EIS shall adjust all channels except O<sub>2</sub> to zero. The O<sub>2</sub> channel shall be calibrated to 20.9%. The EIS shall record each channel's adjusted zero reading (span reading for O<sub>2</sub>).
- iii. The software shall then cause High Range BAR-97 calibration gas to flow through the analyzer until the readings have stabilized. (The EIS manufacturer shall determine the time required for the readings to stabilize.) The response time check in Step iv below shall be performed at this point. The EIS shall record each channel's precal high-range reading (zero reading for O<sub>2</sub>). Each channel shall then be adjusted to the center of its tolerance range, except that O<sub>2</sub> shall have its zero reading adjusted to the center of its tolerance range. The adjusted values shall be within  $\pm 1\%$  of the actual values shown on the High Range calibration gas cylinder. The EIS shall record each channel's calibrated high-range reading (calibrated zero reading for O<sub>2</sub>).
- iv. During the calibration procedure, analyzer/sensor response times for the CO, NO and O<sub>2</sub> channels shall be checked. *The EIS shall introduce high range calibration gas and shall calculate the time required to reach T<sub>90</sub> (see §2.4.5 r), or T<sub>10</sub> for O<sub>2</sub>, and shall compare it to the values in §2.4.5 r (10 seconds for O<sub>2</sub>). If the measured response time for any channel exceeds its allowable response time by more than one (1) second, a message shall be displayed on the EIS monitor.*

DISPLAY PROMPT:

**ANALYZER RISE TIME TOO SLOW. CALL FOR SERVICE. PRESS [function key] TO CONTINUE.**

If the difference between the values (except for O<sub>2</sub>) exceeds two (2) seconds, the EIS shall fail the gas calibration, prevent any smog checks from being performed, and a suitable message displayed.

DISPLAY PROMPT:

**FAILED GAS CALIBRATION. ANALYZER RISE TIME TOO SLOW. CALL FOR SERVICE. PRESS [function key] TO CONTINUE.**

An O<sub>2</sub> channel response time failure shall not cause a calibration failure unless its response time has been at least two seconds over the limit for seven calendar days.

Similarly, the EIS computer shall measure the analyzer/sensor responses to the purging of the high range calibration gas, shall calculate the time required to reach T<sub>10</sub> and shall compare it to the values in §2.4.5 r. If the difference between the values exceeds one (1) second, a message shall be displayed on the EIS monitor.

DISPLAY PROMPT:

**ANALYZER FALL TIME TOO SLOW. CALL FOR SERVICE. PRESS [function key] TO CONTINUE.**

If the difference between the values (except for O<sub>2</sub>) exceeds two (2) seconds, the EIS shall fail the gas calibration, store any results to the calibration record, prevent any smog checks from being performed, and a suitable message displayed. The O<sub>2</sub> criterion for causing a calibration failure shall be the same as that for a T<sub>90</sub> failure.

DISPLAY PROMPT:

**FAILED GAS CALIBRATION. ANALYZER FALL TIME TOO SLOW. CALL FOR SERVICE. PRESS [function key] TO CONTINUE.**

- v. If the analyzer passed the response time test, the EIS shall then cause Low Range BAR-97 calibration gas to flow through the analyzer. No precal readings shall be recorded. The channels shall be checked, but NOT adjusted, to determine that each channel is still within the accuracy requirements listed in §2.4.5 j.

Acceptance Criteria: (1) If Steps i through v, above, are all successfully completed, the software shall display the prompt

DISPLAY PROMPT:

**PASSED GAS CALIBRATION. PRESS [function key] TO CONTINUE.**

When the technician presses the [function key], the software shall return to the calibration menu. If this is a 3-day calibration and leak check, it shall proceed to the leak check procedure. (2) If any step is not successfully completed, the software shall display the prompt

DISPLAY PROMPT:

**FAILED GAS CALIBRATION. TRY AGAIN? (YES/NO)**

If the technician enters YES, the software shall repeat the calibration procedure from Step iii one more time. If the technician enters NO, the software shall return to the calibration menu, shall store the result in Calibration Data file and shall prevent a smog check from being performed.

**OPTION:** If the EIS manufacturer has chosen single-point calibration as the preferred method, and if the analyzer has failed the gas calibration, and the technician elects to try again, the EIS may at this time perform a two-point calibration, calibrating to the low range gas first, then to the high range gas. However, the following limitations apply:

- (a) Two-point calibrations cannot be performed twice in a row. They must be preceded by an on-point calibration that successfully calibrated to the high range gas.
- (b) A two-point calibration may not be performed if three two-point calibrations have been performed within the previous 21 days.

These limitations are present because the EIS and the analyzer/sensor manufacturers have determined that the single-point calibration method provides better accuracy and consistency in their systems than does the two-point calibration method..

5. *Two-Point Calibration*

DISPLAY PROMPT:

**OPEN CAL GAS CYLINDERS AND ZERO AIR. PRESS [function key] TO CONTINUE.**

- i. After the technician presses the function key, the software shall cause zero air to flow through the analyzer. (It is permissible to flush the system with ambient air before flowing zero air; however, sufficient zero air must flow to flush the ambient air before zeroing.) The EIS manufacturer shall determine how long the flow must be maintained. The EIS shall record each channel's precal zero reading (span reading for O<sub>2</sub>).

- ii. The EIS shall adjust all channels except O<sub>2</sub> to zero. The O<sub>2</sub> channel shall be calibrated to 20.9%. The EIS shall record each channel's adjusted zero reading (span reading for O<sub>2</sub>).
- iii. The software shall then cause Low Range BAR-97 calibration gas to flow through the analyzer until the readings have stabilized. (The EIS manufacturer shall determine the time required for the readings to stabilize.) The EIS shall record each channel's precal low-range reading (zero reading for O<sub>2</sub>). Each channel shall then be adjusted to the center of its tolerance range, except that O<sub>2</sub> shall have its zero reading adjusted to the center of its tolerance range. The adjusted values shall be within  $\pm 1\%$  of the actual values shown on the Low Range calibration gas cylinder. The EIS shall record each channel's calibrated low-range reading (calibrated zero reading for O<sub>2</sub>).
- iv. The software shall then cause High Range BAR-97 calibration gas to flow through the analyzer until the readings have stabilized. The response time check in Step 4. iv above shall be performed at this point. The EIS shall record each channel's precal high-range reading (zero reading for O<sub>2</sub>). Each channel shall then be adjusted to the center of its tolerance range, except that O<sub>2</sub> shall have its zero reading adjusted to the center of its tolerance range. The adjusted values shall be within  $\pm 1\%$  of the actual values shown on the High Range calibration gas cylinder. The EIS shall record each channel's calibrated high-range reading (calibrated zero reading for O<sub>2</sub>).

*[Note that the T<sub>90</sub> response time is taken over the range of low-range final reading to high-range stabilized value. For example, if the final low range reading for NO was 300 ppm and the stabilized high-range reading was 3000 ppm, the range would be 3000 – 300 = 2700 ppm. 90% of 2700 is 2430 ppm, so the T<sub>90</sub> point would be 2430 + 300 = 2730 ppm.]*

6. Summary: Single-Point Analyzer Calibration Sequence

- 1. The EIS flows zero air; the HC, CO, CO<sub>2</sub> & NO channels are zeroed; the O<sub>2</sub> channel is set to 20.9%.
- 2. The EIS flows high range gas; the EIS measures response times to T<sub>90</sub> for CO & NO and T<sub>10</sub> for O<sub>2</sub> and compares to response times in §2.4.5.r; the HC, CO, CO<sub>2</sub> & NO channels are calibrated; the O<sub>2</sub> channel is zeroed.
- 3. The EIS flows zero air; the EIS measures response times to T<sub>10</sub> for CO & NO (T<sub>90</sub> for O<sub>2</sub>), and compares to response times in §2.4.5.r.

4. The EIS flows low-range gas and checks the analyzer readings to ensure that the accuracy requirements of this specification are met (calibration adjustments are NOT to be made at low range).
5. The EIS makes the analyzer precal audit and calibration pass/fail determinations, purges the bench and goes on to the next step.

7. Summary: Two-Point Analyzer Calibration Sequence

1. The EIS flows zero air; the HC, CO, CO<sub>2</sub> & NO channels are zeroed; the O<sub>2</sub> channel is set to 20.9%.
2. The EIS flows low range gas; the HC, CO, CO<sub>2</sub> & NO channels are calibrated; the O<sub>2</sub> channel is zeroed.
3. The EIS flows high range gas; the EIS measures response times to T<sub>90</sub> for CO & NO and compares to response times in §2.4.5; the HC, CO, CO<sub>2</sub> & NO channels are calibrated; the O<sub>2</sub> channel is zeroed.
4. The EIS flows zero air; The EIS flows zero air; the EIS measures response times to T<sub>10</sub> for CO & NO (T<sub>90</sub> for O<sub>2</sub>), and compares to response times in §2.4.5.r.

The EIS makes the analyzer precal audit and calibration pass/fail determinations, purges the bench and goes on to the next step.

8. If the EIS is configured without a NO<sub>x</sub> measuring device the EIS shall make the following modifications to the calibration routine:
  1. The EIS shall be able calibrate on gas that does contain NO.
  2. The EIS shall be able to accept zero for NO gas bottle values (the software shall still be able to accept the standard high/low NO gas bottle values). The EIS shall also be able to accept the appropriate blend code entries for calibration gas that does not contain NO.
  3. The EIS shall zero fill the appropriate NO results in the calibration data record.
9. The EIS shall write the type of NO<sub>x</sub> Measuring device installed in the EIS to the *NO<sub>x</sub> device installed* field of the calibration record.
  - 1 = NO<sub>x</sub> device installed (standard cell),
  - 2 = NO<sub>x</sub> device not installed-
  - 3 = NDIR bench installed,

- 4 = chemiluminescence installed,
- 5 = NO<sub>x</sub> gel cell installed,
- 6 = NDUV bench installed.

Note: If alternate NO technologies are not used, numbers 3-6 do not apply.

Upon completion of the gas calibration, the gas calibration interval as determined by the analyzer software shall be stored in the calibration record (i.e. 24, 48, or 72 hours).

**c) EIS Sample System Leak Check**

Selection of this item shall bring up a set of leak check procedures. The procedures shall be user friendly and shall indicate every step needed to properly perform a leak check (including when it is necessary to turn the gas cylinder valve on and off). Procedures shall be approved by the BAR. Results of the leak check shall be displayed and recorded on the calibration record. If the EIS fails the three-day gas calibration or the leak check, the unit shall be "locked out" (prevented from testing) and a message shall be displayed on the screen indicating that and instructing the technician how to correct the failure or to call for repairs.

**d) Dynamometer Calibration**

The dynamometer shall be calibrated every 72 hours using the following calibration procedures described below. If the dynamometer fails the calibration, the EIS shall not be locked out of two-speed idle testing. If the EIS is configured without a dynamometer do not prompt for a dynamometer calibration during a Three-Day Calibration.

- 1) **Warm-Up:** Whenever the dynamometer is due for dynamometer warm-up check, the EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER WARM-UP REQUIRED.**

Programming Criteria:

1. The dynamometer shall be warmed up in accordance with the dynamometer manufacturer's warm-up procedure. The EIS shall provide sufficient information (temperature compensation) to instruct the technician regarding the dynamometer manufacturer's warm-up test procedure. The technician shall be required to press a function key to start the warm-up procedure and the EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER WARM-UP IS IN PROGRESS.**

2. If the dynamometer does not meet the manufacturer's warm-up time, the EIS shall be locked out of loaded mode inspection for DYNAMOMETER WARM-UP FAILURE. If the dynamometer warm-up time is within the dynamometer manufacturer's specification, then the dynamometer passes the warm-up check, the EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER PASSED WARM-UP CHECK.**

If the dynamometer doesn't meet the manufacturer's warm-up time, the EIS shall be locked out of inspection for DYNAMOMETER WARM-UP FAILURE.

DISPLAY PROMPT:

**DYNO WARM-UP FAILURE -- CALL FOR SERVICE.**

- 2) **Coast-down Check:** Whenever the dynamometer is due for dynamometer coast-down check, the EIS shall perform the coast-down check in accordance with §2.5.7.2 (a) and (b). The EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER COAST-DOWN CHECK IS REQUIRED**

Programming Criteria:

1. The EIS shall provide sufficient information to instruct the technician to perform the dynamometer coast-down check. The technician shall be required to press a function key to start this check procedure and the EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER COAST-DOWN CHECK IN PROGRESS.**

2. Upon completion of the dynamometer coast-down check, the EIS shall store in the calibration record file the coast-down times.
  - a. If the dynamometer coast-down times are within the limits, then the dynamometer passes the coast-down check and the EIS shall display the following message:

DISPLAY PROMPT:

**DYNAMOMETER CALIBRATION COMPLETE.**

- b. If the dynamometer coast-down times are not within the limits, the EIS shall be locked out of inspection for DYNAMOMETER COAST-DOWN FAILURE.

DISPLAY PROMPT:

**DYNO COAST-DOWN FAILURE -- PERFORM PARASITIC LOSS DETERMINATION**

- 3. Parasitic Loss Determination: Perform the parasitic loss determination according to the procedures in §2.5.7.3. The EIS shall store parasitic losses measured in horsepower in the calibration record.
  - a) If the dynamometer parasitic losses are within the limits, then perform another coast-down check using the new parasitic loss values.

DISPLAY PROMPT:

**DYNO PARASITIC LOSSES RECALIBRATED -- PERFORM COAST DOWN CHECK**

- 1. If the coast-down times are within manufacturer required specifications, the dynamometer calibration is complete.

DISPLAY PROMPT:

**DYNAMOMETER CALIBRATION COMPLETE**

- 2. If the coast-down times are not within manufacturer required specifications, the dynamometer shall be locked out of inspection for DYNAMOMETER LOAD CELL CALIBRATION FAILURE.

DISPLAY PROMPT:

**DYNAMOMETER LOAD CELL CALIBRATION FAILURE -- PERFORM DEAD WEIGHT CALIBRATION**

- b) If the dynamometer parasitic losses are not within the manufacturer's allowable limits, then the EIS shall be

locked out of inspection for DYNAMOMETER  
PARASITIC LOSSES FAILURE.

DISPLAY PROMPT:

**DYNO PARASITIC LOSS FAILURE -- CALL FOR  
SERVICE**

4. If a dynamometer's parasitic losses fall within the manufacturer's recommended limits but the dynamometer cannot pass the coast-down test, perform the dead weight calibration according to the manufacturer's recommended procedures followed by another coast-down test. Record the coast-down values and the dead weight test results in the test record.
  - a) If the load cell will not come to within manufacturer's recommended specifications, the EIS shall be locked out of inspection for DYNAMOMETER LOAD CELL FAILURE.

DISPLAY PROMPT:

**DYNO LOAD CELL FAILURE -- CALL FOR  
SERVICE.**

- b) If the coast-down times are still not within the limits after the load cell calibration, the EIS shall be locked out of inspection for DYNO CALIBRATION FAILURE.

DISPLAY PROMPT:

**DYNO CALIBRATION FAILURE -- CALL FOR  
SERVICE**

- c) If the parasitic losses and the coast-down times are within the allowable limits, the dynamometer may be used to perform inspections.

DISPLAY PROMPT:

**DYNAMOMETER CALIBRATION COMPLETE**

The following values taken at the completion of the dynamometer calibration shall be written to the calibration record: Dynamometer Bearing Temperature, PAU Load Cell value, Dynamometer Weight Scale Value, Date and Time of the last Dynamometer Calibration.

**e) Fuel Cap Tester Calibration**

The fuel cap tester shall be checked for proper calibration accuracy every 72 hours. The EIS shall display the following prompts.

**A. Pass Cap**

- i. DISPLAY PROMPT:

**TIGHTLY INSTALL THE "PASS CALIBRATION CAP" ON THE FUEL CAP TESTER AND PRESSURIZE THE SYSTEM AND PRESS THE START TEST BUTTON.**

- ii. The tester shall send a pass/fail to the EIS. If a pass is sent to the EIS, the EIS shall continue on with the fail cap test **(B)**. If a fail is sent to the EIS, the EIS shall display the following prompt.

DISPLAY PROMPT:

**THE "PASS CALIBRATION CAP" HAS FAILED. REMOVE THE "PASS CALIBRATION CAP" AND CHECK FOR PROPER SEAL. BE SURE THE CALIBRATION CAP IS TIGHTLY INSTALLED.**

- iii. The tester shall send a pass/fail to the EIS. If a pass is sent to the EIS, the EIS shall continue on with the fail cap test **(B)**. If a fail is sent again, the EIS shall display the following prompt.

DISPLAY PROMPT:

**THE FUEL CAP TEST SYSTEM IS NOT CALIBRATED OR IS MALFUNCTIONING. SET FUEL CAP TEST SYSTEM CALIBRATION (only if system is designed for recalibration) OR CALL FOR SERVICE.**

**B. Fail Cap**

- i. DISPLAY PROMPT:

**TIGHTLY INSTALL THE "FAIL CALIBRATION CAP" ON THE FUEL CAP TESTER AND PRESSURIZE THE SYSTEM AND PRESS THE START TEST BUTTON.**

- ii. The tester shall send a pass/fail to the EIS. If a fail is sent to the EIS, the calibration shall end at this point.

- iii. If a pass is sent to the EIS, the EIS shall display the following prompt.

DISPLAY PROMPT:

**THE FUEL CAP TESTER HAS FAILED THE CALIBRATION CHECK. THE FUEL CAP TEST SYSTEM IS NOT CALIBRATED OR IS MALFUNCTIONING.**

If the system is designed for recalibration, the following prompt shall be displayed:

DISPLAY PROMPT:

**SET THE FUEL CAP TEST SYSTEM CALIBRATION.**

If the system is NOT designed for recalibration, continue with the following prompt: **CALL FOR SERVICE**. A lockout shall be set if the fuel cap tester cannot be recalibrated or fails after recalibration.

NOTE:Manufacturers may modify the above procedure upon approval by BAR.

**f) USB Drive Check**

The State-secured USB drive shall be checked every 72 hours. Check to ensure that the USB drive is capable of reading/writing data and free from viruses.

DISPLAY PROMPT:

**PRESS ENTER TO START USB DRIVE CHECK.**

If no errors are found, the following prompt shall be displayed.

DISPLAY PROMPT:

**USB DRIVE CHECK PASSED**

If an error is found and the error can not be repaired, a lockout shall be set and the following prompt shall be displayed.

DISPLAY PROMPT:

**USB DRIVE ERROR. CALL FOR SERVICE.**

NOTE: All USB drive errors require the above prompt. Software repairs are not usually adequate and these errors are a sign of drive deterioration.

**3.10 STATUS PAGE**

Selection of this item will display a status screen containing the following information:

- EIS number
- PEF number
- Span gas cylinder values
- Date and time of last calibration
- Gas Analyzer
- Fuel Cap Tester
- Dynamometer
- Leak Check
- Date EIS was last serviced
- Time and date
- Active software version number
- Update software version number
- Update activation date
- Date and time of last network access
- Number of Smog Checks and number of days since last network access
- Station license has expired
- Station license suspended
- Station license revoked
- Failure to pay for certificate numbers purchased
- Failure to pay for communication services
- Warm-up in progress
- Warm-up failure
- Dynamometer warm-up in progress
- Dynamometer calibration required
- Dynamometer calibration failure
- Dynamometer failure
- Gas calibration required
- Gas calibration failure
- Gas analyzer failure
- Calibration Gas Cylinder Violation
- Fuel cap tester failure
- Fuel cap tester out of calibration
- Dyno lift failure
- Leak check required
- Leak check failure
- Cabinet tampering
- Out of certificates
- Hard disk is full
- USB Drive failure
- Hard disk or disk mechanism failure
- QA/State EIS lockout
- EIS initialization (data missing, incorrect or incomplete)
- Certificate sequencing error
- State drive tampering

- O<sub>2</sub> Sensor Out of Calibration
- Clock lockout
- VLT corrupt
- Dynamometer scale failure
- Excessive Number of Aborts
- Live weight scale reading
- Humidity reading
- Temperature reading
- Barometric pressure reading
- NO<sub>x</sub> measuring device is installed (Y/N)
- Dynamometer installed (Y/N)
- Confirm EIS to EVAP tester communication

There shall be an option on the status page which polls the EVAP tester and confirms that communication between the EIS and the EVAP tester can be achieved.

### 3.11 Network Communications Diagnostics

This item shall be used to diagnose communications-related problems. The following diagnostic tests shall be provided:

- a) Network Diagnostics: The EIS shall provide the data needed to conduct NETWORK DIAGNOSTICS. The structure of this file is determined by each EIS manufacturer. The data file Network DIAGNOSTIC TRANSMIT RECORD shall be transmitted to the VID and the data file NETWORK DIAGNOSTIC RECEIVE RECORD shall be sent back to the EIS from the VID. They should be identical upon completion of the network diagnostics routine for this test to pass. The EIS shall display the following message:

DISPLAY PROMPT:

**TRANSMITTING DATA, PLEASE WAIT.**

Programming Criteria:

1. If, upon completion of network access, the data transmitted by the EIS to the VID is the same as the data received by the EIS from the VID, then the EIS shall display the following message:

DISPLAY PROMPT:

**NETWORK COMMUNICATIONS PASSED.**

2. If, upon completion of network access, the data transmitted by the EIS to the VID is **not** the same as the data received by the EIS from the VID, then the EIS shall display the following message:

DISPLAY PROMPT:

**NETWORK COMMUNICATIONS FAILED.**

3. If network communications access is not achieved, the EIS shall display the following message:

DISPLAY PROMPT:

**CANNOT ACCESS NETWORK.**

**3.12 PRETEST/TRAINING MODE**

When this item is selected, the EIS shall provide an option to perform either a Pretest or Training Mode. Prompts shall be provided to allow the trainee to perform a practice inspection in accordance with the requirements specified in §3.2.10.

**3.13 RECALL PREVIOUS VEHICLE TESTS**

The EIS must be able to recall the previous data and reprint a VIR for at least the most recent 100 inspections. The EIS shall provide prompts to the technician to review or print, if required, a summary of the test result or the specific vehicle information.

**3.14 QA FUNCTIONS**

The EIS shall display the list of State/QA functions when this item is selected.

**3.14.1 QA/State Menu**

Access to initialize the EIS by QA/State representatives must be in place at the time the EIS is delivered.

The access code for the QA/State menu is a case-sensitive alphanumeric code that changes daily. The access code will be supplied by the state (refer to §1.4). The EIS shall display the access code as Xs on the screen when the access code is entered.

The manufacturer shall display the following menu options for the QA inspectors and State representatives:

1. **LEAK CHECK**
2. **GAS AUDIT**
3. **UPDATE STATION INFORMATION**
4. **VIEW TECHNICIAN INFORMATION**
5. **RESET DATE & TIME**
6. **HANDS-ON TEST**
7. **LOCKOUT EIS**
8. **PERFORM EMERGENCY SOFTWARE UPDATE**
9. **SEARCH AND RETRIEVE TEST RECORD**
10. **COMMUNICATIONS LOG**

Access to the QA/State Menu will require entry of an access code by a QA/State representative when the initial station inspection has been completed. The EIS's I/M testing functions shall not operate until the access code is entered. Information contained

in the files associated with the QA/State Menu shall be hidden in software to the BAR's satisfaction.

The access code shall consist of five case-sensitive alphanumeric characters. When **QA/STATE MENU** is selected, the EIS shall display the following message:

DISPLAY PROMPT:

**ENTER THE QA/STATE ACCESS CODE**

When the correct QA/State access code for the day has been entered, the EIS shall display the "QA/State Menu" functions.

Once access to the QA/State Menu functions has been allowed, the EIS shall monitor for keyboard strokes. If the EIS does not detect keyboard strokes or processor activities continuously for five minutes, the EIS shall automatically close the QA/State Menu and return to the Main Menu.

#### 3.14.1.1 Leak Check

Instructions for conducting a leak check (refer to §3.9.c)) shall be displayed on one screen and the EIS shall allow the QA inspector to press a function key when ready to begin the leak check. The following message shall be displayed at the bottom of the leak check instruction page:

**PRESS (Function key) WHEN YOU WANT TO START THE LEAK CHECK.**

#### 3.14.1.2 Gas Audit

The EIS shall prompt the gas audit procedure specified in §2.4.5; the ambient temperature, relative humidity and barometric pressure shall also be displayed. HC readings shall be displayed as ppm propane, or selectable as ppm hexane or propane. The actual PEF values must be displayed along with the readings.

#### 3.14.1.3 Update Station Information

Selecting this item will cause the EIS to display a table showing the following station information. This information is entered by BAR upon initialization of the station and when the information changes.

**STATION LICENSE NUMBER**

(8 alphanumeric)

**DYNAMOMETER CONFIGURATION**

(2WD, AWD, NO DYNAMOMETER)

**NO<sub>x</sub> MEASURING DEVICE INSTALLED**

1 = NO<sub>x</sub> cell installed (standard cell), 2 = NO<sub>x</sub> device not installed , 3 = NDIR bench installed, 4 = chemiluminescence installed, 5 = NO<sub>x</sub> gel cell installed, 6 = NDUV bench installed

Note: If alternate NO technologies are not used numbers 3 – 6 do not apply.

**EIS #**

(8 alphanumeric)

The EIS shall record the above data to the appropriate fields in the test record, i.e. *Station License Number, Dyno Configuration, NO<sub>x</sub> cell installed, and EIS Number.*

**3.14.1.4 View Technician Information**

The technician information shall be transferred from the VID to the EIS. The EIS shall provide viewing option to the State/QA inspector. When the technician information is displayed, a function key must be pressed to display the technician access code. The technician access code shall be displayed for two seconds after the function key is pressed. The technician access code shall never be printed.

**TECHNICIAN NAME**

(20 alpha)

**ACCESS CODE**

(5 numeric)

**LICENSE NUMBER**

(8 alphanumeric)

**ENDORSEMENTS**

(1 alpha)

**EXPIRATION DATE**

(MMDDYYYY)

Space for 99 licensed technicians shall be provided. Alternative arrangements of the information will be considered by the BAR.

**3.14.1.5 Reset Date and Time**

Selection of this item shall cause the date and time to be displayed. The date and time shall be displayed in the following manner:

**MONTH DAY, YEAR**

(8 digits)

**HOUR:MINUTES:SECONDS**

(24-hour time)

The manufacturer shall provide mechanisms for direct entry of the date and time.

**3.14.1.6 Hands-on Test**

When this item is selected, the EIS shall not issue a certificate, but shall record an H (Hands-on Test) for the inspection reason on the test record. The test results shall be printed on the VIR, QA Audit Hands-on Evaluation printed in the test results block and recorded to the Hands-on Test file; they shall be transmitted to the VID during the next required communication session.

#### 3.14.1.7 EIS Lockout/Tamper

When this item is selected, the EIS shall display the list of the lockouts/tampers and current lockout/tamper status.

DISPLAY PROMPT:

**SELECT "Y" FOR YES TO SET LOCKOUT.**

**SELECT "N" FOR NO TO CLEAR LOCKOUT.**

List of lockouts/tampers:

- QA/State EIS lockout
- Cabinet tampering
- State drive tampering
- Station license suspended
- Station license revoked
- Station license expired
- Failure to pay for certificate numbers purchased
- Failure to pay for communications services
- Certificate sequencing error
- No communication with VID in XXX days and XXX tests
- Clock lockout
- VLT Corrupt (self-correcting upon VID verification of VLT data replacement)
- Calibration Gas Cylinder Violation
- Excessive Number of Aborts
- Dynamometer scale failure

The EIS shall allow the lockouts to be set or cleared (tampers can only be cleared) by a method approved by BAR.

The EIS shall display a message if the EIS is locked out from I/M testing.

Only the QA/State Representatives, either at the EIS unit or via the VID, shall be able to clear lockouts set by BAR staff. The EIS shall be designed to allow the BAR to set or clear all lockouts that are transmitted to the VID via the VID. However, if a lockout is cleared at the EIS unit and not via the VID, the lockout will be re-set during the next VID contact. A tamper can only be set initially by the EIS unit.

#### 3.14.1.8 Perform Emergency Software Update

If an emergency software update is required, the EIS, using this menu selection, shall allow the BAR representative or the QA inspector to install the software update on affected, if applicable, EIS units.

If this menu selection is made, the EIS shall display the following prompt:

DISPLAY PROMPT:

**DO YOU WANT TO PERFORM AN EMERGENCY SOFTWARE UPDATE?  
(YES/NO)**

Programming Criteria:

1. If Yes, the EIS shall automatically open the door to the secured state drive or (if a lock mechanism is used) shall display a message regarding how to open the door. The EIS shall then prompt to insert the update medium in the state drive and press a function key to implement the software update. After the update has been completed, the EIS shall prompt to remove the update medium and close the-secured state drive door. The EIS shall then return to the QA/State menu. Any time a software update is performed, the EIS shall require the technician to perform a Data file refresh before a Smog Check can be initiated.
2. If No, the EIS shall return to the QA/State menu.

#### 3.14.1.9 Search and Retrieve Test Records

The search shall locate, display and printout completed test and calibration records based on knowledge of the vehicle license plate number, VIN, date/time or certificate number. Once a test record is located, the QA/State Representative shall be allowed to review the previous test records as well as those which follow the target record. If an exact match is not found, the closest match shall be displayed. Once a record is located, the QA or state representative shall be allowed to review the complete vehicle inspection or calibration record and print those records using the VIR printer.

#### 3.14.1.10 Communications Log

This function will allow the QA or State Representative to view the communications log and shall provide an option to view and print. The EIS shall keep a log of the 100 most recent communication transactions. The logs are to be created using the "/L" switch built into ESP's "BAR 97 EIS COMMUNICATION INTERFACE TO VID" specification. The log files must be created regardless of whether or not the "/L" switch enables or disables the log feature. (This log shall also be made available to the manufacturer's representatives in the FIELD SERVICE MENU.)

### 3.15 STATION MANAGER MENU

1. **PURCHASE CERTIFICATE NUMBERS**
2. **REVIEW CERTIFICATE INVENTORY**
3. **DATA FILE REFRESH**
4. **UPDATE NETWORK COMMUNICATIONS DATA**

5. STATION IDENTIFICATION
6. SET STATION PASSWORD
7. UPDATE VLT
8. LPFET TEST SETTINGS

### 3.15.1 Purchase Certificate Numbers

This function will allow certificate numbers to be purchased via the network. The EIS shall only allow authorized personnel (station manager's access code) to enter this feature. Upon selection, network access shall be attempted and, if successful, certificate numbers in multiples of fifty (50) may be ordered.

If transmission of certificate numbers is successful, then the certificate numbers shall be returned (in the CERTIFICATE NUMBERS data file) either immediately or at a subsequent network access and should be stored in the REVIEW CERTIFICATE INVENTORY file. If sufficient funds are not available, the VID shall send a lockout message. The EIS shall display the following menu items under purchase certificate numbers:

1. SET AUTOMATIC ORDER QUANTITY
2. MANUAL ORDER

When automatic order quantity is selected, the EIS shall allow the operator to set the low certificate warning threshold and set the number for automatic certificate order. When manual order is selected, the EIS shall commence with certificate purchase.

DISPLAY PROMPT:

**TRANSMITTING DATA, PLEASE WAIT.**

Programming Criteria:

- 1) Certificate numbers purchase request will be transmitted to VID.
- 2) Upon successful transmission of the request, the EIS shall display the following message provided that certificate numbers are not sent from VID at this time:

DISPLAY PROMPT:

**CERTIFICATE ORDER HAS BEEN PLACED. ENSURE THAT ACCOUNT HAS SUFFICIENT FUNDS.**

- 3) Upon receipt of certificate numbers, the EIS shall display the following message:

DISPLAY PROMPT:

**CERTIFICATE NUMBERS RECEIVED.**

A receipt shall be printed.

The EIS shall display a CERTIFICATE RECEIVED message and shall print a receipt as shown below:

### ELECTRONIC CERTIFICATE NUMBER PURCHASE RECEIPT

Date: MM/DD/YYYY                      Time: HH:MM  
 Station: Station License #  
 EIS ID: EIS #

Certificate Numbers have been issued to this station via electronic transfer. If purchase has not been pre-paid, usage of these certificate numbers will be revoked immediately if payment is not received.

For example:

<u>Range of Cert #</u>	<u>Total Cert #.</u>	<u>Cost/Cert.</u>	<u>Total Cost</u>
AA000001-AA000050	50	\$8.25	\$412.50

Note: List each range of fifty (50) certificates.

- 4) If the requestor's bank cannot honor the debit transaction due to insufficient funds in the requestor's account, etc., the EIS shall be locked out after all "paid-off" certificates have been used. The EIS shall display the following message:

DISPLAY PROMPT:

**INSUFFICIENT FUNDS. THE EIS SHALL BE LOCKED OUT. CALL DCA/BAR ACCOUNTING DEPARTMENT.**

- 5) If a certificate order will not be acknowledged until funds are received, then the following message will be displayed:

DISPLAY PROMPT:

**FUNDS MUST BE CLEARED THROUGH DEBIT PROCESS BEFORE CERTIFICATES ARE ISSUED.**

- 6) If a certificate order is not approved by BAR, then the following message will be displayed:

DISPLAY PROMPT:

**PURCHASE IS NOT AUTHORIZED. CONTACT NEAREST BAR OFFICE.**

The number of certificates remaining shall be displayed before each Smog Check. When the number remaining drops below a pre-defined threshold, a warning message will be displayed.

DISPLAY PROMPT:

**ONLY X CERTIFICATES REMAIN. REORDER CERTIFICATES.**

The following data shall be modified through this menu item:

Description	Length	Format
Low certificate warning threshold	3	Numeric
Number of certificates remaining to trigger re-order	3	Numeric

If the station has authorized automatic reordering (provided that the number of certificate lots to be automatically re-ordered is 1), the EIS shall automatically place a certificate order once the number of remaining certificates drops to a pre-defined threshold (number of certificates to trigger reorder is between 0 and 50; 0 = manual ordering). The automatic certificate reordering function is preset by the station manager or authorized personnel.

Automatic reorder shall not be triggered until previously ordered certificates have been received.

### 3.15.2 Review Certificate Inventory

This feature shall display the number of all certificates currently residing in the inventory. The EIS shall display the certificate numbers as follows:

DISPLAY PROMPT:

**REVIEW CERTIFICATE INVENTORY**

**XXXXXXXX to XXXXXXXX**

**THERE ARE XX CERTIFICATES REMAINING IN INVENTORY**

### 3.15.3 Data File Refresh

This feature shall allow the station manager or other authorized station personnel to place a request to the VID to update date and time, BAR messages (if applicable), certificate numbers (that the EIS currently uses and those, if any, that are stored in the inventory), technician's information, ESC Table and lockout status.

The EIS shall overwrite the existing tables with the refreshed data received from the VID.

Whenever a DATA FILE REFRESH is selected and before performing the data refresh procedure, the EIS shall display the following message: (Alternative methods may be used upon approval by BAR.)

DISPLAY PROMPT:

**THE VID SHALL UPDATE THE TECHNICIAN INFORMATION FILE AND THE CERTIFICATE NUMBER INVENTORY.**

Prior to performing the DATA FILE REFRESH, the EIS shall display a list of technician license number endorsements and expiration dates. The EIS shall also display the certificate number inventory that currently exist in the EIS and shall provide an option to print, if desired. Then the EIS shall prompt the technician to perform the refresh procedure.

Upon completion of the DATA FILE REFRESH procedure, the EIS shall display the following message:

DISPLAY PROMPT:

**THE TECHNICIAN LICENSE NUMBERS AND CERTIFICATE NUMBERS HAVE BEEN UPDATED BY THE VID. PLEASE CHECK. IF THERE ARE PROBLEMS, CONTACT YOUR LOCAL BAR FIELD OFFICE.**

After the display prompt, the EIS shall display the updated list of technician license numbers, any new BAR messages (if applicable), and certificate number inventory. During screen display or printing of the technician information, the EIS shall not display the actual technician access codes (hidden) so that they may not be viewed by unauthorized person(s).

#### **3.15.4 Update Network Communications Data**

When selected, the following data shall be required for communications with the VID:

- Unique identifier as defined by BAR
- Name of Diagnostic and Repair Vendor (up to 20 characters)
- Network phone number for Diagnostic and Repair Vendor (up to 15 numeric and commas)

The EIS shall provide space for up to five diagnostic and repair vendor names and telephone numbers within the "Network Communications Data" function.

#### **3.15.5 Station Identification**

This function shall be in the Station Manager menu to allow the station name and address information to be changed and printed on the VIR. Fields required for entry of this information shall be as follows:

Station Name - 50 characters  
 Address - 50 characters  
 City - 50 characters

State - 2 upper case characters  
 Zip - 5 characters

### 3.15.6 Set Station Password

This function will allow the 5-character station password to be changed.

### 3.15.7 Update VLT

Upon selection of this menu item, the EIS shall prompt the station manager to perform a VLT update. The update medium shall be encrypted (for data protection and integrity) in a manner approved by BAR.

### 3.15.8 LPFET TEST SETTINGS

Upon selection of this menu item, the EIS shall display the following submenu:

- 1) LPFET TESTER ENABLE/DISABLE
- 2) PURGE LPFET TEST RECORDS

Programming Criteria:

If the technician selects #1, the EIS shall allow the technician to enable or disable the LPFET tester.

If the technician selects #2, the EIS shall display the following prompt:

DISPLAY PROMPTS:

DO YOU WANT TO PURGE THE LPFET RECORDS? (YES OR NO)

Programming Criteria:

- a) If the technician selects "YES", the EIS shall purge all of the stored test and calibration records.
- b) If the technician selects "NO", the EIS shall return to the STATION Manager Menu.

### 3.16 Perform Software Update

The EIS shall provide a menu option to perform a software update. Any time a software update is performed, the EIS shall require the technician to perform a data file refresh before a Smog Check can be initiated.

### 3.17 Recall BAR Message

The EIS shall save the most recent 100 BAR messages. The EIS shall allow the technician to scroll through the list of messages, or select a message by the date the message was received. If an exact match by date is not found, the EIS shall display the message(s) with the closest match. The file format and location of the file is up to the EIS manufacturer. Once a message is located, the EIS shall allow the technician to print the message(s).

**SECTION 4. DOCUMENTATION, LOGISTICS, WARRANTY, CERTIFICATION  
TERMS AND IN-USE PERFORMANCE REQUIREMENTS****4.1 GENERAL**

The following items shall be included with each BAR-97 submitted for certification or delivered to stations:

- a) Instruction manual, securely held in a binder (or other suitable container) made of a material that is resistant to most petroleum-based products used in the garage environment.
- b) A copy of the warranty and annual service agreement. (See ' 4.3)
- c) A copy of the disclosure statement. (See ' 4.4)
- d) For the analyzer, at least four extra sets of particulate filter elements.
- e) Special adjustment tools if needed for calibration of the analyzer, the dynamometer, the fuel cap tester and any other internal/integral device.
- f) Attached placard denoting operating procedures, gas checking/calibrating steps, maintenance items and local service contact with phone number and address.

**4.2 INSTRUCTION MANUAL**

The instruction manual accompanying each BAR-97 shall contain the following minimum information:

- a) Background information describing how vehicular emissions are formed during the combustion process, the general types of controls that are used on vehicles and what negative health impacts can result from vehicle emissions;
- b) Functional diagrams (mechanical and electrical);
- c) Accessories and options (included and/or available);
- d) Model number and identification markings and locations;
- e) Maintenance procedures and frequencies recommended by the manufacturer. The services that should be performed only by the manufacturer shall be clearly identified;
- f) Gas calibration/leak check procedures as well as calibration procedures for the dynamometer, the fuel cap tester and any other internal/integral devices;
- g) Brief description with a subject index of the inspection/test procedures as they pertain to the EIS prompts;
- h) Brief description of emission analyzer and dynamometer operating principles (including the significance of inertia, horsepower and torque);
- i) A listing and easily understood explanation of warranty provisions (including the extended warranty and service contract), to be signed by a company representative and the purchaser. Information provided shall include a listing of warranty repair stations by name, address and phone number; and
- j) Name, address and phone number of the manufacturer's representative in charge of sales and service personnel for the company in California. In addition, information shall be provided indicating the name, address and phone number for the company's Vice President of service (or equivalent) who reports directly to the

Chief Executive Officer. The names of these representatives shall be verified, or updated as needed, every time a manufacturer service technician visits a station.

#### 4.3 **BAR-97 WARRANTY AND SERVICE MAINTENANCE CONTRACT**

Warranty or service contract work shall include repair and or replacement as necessary to restore EIS to a fully functional condition.

- a) The cost of the BAR-97 shall include a one-year, transferable warranty covering parts and labor. Also, at the time of original sale, the manufacturer shall offer an optional additional two or three-year warranty to be included in the cost of the EIS.

All EIS upgrades or software updates shall be covered by at least a one-year warranty.

Warranty provisions protecting the interest of the buyer shall include:

1. Location, phone number and address of the repair centers throughout the state. These shall be an adequate number of qualified repair technicians and an adequate number of repair locations conveniently located to efficiently and promptly meet statewide service needs. The response time established by the manufacturer may be longer for a lower purchase price or shorter if the price is higher. All response time and cost provisions shall be clearly indicated in the warranty provisions.
2. Name of the manufacturer's representative closest to each franchised service center - if not a factory service center.
3. Coverage of at least all of the hardware and software contained inside the tamper resistant analyzer cabinet, the computer keyboard and monitor, the dynamometer and the fuel cap tester. A description of specific parts and labor covered by the provisions of the warranty shall be permanently provided to the purchaser. In addition, the warranty shall itemize the parts and labor which are not covered by the warranty. (It is not necessary for the manufacturers to warranty any parts or equipment not provided by them.)

To ensure that purchasers are properly notified regarding the cost and provisions of the warranty, the BAR-97 shall not be delivered until a copy of the warranty has been signed by the purchaser and a company representative. Service response time and loaner provisions shall be initialed by the purchaser. A copy of the signed warranty shall be provided to the purchaser and a copy filed by the company.

- b) The manufacturer shall make available an annual service contract covering, as a minimum, all of the items located inside the secured area(s) of the analyzer, the dynamometer and the fuel cap tester.

Service contract provisions protecting the interests of the buyer shall include:

1. The necessary level of service to ensure that the BAR-97 functions properly within the operating conditions listed in this specification. Such items as filters, disk drive cleaning and alignment, analyzer bench service, and pump maintenance are typical service maintenance items.
2. The manufacturer is responsible for specifying the frequency of performance.
3. The manufacturer shall include in the annual service/maintenance contract the cost of making the necessary software changes. This covers software changes to correct outstanding and / or non-compliant issues.
4. The manufacturer or his sales representative must notify the BAR of the cost for this service as a condition of certification and include projected increases.
5. The information in Items 1 - 4 above must also be made available to the potential buyer of a BAR-97 before purchase or lease.

- c) The following provisions apply to both the warranty and service maintenance contract:

1. Any change to the warranty or service contract must be approved by the BAR.
2. If the manufacturer fails to provide the purchaser with a warranty and warranty description, and the purchaser files a written complaint with the BAR, the manufacturer shall refund to the purchaser the depreciated value of the BAR-97 based on straight line depreciation over 5 years.
3. The BAR-97 owner shall be provided a cost estimate prior to the performance of any service or maintenance unless the work is covered by the warranty or service contract. Regardless of whether or not the work is covered by the warranty or service contract, the owner shall be provided a detailed description of the work performed when the job is completed. In addition, the manufacturer shall include a toll-free telephone number for the owner of the analyzer to call if he/she wants to complain about the work performed, the courtesy or competency of the manufacturer's technician or any other aspect of the warranty or service contract.

4. Manufacturers shall provide a station with a loaner BAR-97 if the station's EIS is out of service for more than three days. Manufacturers shall have on hand sufficient loaners to satisfy these service needs, based on a thorough review of their BAR-90 history. Loaner units shall be calibrated, provided with new filters, and shall contain the latest version of I/M testing software. The BAR-97 shall contain a loaner unit procedure, to be available to manufacturer field service personnel, which will perform EIS functions. The BAR will review and approve the written alternative loaner unit procedure submitted by the EIS manufacturer that provides sufficient protection to maintain the integrity of electronic transmission. This alternative procedure should clearly illustrate the methods used to initialize and establish the *personality* of the loaner unit. The procedure should be capable of automatically retrieving *personality* information of the old unit from its disk drives and transfer that information to the loaner unit without manufacturer service technicians performing manual key entry.

#### 4.4 DISCLOSURE STATEMENT

The manufacturer shall provide a disclosure statement, which is subject to BAR approval, to a BAR-97 purchaser prior to consummation of the sale, disclosing, as a minimum, the following items. The statement shall be signed by the purchaser and each item shall be initialed by the purchaser acknowledging the disclosure.

- a) The cost of installing any BAR-required software update shall be the responsibility of the BAR-97 owner. The cost per software update is estimated to be \$\_\_\_\_\_.
- b) Any upgrade offered and installed by the BAR-97 manufacturer shall be covered by at least a one-year warranty.
- c) The certification issued by the BAR for a BAR-97 indicates that the EIS system meets the requirements of the BAR-97 Specification and is therefore authorized to perform required I/M inspections on vehicles. In no way does the certification make the BAR liable or responsible for any damage caused by the BAR-97.
- d) Any change to the warranty or service contract must be approved by BAR.
- e) If the manufacturer fails to provide the purchaser with a warranty and warranty description, and the purchaser files a written complaint with the BAR, the manufacturer shall refund to the purchaser the depreciated value of the BAR-97 based on straight line depreciation over 5 years.

#### 4.5 SPARE PARTS

The BAR-97 manufacturer shall maintain an adequate supply of spare parts and accessories to fulfill the service requirements of the warranty or service contract. The manufacturer shall, at the time of delivery, supply the purchaser with four sets of filters,

at least 500 sheets of paper, one extra printer cartridge and one extra set of calibration gas cylinders. Manufacturers are not required to deliver spare parts to stations if the station operator agrees to accept a voucher, good for the full price of the spare parts, provided when the BAR-97 is purchased.

#### **4.6 SERVICE CENTERS**

The EIS manufacturers shall provide or contract for warranty or service contract repairs within each region where analyzers are sold. The following are considered regional areas of California: (1) Northern California includes an area north of an essentially horizontal line drawn from the coast through Santa Rosa, Sacramento and South Lake Tahoe; (2) the Bay Area includes everything in a line from the coast east to Napa, south to Hayward and Hollister, and west to Monterey; (3) the San Joaquin Valley including everything between the Coast Range and the Sierra Nevada mountains and from Stockton south to Bakersfield; (4) the Santa Barbara-Ventura area; (5) the South Coast Air Basin which includes San Bernardino and Riverside on the east, and San Clemente on the south; and (6) the San Diego area including from Oceanside south to the Mexican border and east to Escondido and El Cajon. Shipping units by common carrier after repair or service is accomplished should only be done in cases where remanufacturing is required or where solving a problem requires research beyond the capabilities of field service personnel.

#### **4.7 WORKMANSHIP**

Each manufacturer, or his agent, shall guarantee the repairs made for a period of 90 days. The manufacturer shall ultimately be held responsible, regardless if an agent performed the repairs. Upon completion of any repairs to the EIS sample system, optical bench, O<sub>2</sub> or NO sensors, the service technician must perform a full four-gas audit in accordance with section 2.4.5i of this specification. If the EIS fails this audit, the technician shall correct the problem. When the EIS passes the post repair audit, the technician must sign and transmit the full results of the passed audit to the local BAR field office. The preferred audit form may be found at the end of this section.

In addition, the EIS shall be repaired on the first visit and within 72 hours of the service request. If the EIS is not repairable in 72 hours, then a loaner shall be provided.

#### **4.8 PARTS REMOVED**

All parts removed from an EIS to accomplish repairs shall be accounted for and given to the owner when the EIS is returned to service, except for parts covered under warranty or the service contract. Parts which can be rebuilt and returned to service shall be listed on the completed work order.

**4.9 4 CERTIFICATION TERM AND RENEWAL**

Certification Terms: BAR-97 Certificates and Approvals shall expire *one year* from the date of issuance, unless otherwise stated. Certification/approval shall also expire if the approved company changes ownership.

Conditions of Certificate/Approval: *If any problems or discrepancies occur subsequent to certification, the manufacturer shall correct or resolve the problem to the satisfaction of BAR and in a timeframe acceptable to BAR. The certification only applies to equipment meeting the current specification and only to the original configuration. BAR must approve all future updates and modifications. Non-compliance with a BAR required hardware or software update and / or non-compliance with any deferred items may result in a terminated certificate / approval.*

To renew the BAR-97 Certificate, each manufacturer shall correct any identified problems including in-use performance failures. In addition, each manufacturer must submit the following, 90 days prior to the expiration of the existing BAR-97 Certificate:

- a description of any proposed or BAR approved changes to the EIS hardware and software
- a current company organization chart and phone list
- manufacturing quality control data
- when applicable, BAR specified software update in a fully functional condition along with data showing the required update meets the BAR-97 specification / software instruction, see § 3.2.3(d).

Once the above items are received and, when applicable, tested by BAR, the EIS manufacturers must demonstrate the software update, changes and/or corrections meet the BAR-97 Specification. This demonstration shall be conducted in accordance with the requirements set forth in §5.12 of this specification. During beta testing, the EIS must meet or exceed the minimum in-use performance standards and operate continuously to BAR's satisfaction with no major defects. The beta sites shall be clustered in locations to allow auditors to visit multiple sites in one day. Upon completion of successful beta testing the software update, changes and or corrections shall be installed in all remaining EIS within 30 days. Once installed in all of the applicable EIS, the Certificate will be renewed. Note: Before installing in all EIS, the software update, changes and or corrections must meet BAR's approval.

BAR-97 Certificate Renewal Timelines														
BAR-97 Certificate Valid for 12 months	Month	1	2	3	4	5	6	7	8	9	10	11	12	13
BAR Software Update											Submit software update 90 days before expiration.			
Certificate Renewal											Submit changes, QC data, org. chart 90 days before expiration			
BAR Review and Testing														
Beta Testing 30 days														
If applicable, install software in all EIS														

If the EIS manufacturer meets the renewal requirements, however, needs additional time to implement in all EIS, BAR may extend the existing certification until full implementation. BAR-97 certification will not be renewed if a manufacturer fail to meet the certification renewal requirements.

These terms and conditions are in addition to those specified in a conditional certificate and/or terms specified in other parts of the BAR-97 specification.

**4.10 IN-USE PERFORMANCE**

As part of the Smog Check Quality Assurance program, BAR auditors conduct four-gas accuracy audits of the EIS analyzers. These audits are conducted on an on-going basis and are used to evaluate the individual and overall accuracy of the EIS analyzers.

To ensure uniform and accurate audits, each auditor follows standardized audit procedures. These procedures include the use of an automated gas audit program to collect data and determine individual EIS pass/fail results. In addition, the standardized procedures include processes (comprehensive visual inspection and leak check) to evaluate the condition of each EIS analyzers before an actual gas audit is conducted. See Section 2.4.5 i of this specification for audit details.

Individual analyzers must meet the minimum gas audit accuracy standards specified in Section 2.

The cumulative results of the first gas audit (only conducted on EIS in the “as is”

condition found by the auditor...no repairs allowed before audit) are used to assess the overall in-use performance of each manufacturer's EIS fleet. The gas audit shall be completed after each EIS passes the leak check and visual inspection. Each EIS manufacturer shall ensure that their EIS fleet meets the in-use performance standards described in the table below. In the event of an in-use performance failure, the EIS manufacturer shall correct the failure in a time frame specified by BAR and in a manner satisfactory to BAR. Failure to correct within the BAR specified time-frame or in a manner satisfactory to BAR will result in punitive actions, including but not limited to those set forth in the California Code of Regulations and Section 44036 of the Health and Safety Code.

**Note: Meeting the in-use performance standards does not negate any other requirement of the BAR-97 specification or preclude the EIS manufacturers from meeting any other BAR-97 specification.**

Performance Measure	Performance Standard
Gas Audit Accuracy (Per EIS manufacturer fleet)	<ul style="list-style-type: none"> <li>As of April 30, 2000 90% of the BAR-97 or newer shall be within specification for all gas ranges.</li> </ul>

### Gas Ranges of Interest

Gases (HC, CO, NO and CO<sub>2</sub>) are audited at four ranges: low, mid-1, mid-2 and high. Pass/fail determinations are made for each range within each gas and a failure at any point results in an overall unit failure. Table 2 shows the audit gas concentrations for the BAR-97.

**Table 2 – Audit Gas Concentrations**

Range	HC (ppm) hexane	CO (%)	NO (ppm)	CO <sub>2</sub> (%)
Low	100	0.50	300	6.00
Mid-1	480	2.40	900	3.60
Mid-2	960	4.80	1800	7.20
High	1600	8.00	3000	12.00

Gas ranges of interest are the specific pollutant levels where almost all pass/fail decisions are made during the Smog Check inspection. For example, 90% of the vehicles tested during the first week of September 2001 had a pass/fail determination point for HC falling between 33.9 ppm and 148.1 ppm as shown in Table 3, see report titled "BAR-97 Emissions Inspection System Gas Audit Evaluation". Based on this

analysis, the audit gas concentrations pertinent to pass/fail decisions are indicated in Table 4 below.

**Table 3 – Point Pass/Fail Decisions Made**

Percentile	HC (ppm) hexane	CO (%)	NO (ppm)
5 <sup>th</sup> Percentile	33.9	0.47	741.7
95 <sup>th</sup> Percentile	148.1	1.16	1883.3

**Table 4 – Audit Gas Concentrations Pertinent to Pass/Fail Decisions**

Range	HC (ppm)	CO (%)	NO (ppm)	CO <sub>2</sub> (%)
Low	⇒100	⇒0.50	300	⇒6.00
Mid-1	⇒480	⇒2.40	⇒900	⇒3.60
Mid-2	960	4.8	⇒1800	⇒7.20
High	1600	8.0	3000	⇒12.00

Note: ⇒ = Gas ranges of interest. In addition, all CO<sub>2</sub> ranges are important since CO<sub>2</sub> is used in the dilution correction factor (DCF) calculation. An erroneous DCF could result in an erroneous pass/fail decision.

#### **4.11 PERIODIC BAR TESTING**

To ensure EIS units remain in a certified configuration BAR may select in-use EIS units for evaluation and testing at BAR. In this case, the corresponding EIS manufacturer shall provide a loaner unit to the Smog Check station during the evaluation period.

#### **4.12 USER FRIENDLY**

BAR-97 hardware and software shall be user friendly. A user friendly EIS shall not add any unnecessary additional time or cost to the smog check procedure. Software menus, entry prompts, and sequence of events shall be optimized to prevent unnecessary additional time. The smog technician must easily understand, operate, and calibrate the EIS and all required EIS auxiliary devices.

#### **4.13 LOCKUP RATE**

Upon this specification release date, all EIS certified to this specification shall not lock up more than 5% of the time (based on a BAR Engineering survey of 120 BAR-97 addendum 7 beta stations to determine an acceptable industry standard lock up rate). A lock up shall be defined as an event during an inspection where the EIS will freeze, preventing completion of the inspection; causing the operator to reset or reboot the EIS, restart the inspection, and inconveniencing the technician and consumer. A lock up may be caused by defective hardware or software. An EIS or auxiliary device is considered defective if it locks up frequently due to defective hardware or software. BAR reserves the right to conduct periodic surveys to verify compliance or other method proposed by

manufacturer and approved by BAR.

**4.14 BASIC AND CHANGE OF OWNERSHIP AREA EQUIPMENT**

EIS manufacturers may sell BAR-97 systems without NO measurement capability and without a dynamometer to stations performing only Two-Speed-Idle (TSI) tests. The analyzer shall be identical to the Enhanced area EIS with the exception of a NO measurement device that is not installed or is disabled in software.

**SECTION 5. CERTIFICATION TEST PROCEDURES****5.1 GENERAL**

These test procedures are an integral part of the BAR-97 Emissions Inspection System (EIS) specifications and have been developed to ensure that the systems proposed for use in the California Inspection and Maintenance (I/M) program comply with certain minimum requirements of state and federal law and regulation. Additional testing will be performed by BAR staff to determine conformance with the goals of the program, the intent of the legislation, and the specification. Verbal agreements with BAR staff are non-binding.

In addition, if it is determined that any item or section of the BAR-97 specifications has not been tested, BAR reserves the right to modify the certification test procedures to insure compliance with the BAR-97 specifications.

**MANUFACTURERS / THIRD PARTY DEVELOPERS NOT IN GOOD STANDING WITH BAR WILL NOT RECEIVE IMMEDIATE ATTENTION UNTIL OUTSTANDING DEFICIENCIES ARE CORRECTED.**

The following rules apply to BAR Certification:

1. **BAR Certification:**  
Applicable only to complete EIS systems. As a result of certification and beta-site testing, a BAR-certified system has been found to be in full compliance with the BAR-97 Specification. Any flaws subsequently found during field use shall be corrected by the EIS manufacturer in a timely manner that is satisfactory to the BAR.
2. **Provisional BAR System Approval:**  
A partial certification that may be awarded to an EIS manufacturer in the event that its EIS has passed most of the requirements for BAR certification, but that one or more modifications, additions or corrections (listed in the Provisional BAR System Approval) are still necessary. These modifications, additions or corrections are of such a nature that, in the judgment of BAR Engineering, little doubt exists of their successful implementation (e.g., typographical corrections, representation of data on screen, screen prompts, etc.)
3. **BAR Component Approval:**  
Applicable to dynamometers, analyzers, and devices that integrate with a BAR 97 system. This approval may include provisional clauses.
4. **BAR Device Approval:**  
Applicable only to devices such as zero air generators which can be used in conjunction with EIS without requiring software/hardware integration with the system.

5. BAR Aftermarket Parts Approval: (refer to Section 6)

Applicable to aftermarket parts such as probes, sample hoses, filters, bar code scanners, and tachometers. BAR approval states that the components meet the applicable portions of the BAR-97 Specification, and are thus suitable for direct sale to Smog Check stations (aftermarket parts only) or eligible for integration into an EIS by the EIS manufacturer (computers and other major components).

The candidate shall be tested using the procedures specified below. In addition, as a condition of initial certification, the units shall undergo field (*beta*) testing to verify the performance, *accuracy*, reliability and "user-friendliness" of the systems in the actual garage environment. The units may be rejected for user unfriendliness or for any function, prompt or entry that the BAR feels would induce incorrect or inaccurate entries. The BAR will identify or approve licensed Smog Check stations that may be candidate sites for field-testing. **Note: See Section 4.9 of this specification for certification terms, conditions and renewal requirements.**

The following paragraphs describe the standard instruments, and the testing, recording and reporting requirements.

### 5.1.1 Certification Requirements

- a) All of the tests in this section shall be performed by the manufacturer, and all the certification criteria shall be met.
- b) A Certification Test Report shall be prepared, and included in the certification submittal package.
- c) A certification submittal package shall be prepared along with an application for certification, and one copy shall be submitted to the BAR. Additional copies must be provided if requested by the BAR.
- d) Three EIS units and applicable peripheral equipment shall be provided to the BAR for testing at its laboratory facilities. Five to ten EIS units and applicable peripheral equipment shall be made available for field testing in the Sacramento area. Field testing may be, at BAR's discretion, performed concurrently with BAR lab testing or after completion of the lab testing. It is recommended that a spare unit be readily available (i.e., within two hours') in the event that a problem develops during the BAR laboratory testing or field testing. To expedite verification testing, BAR may require additional units at its laboratory.
- e) All EIS designs must meet the intent of the specification.

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- f) The manufacturer shall certify to the BAR that their EIS design meets or exceeds the performance specifications of this document.
- g) With respect to the electronic transmission of test data to the BAR VID, manufacturers shall demonstrate, to the BAR's satisfaction, full system compatibility, including successful USB drive, and TCP/IP transfer of files to the VID.
- h) The proposed hardware configuration must be fully supported by all software and/or operating systems listed in this specification. Performance tests to prove compatibility will be required.
- i) All equipment and software submitted for certification must be the full and current configuration proposed for sale. PARTIAL, DATED, OR INCOMPLETE MODELS ARE NOT ACCEPTABLE.
- j) The manufacturer will be responsible for all shipping and equipment preparation charges for the certification testing.
- k) The BAR shall charge a fee for certification/approval testing of the BAR-97 and related components and parts. The certification fee shall only cover one (1) round of testing, additional testing will require additional fees. The fee shall be fixed by the department based upon its actual costs of certification testing, shall be calculated from the time that the equipment is submitted for testing until the time that certification testing is complete, and shall in no event exceed the dollar limit specified in §44036(b) of the Health and Safety Code. In any event, the initial deposit is \$10,000 for certifying a EIS or \$5,000 for approving any other BAR-97 component such as dynamometer or analyzer/sensor, or \$2,000 for a device approval. The initial deposit for certification/approval of a replacement part depends on the extent of the required testing.

If the manufacturer's application for certification is complete and acceptable, and is substantiated by evaluation tests (from this specification) conducted by the manufacturer or an approved laboratory, the BAR will certify that specific model subject to its verification testing. That model will then be acceptable for sale and use in licensed stations in California.

During the course of the program, the BAR may, at its discretion, direct the manufacturer to retest at his expense any production model from the manufacturer's supply to verify that quality control standards are being met. Should the retest indicate substandard quality or nonconformance with the technical specifications, it shall be the manufacturer's responsibility to recall and correct or replace, at his expense, all defective units. At the BAR's discretion, certification/approval may be withdrawn if deficiencies and problems are not expeditiously corrected.

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It is the BAR's intent that no deviations in the performance requirements be granted. If, in order to comply, a candidate would require a major cost increase on an item that is in no way related to performance, a waiver request may be considered and should include the following:

1. Reason for the request.
2. Description of the deviation from the design specifications.
3. The effect of the deviation on overall compliance of the EIS.
4. Extent and impact of corrective action required to modify the EIS if the waiver is not granted.
5. Delivery of a sample unit to the BAR for demonstration purposes.

Allow at least 30 days from the BAR's receipt of the waiver request and demonstration unit to receive approval or disapproval.

### **5.1.2 Certification Submittal Package**

- a) The submittal package for EIS certification shall contain the documentation listed below. Contact BAR for submittal package, which provides a submittal requirement reference for other submittal types such as hardware or software modifications and aftermarket replacement parts.
  - Application for certification
  - EIS description
  - Software documentation
  - Certification test report
  - Instruction manual
  - Business and financial report
  - Organization chart
- b) The submittal package and its contents will be treated by the BAR as confidential, and will be kept secured.
- c) In addition to a hard copy of the certification submittal package documentation, manufacturers shall provide an electronic copy in the form and format specified by the BAR.

#### **5.1.2.1 Application for Certification**

A completed Application for Certification form must accompany the certification submittal package at the time the EIS is submitted for certification. The BAR will make a preliminary review of the EIS and certification submittal package before formally accepting the application for certification.

### 5.1.2.2 Candidate Description

- a) Operation: Furnish a complete description of the candidate and its operation including descriptive brochures (proof copies acceptable) of the units.
- b) Specifications: Submit performance, mechanical, power, weight and dimensional specifications for each model. For analyzers, include zero drift lockout threshold (see §2.4.5 b).
- c) Price List: Submit a base retail price list for each model and a price list of optional accessories available to the purchaser.
- d) Schematics and Photographs: Detailed mechanical, electrical drawings and schematics shall be submitted of the entire EIS and its components, if applicable. Color 8 x 10 photographs of the sample handling and filtering system, analyzer section, enclosures, nameplates, sensors, displays, keyboard/controls, dynamometer and gas calibration instruction plates shall be provided in the package.
- e) Instruction Manual: A complete instruction manual (proof copies acceptable) for each model unit shall be submitted. The manual shall contain, as a minimum, all items specified in Section 4 of the Specification. Each step of the operating and calibrating procedure shall be verified by the manufacturer.
- f) Components, Devices and Aftermarket Replacement Parts: Required descriptive information is also required. See Section 6 of this specification

### 5.1.2.3 Software Documentation

- a) The BAR-97 software shall be fully documented. One copy of the documentation listed below shall be submitted to the BAR unless otherwise requested. Manufacturers shall agree, in writing (signed by the CEO of the company), to submit copies of the program listings to the BAR upon request, within a time frame satisfactory to the BAR, or whenever a decision is made by the manufacturer to voluntarily suspend or terminate production of the BAR-97. **The BAR does not expect to ever have a need to review the program listings and therefore, will not require that they be included with the application for certification. However, the BAR reserves the right to require that copies be provided, if the need does arise.** Software documentation shall include at least the following:
  - 1. Complete program listings, including the source code as well as the object code, in both machine-readable and paper form, shall be provided upon

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request. They are not required to be submitted with the application for certification.

2. Functional specifications.
  3. Functional flowcharts of the manufacturer's software routines and subroutines. These flow diagrams shall include decision points and decision/timing criteria so that the logic of the programming can be correlated, where applicable, to the specification.
  4. Sample inputs and outputs from all processes.
  5. Detailed interface information on the optical bench including the identification of protocol and output specifications.
  6. All OS file layouts with file names, file types and file security.
- b) Documentation provided by the manufacturer to meet this requirement will be treated as proprietary information by the State provided such material is clearly marked as confidential. Gross marking of all material as confidential is not acceptable. Mark only that material which is proprietary.

The purpose of the requirement for detailed code is to provide the State with a mechanism to assure continued performance of Smog Check stations using BAR-97s in the event that a major supplier should fail or withdraw from the program. The State is not interested in sharing proprietary information, or the detailed inner workings of manufacturer's software code. However, it is essential that all of the necessary working codes, schematics, and drawings be available in case of such demise or withdrawal.

### 5.1.2.4 Certification Testing

- a) The data establishing the performance and technical capabilities of the EIS shall be included in a test report prepared by the manufacturer or a BAR-approved commercial laboratory. Confirmation of the test data will be made by the BAR. Components, Devices & Aftermarket Replacement Parts: submittals shall comply with the requirements of this section as applicable.
- b) The manufacturer shall certify that the EIS submitted for certification complies with all applicable California and Federal administrative, safety, ergonomic, licensing, and certification requirements. Ignorance of the law is no excuse for noncompliance.

Manufacturers shall utilize a testing laboratory or laboratories meeting BAR approval. The manufacturers may perform the required testing themselves. The manufacturers shall supply the BAR with the following specific information before submitting their application for certification:

1. Safety Laboratory:

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- i. Description of the laboratory's capabilities, including the types of testing commonly performed there;
  - ii. Description of the laboratory's facilities, including size, location and specialized facilities, such as electromagnetic interference (EMI) rooms;
  - iii. Description of the laboratory's test instrumentation, including manufacturer, model number, accuracy, and frequency of calibration;
  - iv. Description of the laboratory's testing and follow-up procedures.
2. Functional Testing Laboratory: In addition to the requirements of items i, ii, and iii above, the following information must be provided:
- i. Credentials of the staff that will be performing the tests at the selected laboratory;
  - ii. A statement from the person in charge of testing at the lab and the manufacturer's representative witnessing the tests, certifying that all tests were performed and that they were performed in the manner required in the specifications.
  - iii. A description (i.e., brand names, model numbers and list of specifications) of the equipment used to perform the tests contained in this specification.
3. The BAR recommends that manufacturers collect the required information and forward it to the BAR before initiating any testing to ensure that we are satisfied with the laboratory chosen.

If the BAR is familiar with the Safety Laboratory and/or the Functional Testing Laboratory, and the BAR's information is current, these informational requirements may be waived.

### 5.1.2.5 Business Status

- a) Financial and Business Information: Manufacturers and distributors shall submit information with their request for certification, including the following:
  1. Evidence that the applicant is a bona fide manufacturer or distributor of emission inspection systems (exhaust gas analyzers, dynamometers, fuel cap testers and other internal/integral devices). As a minimum, include an

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approximate number of products of the type for which certification is requested that have been manufactured and sold.

2. Evidence that the applicant possesses sufficient insurance to cover product liability claims, and secured funds for prepaid warranty or service contracts.
  3. Evidence that the applicant is either a California corporation or out-of-state/foreign corporation registered to do business in California.
  4. Annual sales volume during the most recent fiscal year for all products including exhaust gas analyzers and dynamometers.
  5. Manufacturing capacity dedicated to, or available for, producing the EIS, including number of manufacturing personnel and size of factory.
  6. Total assets, total liabilities and net worth of the applicant at the time of the most recent quarterly report. To qualify, the financial statement shall show that the manufacturer's net worth is at least \$2,000,000 for full EIS manufacturers and \$1,000,000 for dyno manufacturers (if dyno submitted separately). The BAR may consider bonds or additional insurance to supplement a portion of the monetary requirement. In addition, the BAR may accept deposit of monies (a portion of each unit sold) into an escrow account to be used exclusively for replacement of defective systems. However, any equivalent proof of financial soundness must be presented to the BAR for its approval.
  7. The most recent annual or quarterly report of publicly held corporations may be substituted if it contains all the same information.
- b) Marketing/Training Plan: The marketing plan shall include statewide distribution methods and a training plan to cover all new EIS purchasers and designated trainees. The scope of the training plan shall encompass the system's use as an inspection and diagnostic tool, steps in performing gas calibrations and leak checks, dynamometer operation, safety and calibration, preventative maintenance and recognition of malfunctions requiring assistance of a manufacturer's service representative.

The EIS manufacturer shall be capable of providing units for delivery within 180 days after certification has been granted or within 30 days after acceptance of an order from a customer.

- c) Servicing Products (see Section 4): The manufacturer's statewide service network shall be such that each EIS marketed can obtain service within a reasonable time. Warranty response provisions shall be listed.

In addition, service facilities shall be located throughout California at locations that ensure reasonable access by all purchasers. Each EIS manufacturer will provide a permanent company representative within the state to control and ensure continued quality maintenance of their product.

#### 5.1.2.6 Organization Chart

An organization chart listing the names and titles of the key persons involved with the development, testing, sales and service for the BAR-97 emission inspection systems, including regional and local sales and service staff throughout California and a telephone and address directory for those persons.

#### 5.1.3 Changes to Test Requirements

The BAR may, at its option, add, modify or delete certain test and/or documentation requirements. Any changes will be based on such factors as questionable validity, excessive cost, implementation problems, or unforeseen problems with EIS (candidate or standard), equipment or procedures. Manufacturers will be notified and, if necessary, requested to run the modified tests at their testing facility.

#### 5.1.4 Certification Test Report

The certification test report shall include the following:

- a) Table of contents
- b) Introduction: Include a description of the candidate EIS from a hardware and functionality standpoint, a description of the test facilities and equipment used, and the rationale for the testing sequence employed and any tests which were combined.
- c) A list of all tests performed, including repeated tests, in chronological order. Reference the ***BAR-97 Specification*** paragraph number of each test, and include pass/fail results.
- d) A list of all failures encountered, including which candidate failed, test during which the failure occurred, cause of failure, repairs performed.
- e) A list of adjustments and component replacements, including tests during which they were performed and the reason why they were performed.
- f) Completed data sheets. Out-of-specification data shall be clearly noted on the data sheets, by color, asterisk, or other device, along with percent deviation, where:

$$\% \text{ Deviation} = \frac{(\text{Test reading} - \text{std. value})}{\text{-----}} \times 100\%$$

Std. value

- g) Certification by an official of the manufacturer that the instructions and other information in the operator's manual are correct and complete, both in fact and in sequence.
- h) Certification by an official of the manufacturer that the data in the Certification Test Report are the actual test data taken during testing to the requirements of these procedures.

### 5.1.5 Failure Criteria

At least two of the three candidate EIS must pass all tests with no adjustments or service except as permitted or required by the individual test procedures. Failure of a component constitutes failure of that individual EIS. The component may be replaced and the testing continued if the manufacturer's failure analysis confirms that:

- a) The failure is not related to the EIS design.
- b) A reliability study predicts that the service life of the failed component or system is consistent with the certification period.
- c) The validity of the test data will not be affected by replacing the component.

Example of failure: Any type of dynamometer mechanical or electrical problem, or sample system failure (other than replacing or cleaning particulate filters) constitutes a failure of the individual EIS. The same criteria for replacement and test continuance apply as for components.

If any one of the three criteria above cannot be met, the certification testing must begin again as necessary to ensure at least two of the three candidate EIS are in full compliance.

### 5.1.6 Termination Policy for Certification Testing

**IF THE BAR ENGINEERING STAFF IDENTIFIES 10 OR MORE DEFECTS, TESTING WILL BE TERMINATED AND THE AFFECTED MANUFACTURER WILL BE REQUIRED TO RESUBMIT ITS APPLICATION FOR BAR-97 CERTIFICATION. TESTING WILL COMMENCE AFTER MANUFACTURERS RESUBMIT THEIR APPLICATIONS AND ARE SCHEDULED INTO THE NEXT TEST CYCLE. DEFECTS ARE DEFINED AS MISSING OR NONFUNCTIONAL REQUIREMENTS, OR FUNCTIONAL FEATURES WHICH DO NOT OPERATE IN STRICT ACCORDANCE WITH THE BAR-97 SPECIFICATIONS AND THE ASSOCIATED ADDENDA. TYPOGRAPHICAL ERRORS, MISSPELLINGS, INCORRECT GRAMMAR, ERRONEOUS FORMATS OR OTHER SUCH DISCREPANCIES WILL NOT CAUSE THE**

**TESTING TO BE TERMINATED, BUT WILL STILL HAVE TO BE CORRECTED BEFORE CERTIFICATION IS GRANTED.****5.2 CERTIFICATION TEST PROCEDURES FOR BAR-97 - GENERAL****a) Candidate Units**

The tests shall be performed on three candidate units, each of which shall be of production configuration. Minor deviations, cosmetic in nature, may be allowed by the BAR.

**b) Standard Instruments**

Where appropriate (see individual test procedures), candidate EIS readings shall be compared with the readings of laboratory-grade analyzers such as the Horiba 200 Series NDIR, chemiluminescent, and paramagnetic analyzers or equivalent. Each standard instrument shall be individually characterized for accuracy, repeatability, response time, etc., before certification testing is begun.

**c) Gases**

Span gases and gases used for accuracy, response time and other tests shall be high purity, 2% blend tolerance, with a manufacturer-certified accuracy of 1.0% of the concentrations shown on the cylinder label. "Quad-blends" of propane, CO, CO<sub>2</sub> and NO in nitrogen shall be used rather than blends of the individual gases with nitrogen, except as otherwise specified in the individual test procedures.

**d) Recorders**

Where required, analyzer outputs shall be recorded by analog or digital strip chart or equivalent recorders equipped with event marking capability, or by data acquisition systems sampling at a minimum rate of 10 Hz. If strip chart recorders are used, each analog record shall note the chart speed and the scale (i.e., volts per division). Event marking shall be used to record the start and finish of test intervals to fully substantiate report data. Digital recorders shall sample at a minimum rate of 10 Hz. (Note: ASM testing (see §5.4.12) shall sample and record data at a 1 Hz rate.) Copies of desired records will be made available to the BAR on request. All records, analog or digital, shall identify, at a minimum, the candidate EIS, the test performed, date, ambient temperature, humidity and barometric pressure.

**e) Fuel**

In cases where the test procedures require sampling vehicle exhaust, the vehicle shall be fueled with commercially available gasoline.

**f) Test Sequence**

The sequence of performing the tests is left to the testing organization's discretion, except as otherwise noted. Where possible, the testing organization may combine

tests to their best advantage, while ensuring that valid data is collected for all tests.

### 5.3 CERTIFICATION TEST PROCEDURES FOR BAR-97: SAMPLE CONDITIONING SYSTEM

The EIS evaluation procedures below are designed to determine candidate EIS compliance with the technical provisions of the other sections of this document.

#### 5.3.1 Exhaust Sampling Hose

- a) **Crush Test:** Place the sample hose on a concrete floor. Drive a vehicle weighing at least 4,000 lbs over the hose twice at a rate of 3 - 5 mph and in a direction perpendicular to the hose.

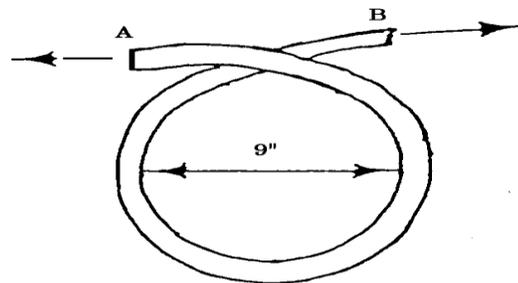
**Acceptance Criteria:** The candidate hoses shall exhibit no permanent deformation or kinking. They shall quickly return to their original shape and cross-section. They shall show no evidence of any test-induced defect or abnormality, such as a collapsed core or separated layers.

- b) **Flexibility Test:** In a temperature-controlled chamber, stretch each candidate hose out in a straight line and restrain the ends so that the hoses cannot curl. The hoses shall remain in the chamber at a stabilized temperature of  $60^{\circ}\text{F} \pm 5^{\circ}\text{F}$  for three hours. At the end of this period, lay one end of the hose on the floor of the chamber, leaving it unrestrained in any way. Holding the other end, coil the entire hose into as tight a coil as possible.

**Acceptance Criteria:** Each candidate coil shall have a maximum diameter of 24 inches.

- c) **Kink Test:** Form a portion of each candidate hose into a 9-inch diameter loop (see figure below). Grasp hose at points A and B and pull so as to tighten the loop and force a kink.

**Acceptance Criteria:** Candidate hoses shall roll out of the loop, rather than be forced into a kink.



### 5.3.2 Hose and Probe:

#### a) **Temperature Test**

This test verifies the ability of the sample hose and probe to withstand the high idle exhaust gas temperatures produced by converter-equipped vehicles. Adjust the engine of a catalytic converter-equipped vehicle so that the tailpipe temperature is  $1100^{\circ}\text{F} \pm 100^{\circ}\text{F}$  within 16 inches of the exit. (It may be necessary to run the vehicle on a dynamometer to reach this temperature.)

With the candidate EIS unit on and sampling, insert the sample probe fully into the tailpipe.

Sample the exhaust gas while monitoring the temperature for 5 minutes.

Remove the probe from the tailpipe and examine the hose and probe for any signs of permanent damage, such as charring, melting, weakness, permanent change in flexibility, separation of layers, or any change in overall functioning. To examine the interior of the hose, it will be necessary to cut it open at a point within 1 to 1½ inches from its connection to the probe.

**Acceptance Criteria:** No signs of permanent damage or change in functionality. No changes that would be considered detrimental to the life expectancy of the hose or probe.

#### b) **Flow Balance Test**

This test verifies that the auxiliary hose and probe arrangement (for use with vehicles having dual exhaust systems) complies with the provisions of §2.12 of this specification.

1. Measure the length of the main sample hose between the end of the probe to the auxiliary hose fitting

**Acceptance Criterion:** The length shall be at least 7 feet.

2. Measure the length of the auxiliary hose.

**Acceptance Criteria:** (1) The length shall be at least 7 feet. (2) The length of the auxiliary hose shall be within  $\pm 3$  inches of the probe-end-to-fitting length of the main hose.

3. Connect the auxiliary sample hose to the quick-connect fitting in the main sample hose. Connect flexible-tip probes to both the main hose and the auxiliary hose. Connect identical flowmeters to the probe inlets. With the EIS in Manual

## SECTION 5

Mode and the sample pump running, measure the flow rates through the main and auxiliary paths.

**Acceptance Criterion:** The flow rate through the auxiliary hose shall differ by no more than 10% from the flow rate through the main hose path. This relative difference shall be calculated using the formula

$$\text{Rel. Diff., \%} = 100 \times (A - M)/M,$$

A = the flow through the auxiliary path,  
M = the flow through the main path.

4. Remove the flexible tip from the auxiliary probe and replace it with the manufacturer's straight tip. Repeat Step 3 and use the same acceptance criterion.

### 5.3.3 Sample System Leaks

The sample system shall be tested for leaks prior to performing any of the certification tests that follow.

- a) **Sample System:** Perform a sample system leak check using the manufacturer's instructions.

**NOTE:** If the method of checking for leaks is based on gas introduction through the probe, the gas pressure at the probe inlet shall be  $0 \pm 0.1$  psig.

**Acceptance Criteria:** Per manufacturer. Repair any leaks found and repeat the leak check until the sample system shows no more leakage.

Flow High Range BAR-97 calibration gas through the probe. Gas pressure at the probe inlet shall be  $0 \pm 0.1$  psig. Record the readings. Using a needle valve teed into a line upstream of the sample pump inlet, introduce a leak which reduces the readings by 1% (e.g., if the reading was 8.00% CO, the new reading would be 7.92% CO). Perform a leak check following the manufacturer's instructions.

**Acceptance Criteria:** The candidate unit (1) shall fail the leak check and (2) shall not allow an inspection to be performed.

- b) **Integral Calibration Gas Control System:** With the EIS unit's calibration gas flow control valve in the off position, open the cal gas cylinder valve. Shut the cylinder valve off when the downstream pressure gauge on the cylinder regulator has stabilized. Monitor the pressure for 10 minutes.

**Acceptance Criteria:** There shall be no perceptible loss of pressure.

Visually check all tubing and connections between the cal gas flow control valve and the sample cell(s) of the optical bench.

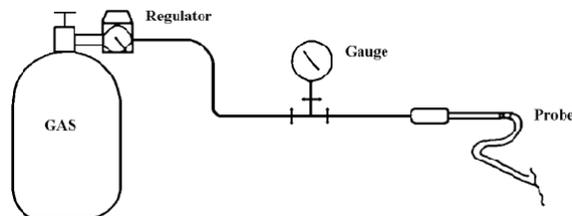
**Acceptance Criteria:** There shall be no signs of loose fittings or tubing, and no signs of defective or damaged fittings or tubing.

### 5.3.3 Flow Sensitivity:

#### 1. Sample System Variations

This test characterizes the effect of variations in pressure differential/flow upstream of the sample pump on gas readings.

- a) Gas calibrate the EIS.
- b) Connect the regulator outlet of a cylinder of Mid Range #2 BAR-97 audit gas (see §2.4.5.i) to the inlet of a throttling valve, connect the outlet of the valve to a tee and then from the tee to the sample probe inlet. Connect a pressure/vacuum gauge, capable of reading  $\pm 5$  psig to the last tee opening. (See figure.)



- c) Open the gas cylinder valve and adjust the gas flow (using the cylinder regulator and the throttling valve) so that the inlet pressure to the probe is 0 psig  $\pm 0.1$  psig. Let the readings stabilize, then record them.
- d) Adjust the gas flow so that the inlet pressure to the probe is +1.5 psig  $\pm 0.1$  psig. Let the readings stabilize, then record them.
- e) Adjust the gas flow so that the inlet pressure to the probe is -1.5 psig  $\pm 0.1$  psig. Let the readings stabilize, then record them.
- f) Repeat Steps c), d) and e) two more times.

**Acceptance Criteria:** All gas readings shall differ by no more than 1% of each other.

#### 2. Calibration Gas Path Variations

This test characterizes the effectiveness of the EIS calibration gas regulation as the calibration gas cylinders are emptied.

## SECTION 5

- a) Disconnect the EIS's calibration gas cylinders. Connect a cylinder of high range audit gas to the EIS high range cal port using a length of high-pressure (400 psig minimum rating) hose and a CGA-165 adapter to connect to the EIS's regulator inlet. Connect a cylinder of low range audit gas to the EIS low range cal port in a similar manner. [NOTE: The cylinder regulators used with the audit gas cylinders shall be dual-stage, compatible with the audit gas blends, with a delivery pressure range of at least 5 psig to 200 psig and capable of delivering at least 10 liters per minute of gas blend.] **DO NOT disturb the adjustments on the EIS regulators.**
- b) Set the audit gas regulators to deliver 160 psig. Perform a standard gas calibration.
- c) Perform a 4-gas audit, following the procedure in §2.4.5 i). Record the HC, CO, CO<sub>2</sub> and NO readings.
- d) Set the audit gas regulators to deliver 30 psig. Perform a standard gas calibration.
- e) Perform a 4-gas audit, following the procedure in §2.4.5 i). Record the HC, CO, CO<sub>2</sub> and NO readings.

**Acceptance Criteria:** The relative difference between the audit readings taken at 30 psig delivery pressure and those taken at 160 psig delivery pressure shall not exceed 1%, using the formula  $\text{Rel. Diff., \%} = 100 \times (R_{30} - R_{160})/R_{160}$ , where  $R_x$  is the audit reading when the EIS was calibrated with a delivery pressure of x psig. **[NOTE: For the low range audit gas, the Acceptance Criteria shall be: HC < 3ppm propane; CO < 0.01%; CO<sub>2</sub> < 0.1%; NO < 8 ppm. For Midrange #1 audit gas, CO<sub>2</sub> < 0.1%; HC, CO and NO shall meet the 1% relative difference criterion.]**

### 5.3.5 Flow Restrictions

- a) Using a Mid Range #2 BAR-97 audit gas entering the sample probe at atmospheric pressure, take a base reading with no restriction in the line. Insert a throttling valve in the vacuum side of the sampling system. With the gas flowing (still at atmospheric pressure), restrict the sample flow until (1) the low flow indication is activated, (2) the system response time of the slowest NDIR channel exceeds 11 seconds to 90% of the base reading, or (3) the actual gas reading differs from the base reading on any channel by more than 3% of the base reading.

**Acceptance Criteria:** The low flow indication is activated and the system response times of all NDIR channels are 11 seconds or less to 90% of the base readings, and the actual gas readings differ from the base readings by 3% of the base readings or less.

- b) If the low flow sensor is activated by pressure (or vacuum), insert a 0-10 psig (0-30 in. Hg) gauge between the throttling valve and the inlet to the low flow sensor. Use the throttling valve to activate and deactivate the low flow indication. Measure the pressure (vacuum) at which activation and deactivation occur. Perform this test three times.

**Acceptance Criteria:** The difference between the activation and deactivation point shall be no greater than 3% of the activation point (pressure or vacuum).

### 5.3.6 Particulate Filter

Install a new particulate filter per the manufacturer's instructions and perform a leak check. Adjust a 3.0L or larger engine to produce an exhaust gas hydrocarbon concentration of 1000-1200 ppm. Sample the exhaust gas for two hours or until the low flow indication is activated.

**Acceptance Criteria:** The low flow indication shall not be activated at any time during or at the end of the two-hour test period.

**Note:** This test must not be performed before the successful completion of the flow restriction test.

### 5.3.7 Hydrocarbon Hangup

With a new particulate filter installed, zero the analyzer. Insert the candidate unit's sample probe in the tailpipe of a vehicle whose eight-cylinder idling engine is emitting between 600 and 700 ppm HC. After sampling the exhaust gas for one minute, remove the sample probe from the tailpipe. Holding the probe in clean air, time the drop in the HC reading. Make three such tests, allowing at least three minutes between each complete test. These three minutes shall commence at the end of the preceding test, after the reading has dropped to 20 ppm or the timer has reached 20 seconds, whichever comes first. The sample hose must be 25 ft  $\pm$  0.5 ft measuring from the front of the analyzer.

**Acceptance Criteria:** For each complete test, (1) the HC reading shall decay to 20 ppm or less within 20 seconds. (2) Inspection testing shall be locked out until the HC reading drops to 7 ppm or less.

### 5.3.8 Probe Antidilution

This test evaluates the ability of candidate antidilution device to (a) prevent dilution of the sample, and (b) allow no dilution when testing certain vehicles of the mid-seventies having noise baffles in their tailpipes.

- a) **Antidilution:** Use a test vehicle whose engine size is between 1.3 and 1.8 liters, and which idles between 650 and 850 RPM. The test vehicle's tailpipe shall have an outer diameter of between 1.25 and 1.5 inches.

## SECTION 5

1. With the engine at normal operating temperature, and normal idle speed, de-tune the engine to produce at least 1000 ppm HC or 5% CO.
2. The candidate unit shall be properly adjusted and warmed up, operating in the Manual Mode with the Dilution Correction OFF and Ten-Second Moving Average selected. Insert the standard probe into the tailpipe to its full insertion depth of 16 inches. Record the stabilized average HC, CO, CO<sub>2</sub>, NO and O<sub>2</sub> readings.
3. Withdraw the probe to 4 inches and record the stabilized average readings.
4. Repeat steps 2, 3, and 2 again.
5. Average the (2) stabilized average readings for each channel, average the (3) stabilized average readings for each channel, and subtract the (3) average from the (2) average.
6. For units provided with an antidilution device, repeat steps (2) through (5) using the antidilution device.

**Acceptance Criteria:** The difference found in (5) if no antidilution device is provided, or (6) if one is provided, shall be within the accuracy requirements specified in §2.4.5 j).

- b) **Noise Baffles:** Use a test vehicle with at least one noise baffle in its tailpipe.

**Acceptance Criteria:** The standard probe (or antidilution device, if provided) shall demonstrate its ability to pass through the holes in the noise baffle(s) to its full insertion depth of 16 inches, or shall meet the acceptance criteria of (a) above with insertion to the depth of the baffle screen.

### 5.3.9 Dilution

- a) Set vehicle with 1.6 liter maximum engine displacement at factory-recommended idle speed, OEM configuration exhaust system transmission in neutral, hood up (a blower to cool the engine may be used if needed). Set idle speed not to exceed 920 RPM. (Set for 900 RPM with an upper tolerance of 20 RPM.)
- b) With a laboratory grade analyzer system, sample the exhaust at 16 inches depth with a flow sample rate below 320 liters per hour. Allow sufficient time for this test. Record all HC, CO, NO and CO<sub>2</sub> readings.

A chart recorder may be used to detect the point of stable readings.

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- c) Set the EIS in the Manual Mode with Dilution Correction OFF and Ten-Second Moving Average selected. Record the stabilized average HC, CO, CO<sub>2</sub>, NO and O<sub>2</sub> readings. Use these readings for the computations in (e) below.
- d) Repeat (b).
- e) If the difference of the stabilized average readings between parts (b) and (d) exceeds 2% of the average of (b) and (d), repeat parts (b), (c) and (d); otherwise average (b) and (d) and compare with (c). If (c) is within 2% of the average of (b) and (d), then the equipment meets dilution specifications.

**Acceptance Criteria:** The flow rate of the EIS unit shall not cause more than 2% dilution during sampling of the exhaust of a 1.6L engine at normal idle. Two-percent dilution is defined as a sample of 98% exhaust and 2% ambient air.

### 5.4 CERTIFICATION TEST PROCEDURES: ANALYZER

#### 5.4.1 Storage Temperature Conditioning

This preconditioning operation demonstrates the ability of the candidate units to meet the storage temperature requirements of the specifications. This test shall be performed before proceeding with the remaining tests. Each unit shall be stabilized at an ambient temperature of -4°F for at least three hours with power off, followed by a three-hour soak at +130°F. At completion of these soaking temperatures, re-stabilize the unit to approximately 75°F before continuing with the tests.

#### 5.4.2 Temperature Stability

This test will be run continuously until completed in the sequence shown. Any deviation or failure will require that the test be redone.

- a) Stabilize the units at an ambient temperature of 75°F ± 5°F for at least two hours, with power and pump on.
- b) Gas calibrate the units using the standard BAR-97 blends for HC, CO, CO<sub>2</sub>, NO and O<sub>2</sub>. Flow Mid Range #2 BAR-97 audit gas through the units and record the readings.
- c) Lower the ambient temperature to 50°F ± 5°F and stabilize the units for two hours, leaving the power on and pump running. Readjust zero only as necessary, then reintroduce the audit gas WITHOUT ADJUSTING THE UNITS (gas calibration is not permitted). Record the readings.
- d) Raise the ambient temperature to 100°F ± 5°F and stabilize for at least two hours leaving the power on and pump running. Readjust zero and electronic span only

as necessary. Reintroduce the audit gas (gas calibration is not permitted). Record the readings.

- e) Return the unit to  $75^{\circ}\text{F} \pm 5^{\circ}\text{F}$  and stabilize. Adjust zero, introduce the audit gas and record the readings, showing error as percent of reading.

**Acceptance Criteria:** When gas calibrated at  $75^{\circ}\text{F}$ , the difference between the highest and the lowest readings, regardless of temperature, shall not exceed 3% of reading.

### 5.4.3 Controlled Ambient Conditions

All subsequent analyzer performance tests (unless otherwise noted) shall be conducted at each of the following ambient conditions in the sequence shown:

- a)  $75^{\circ}\text{F}$  ( $\pm 2^{\circ}\text{F}$ ).
- b)  $110^{\circ}\text{F}$  ( $\pm 2^{\circ}\text{F}$ ), 80% ( $\pm 5\%$ ) relative humidity.
- c)  $35^{\circ}\text{F}$  ( $\pm 2^{\circ}\text{F}$ ), 80% ( $\pm 5\%$ ) relative humidity and 10 mph wind.

### 5.4.4 Warm-up Time

- a) Prior to the warm-up test, unit power shall be off and the unit shall have been stabilized at the selected environmental test condition for a minimum of two hours. The unit shall then be turned on, warmed up, zeroed and gas calibrated, then turned off for a minimum of six hours.
- b) Upon completion of this stabilization period, unit power shall be turned on. For each candidate unit, record the time interval between Power On and System Ready indication. Verify that, during this time interval, the emissions analyzer is prevented from performing an inspection, and that no exhaust readings of any kind can be made.
- c) Perform an automatic zero, enter the Manual Mode (Dilution Correction and Ten-Second Moving Average both OFF), and sample BAR-97 Low Range calibration gas through the probe. Gas entering the probe shall be at room atmospheric pressure. Record the zero and span gas readings for each channel.
- d) Wait five minutes. Do not perform any adjustments. Record the zero reading, feed BAR-97 Low Range calibration gas through the probe, and record the gas reading.

**Acceptance Criteria:**

(1) Warm-up time of the complete system shall not exceed 30 minutes from "power on" to "system ready" at all temperature conditions. The unit is considered warmed up as soon as the zero and span readings for each channel (a) have drifted less than the accuracy tolerances listed in §2.4.5.j)

over a five-minute interval without adjustment, and (b) are within these accuracy tolerances of the zero and gas cylinder values;

(2) The system lockout and system ready features shall demonstrate their proper functioning during the analyzer warm-up period.

#### 5.4.5 Drift Tests

a) **Zero Drift**

The zero drift test shall be conducted immediately following completion of the warm-up test, and is essentially a continuation of it. Units which cannot display negative values shall be monitored directly at the signal outputs of the bench, or at some other position in the signal path where negative values can be monitored. Record the readings for each channel at five-minute intervals for one hour after warm-up. The first reading (time = zero) shall be the first **zero** reading taken after the unit completed its warmup cycle; the second reading (time = 5 minutes) shall be the second **zero** reading taken during the warmup test. During this test, zero adjustments are allowed at t = 30 minutes and t = 60 minutes. ( NOTE: zeroing shall not occur at any time during a Smog Check). All components such as motors, pumps and lighting shall remain on during the one-hour test.

**Acceptance Criteria:** (1) Drift over the one-hour period shall not exceed the accuracy tolerances listed in §2.4.5 j). (2) No cyclical variation with a period less than 10 minutes shall have a peak value of more than 1.5 times these accuracy tolerances.

b) **Span Drift**

This three-hour test shall be conducted simultaneously with the zero drift test.

Sample BAR-97 Low Range calibration gas through the probe every five minutes for the first 30 minutes, every 10 minutes for the second 30 minutes and every 15 minutes for the second and third hours. The first reading (time = zero) shall be the first gas reading taken after the unit has completed its warmup cycle; the second reading (time = 5 minutes) shall be the second reading taken during the warmup test. The gas pressure shall be room atmospheric at the entrance to the probe.

Electronic zero adjustment is permissible at t = 30 minutes, 60 minutes, and 120 minutes. Zeroing shall not occur at any time during a smog check. Components such as pumps, motors and lighting shall remain on for the duration of the test.

**Acceptance Criteria:** (1) Span drift shall not exceed the accuracy tolerances listed in §2.4.5 j) during the first hour. (2) Span drift shall not exceed 2/3 of these values or two least significant display digits, whichever is greater, during each of the second and third hours.

**5.4.6 Analyzer Accuracy and Bias**

This test confirms the ability of the candidate units to read various concentrations of gases within the tolerances required by this specification.

This test shall be performed after completion of the drift tests. The candidates shall be zeroed and gas calibrated using the BAR-97 High and Low Range calibration gases. The units shall be tested using blends of propane, carbon monoxide, carbon dioxide and nitric oxide in nitrogen, and oxygen in nitrogen, blended to 1% certified accuracy, in the following concentrations:

- 5000 ppm propane, 12.00% CO, 18% CO<sub>2</sub>, 4500 ppm NO, 25% O<sub>2</sub>
- 0%, 20%, 40%, 60%, 80%, 100% of these concentrations
- 500 ppm propane, 1.2% CO, 6% CO<sub>2</sub>, 800 ppm NO, 5% O<sub>2</sub>
- 0%, 10%, 20%, 40%, 60%, 80%, 100% of these concentrations
- 80 ppm propane, 0.20% CO, 3% CO<sub>2</sub>, 200 ppm NO, 1.0% O<sub>2</sub>
- 0%, 20%, 40%, 60%, 80%, 100% of these concentrations.

**Alternatively, the fractional concentrations may be achieved using a gas divider.**

- a) Introduce the gases in ascending order of concentrations beginning with the zero gas (nitrogen). Record the readings of the candidate units to each concentration value.
- b) After the highest concentration has been introduced and recorded, introduce the same gases to the candidate analyzers in descending order, including the zero gas. Record the response of the analyzers to each gas. Record negative values of zero, if any.
- c) Repeat Steps (a) and (b) for the candidate units four more times, for a total of five.
- d) **Calculations:**
  1. Calculate the mean ( $\bar{x}$ ) and standard deviation of each candidate's readings for each concentration. Include both upscale and downscale readings for the same gas concentration. (All calculations may not be possible for zero readings.)
  2. For each concentration, compute the following:

$$y_1 = \bar{x} + K_{sd}$$

$$y_2 = \bar{x} - K_{sd}$$

Where  $K_{sd}$  = standard deviation x 1.24 (for zero and highest

concentration value), or  
 $K_{sd} = \text{standard deviation} \times 0.715$  (for all other concentration values)

3. Compute the uncertainty of the calibration curve for each concentration as follows:

$$U_1 = \text{concentration value} - y_1$$

$$U_2 = \text{concentration value} - y_2$$

**Acceptance Criteria:**

(1) For each concentration, the mean (0) shall be no greater than the tolerances in the table below. Note that these tolerances are root-sum-square values accounting for such variables as test and calibration gases.

Channel	Tolerance
HC	$\pm 3.40\%$ or $\pm 5\text{ppm}$ , whichever is greater
CO	$\pm 3.32\%$ or $\pm 0.03\%$ CO, whichever is greater
CO <sub>2</sub>	$\pm 3.54\%$ or $\pm 0.4\%$ , whichever is greater
NO	$\pm 4.25\%$ or $\pm 27\text{ppm}$ , whichever is greater
O <sub>2</sub>	$\pm 5.26\%$ or $\pm 0.2\%$ O <sub>2</sub> , whichever is greater

(2)  $U_1 - U_2$  shall be no greater than the tolerance spread allowed in the table above.

**5.4.7 Hexane/Propane Conversion Ratio (75°F only)**

- a) Calibrate the units per the manufacturer's instructions, using gas blends having propane as the hydrocarbon.
- b) Sample a BAR-97 Low Range tri-blend having hexane as the hydrocarbon. Record the readings.
- c) Sample a BAR-97 High Range tri-blend having hexane as the hydrocarbon. Record the readings.

**Acceptance Criteria:** The HC readings taken in Steps (b) and (c) shall not differ from the associated cylinder values by more than 4 ppm (Step b) or 48 ppm (Step c).

#### 5.4.8 Gas Interference

This test examines the effect of non-interest gases on the analyzer channels. Testing shall be performed under the **35°F**, 75°F and **110°F** conditions, except as noted below.

- a) Zero and span the candidate units.
- b) Sample the following gases for at least one minute. Record each channel's response to the presence of these gases. The list below does not imply a sequence; the gases may be used to challenge the analyzer in any order.

#### Interfering Gas

16%	Carbon Dioxide in Nitrogen
1600 ppm	Hexane in Nitrogen
10%	Carbon Monoxide in Nitrogen
3000 ppm	Nitric Oxide in Nitrogen
75 ppm	Hydrogen Sulfide in Nitrogen
75 ppm	Sulfur Dioxide in Nitrogen
9%	Carbon Monoxide and 18% Carbon Dioxide in Nitrogen
	28 ppm each Benzene, Toluene, Xylene in O <sub>2</sub> -free N <sub>2</sub> (NDUV technology only)
	Water-Saturated Hot Air

**NOTE:** The water-saturated hot air shall be drawn through the probe from the top of a sealed vessel partially filled with water through which ambient air will be bubbled. The water shall be maintained at a temperature of 50°C ±5°C. **THIS TEST SHALL BE PERFORMED AT THE 75°F AND THE 110°F CONDITIONS ONLY.**

**Acceptance Criteria:** (1) No gas or vapor in the above list shall cause a change in reading of more than the excursions allowed in §2.4.5 o) on any channel. (2) Immediately after the water vapor test, there shall be no evidence of condensation anywhere in the sample inlet tubing to the analyzer sample cell. (3) The actual CO and CO<sub>2</sub> readings when sampling the collision-broadening test gas (9% CO, 18% CO<sub>2</sub>) shall be within the tolerances specified in §5.4.6.3.

- c) **Quench Effects (NO and O<sub>2</sub> channels only. Not applicable to NDUV.)**

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1. Connect a cylinder of N<sub>2</sub> to the balance gas side of a gas divider, and the interference gas cylinder of 3000 ppm NO in N<sub>2</sub> to the other side.
2. Record the NO channel readings at 0% on the gas divider, 20%, 40%, 60%, 80%, 100%.
3. Connect the interference gas cylinder of CO (for electrochemical cells; CO<sub>2</sub> for chemiluminescent sensors and NDIR) to the balance gas side of the gas divider, leaving the interference gas cylinder of 3000 ppm NO in N<sub>2</sub> connected to the other side.
4. Record the NO channel readings at 100% on the gas divider, 80%, 60%, 40%, 20%, 0%.
5. For each dilution level, calculate the relative error,

$$E_R, \% = 100 \times (\text{Readings from Step 4} - \text{readings from Step 2}) / (\text{readings from Step 2})$$

6. Repeat Steps 3 through 4.
7. Repeat Steps 1 through 6 using a cylinder of zero air in place of the cylinder of NO.

**Acceptance Criteria:** For each gas, for each dilution level, the E<sub>R</sub> shall be no more than 1% of point.

d) **Saturation Effects (NO and O<sub>2</sub> channels only):**

1. Flow NO interference gas through the analyzer and record the stabilized NO reading.
2. Flow the CO (or CO<sub>2</sub>) interference gas through the analyzer for three minutes.
3. Flow NO interference gas through the analyzer again, and record the stabilized NO reading.
4. Calculate E<sub>R</sub> for the readings recorded in Steps 1 and 3.
5. Repeat Steps 1 through 4 using zero air in place of the NO interference gas.
6. Repeat Steps 1 through 5 using the H<sub>2</sub>S, SO<sub>2</sub> and H<sub>2</sub>O (see Step 7) interference gases in place of the CO (or CO<sub>2</sub>) gas.

7. Unlike the other interferents, water and water vapor are not swept out of the sample system quickly. To correct for this, perform Step 1; then with a dew point meter measuring the moisture in the sensor's exhaust, bubble N<sub>2</sub> through water at 50°C (122°F) to the analyzer until the measured dew point has been stable for 30 seconds. Finally, perform Step 3 and also record the dew point reading. From standard steam tables, determine the partial pressure of water vapor at the dew point temperature. Divide the H<sub>2</sub>O partial pressure by the barometric pressure to determine the fraction of water vapor in the sample. Multiply the dry NO reading recorded in Step 1 by (1 – the fraction); this is what the wet reading should be to compensate for the moisture fraction in the sample. The actual wet reading, when compared to the calculated wet reading, shall meet the Acceptance Criteria below.

**Acceptance Criteria:** In no case shall E<sub>R</sub> exceed 1% of point.

#### 5.4.9 Voltage Variations

This test examines the effects of variations in AC line voltage on EIS readings.

- a) Perform a gas calibration on the candidate units with the line voltage at 115 volts AC.
- b) Sample a BAR-97 Mid-Range #2 audit gas blend through the probe. Gas pressure shall be zero psig (room ambient atmospheric) at the entrance to the probe. Record the readings.
- c) Adjust the line voltage to 127 VAC while continuing to sample the gas. Record the readings.
- d) Adjust the line voltage to 103 VAC while continuing to sample the gas. Record the readings.
- e) Adjust the line voltage to 115 VAC while continuing to sample the gas. Record the readings.

**Acceptance Criteria:** Readings shall not vary more than 1/3 of the accuracy requirements in §2.4.5.j), or two least significant digits of resolution, whichever is greater, over the entire voltage variation.

#### 5.4.10 Pressure Compensation

This test examines the precision of the candidate unit's pressure compensation system in keeping the readings constant over swings in barometric pressure. Two methods are used to compensate for pressure variations. One involves monitoring ambient barometric

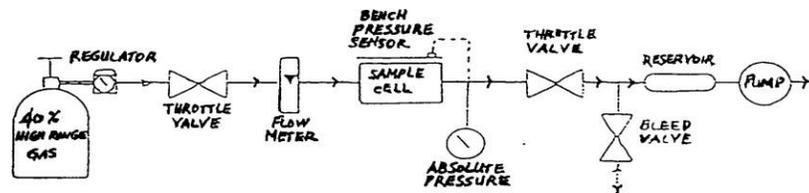
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pressure; the other involves monitoring sample cell pressure. The following test procedure applies to both.

- a) Insert a flowmeter at the sample cell inlet. To avoid unnecessary flow restriction, the flowmeter shall not have an integral needle valve.
- b) Sample room air through the probe. Measure and record the flow rate.

**NOTE: BEFORE PROCEEDING, DETERMINE THE MAXIMUM RECOMMENDED SAMPLE CELL PRESSURE FROM THE BENCH MANUFACTURER. BE SURE TO AVOID EXCEEDING THIS VALUE DURING TESTING.**

- c) Disconnect the tubing between the sample system and the flowmeter inlet. Install a throttling valve upstream of the flowmeter, and a source of BAR-97 Mid-Range #2 audit gas with a low-pressure regulator upstream of the throttling valve. At the sample cell discharge, tee in the bench's pressure sensor (if not already there) and a pressure gauge capable of reading 0-32 inches Hg absolute. Follow this with a second throttling valve, a reservoir of about 125 cu. in. (2 liters), and a vacuum pump with a bleed valve at its inlet. See the figure below.



- d) Adjust the gas flow and the two throttling valves (and the vacuum pump and/or the bleed valve, if necessary) to produce the flow rate found in Step (b) and an exhaust pressure of  $29.0 \pm \text{HgA}$ . Adjust the readings to agree with the cylinder values.
- e) Readjust the system to maintain the flow rate at a pressure of  $31 \pm \text{HgA}$ . Record the readings.
- f) Readjust the system to maintain the flow rate at a pressure of  $27 \pm \text{HgA}$ . Record the readings.
- g) Readjust the system to maintain the flow rate at a pressure of  $26 \pm \text{HgA}$ . Adjust the readings to agree with the gas cylinder values.

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- h) Readjust the system to maintain the flow rate at a pressure of  $28 \pm$  HgA. Record the readings.
- i) Readjust the system to maintain the flow rate at a pressure of  $24 \pm$  HgA. Record the readings.
- j) Repeat Steps d) through i) using 6% O<sub>2</sub> in N<sub>2</sub>.

**Acceptance Criteria:** (1) The difference between the readings in Steps (d), (e) and (f) shall be no greater than the allowable accuracy tolerances in §2.4.5 j) of this specification. (2) The difference between the readings in Steps (g), (h) and (i) shall be no greater than the allowable accuracy tolerances in §2.4.5 j) of this specification. (3) The above criteria apply to the results of Item j).

### 5.4.10 (Alt) **Pressure Compensation – Alternate Methods**

Some sensors cannot be given a valid pressure compensation test by the above method. The following procedures apply to all designs.

- a) *Barometric Pressure Chamber:* A pressure chamber large enough to house the units under test may be used. The procedure specified above shall be used; however, it is not necessary to use the above setup. Instead, flow Mid #2 audit gas through the EIS sample probe using the adapter with balloon. Adjust the ambient pressure in the chamber in accordance with the above procedure. Record the readings as above
- b) *Altitude Method:* If such a chamber is not available, the units under test and the necessary test equipment will need to be driven by truck to the various altitudes.
  - i. Equipment needed:
    - The units to be tested.
    - BAR-97 Midrange #2 audit gas
    - An AC generator to power the units to be tested.
    - A large fan, such as those used to cool the engines of vehicles undergoing an ASM test.
    - An adapter with balloon (and spares) to feed the gases from the audit cylinders into the sample probes of the units to be tested.
    - Power cables, wrenches, etc.
    - A truck or other means of transportation. (No trailers.)
  - ii. At an altitude or pressure equivalent of <100 feet, perform a leak check and a gas calibration.
  - iii. Zero the units and introduce the Mid #2 audit gas to the sample probe through the adapter with balloon. (The balloon should be erect, but not

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inflated.) Record the readings on the data sheets on the first "<100 feet" row.

- iv. At the altitude or pressure equivalent of 3000 feet, turn on the units to be tested (if they are not already running) and allow them to warm up. Wait another 15 minutes before testing. Zero the units and introduce the Mid #2 audit gas to the sample probe through the adapter with balloon. (The balloon should be erect, but not inflated.) Record the readings on the data sheets on the "3000 ft" row.
- v. Calibrate the units, then Reintroduce the Mid #2 audit gas.. Record the audit readings on the "3000ft (+ cal)" row.
- vi. At the altitude or pressure equivalent of 7000 feet, turn on the units to be tested (if they are not already running) and allow them to warm up. Wait another 15 minutes before testing. Zero the units, but do not calibrate. Introduce the Mid #2 audit gas to the sample probe through the adapter with balloon. (The balloon should be erect, but not inflated.) Record the readings on the data sheets on the "7000 ft" row.
- vii. At the altitude or pressure equivalent of <100 feet, turn on the units to be tested (if they are not already running) and allow them to warm up. Wait another 15 minutes before testing. Zero the units and introduce the Mid #2 audit gas to the sample probe through the adapter with balloon. (The balloon should be erect, but not inflated.) Record the readings on the data sheets on the last "<100 ft" row.

**Acceptance Criteria:** For each channel, the absolute and relative differences between the highest reading recorded in Steps v., vi., and vii. above and the lowest reading shall be as follows:

Channel	Relative Error, %	Absolute Error
HC	3%	4.0/PEF ppm C <sub>3</sub> H <sub>8</sub>
CO	3%	0.02% CO
CO <sub>2</sub>	3%	0.3% CO <sub>2</sub>
NO	4%	25 ppm
O <sub>2</sub>	5%	0.1% O <sub>2</sub>

**5.4.11 Analyzer/Sensor Response Time**

This test measures the response times of the analyzer or sensor itself, without the influence of the sample system.

- a) Connect a strip chart recorder or data acquisition system (DAS) to the analyzer/sensor output(s). See §5.2(d).

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- b) Zero and gas-calibrate the candidate per the manufacturer's instructions.
- c) Install a flowmeter just upstream of the analyzer/sensor inlet port. Note that some configurations have the NO sensor in a bypass stream around the NDIR bench. In this case, install the flowmeter upstream of the bypass branch.
- d) With the sampling system in the exhaust-sampling mode, measure and record the flow rate to the analyzer/sensor.
- e) Connect a cylinder of High Range BAR-97 calibration gas with pressure regulator, needle valve and 3-way solenoid valve or other switching means, to the inlet of the flowmeter. (The sample system is thus disconnected.) Connect a cylinder of zero gas (nitrogen or zero air) with pressure regulator and needle valve to the other port of the solenoid valve.
- f) Adjust gas flow from each cylinder to the analyzer/sensor so that their flow rates match that recorded in Step (c).
- g) With the recorder or DAS running, feed zero gas to the analyzer/sensor for 60 seconds.
- h) Switch the solenoid valve so that calibration gas flows to the analyzer/sensor for 60 seconds.
- i) Repeat Steps (g) and (h) two more times, and then Step (g) once more.

**Acceptance Criteria:** Rising and falling response times shall meet the requirements of Section 2.4.5 r.

### 5.4.12 Ambient Temperature Noise Tests

The following tests examine the sensitivity of the candidate units to extraneous electrical and electromagnetic inputs.

#### a) **Automotive RFI Test**

1. Use a test vehicle with an engine having a high-energy ignition system or equivalent, a solid core coil wire and a 3/8" air gap. Leave the engine off.
2. Locate the EIS within 5 feet of the front of the vehicle. Gas-calibrate the unit.
3. Sample BAR-97 Low Range calibration gas through the probe. Gas pressure shall be room ambient atmospheric (zero psig) at the entrance to the probe. Record the readings.

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4. Start the engine. With the hood open, cycle the engine from idle through 2500 RPM. With the Low Range gas flowing through the probe, record the readings.
5. Relocate the unit to within 6 inches of one side of the engine compartment and repeat the test in Step 4.
6. Relocate the unit to within 6 inches of the other side of the engine compartment and repeat the test in Step 4.

**Acceptance Criteria:** The readings shall deviate no more than 1/3 of the accuracy requirements in §2.4.5.j), or one least significant digit, whichever is greater.

**b) Induction Field Test**

Use a variable speed (commutator type) hand drill having a plastic housing and rated at 3 amps or more. While sampling BAR-97 Low Range calibration gas, vary the drill speed from zero to maximum while moving from the front to the sides of the unit at various heights.

**Acceptance Criteria:** The readings shall deviate no more than 1/3 of the accuracy requirements in §2.4.5.j).

**c) Line Interference Test**

Plug the variable speed drill described in subsection b) into one of the two outlets of a #16-3 wire extension cord 20 feet long. Connect the unit into the other outlet of the extension cord. Repeat subsection b) above.

**Acceptance Criteria:** The readings shall deviate no more than 1/3 of the accuracy requirements in §2.4.5.j), or one least significant digit, whichever is greater.

**d) VHF Band Frequency Interference Test**

While sampling BAR-97 Low Range calibration gas, press and release the transmit button of a citizens band radio transmitter (with output equivalent to FCC legal maximum), and simultaneously key a highway patrol transmitter (or equivalent). Both transmitters shall be located within 50 feet of the analyzer.

**Acceptance Criteria:** The readings shall deviate no more than 1/3 of the accuracy requirements in §2.4.5.j), or one least significant digit, whichever is greater.

**5.4.13 Vibration and Shock — Ambient Temperature Only**

The vibration test simulates rolling a mobile unit over a rough garage floor. The shock test simulates a rolling EIS which collides with a wall or other fixed object. (This test does not require temperature conditioning.)

The test floor shall be a 6' x 10' expanded metal grating with diamond-shaped openings of 1 x 3.7" or equivalent, elevated 2" off the test facility floor.

- a) Zero and calibrate the unit in accordance with the EIS manufacturer's instructions. Introduce BAR-97 Low Range calibration gas to the probe (pressure = zero psig); record the readings.
- b) Roll the unit six times over the 6' x 10' expanded metal grating in the direction of the "short way of the diamond." Roll the unit completely off the edge of the grating each time.
- c) Introduce the Low Range calibration gas to the probe (pressure = zero psig); record the readings.

**Acceptance Criteria:** The EIS readings shall not have permanently shifted more than the accuracy requirements in §2.4.5.j) from the original zero and span check values.

**5.5 CERTIFICATION TEST PROCEDURES: ANALYZER/SAMPLE SYSTEM INTEGRATION****5.5.1 System Repeatability and Calibration/Sample Path Balance**

This test characterizes the ability of the EIS to give consistent readings when repeatedly sampling the same gas concentration.

- a) Introduce BAR-97 Low Range calibration gas through the calibration port. Record the readings.
- b) Purge with ambient air or zero air for a minimum of 30 seconds and a maximum of one minute.
- c) Repeat Steps (a) and (b) four more times.
- d) Repeat Steps (a), (b) and (c), introducing the gas through the probe.

**NOTE:** If only one path exists through the analyzer, perform Steps (a) and (b) ten times.

**Acceptance Criteria:** The difference between the highest and the lowest readings from the data for both the calibration port and probe combined shall not exceed the Repeatability requirements of §2.4.5.k).

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- e) *Average the five sets of readings taken in Steps a) through c), above. In other words, take the average of the five HC readings, the five CO readings, etc.*
- f) *Average the five sets of readings taken in Step d), above.*
- g) *Determine the relative difference between the HC, CO, CO<sub>2</sub>, and/or NO averages in Step e) and those in Step f); e.g.,  
Relative Difference for HC, %, =  $100 \times [(f_{avg} - e_{avg})/e_{avg}]_{HC}$*

**Acceptance Criteria:** *None of the relative differences calculated in Step g) above shall exceed  $\pm 1\%$  or 1 least significant digit, whichever is greater.*

### 5.5.2 System Response Time

This test determines the speed of response of the candidate units to the introduction of a gas through its probe when their sample systems are clean.

- a) Connect a strip chart recorder or data acquisition system (DAS) to the EIS output(s). See §5.2 (d)
- b) Zero and gas-calibrate the candidate per the manufacturer's instructions.
- c) A 3-way solenoid valve or equivalent selector system (or alternate BAR-approved method), shall be used to alternately introduce zero air (or nitrogen) and BAR-97 High Range calibration gas to the probe. The gas pressure at the entrance to the probe shall be equal to room ambient (i.e., zero psig). A balloon teed into the gas line just ahead of the probe may be used to adjust the pressure at the probe tip for each gas. The balloon, with the sample pump running, shall stand erect but shall not be inflated.
- d) With the recorder or DAS running, feed zero gas to the EIS for 60 seconds.
- e) Switch the solenoid valve so that the High Range calibration gas flows to the EIS for 60 seconds.
- f) Repeat Steps (d) and (e) two more times, and then Step (d) once more.

**Acceptance Criteria:** Response times for each channel shall meet the requirements of §2.4.6 g).

### 5.6 CERTIFICATION TEST PROCEDURES: DYNAMOMETER, CONTROLS & INTERFACING

At the time of dynamometer certification, each dynamometer manufacturer shall submit data demonstrating the dynamometer's ability to meet BAR-97 specifications. This data shall include, as a minimum, verification of the following tests.

To aid in the testing of the dynamometers at BAR, the dynamometer must be accompanied by software capable of:

1. Performing steady state tests at different loads
2. Coast downs at different load settings (30 to 15 mph) according to the BAR-97 specification
3. Performing specialized coast down algorithm in accordance with §5.6.5.
4. Performing BAR-31 simulation given different load coefficients
5. Parasitic loss determination according to the BAR-97 specification
6. Conducting a free form drive trace given different load coefficients

Once the dynamometer has been submitted for testing, BAR will spot check the manufacturer's generated test results for accuracy. In addition, BAR will also perform additional testing to ensure compliance with the BAR-97 specification.

#### **5.6.1 Base Inertia Determination**

The dynamometer manufacturer shall demonstrate their method for base inertia determination and submit test results verifying that the base inertia of the dynamometer is within BAR-97 specifications. The determination method is subject to BAR approval.

**Acceptance Criteria:** Base inertia shall be 2000  $\pm$ 40 lbs. The base inertia quantified on the dynamometer ID plate matches the measured base inertia within  $\pm$ 10 lbs.

#### **5.6.2 Speed Accuracy Determination**

The dynamometer manufacturer shall demonstrate their method for speed accuracy determination and submit test results verifying that the speed measurement of the dynamometer is within BAR-97 specifications. The determination method is subject to BAR approval.

**Acceptance Criteria:** Speed shall be accurate to within 0.1 mph.

#### **5.6.3 Load Accuracy**

As a minimum, 12 tests must be conducted to demonstrate load accuracy under varying conditions as provided in the Load Accuracy Test Condition Matrix (i.e., test 6 requires a calibration temperature and test ambient temperature of 75F with nominal calibration voltage and high test supply voltage in a maximum warm-up condition and a 15 hp load). Changes that might affect the accuracy of the system may not be made in between these tests. If a change must be made, the testing shall start over.

In each case, the dynamometer must soak for at least eight hours in the appropriate temperature before conducting either calibration or testing. For both calibration and testing, the dynamometer shall be warmed-up according to the manufacturer's requirements. If no warm-up is required, none will be allowed.

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After waiting the required amount of time (see warm-up time), coast down checks, from 30.0 mph to 15.0 mph according to the BAR-97 procedures, shall be performed according to the conditions listed for each of the 12 tests in the matrix. In each case, for acceptance testing purposes, the time from when the rolls start turning until the dynamometer begins coasting shall not exceed 30 seconds. An external means may be used to bring the dynamometer up to speed in the required time as long as it can be disengaged during the coast down.

The dynamometer shall use any applicable temperature correction or similar algorithms during the coast downs that would be used normally during an ASM test.

Each of the load accuracy tests will be followed by the Response Time Tests and the Variable Load Coast-Down Tests, which will be conducted under the same conditions.

Load Accuracy Test Condition Matrix

Condition		Test Number											
		1	2	3	4	5	6	7	8	9	10	11	12
Calibration Temp	110 F									x	x	x	x
	75 F					x	x	x	x				
	35 F	x	x	x	x								
Test Ambient Temp	110 F	x	x	x	x								
	75 F					x	x	x	x				
	35 F									x	x	x	x
Calibration Voltage	High	x	x									x	x
	Nominal					x	x	x	x				
	Low			x	x					x	x		
Test Supply Voltage	High			x	x	x	x						
	Nominal									x	x	x	x
	Low	x	x					x	x				
Warm Up	Maximum		x		x		x		x		x		x
	Minimum	x		x		x		x		x		x	
Load	25 hp		x	x						x			x
	15 hp					x	x	x	x				
	5 hp	x			x						x	x	

## Definition of Terms:

**Calibration Temp** is the temperature at which to calibrate the equipment. Prior to conducting the calibration, the equipment must soak for at least eight hours at the calibration temperature so that the dynamometer is in thermal equilibrium with its environment.

**Test Ambient Temp** is the temperature at which to conduct the test. Prior to conducting this test (and after calibration), the equipment must soak for at least eight hours in the ambient temperature to achieve thermal equilibrium.

**Calibration Voltage** is the supply voltage powering the equipment during calibration expressed as a percentage of nominal required voltage, as follows:

Possible nominal voltages (volts AC):	115	230	460
Corresponding high voltages (volts AC):	127	254	508
Corresponding low voltages (volts AC):	103	206	412

**Test Supply Voltage** is the supply voltage powering the equipment during the test expressed as a percentage of nominal required voltage. See Calibration Voltage for definition of high, nominal, and low voltages.

**Warm-Up** The maximum warm-up condition occurs after the dynamometer completes any required warm-up immediately prior to completing the test (not calibration). The minimum warm-up condition occurs when the dynamometer rests for the maximum amount of time allowable by the manufacturer between tests without performing a dynamometer warm-up. During this wait time, the dynamometer shall be soaked at the required test ambient temperature. If no warm-up is required, this time will be assumed to be two hours.

**Load** is the horsepower that the dynamometer should be applying during the coast down test.

**Acceptance Criteria:** Coast down times must be within 4% of the nominal time for the 5 hp and 25 hp coast downs, and within 2% of the nominal time for the 15 hp setting. Nominal values for the coast down times can be calculated from the equation in §2.5.7.2 of the BAR-97 specifications.

#### 5.6.4 Response Time

After conducting each of the load accuracy tests, the following response time tests must be conducted, which will then be followed by the variable load coast down test.

1. The dynamometer rolls should be spinning at a speed of approximately 40 mph with no force being applied by the PAU.
2. A torque equivalent to [b]\* horsepower at [a]\* mph should be applied by the PAU when the dynamometer speed reaches 35 mph.
3. When the speed reaches [a]\* miles per hour, apply a command torque to the PAU Controller equal to [c]\* horsepower at that speed.
4. Record the start time as the time when the command torque (step 3) is sent to the PAU Controller.
5. Monitor and record the actual PAU load sensing device output signal.
6. When the output reaches 90% of the command torque (step 3), the time shall be recorded as the response time.
7. When the output reaches its peak overshoot (if any) above the command torque (step 3), this value shall be recorded as the overshoot.
8. The mean settling time shall be recorded when the following conditions are met.
  - a. The mean torque output averaged over 300 milliseconds settles within either  $\pm 2\%$  of the command load or 0.25 horsepower at [a]\* mph.
  - b. The instantaneous horsepower falls within 5% of the command load during the entire 300 ms that the average is being calculated.

\* refers to the variables listed in the chart below.

Variable	Test Number							
	1	2	3	4	5	6	7	8
a. Speed (mph)	10	10	15	15	25	25	30	30
b. Initial Load (hp)	4	10	16	22	20	26	6	16
c. Final Load (hp)	10	4	22	16	26	20	16	6

**Acceptance Criteria:** The dynamometer must respond to 90% of a torque step change within 300 milliseconds. The mean settling time must be less than 600 milliseconds from the initiation of the step change.

### 5.6.5 Power Absorber Range

The dynamometer manufacturer shall demonstrate their method for power absorber's range determination and submit test results verifying that the response time measurement of the dynamometer is within BAR-97 specifications. The determination method is subject to BAR approval.

**Acceptance Criteria:** The power absorber shall be able to absorb, at 14 mph 0.3 mph, a minimum of 25 hp  $\pm 0.25$  hp or 2.0%, whichever is greater, continuously both at the beginning and at the end of the test. The absorber shall meet this specification for a steady-state test lasting at least five minutes, with three minutes between tests for a total of 10 cycles.

### 5.6.6 Augmented Braking

The dynamometer manufacturer shall demonstrate that augmented braking is applied at the conclusion of the 2525 mode of the ASM test. The determination method is subject to BAR approval.

### 5.6.7 Speed Synchronization (4wd dynamometers and/or dynamometers with split rolls that are not rigidly connected)

The dynamometer manufacturer shall demonstrate their method for roll speed synchronization determination and submit test results verifying that the speed synchronization is within BAR-97 specifications. The determination method is subject to BAR approval.

**Acceptance Criteria:** Front and rear-wheel or side-to-side rolls shall maintain speed synchronization of  $\pm 0.2$  mph.

### 5.6.8 RFI Noise Test

The dynamometer manufacturer shall demonstrate their method for determining the system's noise resistance and submit test results verifying that the interference noise resistance is within BAR-97 specifications. The determination method is subject to BAR approval.

**Acceptance Criteria:** The values read by the dynamometer tester shall be within 0.5 hp of the target value within 15 seconds of reaching the target speed, and within 0.25 hp within 30 seconds of reaching the target speed. In addition, there must be no detectable glitches resulting from the presence of the RFI noise, up to 3000-rpm engine speed.

#### **5.6.9 Variable Load Coast Down**

The following procedure shall be followed to verify the system's ability to apply variable loading accurately in spite of response time differences that may exist between a positive step torque change and a negative step torque change.

1. Spin the dynamometer rolls up to 55 mph.
2. Load the dynamometer to 5 hp.
3. When the dynamometer speed reaches 50 mph, record the start time.
4. According to the following chart, load the dynamometer appropriately for each speed shown. At each increment, the load shall be applied in step increments (i.e., the load for a speed less than or equal to 50 mph and greater than 49 shall be 5 hp).
5. Record the times at each speed.

The time it takes to perform this operation will be predictable when the exact dynamometer inertia is known. Variances from the nominal time may be accounted for with load inaccuracies, response time problems, etc. For a dynamometer with 2000 pounds of base inertia, the nominal time for the dynamometer to coast from 50 mph to 5 mph is 25.31 seconds given the following scenario.

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SPEED	HP LOAD	SPEED	HP LOAD	SPEED	HP LOAD
50	5	34	24	19	16
49	6	33	25	18	15
48	7	32	24	17	14
47	8	31	23	16	12
46	9	30	22	15	10
45	10	29	21	14	11
44	8	28	20	13	12
43	10	27	18	12	11
42	12	26	16	11	10
41	14	25	14	10	9
40	16	24	15	9	8
39	18	23	16	8	7
38	20	22	17	7	6
37	21	21	18	6	5
36	22	20	17	5	5
35	23				

**Acceptance Criteria:** The time it takes the dynamometer to decelerate through the above steps must fall within the following tolerances.

Initial Speed	Final Speed	Nominal Time	Tolerance
50.00	5.00	25.31	4.00%
45.00	10.00	15.35	2.00%
38.00	27.00	3.92	3.00%

**5.7 CERTIFICATION TEST PROCEDURES: THROUGHPUT CAPACITY**

The emissions analyzer/sampling system shall be designed so that it is capable of performing at least 10 tests per hour for eight consecutive hours without experiencing excessive hangup or other deleterious effects. A study shall be submitted to the BAR indicating the maximum number of tests per hour that were achieved using the analyzer submitted for certification. A brief description of the study methodology used by the manufacturer to make the throughput determination shall be included in the study. This evaluation shall not include the time required to enter vehicle identification data or to conduct the visual and/or functional inspections.

**5.8 CERTIFICATION TEST PROCEDURES: AUXILIARY TEST EQUIPMENT****5.8.1 Certification Test Procedures for Standard Tachometer & Connection (1995 and Earlier Model Year Vehicles)**

The following test shall be performed on each of the following engines as a minimum: conventional ignition, Quad 4, Nissan Pulsar, rotary engine with DIS Distributorless Ignition System (DIS), and C3I.

- a) Connect the candidate unit's RPM sensor to a test vehicle's engine (an engine on a test stand may be substituted).
- b) Place a piece of reflective foil suitable for use with an optical tachometer on an appropriate rotating engine component whose ratio of rotation with respect to engine RPM is known.
- c) With the engine warmed up and at idle RPM, measure the engine speed using the candidate's tachometer and also using an optical tachometer having an accuracy of 1 rpm. Record the readings.
- d) Repeat Step c) at engine speeds of 1500, 2000, 2500, 3000, 2500, 2000, 1500 (all +/-50 RPM), and idle RPM.
- e) For each engine speed, calculate the differences between each candidate reading and its paired optical tachometer reading.

**Acceptance Criteria:** For each engine speed, no difference shall be greater than +/-3% of the nominal engine speed being measured.

**5.8.2 Certification Test Procedure for OBDII Tachometer & Connection (1996 and Later Model Year Vehicles)**

Manufacturers must provide complete test results (OBDII rpm readings compared to optical tachometer) showing the functionality of the OBDII diagnostic test connector for the following vehicles:

- a) Four domestic vehicles from different manufacturers and engine types.
- b) Two vehicles manufactured in Japan. Both vehicles must be from different manufacturers and different engine types. The vehicles must not be under a domestic manufacturer's name.
- c) One vehicle manufactured in Europe (not under a domestic manufacturer's name).

**Acceptance Criteria:** For each engine speed, no difference shall be greater than +/-3% of the nominal engine speed being measured.

### 5.8.3 Bar Code Scanner

Manufacturers seeking BAR certification for their bar code scanner must specify the model name and serial number of the scanner they intend to use with their EIS. The specified bar code scanner must be compatible with at least two different off-the-shelf bar code scanners from different manufacturers (including all required cabling and power supplies) and capable of reading VIN, etc. Once the specified bar code scanner has been accepted, information about the scanner will be non-proprietary and BAR will release such information to all EIS owners.

For the purpose of certification, BAR will obtain off-the-shelf scanners and perform acceptance tests on them (rather than accept submission by the manufacturer).

Each of the following bar code scanner reading tests shall be performed five times by scanning the bar code and clearing the reading from the EIS before each attempt:

- a) Bar code is on a sticker located about one inch behind a windshield.
- b) Bar code is etched through a white painted area on a standard black metal VIN plate.
- c) Bar code is on the domed section of a disposable calibration gas cylinder.

**Acceptance Criteria:** The scanner must demonstrate its ability to reliably read all configurations by successfully reading the code on all ten attempts.

### 5.8.4 Fuel Cap Tester

#### a) Accuracy

(NOTE: This test may be performed as part of the Temperature test (see (b), below.)

1. Calibrate the candidate fuel cap tester with the manufacturer-provided "Pass/Fail Master" cap set. The candidate fuel cap tester shall pass this calibration check.
  - i. The "Master Pass" calibration cap shall be flow tested. Attach a flowmeter (such as a Sierra Toptrack Series 800) and an adjustment device to the cap and adjust the pressure to 30" of H<sub>2</sub>O. Measure the flow with the attached flowmeter and record the flow rate. The "Master Pass" cap shall not be less than 52cc nor more than 56cc.
  - ii. The "Master Fail" calibration cap shall be flow tested. Attach a flowmeter/adjustment device to the cap and adjust the pressure to 30" of H<sub>2</sub>O. Measure the flow with the attached flowmeter and

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record the flow rate. The "Master Fail" cap shall not be less than 64cc nor more than 68cc.

2. Attach the flowmeter/adjustment device to the candidate tester, and adjust the leakage flow to between 52 and 56 cc/min.
3. Release the pressure; then repressurize to start the test.
4. Record the tester's pass/fail determination.
5. Repeat (3) and (4) four times, each time noting the leakage flow to ensure that it has not drifted out of the set range.
6. Pressurize the tester and adjust the leakage flow to between 64 and 68 cc/min.
7. Repeat steps (3), (4), and (5) for the new leakage flow setting.

**Acceptance Criteria:** (1) For steps 4) and 5), the tester's pass/fail determination shall be "Pass" for all five runs. (2) for step 7), the tester's pass/fail determination shall be "Fail" for all five runs.

### b) **Temperature**

Temperature testing shall be performed in an environmental chamber at the same time as the analyzer is undergoing the Temperature Stability Test (see §5.4.2).

1. At 75°F, perform the complete accuracy test (see (a), above).
2. At 50°F and 100°F, perform steps 2) through 7) of a) above. DO NOT RECALIBRATE.

**Acceptance Criteria:** For each temperature, same criteria as those of the accuracy test (see (a) above).

### c) **Altitude**

1. Calibrate the candidate fuel cap tester with the manufacturer-provided "Pass/Fail Master" cap set.
2. Attach a gauge/valve/reservoir/pump arrangement (similar to that attached to the analyzer's sample cell exhaust during pressure compensation testing, §5.4.10) to the outlet of the flowmeter/adjustment device.

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3. Evacuate the entire fuel tester system to 24" HgA. Allow the tester's pressurization system to pressurize to 30" H<sub>2</sub>O gauge (i.e., 30" H<sub>2</sub>O above 24" HgA).
4. Adjust the flow to between 52 and 56 cc/min.

**Acceptance Criteria:** The tester shall indicate a "Pass."

5. Adjust the flow to between 64 and 68 cc/min.

**Acceptance Criteria:** The tester shall indicate a "Pass."

### 5.8.5 Fan Testing

The fan flow testing shall be done using an air velocity meter. Readings shall be taken at the fan shroud exhaust surface, from the center to the edge of the shroud in 1 inch increments. The velocity of the exhaust air shall be summed over the area of the fan to determine the volumetric flow rate in cfm of the fan.

**Acceptance Criteria:** The fan shall have a maximum outer diameter of 30 inches and must deliver at least 3000 cfm or at least 10mph air velocity averaged over the cross section of the fan, whichever is greater. See section 2.5.8.8.

### 5.8.6 Zero Air Generators

#### 1. SCOPE

BAR performs the following tests to determine if a zero air generator is BAR-97 compliant. The tests apply regardless of whether the generators are mounted internally or externally to an Emissions Inspection System (EIS) cabinet. The acceptance criteria may, however, be reinterpreted for internally- vs. externally-mounted generators. For example, the term "visual indication" may be interpreted as a lit lamp on an external unit and as a prompt on the EIS display for an internal unit. Performance criteria are identical between the two types of zero air generators.

Note: Zero Air generators shall have a BAR registered manufacturers part number visible for field inspection and verification. See section 2.12.

#### 2. TESTING & METHODOLOGY

##### a. Tests To Be Performed

- i. **Warmup at 35°F & 110°F Ambient:** To determine that the zero air generator...
  - 1) warms up in 30 minutes or less;
  - 2) delivers no air during warmup;
  - 3) delivers air of the required purity after exiting its warmup mode when challenged

- with supply air at the specified limits of contamination;
- 4) provides a visual indication that the unit is warming up.

**ii. Outlet (Delivered) Air Purity at 35°F & 110°F Ambient:** To determine that the generator delivers air of the required purity over a continuous two-hour period when challenged with supply air at the specified limits of contamination.

**iii. Response to Abnormal Conditions (Any Temperature):** The generator must deliver no zero air, and must provide a visual indication when the following conditions are present:

- 1) Warmup Mode
- 2) Low supply pressure
- 3) Low catalyst temperature
- 4) Pressure swing system fault (e.g., solenoid valve failure)

## **b. Test Methodology**

### **i. Equipment:**

- 1) Equitherm Environmental Room, 8' x 8' x 8'.
- 2) HC Analyzer: FID, Horiba Model FIA-220
- 3) CO Analyzer: NDIR, Horiba Model APMA-360
- 4) NO Analyzer: Chemiluminescent, Horiba Model CLA-220
- 5) CO<sub>2</sub> Analyzer, NDIR, Horiba Model APBA-210
- 6) Data Acquisition Unit (DAU) & software, Strawberry Tree DATAshuttle
- 7) Zero Air
- 8) Nitrogen (N<sub>2</sub>)
- 9) Challenge Gas: 100 ppm CH<sub>3</sub>, 100 ppm CO, 1500 ppm CO<sub>2</sub>, Balance: Air
- 10) Challenge Gas: 100 ppm NO, Balance: N<sub>2</sub>
- 11) Compressed air supply
- 12) Flowmeters, valves, fittings, pressure gauges, no-outgassing hose, adapters

### **ii. Warmup Test Procedure**

*NOTE: Due to the delivery flow rate limitations of some ZAGs and the needs and characteristics of the analyzers, the warmup testing must be done in three stages: once for HC, once for NO, and once for CO and CO<sub>2</sub>. This is because the analyzers cannot be connected in series — the CO & CO<sub>2</sub> analyzers have pumps, the others don't, and only the CO<sub>2</sub> analyzer doesn't change the gas in some way during measurement — and because the NO must be in a separate cylinder from the other gases to avoid interaction with air.*

- 1) Set environmental room (ER) temperature to 35°F
- 2) Place zero air generator in ER with power OFF.
- 3) After the ER has reached 35°F, let the generator stabilize for an additional 1½ hours with the power off.
- 4) Start DAU logging (record date/time and analyzer outputs at 0.25 Hz sampling

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- rate).
- 5) Analyzers have been powered up for 24 hours. Zero and calibrate those to be used (see note above), using the DAU's laptop display for adjustments.
  - 6) Connect the outlet port of the generator through a needle valve and flowmeter to the analyzer.
  - 7) Connect the challenge gas directly to the supply air inlet of the zero air generator, open the cylinder and regulator shutoff valves, and set the cylinder outlet pressure to 100 psig..
    - a) *NOTE: For NO, the challenge gas must be diluted with an equal part of air to bring it down to the specified value of 50 ppm, since the generator needs air to function.* Connect the challenge gas regulator output to a flowmeter, then to one branch of a tee fitting. Connect a similarly-equipped zero air cylinder to a second branch of the tee. Connect the third branch of the tee to the fully-closed needle valve (see (6) above) going to the NO analyzer sample input.
    - b) With both cylinder regulators set to provide 100 psig, gradually open the needle valve until the NO analyzer is receiving 1.5 – 2 Lpm. Adjust the zero air cylinder's regulator until the analyzer reads 50 ppm NO.
    - c) Close the zero air and challenge gas cylinder valves *without touching the regulator controls*. Let trapped gas bleed out through the analyzer.
    - d) Disconnect from the needle valve at the analyzer sample inlet, and connect to the supply air inlet of the generator using an appropriate quick-connect adapter. Open the cylinder shutoff valves simultaneously, or, if this is not possible, open the challenge gas cylinder first.
    - e) Reconnect the generator output to the analyzer.
  - 8) Turn on the power to the generator. Note the time. (A stopwatch may be used.)
    - a) Verify that the generator gives a visual indication that it is in the warmup mode.
    - b) Check the flowmeter to the analyzer to verify that the generator is delivering no flow.
  - 9) Note the time at which the generator completes warmup (the visual indication turns off; the generator starts delivering flow.)
  - 10) Verify (from the DAU real-time display) that the analyzer readings are less than or equal to the required values ( $\leq 1$  ppm THC, CO, NO;  $\leq 200$  ppm CO<sub>2</sub>).
  - 11) With the DAU still logging, shut off the challenge gas(es), let the pressure bleed down, and note the pressure at which the "Low Supply Pressure" visual indication is activated, and verify that the generator's outlet flow is stopped.
  - 12) Close the regulator(s) shutoff valve, disconnect from the generator's supply air inlet, and connect the compressed air supply in its place. Verify that the fault indication is deactivated and that outlet flow resumes.
  - 13) Disconnect the generator outlet from the analyzer, then flow zero gas (zero air or N<sub>2</sub> to the analyzer, followed by calibration gas, to check the analyzer's drift..
  - 14) Reconnect the generator's outlet to the analyzer to clean it out. Stop the DAU's logging.

Acceptance Criteria: (a) The generator shall give a visual indication that it is in

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the warmup mode. (b) The generator shall deliver no flow during warmup. (c) The generator shall exit the warmup mode in 30 minutes or less. (d) At completion of the warmup mode, the “Warmup” indication shall be deactivated and a “Normal Operation” indication shall be activated. (e) The analyzer readings are less than or equal to the required values ( $\leq 1$  ppm THC, CO, NO;  $\leq 200$  ppm CO<sub>2</sub>).

### iii. Outlet Air Purity

- 1) Setup is the same as for Warmup testing, except the test is performed on a fully warmed-up generator. *Note that this test should be performed as a continuation of the Warmup test.*
- 2) With the challenge gas entering the generator’s supply air inlet, the generator outlet connected as above to the analyzer(s), and the DAU logging, monitor the generator’s output air purity for two hours.
- 3) Perform Steps (10) through (14) of the Warmup test, as applicable.

Acceptance Criteria: At the end of the two hours, The analyzer readings shall be less than or equal to the required values ( $\leq 1$  ppm THC, CO, NO;  $\leq 200$  ppm CO<sub>2</sub>).

### iv. Response to Abnormal Conditions

- 1) Low Supply Pressure: See ii 11) and 12).
- 2) Low Catalyst Temperature: Disconnect the power to the catalyst while the unit is operating. Verify that outlet flow is shut off and a visual indication is activated when the catalyst temperature falls below the manufacturer’s set threshold.
- 3) Pressure Swing Fault: Disconnect power to the pressure swing solenoid valve. Alternatively, disconnect the tubing to the pressure sensor (if used) that monitors the switching action. Verify that outlet flow is shut off and a visual indication is activated when a column switchover does not take place in double the manufacturer’s switching interval.

Acceptance Criteria: (a) If supply pressure to the generator falls below the manufacturer’s set threshold, (i) a “Low Supply Pressure” indication shall be activated, and (ii) generator output flow shall be interrupted. (b) Upon restoration of supply pressure, (i) the “Low Supply Pressure” indication shall be deactivated, and (ii) generator output flow shall be restored. (c) When the catalyst temperature falls below the manufacturer’s set threshold, (i) an indication shall be activated and (ii) outlet flow shall be shut off. (d) When the catalyst temperature rises above the manufacturer’s set threshold, (i) the indication shall be deactivated and (ii) outlet flow shall be restored.

**v. Transfer all data to the appropriate blank data sheets****5.8.7 Ambient Relative Humidity, Temperature & Barometric Pressure Sensors (Ref: §2.4.11, 2.4.12, 2.4.13)**

- a) During each condition of the Temperature Stability Test (§5.4.2), and during each condition of the Accuracy & Bias Test (§5.4.6), the readings from these sensors shall be compared to the readings from standard instruments.

**Acceptance Criteria:** (1) The temperature readings shall differ by no more than 6°F at any ambient condition. (2) The relative humidity readings shall differ by no more than 6% RH at any ambient condition. (3) The barometric pressure readings shall differ by no more than 0.40 inches Hg at any ambient condition.

- b) During Pressure Compensation testing for the O<sub>2</sub> cells, the readings from the barometric pressure sensor shall be compared to the readings from a standard instrument.

**Acceptance Criteria:** The barometric pressure readings shall differ by no more than 0.40 inches Hg at any ambient condition.

**5.9 CERTIFICATION TEST PROCEDURES: COMPUTER AND PERIPHERALS****5.9.1 Compatibility**

Computers must be able to read and write to either CD, DVD or USB drives.

Systems must be able to interchange/use software and data files with existing State-owned IBM-PC compatible models without requiring software or hardware reconfiguration.

Systems must be capable of producing graphic output on CRT displays and dot matrix printers. Use of 'PrintScreen' key must cause text displayed on CRT to print on printer.

**5.9.2 Hard Disk**

This test exercises the hard disk under high-temperature, high-humidity conditions to ensure that it will function consistently in an adverse environment. **THE TEST SHALL BE PERFORMED AT THE 105°F (5°F), 80% (5%) R.H. CONDITION ONLY.**

A sequence of read/write operations shall be performed under the automatic control of the latest version of either Norton Utilities' Disktest (DT) and System Information (SI) programs, or PC Magazine Laboratory's Benchmark Series Hardware Performance Tests.

**5.10 CERTIFICATION TEST PROCEDURES: SOFTWARE & COMMUNICATIONS**

The manufacturer shall perform software verification before submittal of the EIS units for certification testing. Certification testing will be conducted at BAR Headquarters in Sacramento, California. The manufacturer is required to provide and set up the entire proposed configuration, based on BAR-provided specifications and protocols. The BAR will test all critical areas to ensure that the proper logic is followed, the proper decisions made, the correct screen data is displayed and the correct printing formatting has been implemented. Simulated and actual inspection tests will be performed to determine that they are properly and completely performed. Test and calibration records will be examined to verify that all the fields are properly formatted and filled, and that the records are accurate and complete. Testing will be performed to verify the ability of the EIS to dial up and connect with the BAR Vehicle Information Database (VID) and to transfer and receive files, data, messages, etc. to and from the VID. Other tests will be made on an ad hoc basis to attempt to uncover flaws in the software, procedures and security, and that recovery from operator errors is benign.

As an aid to software certification testing, analyzer and dynamometer simulators shall be provided, as described below.

**a) Gas Analyzer Simulator**

The simulator may be either hardware, software or both. It must be capable of performing the following simulated functions as a minimum. The functions shall be selectable in any combination:

1. Warmup - Simulate the gas analyzer warming up in about two minutes. Simulate the analyzer failing warmup.
2. Zero - Simulate zeroing after warmup and on demand (see §2.4.5.a). Simulate the analyzer failing zero.
3. Sample Dilution - Simulate CO + CO<sub>2</sub> readings allowing a test to proceed. Simulate CO + CO<sub>2</sub> readings that will elicit a "Sample Dilution" message.
4. "Pass" Readings - Simulate passing readings for HC, CO & NO.
5. "Fail" Readings - Simulate failing readings for HC only, CO only, NO only, HC & CO, HC & NO, CO & NO, and HC, CO & NO. Failing readings shall be appropriate to the cutpoints for the simulated vehicle under test.
6. "Gross Polluter" Readings - Simulate Gross Polluter readings for HC only, CO only, NO only, HC & CO, HC & NO, CO & NO, and HC, CO & NO. Readings shall be appropriate to the Gross Polluter cutpoints for the simulated vehicle under test.

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[Note: As an alternative, the individual channels may be individually adjustable over their full concentration ranges.]

7. Gas Calibration - Simulate the analyzer's responses to the Gas Calibration, Leak Check, and Three-day Gas Calibration/Leak Check modes. The 3-day calibration mode shall include a simulation of the response time checks. (See §3.9) The simulator shall be capable of passing and failing the calibration, response time, and/or leak check modes.
8. HC Hangup Checks - simulate a passing check and a failing check.

### b) **Dynamometer Simulator**

The dynamometer simulation software shall be able to simulate the following:

- Coast down pass and fail
- Parasitic loss pass and fail during calibration
- Load cell pass and fail during calibration
- Loading error during test mode
- Restraints on or off
- Lift up - not responding to the given signal
- Lift down - not responding to the given signal
- Speed ramps of selectable constant acceleration rate from 0 to 15 mph
- Speed ramps of selectable constant acceleration rate from 15 to 25 mph
- Speed ramps of selectable constant deceleration rates from 25 to 0 mph
- Simulate selectable speeds
- Read and respond to (feedback) command load sent to the dynamometer
- Axle weight measuring device - simulate any weight selected by the test operator
- If dynamometer is 4wd and will have automatic engagement of the auxiliary rolls, the simulator must be able to simulate the condition where the auxiliary rolls fail to engage or fail to disengage.

### **Driver Simulation**

In addition to the above, the simulator must also be able to simulate the following mode situations. These mode situations will start at the end of the appropriate ramp as selected above and end with the next appropriate ramp. These situations must be applied to both the 5015 portion of the test and the 2525 portion of the test. These situations shall be able to be employed in conjunction with the above ramps to make a seamless drive trace. Modes may be terminated early as selected by the operator to allow for circumstances where the EIS software passes a vehicle prior to the completion of the maximum mode length.

**Traces to Simulate**

1. Excessive Number of Acceleration Violations. The software shall simulate 6 acceleration violation events having a cumulative violation time of 5 seconds. These events must occur no earlier than 11 seconds after the emissions averaging portion of the test has begun, though other acceleration violations shall occur before 11 seconds. Violations shall be grouped in such a way as not to prevent 25 valid 10 second averages from being collected. (Software should restart test mode for excessive number of acceleration violations - §3.6.11.d & e)
2. Excessive Acceleration Violation Cumulative Time. The software shall simulate 5 acceleration violation events having a cumulative violation time of 6 seconds. These events must occur no earlier than 11 seconds after the emissions averaging portion of the test has begun, though other acceleration violations shall occur before 11 seconds. Violations shall be grouped in such a way as not to prevent 25 valid 10 second averages from being collected. (Software should stop test mode for excessive acceleration violation cumulative time - §3.6.11.d & e)
3. Allowable Driver Speed Violations. The software shall simulate driver speed violations (speed deviates by more than 1 mph from target speed, i.e., 15 or 25 mph) lasting 5 seconds. There shall be 3 occurrences per test mode. (Software should permit speed violations of this length - §3.6.11.d & e)
4. Illegal driver speed violations. The software shall simulate a driver speed violation lasting 6 seconds. (Software should stop test mode for excessively long speed violation - §3.6.11.d & e)
5. Inadequate Number of Valid 10-Second Averages. The software shall simulate the situations where 25 valid 10-second averages could not be taken due to acceleration violation errors rendering the average invalid. This may not be possible in both modes (i.e., with a fast enough response time, this may not be possible in the 5015 mode without failing the acceleration criteria first). (Software should require restart - §3.6.11.h.1.vi)
6. Driver error-free tests. Normal ASM drive trace without errors or excursions.

**5.11 CERTIFICATION TEST PROCEDURES: SYSTEM INTEGRATION**

The EIS shall be tested as an integrated system, as follows, using the BAR dynamometer tester as the "test vehicle."

- a) Precision gases simulating true vehicle exhaust shall be used.
- b) Six ASM tests shall be run as a minimum:
  - 1. At least two tests with final result "pass,"
  - 2. At least two tests with final result "fail" (marginal fail),
  - 3. At least two tests with final result "fail" (gross polluter).

[Note: The gas blends used for testing will contain HC, CO, CO<sub>2</sub>, and NO values appropriate to these categories.]

**Acceptance Criteria:** The EIS shall respond to each of the test conditions in accordance with the applicable requirements of this specification. Analyzer and dynamometer accuracy, response, response times, etc. shall remain within the tolerances allowed by this specification. No performance parameters of the EIS shall be degraded as a result of system integration.

#### **5.12 CERTIFICATION TEST PROCEDURES: FIELD BETA TESTING**

Manufacturers shall demonstrate that candidate systems, software, hardware, components and replacement parts meet the BAR-97 Specifications while operating in actual shop environment. During the beta demonstration, the EIS shall have all operational capabilities activated including connectivity with the VID.

The demonstration shall consist of a two-stage beta testing process in which the number of candidate units increases as successful testing progresses. Manufacturers must demonstrate the equipment continuously and correctly operates to BAR's satisfaction during the entire beta testing process. The beta test stations must be approved by BAR in advance and must agree to participate in the beta process. Station personnel shall be trained to conduct normal maintenance and calibrations.

The first stage consists of not more than ten units properly operating for a minimum of 2 weeks. Upon successfully completing stage one and with BAR's authorization, manufacturers may proceed to stage two. Stage two increases the number of units to between 50 and 100 and requires the successful operation of those units for a minimum of 8 weeks. Beta time may be shorter for minor changes as determined by BAR. During the beta demonstration, manufacturers shall provide field support and conduct weekly audits of the units. When applicable, the audits shall include a physical inspection of the sample system, the dynamometer and an evaluation of test and calibration records. The manufacturers shall provide BAR the weekly audit results.

See §4.9 for additional certification renewal requirements.

**5.12.1 Hexane/Propane Ratio**

Upon installation at the beta sites, the EIS units shall have the PEF measured, using the procedure in §5.4.7, but checking at only one point with High Range BAR-97 calibration gas. Record the data and provide it to BAR.

Repeat this PEF test on completion of the field beta test process, as the very last task before shutdown.

**Acceptance Criteria:** The difference in PEF values from beginning to end of the field test shall be no more than 0.005.

**5.12.2 Calibration Monitoring**

Analyzer calibration shall be checked, but not adjusted (unless necessary), once a day at random times during the course of the day. The candidate unit shall be zeroed; then both Low and High BAR-97 blends shall be introduced through the probe (gas pressure at the probe tip  $\pm 0.1$  psig) and the readings recorded, along with the ambient temperature and the barometric pressure.

**Acceptance Criteria:** (1) The EIS shall require no unscheduled gas calibrations during the course of the field tests. (2) A failed leak check shall lock out the inspection mode.

**5.12.3 Inspections**

At least five inspections per day shall be performed on a variety of vehicles to exercise the EIS unit, the software and the procedures. Any problems encountered shall be brought to the attention of the BAR, and an analysis shall be made as to whether the cause is design-related or procedural. All EIS failures shall be investigated and a failure report submitted to BAR. Any flaws shall be corrected before full certification will be issued.

## SECTION 6. AFTERMARKET PARTS APPROVAL, WARRANTY, AND IN-USE PERFORMANCE REQUIREMENTS

### 6.1 Definition

An aftermarket part shall be defined as a part or accessory used to maintain a certified BAR-97 Emission Inspection System supplied by a company other than the EIS manufacturer (system integrator), including but not limited to: bar code scanners, sample hoses, exhaust probe tips and handles, sample system filters, rpm probes, cables, and keyboards. See section 2.12 for part code labeling requirements. This section does not apply to: engine cooling fan, fuel cap tester, zero air generator, O2 and NO sensor, analyzer, and dynamometer.

### 6.2 Submittal Requirements

All equipment and software submitted for certification must be the full and current configuration proposed for sale. **PARTIAL, DATED, OR INCOMPLETE MODELS ARE NOT ACCEPTABLE.** The manufacturer will bear all shipping and equipment preparation charges for the certification testing. The BAR shall charge a fee for certification/approval testing of the BAR-97 and related components and parts. The certification fee shall only cover one (1) round of testing; additional testing will require additional fees. The fee shall be fixed by the department based upon its actual costs of certification testing, shall be calculated from the time that the equipment is submitted for testing until the time that certification testing is complete, and shall in no event exceed *the dollar limit specified in §44036(b) of the Health and Safety Code. The aftermarket part approval fee depends on the extent of the required testing. See Section 6.10.*

If the manufacturer's application for approval is complete and acceptable, the BAR will approve that specific model subject to its certification testing. That model will then be acceptable for sale and use in licensed stations in California.

The submittal package shall include:

- a) Application for Aftermarket Parts Approval (form below);
- b) Confidentiality Agreement (form below);
- c) Contact Information (form below);
- d) Check for applicable test fees (use cost and test tables below);
- e) Instructions for installation and/or operation;
- f) Price list for each model;
- g) Detailed description of each item including:
  - 1) Manufacturer: name, model,
  - 2) Specifications: performance, mechanical, power, weight, material type, dimensions, connections, schematics (assembly views showing mounting and connections sufficient)
  - 3) Model number markings and locations (see Section 2.13);
- h) An explanation of warranty provisions, including a listing of warranty locations by name, address, and phone number;
- i) Three (3) each of the part.

### 6.3 Approval Terms

The Aftermarket Parts Approval shall be valid for one (1) year from approval, provided no changes are made to the part or no in-use defects are discovered. Changes including: materials, dimensions, model number, labeling methods, and manufacturer, etc., require re-submittal for a new Aftermarket Parts Approval.

Conditions of Approval: An Aftermarket Parts Approval shall only be valid for one (1) year from date of approval. Manufacturers wishing to renew approval, shall: submit the application (Section 6.6) listing approved parts and stating that no changes were made or re-submit parts for approval and pay the test fee again if any changes were made. Changes include model number edits, materials, construction, supplier, function, software, hardware, etc.

If any problems or discrepancies occur subsequent to approval, the aftermarket parts seller shall correct or resolve the problem to the satisfaction of the BAR and in a timeframe acceptable to the BAR. The approval only applies to equipment meeting the specification current at the time issuance; the BAR must approve all future updates and modifications.

To renew the Aftermarket Parts Approval, each manufacturer shall correct any identified problems including in-use performance failures. In addition, each manufacturer must submit the following, 90 days prior to the expiration of the existing Approval:

- a description of any proposed or BAR approved changes to the part(s)
- a current company organization chart and phone list
- a description of any changes to part labeling
- a description of and remedy for any BAR or supplier identified performance defects

If no changes are made and no in-use performance defects are identified, BAR may extend the existing approval without repeating verification testing. The Aftermarket Part Approval will not be renewed if a manufacturer fails to meet the approval renewal requirements.

### 6.4 IN-USE PERFORMANCE

As part of the Smog Check Quality Assurance program, BAR auditors conduct EIS analyzer audits. To ensure uniform and accurate audits, each auditor follows standardized audit procedures.

In the event of an in-use performance failure, the Aftermarket part supplier shall correct the failure in a time frame specified by BAR and in a manner satisfactory to BAR. Failure to correct within the BAR specified time-frame or in a manner satisfactory to BAR will result in punitive actions, including but not limited to those set forth in the California Code of Regulations and the Health and Safety Code.

<b>Performance Measure</b>	<b>Performance Standard</b>
Approved Model # Verification	<ul style="list-style-type: none"> <li>• All OEM and aftermarket parts shall be labeled with an identifying model number (see Section 2.13). Approved parts are listed on the Smog Check web page.</li> </ul>
In-use Defect	<ul style="list-style-type: none"> <li>• Defects affecting analyzer performance shall be noted in the audit program and/or form comments section.</li> </ul>

### 6.5 Periodic BAR Testing

To ensure aftermarket parts remain in an approved configuration BAR may select in-use parts for evaluation and testing at BAR. In this case, the corresponding aftermarket parts supplier shall provide a loaner part to the Smog Check station during the evaluation period.



**6.7 Confidentiality Statement**

The document "BAR-97 Emissions Inspection System Specifications" and all subsequent addenda, contains information that is proprietary to the Bureau of Automotive Repair and shall not be disclosed to anyone other than the following authorized person(s). Recipients of BAR-proprietary information shall not disclose the information to anyone for any purpose, nor use the information to develop emission test equipment for any other state or country without prior written approval from the BAR.

\_\_\_\_\_ certifies that  
(NAME OF COMPANY)  
 the BAR-proprietary information shall be handled with the strictest confidentiality and only the following individuals have been authorized to have access to these documents.

\_\_\_\_\_ agrees to  
(NAME OF COMPANY)  
 assume financial responsibility for any compromise in security, damages, or loss to the State of California caused by the company, its employees or any organization or individual which is allowed to access this information.

NAME <i>(Print)</i>	TITLE	SIGNATURE	DATE

The Bureau of Automotive Repair requires all personnel authorized access to the BAR- proprietary information to be named and will return statements that name top level management only.

**6.8 CONTACT INFORMATION**

Name of Aftermarket Parts Seller:

Address:

Contact Person:

Alternative Contact Person:

Telephone Number:

FAX Number:

E-Mail Address:

**AFTERMARKET PART SELLER**

**PART MANUFACTURER**

Name of Seller:

Name of Mfr:

Address:

Address:

Contact Person:

Contact Person:

Alternative  
Contact Person:

Alternative  
Contact Person:

Telephone #:

Telephone #:

FAX #:

FAX #:

E-Mail Address:

E-Mail Address:

Do you wish to receive mailings directly from the BAR?     Yes             No

## 6.9 APPROVAL FEE TABLE

Spec. Para.	Test	Charge per Test	BAR-97 DG Totals
5.3.1	Exhaust Sampling Hose	\$ 50	\$ 50.00
5.3.2	Hose & Probe Temperature	\$ 100	\$ 100.00
5.3.3	Sample System Leaks	\$ 120	\$ 120.00
5.3.4	Flow Sensitivity	\$ 150	\$ 150.00
5.3.5	Flow Restrictions	\$ 200	\$ 200.00
5.3.6	Particulate Filter	\$ 90	\$ 90.00
5.3.7	Hydrocarbon Hangup	\$ 90	\$ 270.00
5.3.8, 5.3.9	Probe Dilution & Antidilution	\$ 120	
5.4.2	Temperature Stability	\$ 680	\$ 680.00
5.4.4, 5.4.5	Warmup & Drift*	\$ 620	\$ 1,860.00
5.4.6	Accuracy & Bias*	\$ 730	\$ 2,920.00
5.4.7	Hexane/Propane Ratio (PEF)	\$ 40	
5.4.8 a), b)	Gas Interference*	\$ 190	\$ 380.00
5.4.8 c)	Quench Effects (NO, O <sub>2</sub> only)*	\$ 90	\$ 180.00
5.4.8 d)	Saturation Effects (NO, O <sub>2</sub> only)*	\$ 150	\$ 300.00
5.4.9	Voltage Variations*	\$ 30	\$ 60.00
5.4.10	Pressure Comp'n - HC, CO, CO <sub>2</sub> *	\$ 410	\$ 1,230.00
"	- NO, O <sub>2</sub> *	\$ 1,060	\$ 2,120.00
5.4.11	Analyzer/Sensor Response Time*	\$ 390	\$ 1,560.00
5.4.13	Noise tests	\$ 60	\$ 60.00
5.4.14	Vibration & Shock	\$ 50	\$ 50.00
5.5.1	System Repeatability*	\$ 150	\$ 450.00
5.5.2	System Response Time*	\$ 420	\$ 840.00
5.8.3	Bar Code Scanner	\$ 150	\$ 150.00
NOTES: * Cost is for one temperature only. Specification requires testing at: 35F, 75F & 110F.			

**6.10 APPLICABLE TESTS**

<b>PART</b>	<b>APPLICABLE TESTS</b>	<b>COST</b>
sample probe, hose, handle	5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.7	510.00
particulate filter	5.3.6, 5.3.7, 5.5.2	780.00
tachometer pickup	2.9	150.00
bar code scanner	2.7, 2.7.1, 5.8.3	150.00
other	as applicable	call BAR engineering