

DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Air Quality Control Commission

REGULATION NUMBER 11

MOTOR VEHICLE EMISSIONS INSPECTION PROGRAM

5 CCR 1001-13

PART A: General Provisions, Area of Applicability, and Schedules for Obtaining Certification of Emissions Control, Definitions, Exemptions, and Clean Screen/Remote Sensing

PART B: Standards and Procedures for the Approval, Operations, Gas Span Adjustment, Calibration and Certification of the Air Pollution Control Division (Division) Approved Test Analyzer Systems for Use in the Basic and Enhanced Program Areas, Test Analyzer Systems for Licensed Dealers in the Enhanced Area, and Clean Screen Test Analyzer Systems

PART C: Inspection Procedures and Requirements for Exhaust Emissions, Fuel Evaporation Control, Visible Smoke Emissions, Emissions Control Systems, On-Board Diagnostics Clean Screening; and Practices to Ensure Proper Emissions Related Adjustments and Repairs

PART D: Qualification and Licensing of Emissions Mechanics, Emissions Inspectors, and Clean Screen Inspectors; Licensing of Emissions Inspection and Readjustment Stations, Inspection-Only Stations, Inspection-Only Facilities, Fleets, Motor Vehicle Dealer Test Facilities and Enhanced Inspection Centers, Clean Screen Inspection Sites; and Registration of Emissions Related Repair Facilities and Technicians

PART E: Prohibited Acts and Penalties to Ensure Proper Inspection Procedures, Adherence to Prescribed Procedures and Effective Emissions Related Repairs

PART F: Maximum Allowable Emissions Limits for Motor Vehicle Exhaust, Evaporative and Visible Emissions for Light-Duty and Heavy-Duty Vehicles

PART G: Reserved

PART H: Statements of Basis, Specific Statutory Authority and Purpose

APPENDIX A: Technical Specifications

APPENDIX B: Standards and Specifications for Calibration/Span Gas Suppliers

REFERENCES

Pursuant to Section 24-4-103 (12.5), C.R.S., material incorporated by reference is available during normal working hours, or copies may be obtained at a reasonable cost, from the Technical Secretary of the Air Quality Control Commission c/o the Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530 or material incorporated by reference within this regulation may be examined at any state publications depository library. References do not include later amendments to or additions of incorporated material.

PART A General Provisions, Area of Applicability, Schedules for Obtaining Certification of Emissions Control, Definitions, Exemptions, and Clean Screening/Remote Sensing

I. APPLICABILITY

Subject to the provisions described in Sections I.A and I.B of this Part A and pursuant to the schedule in Section I.C. and V.B. of this Part A, all non-diesel fueled motor vehicles which are registered in the AIR Program area or which motor vehicle is owned or operated by a non-resident who meets the requirements of Section, 42-4-310(1)(c)(I), C.R.S., will be subject to On-Board Diagnostics and/or an exhaust and evaporative emissions, smoke opacity and emissions control, equipment inspection as a prerequisite to initial or renewal of the vehicle registration. Any person owning or operating a business and any post-secondary educational institution located in the program area as defined in Subsection A of this section shall annually inform by written notice all persons employed by such business or attending classes that they are required to comply with the provisions of this regulation. The provisions of this regulation applicable to Larimer and Weld counties shall not be included in the state implementation plan.

I.A. Geographic Areas of Applicability

This regulation shall apply to the AIR Program area as defined in Section 42-4-304(20), C.R.S. as amended by Senate Bill 09-003.

I.B. Vehicles Eligible for AIR Program Inspection Procedures-

This regulation shall apply to all motor vehicles as defined in Section 42-4-304(18), C.R.S.

Vehicles that are registered in a program area and are being operated outside such area but within another program area shall comply with the requirements of the area where such vehicles are being operated. Vehicles registered in a program area that ~~are~~ is being temporarily operated outside the state at the time of registration or registration renewal may apply to the department of revenue for a temporary exemption from program requirements. Upon return to the program area, such vehicles must be in compliance with all requirements within fifteen days. A temporary exemption shall not be granted if the vehicle will be operated in an emissions testing area in another state unless proof of emissions from that area is submitted.

Pursuant to Section, 42-4-310(1)(c)(I), C.R.S. motorists operating vehicles in the enhanced program area shall comply with the provisions of the enhanced program.

The burden of proof in establishing an exemption from inclusion in all or any part of the AIR Program inspection requirements is on the vehicle owner.

I.C. Schedules for Obtaining Certifications of Emissions Control

I.C.1. REPEALED

I.C.2. Inspection schedules during calendar year 1995 and thereafter, vehicles are to be inspected according to the schedules established in Sections, 42-4-304(3)(b)(II), and, 42-4-310(1)(b)(II), C.R.S. as amended.

I.C.3. No used vehicle which is required to be registered in the program area shall be registered, unless such vehicle has a Certification of Emissions Control, or of Emissions Exemption. The seller of a used vehicle is required to obtain a Certification of Emissions Control for the new owner at the time of sale. This paragraph (3) does not apply to the sale of a motor vehicle that is inoperable or otherwise cannot be tested in accordance with this regulation if the seller of the motor vehicle provides a written notice to the purchaser pursuant to Section 42-4-310(4), C.R.S. If a motor vehicle is being registered for the first time in the program area, the owner shall obtain the certification and submit it with the

application for registration to the Department of Revenue or an authorized agent of the Department of Revenue.

I.C.3.a. On or after October 1, 1989, no used vehicle which is required to be registered in the program area shall be registered, unless such vehicle has a Certification of Emissions Control, or of Emissions Exemption. The seller of a used vehicle is required to obtain a Certification of Emissions Control for the new owner at the time of sale. This paragraph (3) does not apply to the sale of a motor vehicle which is inoperable or otherwise cannot be tested in accordance with this regulation or that is being sold pursuant to Part 18 (Vehicles Abandoned on Public Property) or Part 21 (Vehicles Abandoned on Private Property) of Article 4 of Title 42, C.R.S. if the seller of the motor vehicle provides a written notice to the purchaser pursuant to Section 42-4-310(4), C.R.S. If a motor vehicle is being registered for the first time in the program area, the owner shall obtain the certification and submit it with the application for registration to the Department of Revenue or an authorized agent of the Department of Revenue.

I.C.3.b. An inspection is not required prior to the sale of a motor vehicle with at least twelve months remaining before the vehicle's certification of emissions compliance expires if such certification was issued when the vehicle was new.

I.C.3.c. ~~Effective January 1, 2015 A~~a motor vehicle being registered in the program area for the first time may be registered without an inspection or certification if the vehicle has not yet reached its seventh model year pursuant to Section 42-4-310(1)(a)(II)(C)C.R.S.

I.C.4. Any motor vehicle may be voluntarily inspected and a Certification of Emissions Control obtained which shall be valid as specified in Section I.C.2. of this Part A.

I.C.5. (Reserved)

I.C.5.a. As it pertains specifically to federally owned or leased vehicles; tactical military vehicles are not required to be inspected.

I.C.5.b. Federal installation managers are to declare all federal employee-owned vehicles operated on the installation and demonstrate that these vehicles have complied with periodic inspection requirements pursuant to 40 CFR Section 51.356(A)(4). Inspection results shall be reported to the Department of Revenue AIR Program section and up-dated based on inspection cycles.

I.C.6. (Reserved)

I.C.7. Fleets of twenty or more eligible vehicles shall be periodically inspected, comply with inspection provisions and obtain a Certification of Emissions Control.

I.C.7.a. Fleets may pursue licensing as a fleet inspection station under Part D of this Regulation Number 11 pursuant to Section, 42-4-309, C.R.S. and comply with the provisions of that section.

I.C.7.b. Fleets may elect to comply with periodic inspection requirements under the provisions of Section 42-4-309 (2)(a), C.R.S. to include the inspection schedules of Sections 42-4-304(3)(b)(II) and 42-4-310(1)(b)(II)(a), C.R.S.

I.C.7.c. As it pertains to the fleet vehicles provisions pursuant to Section, 42-4-309, C.R.S. and this Section I.C.7., municipal fleets of twenty vehicles or more may comply with periodic inspection requirements as specified in Section 42-4-309(2)(a), C.R.S. to include inspection schedule of Sections 42-4-304(3)(b)(II) and 42-4-310 (1)(b)(II)(a), C.R.S.

I.C.8. New motor vehicles being registered with a Manufacturer's Statement of Origin (MSO), Manufacturer's Certificate of Origin (MCO) or similar document shall be issued a registration without a Certificate of Emissions Control.

Such new motor vehicles are to be issued a Verification of Emissions Test exemption windshield sticker at the time of sale and valid for up to seven (7) years. The selling dealer is responsible for obtaining the Verification of Emissions Test.

New vehicles under this section shall also include those new vehicles leased under an MSO or MCO or similar document and seven years without an inspection. After the seventh year or a transfer of ownership, such vehicles shall be issued a registration only with a Certificate of Emissions Control. The inspection schedule for these vehicles shall then revert to a biennial cycle.

Effective January 1, 2015 vehicles that were originally issued a Verification of Emissions Test exemption windshield sticker at the time of new vehicle sale that was valid for a period of four years shall have that time period extended to seven years.

I.C.9. Motor vehicle dealer compliance requirements.

I.C.9.a. Compliance with AIR Program inspection requirements will not be required for wholesale transactions between motor vehicle dealers licensed pursuant to Article 6 of Title 12, C.R.S.

I.C.9.b. Motor vehicle dealers shall have motor vehicles inventoried or consigned for retail sale inspected annually. A further inspection is not required at the time of sale if:

- i. For a 1982 or later motor vehicle, there are at least twelve months remaining before the vehicle's certification of emission compliance expires and the dealer has had the vehicle inspected since acquiring it. Such a vehicle purchased from a licensed motor vehicle dealer may be registered in the program area without an inspection if, on the date of vehicle registration, at least twelve months remain before the expiration of such certification.
- ii. For a 1981 or earlier motor vehicle, the vehicle has a valid certification of emission compliance and the dealer has had the vehicle inspected since acquiring it. Such a vehicle purchased from a licensed motor vehicle dealer may be registered in the program area without an inspection if, on the date of vehicle

registration, at least nine months remain before the expiration of such certification.

- I.C.10. For purposes of Sections 42-4-304(3), 42-4-309(3) and 42-4-310, C.R.S., a certificate of emissions Control shall be considered to be issued at the time of sale or transfer of a vehicle if such certificate is issued pursuant to an inspection conducted no later than the date of such sale or transfer, and no earlier than one hundred twenty calendar days prior to such sale or transfer.
- I.C.11. Eligible fleets as defined in Section 42-4-309, C.R.S. that declare not to self-inspect shall be inspected according to the same schedules, subject to the same emissions related repair requirements and waiver provisions as non-fleet vehicles.
- I.C.12. For the purposes of 42-4-309(6)(B) if a vehicle fails the test or is untestable due to mechanical and/or electrical/electronic problem, the motorist shall have the same recourse as that of not passing an inspection. However, Section 42-4-309(6), C.R.S. and the regulations implementing such provision, shall not be federally enforceable, and shall not be incorporated into the State Implementation Plan.

II. DEFINITIONS

- 1. "Accreditation" means certification that the instrument and instrument manufacturer meet the operating criteria specifications and requirements of the Colorado Department of Health, Air Quality Control Commissions as specified in Part B of this regulation.
- 2. "Air Intake Systems" are those systems that allow for the induction of ambient air (to include preheated air) into the engine combustion chamber for the purpose of mixing with a fuel for combustion.
- 3. "AIR Program Station" is an Automobile Inspection and Readjustment (AIR) Station that qualifies and is licensed to operate as an emissions inspection and readjustment station.
- 4. "Air System" is a system for providing supplementary air into the vehicle's exhaust system to promote further oxidation of HC and CO gases and to assist catalytic reaction.
- 5. "BAR 90" refer to the California Bureau of Automotive Repair specifications for Exhaust Gas Test Analyzer Systems (TAS) that became effective in 1990. "BAR 97" refers to the California Bureau of Automotive Repair specifications for Exhaust Gas Test Analyzer Systems (TAS) that became effective in 1997.
- 6. "Basic Engine Systems" are those parts or assemblies which provide for the efficient conversion of a compressed air/fuel charge into useful power to include but not limited to valve train mechanisms, cylinder head to block integrity, piston-ring-cylinder sealing integrity and post-combustion emissions control device integrity.
- 7. "Calibration" is the process of establishing or verifying the total response curve of an exhaust gas analyzer. Calibration is a laboratory procedure using several different calibration gases having precisely known concentrations.
- 8. "Calibration Gases" are gases of precisely known concentration that are usually used in the laboratory as references for establishing or verifying the calibration curve of an exhaust gas analyzer.

9. "Catalytic Converter" is a post-combustion device that oxidizes HC and CO gases and/or reduces oxides of nitrogen.
10. "Certification" means assurance by the authorized source, whether it is a laboratory, the manufacturer, or the State, that a specific product or statement is in fact true and meets all required accreditation requirements.
11. "Certification of Emissions Control" shall have the same meaning as set forth in Section 42-4-304(3)(1), C.R.S.
12. "Chlorofluorocarbon" (CFC) is a class I stratospheric ozone depleting compound as listed in Appendix A, final rule vol.57.mp 147 Federal Register, 40 CFR Part 82.
13. "Clean Screen Inspection Site" is that location within the program area as defined in Section 42-4-304(20)(a), C.R.S., approved by the Division and the Department of Revenue.
14. "Clean Screen Inspector" is a person found qualified by the Division, and licensed by the Executive Director to operate Clean Screen Inspection equipment.
15. "Clean Screen Program" is that program as defined in Section 42-4-304(3.5), C.R.S.
16. "Clean Screened Vehicle" is a vehicle that is eligible for inspection, has at least two consecutive passing remote sensing emissions readings performed on different days or at different approved Clean Screen Inspection Sites prior to its registration renewal date, or for vehicles identified as low emitters on the low emitting vehicle index, one passing remote sensing reading prior to its registration date, and has otherwise complied with the provisions of Section IV of this Part A, Section XII of Part C and Section VI of Part F.
17. "Clean Screen Data Manager" is that person or entity that contracts with the state to provide clean screen data management functions. This same person or entity may also act as general contractor in conducting and facilitating clean screen inspections.
18. "Colorado 94" refers to those test analyzer systems that are based on BAR 90 but modified as specified by the Division for use in the AIR Program for the period of time after January 1, 1994. "Colorado AIR Program BAR 97 Exhaust Gas Analyzer" or Colorado 97" refers to those test analyzer systems that are based on BAR 97, but modified as specified by the Division for all fleet inspection stations and inspection-only facilities that become licenses after May 1, 2010.
19. "Colorado Automobile Dealer Transient Mode Test Analyzer System" is a dynamometer based inspection system capable of performing an inspection grade (IG 240) emissions inspection procedure under simulated driving conditions. The procedure is intended for determining the compliance status for used vehicles prior to retail sale.
20. "Colorado On-Board Diagnostic (OBD) Test Analyzer System" or "OBD TAS" refers to the analytical and testing instrumentation used to verify automotive emissions and to prompt the emissions inspector through the elements of an official Colorado OBD emissions inspection.
21. "Compliance" means verification that certain submission data and hardware submitted by a manufacturer for accreditation consideration, meet all required accreditation requirements.
22. "Diagnostic Trouble Code (DTC)" is an alpha-numeric code representing a specific fault or problem identified by the OBD system on a vehicle. OBD diagnostic trouble codes are standardized across all vehicle manufacturers and are defined individually in the Society of Automotive Engineers Recommended Practice J2012.

23. "Division" is the Air Pollution Control Division of the Colorado Department of Public Health and Environment.
24. "Electrical, Electronic, or Electro-mechanical Span" is the adjustment of an exhaust gas analyzer using an electronic signal rather than a calibration or span gas as a reference source.
25. "Emissions Control Systems" are those parts, assemblies or systems originally installed by the manufacturer in or on a vehicle for the purpose of reducing emissions.
26. "Estes Park Area" means that part of the program area west of Range 71 West in Larimer County.
27. "Executive Director of the Department of Revenue" or "Executive Director" is the representative of the Department of Revenue or designee responsible for the field enforcement of the AIR Program, licensing of emissions mechanics, clean screen inspectors and inspection stations.
28. "Fuel Control Systems" are ~~those~~ mechanical, electro-mechanical, galvanic or electronic parts or assemblies that regulate the air/fuel ratio in an engine for the purpose of providing a combustible charge.
29. "Fuel Filler Neck Restrictor system" is the orifice and obstruction ("Flapper Door") in the gas tank filler neck that prevents the insertion of a "leaded gasoline" nozzle and deters the introduction of "leaded fuel".
30. "Gas Span" is the adjustment of an exhaust gas analyzer to correspond with known concentrations of span gases.
31. "Gas Span Check" is a procedure using known concentrations of span gases to verify the gas span adjustment of an analyzer.
32. "Gross Vehicle Weight (GVW) Rating" is the maximum recommended combined weight of the motor vehicle and its load as prescribed by the manufacturer and expressed on a permanent identification label affixed to the motor vehicle.
33. "Heavy Duty Vehicles (HDV)" are those motor vehicles for model years 1978 and earlier having a GVW rating of greater than 6000 pounds and for model years 1979 and newer, having a GVW rating of greater than 8,500 pounds.
34. "Idle Mode" means a condition where the vehicle engine is warm and running at the rate specified by the manufacturer's curb idle, where the engine is not propelling the vehicle, and where the throttle is in the closed or idle stop position.
35. "Ignition Systems" are those parts or assemblies that are designed to cause and time the ignition of a compressed air/fuel charge.
36. "Inspection Area" is the area that is occupied by the analyzer, sample hose and the vehicle being inspected.
37. "Inspection-only station" is that licensed station within the basic program area as defined in Section 42-4-304(2), C.R.S., which meets the requirements of Section 42-4-308, C.R.S., which facility the operator is licensed to operate by the Executive Director as an inspection-only station.

38. "Instrument" is the complete system that samples and reads out the concentration of pollutant HC and CO gas plus CO₂ gas. The instrument includes the sample handling system, the exhaust gas analyzer and the enclosure cabinet.
39. "Light Duty Vehicles (LDV)" are those motor vehicles (to include trucks) for model years 1978 and earlier having a GVW rating of 6,000 pounds or less and for model years 1979 and newer having a GVW rating of 8,500 pounds or less.
40. "Low Emitting Vehicle Index" refers to a statistical table summarizing the probability of vehicles passing the IM 240 inspection. The statistical table will be updated annually by each July 1st. The low emitting vehicle index must meet the requirements of Part F, VI.B. based on a tabulation of the previous calendar year's IM 240 inspection program results.
41. "Malfunction Indicator Light (MIL)" is a warning light located on the dash of vehicles equipped with On-Board Diagnostic (OBD) systems that notifies the motorist that a malfunction to the vehicle's emissions control system has been detected.
42. "Motor Vehicle Emissions Compliance Inspectors (ECI)" are those persons employed and authorized by the Department of Revenue for licensing and enforcement of the AIR Program.
43. "North Front Range Area" is the portion of the Program Area located in Larimer and Weld Counties as set forth in Section 42-4-304(20) as amended by Senate Bill 09-003. The North Front Range area is a State-Only program and is not part of any State Implementation Plan with the US EPA.
44. "On-Board Diagnostics II (OBD or OBDII) Test" means the electronic retrieval of stored readiness status, diagnostic trouble codes, malfunction indicator light (MIL) illumination status, and other information from a vehicle's OBD system to determine if any emission related trouble codes are present and if the MIL is commanded to be on, which would indicate the existence of an emission related malfunction with the vehicle.
45. "Original Condition" means the condition as installed by the manufacturer but not necessarily to the original level of effectiveness.
46. "Program Area" is that geographic area defined in Section 42-4-304(20), C.R.S. as amended by Senate Bill 09-003.
47. "Registration Renewal Date" is the last day of the month in which the vehicle registration expires as defined in Section 42-3-103, C.R.S.
48. "Span Gases" are gases of known concentration used as references to adjust or verify the adjustment of an exhaust gas analyzer's span settings.
49. "State Emissions Technical Center Personnel" are those persons employed by or authorized by the Department of Health for technical or administrative support of the AIR Program.
50. "Test Analyzer Systems" (TAS) in the context of this regulation is that analytical instrumentation used to measure automotive emissions and prompt the operator through other elements of an emissions inspection.
51. "True Concentration" is the concentration of the gases of interest as measured by a standardized instrument which has been calibrated with 1% precision gases traceable to the National Institute for Standards and Technology.

52. "Zero Gas" is a gas, usually air or nitrogen, which is used as a reference for establishing or verifying the zero point of an exhaust gas analyzer.

III. EXEMPTION FROM SECTION 42-4-314, C.R.S. FOR DEPARTMENT OF DEFENSE PERSONNEL PARTICIPATING IN THE PRIVATELY OWNED VEHICLE IMPORT CONTROL PROGRAM

III.A. U.S. Department of Defense (DOD) personnel participating in the DOD POV (privately owned vehicle) Import Control Program operating a 1975 or subsequent model year automobile, are exempt from the prohibition of C.R.S., 42-4-314(2), C.R.S. insofar as it pertains to filler neck restrictors, catalytic converter systems, and, if applicable, exhaust gas oxygen (O₂) sensor(s), if one of the following conditions are met:

III.A.1. The automobile will be driven to the port and surrendered for exportation under said program within ten (10) working days of disconnection, deactivation, or inoperability of the restrictor, catalytic converter systems, or exhaust gas oxygen (O₂) sensor(s); or

III.A.2. The reconnection, reactivation, or reoperability of the restrictor, catalytic converter systems, and, if applicable, exhaust gas oxygen (O₂) sensor(s), is made within ten (10) working days from the time the owner picked up the automobile at the port.

III.B. Persons disconnecting, deactivating, or rendering inoperable any filler neck restrictor, catalytic converter system, exhaust gas oxygen (O₂) sensor(s) on 1975 or subsequent model year automobile of DOD personnel participating in the DOD POV Import Control Program which will be driven to the port and surrendered for exportation under said program within ten (10) working days are exempt from the prohibition of 42-4-314, C.R.S.

III.C. Unless otherwise exempt under this Section III of Part A, vehicles shall be required to be configured as a vehicle certified by the EPA for sale and use within the United States pursuant to 40 CFR, Part 86, Subpart A.

IV. CLEAN SCREEN/REMOTE EMISSIONS SENSING

IV.A. Geographic Area of Applicability

IV.A.1. (Reserved)

IV.A.2. The Division shall implement an expanded clean screen program in the enhanced program area.

IV.A.3. (Reserved)

IV.B. Vehicles Eligible to participate in the Clean Screen/Remote Emissions Sensing Program

IV.B.1. The clean screen program established in this Section IV. of Part A shall apply to eligible motor vehicles as defined in 42-4-310(5)(a), C.R.S., for which registration will expire within twelve months, a certificate of emissions control is a prerequisite to renewal and which are registered in a clean screen program county.

IV.B.2. The counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer, and Weld are clean screen counties.

IV.C. REPEALED

IV.D. Schedule for collection of emissions inspection fees by county clerks and recorders.

The clerks and recorders for the counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer and Weld shall collect an emissions inspection fee in the amount specified pursuant to Section 42-3-304(19)(a)(I), C.R.S. at the time of registration of a motor vehicle that the Department of Revenue has determined to have been clean screened, unless a valid certification of emissions compliance has already been issued for the vehicle being registered indicating that the vehicle passed the applicable emissions test at an enhanced inspection center, motor vehicle dealer test facility or fleet inspection station.

V. EXPANSION OF THE ENHANCED EMISSIONS PROGRAM TO THE NORTH FRONT RANGE AREA

V.A. Program Commencement

Beginning November 1, 2010, unless the Division comes back to the Commission and the Commission agrees to a later date, motor vehicles registered in the North Front Range Area, and vehicles operating in the North Front Range Area that meet the requirements of Section 42-4-310(1)(c)(I), C.R.S. shall be subject to an Enhanced emissions inspection as defined in Section 42-4-304(8.5). Notwithstanding the above, the Estes Park Area, located west of Range Seventy-one (71) West, shall be excluded from the Enhanced Emissions Program. Such inspection shall be the same as the inspection required in the Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson county portions of the Program Area. The Vehicle Emissions Inspection program in the North Front Range area is a State-Only program and is not part of any state implementation plan with the US EPA.

V.B. Requirement to Obtain Certification of Emission Control and Emissions Inspection Schedule

- V.B.1. Except as otherwise provided in Title 42, Article 4, Part 3, C.R.S. and this Regulation Number 11, a motor vehicle that is subject to the North Front Range Area Inspection and Maintenance Program pursuant to Subsection V.A. above may not be registered or sold without a valid Certification of Emissions Control. In order to obtain a Certification of Emissions Control the vehicle must either pass the applicable emissions inspection or obtain a waiver from the Department of Revenue under this Regulation Number 11.
- V.B.2. Subject to the phase-in provision in Subsection V.B.3. below, emissions inspections shall be conducted and Certification of Emissions Controls shall remain valid in accordance with the schedules set forth in Section 42-4-304(3), C.R.S., Section 42-4-310(1)(b)(II), C.R.S. and Part A, Section I.C. of this Regulation Number 11.
- V.B.3. In order to better balance the number of inspections from year to year, odd number model year motor vehicles that require biennial inspections under Subsection V.B.2. above, shall be inspected commencing January 1, 2011. This phase-in shall not excuse a vehicle from an inspection in 2010 that is required due to the sale or transfer of the motor vehicle.

PART B Standards and Procedures for the Approval, Operation, Gas Span Adjustment, Calibration and Certification of the Division Approved Test Analyzer Systems for

Use in the Basic and Enhanced Areas and Test Analyzer Systems for Licensed Dealers in the Enhanced Area

I. APPROVAL OF THE COLORADO 94 AND COLORADO 97 TEST ANALYZER SYSTEMS

- I.A. From January 1, 1995 and thereafter no emissions inspection required by the AIR Program in the enhanced program area shall be performed unless the instrument used for measuring exhaust gases from motor vehicles is identified as a Colorado AIR Program Colorado 94 exhaust gas analyzer. For any emissions inspection station licensed after May 1, 2010, a Colorado BAR 97 exhaust gas analyzer must be used. Sources of vendors for the approved analyzers may be obtained from the Program Administrator, Mobile Sources Section, Air Pollution Control Division, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver CO 80246-1530.
- I.B. As an element of accreditation, the Division will accept a Certification statement for the exhaust gas analytical and sampling system portion of the Colorado AIR Program Colorado 94 exhaust gas analyzer or a Colorado BAR 97 exhaust gas analyzer from the California Bureau of Automotive Repair (BAR) or a recognized laboratory. The Division or its designee will determine the manufacturers' compliance with the revisions and additions to the specifications necessary for use of the instrument within the AIR Program. Those testing procedures are to be included with the bid specifications.
- I.C. The following statement is a requirement of the AIR Program for approval of an exhaust gas analyzer and is included to make manufacturers and purchasers of exhaust gas analyzers aware of the warranty requirements of Section 207(b) of the federal Clean Air Act, as amended 1981.

207(b) Warranty Requirements:

Unless an exhaust gas analyzer has been certified by the manufacturer as having met the specifications of 40 CFR Part 85, Subpart W as published in Part IX of the May 22, 1980 Federal Register, an inspection performed using that analyzer may not qualify a 1982 or later model year vehicle for warranty repair coverage according to the provisions of the Emission Control System Performance Warranty (Section 207(b) of the federal Clean Air Act).

II. APPLICATIONS FOR APPROVAL OF COLORADO 94 OR COLORADO BAR 97 TEST ANALYZER SYSTEMS EQUIPMENT MANUFACTURERS

Those manufacturers wishing to participate in the open bid process shall make application with the Air Pollution Control Division, Mobile Sources Section, of the Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, CO 80246-1530 on forms provided thereby. All manufacturers making application shall meet the requirements as specified by the Department of Administration and the Procurement Code, Articles 101-112 of Title 24, C.R.S.

A manufacturer requesting the approval of an instrument for the measurement of exhaust gases for use in the AIR Program station shall make application therefore with the Air Pollution Control Division, 4300 Cherry Creek Drive South, Denver, CO 80246-1530 on forms provided thereby. All manufacturers making application shall meet the technical specifications and administrative requirements specified by the Air Pollution Control Division.

III. PERFORMANCE AND DESIGN SPECIFICATIONS FOR THE COLORADO 94 AND COLORADO BAR 97 EXHAUST GAS ANALYZERS

Pursuant to Section 42-4-306(3)(a), C.R.S the specifications for the exhaust gas analyzer required for inspections conducted July 1, 1987 and thereafter are attached to this regulation as Appendix A. These specifications include but are not limited to the provisions of California BAR 90, data collection, service/maintenance, requirements for replacement or loan instruments and warranty for the period of the agreement. These specifications are described in a separate document entitled "Colorado Department of Public Health and Environment Specifications for Colorado 94 Analyzer - Hardware Specifications" March 17, 1994 as adopted by the Commission. This information is available from the Air Pollution Control Division, Mobile Sources Section, 4300 Cherry Creek Drive South, Denver, CO 80246-1530. Those manufacturers making application should refer to Section II of this Part B.

The Division in its discretion may accept substitute specifications for Test Analyzer Systems provisions that such substitute specifications are equivalent to those contained in Appendix A.

IV. SPAN GASES FOR USE WITH COLORADO 94 AND COLORADO BAR 97 TEST ANALYZER SYSTEMS

IV.A. General

The instrument manufacturer and his designated marketing vendors shall, supply span gases approved by the Division to any ultimate purchaser of his unit. The instrument manufacturer shall also provide the analyzer purchaser with a comprehensive, up-to-date list (with addresses and phone numbers) of gas blenders approved by the Division. Each new or used instrument sold by the instrument manufacturer or marketing vendor shall have full span gas containers installed and operational at time of delivery.

IV.B. Span Gas Blends

The span gas concentrations supplied to the AIR Program stations shall conform to the specifications contained in Section VI. of this Part B.

Only gas blends supplied by Division approved blenders selected pursuant to Section 42-4-306(3)(a)(I)(C) shall be offered for sale in Colorado.

Pursuant to Section 42-4-306(3)(a)(I)(C), the Division shall select blenders authorized to provide span gases that comply with the standards and specifications set out in Appendix B. The requirement to use gases procured pursuant to the standards and specification in Appendix B shall not be federally enforceable, and shall not be part of the State Implementation Plan.

IV.C. Optical Correction Factor [also referred to as "C" factor, propane to hexane conversion factor" (P.E.F.)].

Each instrument shall be permanently labeled with its correction factor visible from the outside of its cabinet. The correction factor shall be carried to at least two decimal places e.g., (0.52). Factor confirmation shall be made on each assembled analyzer by measuring both N-hexane and propane on assembly line quality checks. P.E.F. limitations are described in the specifications document attached to this regulation as Appendix A.

IV.D. Running Changes and Equipment Updates

The Commission must approve any changes to design or performance characteristics of component specifications that may affect instrument performance. It will be the instrument manufacturer's responsibility to confirm that such changes have no detrimental effect on analyzer performance. All Colorado 94 exhaust gas analyzers will be updated as needed and as specified in the specifications document.

V. DOCUMENTATION, LOGISTICS, AND WARRANTY REQUIREMENTS

V.A. Instruction Manual

The instruction manual accompanying each analyzer shall contain at least the following:

- V.A. 1. Complete technical description.
- V.A.2. If available, functional schematics (mechanical and electrical).
- V.A.3. Accessories and options (included and/or available).
- V.A.4. Model number, identification markings and location.
- V.A.5. Operating maintenance to include periodic recommendations, i.e., daily, weekly, monthly, and procedure for maintaining sample system integrity (leaks, hang-up, calibration, filters, etc.).
- V.A.6. Required service schedule identifying the items needing maintenance and the procedures to be followed by the purchaser. The services to be performed only by the manufacturer shall be clearly identified.
- V.A.7. Warranty provisions to include listing of warranty repair stations by name, address, and phone number.
- V.A.8. The name, address, and phone number of the permanent Colorado representative offering training, service, warranties, etc.
- V.A.9. Information and terms of manufacturers service contract clearly stating the coverage including but not limited to each party's obligation, period of coverage, cost, service response times, availability of loaner units. Manufacturer or designee performed service/maintenance provisions and costs shall be so stated for the duration of the program and annually up-dateable costs.

VI. CALIBRATION OF COLORADO 94 AND COLORADO BAR 97 TEST ANALYZER SYSTEMS

The Division shall use and require for use in the calibration and spanning of exhaust gas analyzers span gases and containers supplied by authorized blenders meeting the following parameters, blends, and specifications:

VI.A. Standardizing Instruments

The calibration gases for standardizing instruments shall conform to the provisions outlined in 40 CFR, Section 86.114 (July 1, 1992) (EPA) for automotive exhaust emissions testing. Those gases shall be of "precision" quality, certified to be within $\pm 1\%$ of the labeled concentration, and traceable to the National Institute for Standards and Technology (NIST).

VI.B. AIR Program Station Instruments

The span gases supplied to AIR Program stations shall conform to the following:

- VI.B.1. Tri-blends of HC, CO, CO₂ in a carrier gas of nitrogen (N₂). The hydrocarbon (HC) gas will be propane.

VI.B.2. The concentrations) of the span gas blends (two) shall be within limits established by the Division to provide for uniform exhaust gas analyzer spanning. The Division may establish such limits to ensure gasses are measurable based upon the ranges or scales of the equipment.

VI.B.3. The accuracy of the AIR Program station span gas blend shall be certified by the blender to be $\pm 2\%$ of labeled concentration and traceable to the NIST.

VI.C. AIR Program stations will calibrate the exhaust gas instrument once every 72 hours as determined by the instrument or as needed in order to maintain accuracy.

VI.D. All AIR Program exhaust gas analyzers will be calibrated only with span gases bearing a Colorado approval label.

VI.E. Additional specifications related to calibration requirements are described in the specifications document attached to this document as Appendix A.

VII. APPROVAL OF THE COLORADO AUTOMOBILE DEALERS TRANSIENT MODE TEST ANALYZER SYSTEM

Any applicable emissions inspection required by the AIR Program performed by a licensed Motor Vehicle Dealers Test Facility pursuant to Section 42-4-304 (19), C.R.S., in the enhanced program area, shall be performed utilizing a Colorado Automobile Dealer Transient Mode (IG 240) test analyzer system approved by the state open bid process. Sources of vendors for the approved test system may be obtained from the Program Administrator, Mobile Sources Section, Air Pollution Control Division, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver Colorado 80246-1530.

This Section VII, and the associated design and performance specifications set out in Appendix A, Attachment III, shall not be federally enforceable and shall not be part of the State Implementation Plan.

VIII. APPLICATIONS FOR APPROVAL OF THE COLORADO AUTOMOBILE DEALERS TRANSIENT MODE TEST ANALYZER SYSTEM

Those manufacturers wishing to participate in the open bid process shall make application with the Air Pollution Control Division, Mobile Sources Section, of the Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver Colorado 80246-1530 on forms provided thereby. All manufactures making application shall meet the requirements as specified by the Department of Administration and Procurement Code, Articles 101-112 of Title 24, C.R.S.

The design and performance specifications for the Colorado Automobile Dealers Transient Mode Test Analyzer System Technical and Hardware Specification Document of January 27, 1997 attached as Appendix A, Attachment III. Pursuant to 42-4-306(3)(a)(I)(C), the Division shall let bids for the procurement of instruments that comply with such specifications. In addition to the specifications set out in Appendix A, attachment III, qualifying bids shall:

Include a bid for the procurement of any working/support and span gases necessary for the operation of such Colorado Automobile Dealers Transient Mode Test Analyzer System, unless all such gases are already subject to a contract issued pursuant to 42-4-306(3)(a)(I)(C). Any bid for the procurement of such gases shall comply with the relevant requirements of Part B, IV of the Regulation Number 11 and relevant requirements of Standards and Specifications for Calibration and Span Gas Suppliers, attached as Appendix B, including the "Gas Requirements for the Basic and Enhanced Inspection Test Programs, 1997" as set out in Section 5 of Appendix B.

Include a comprehensive and up-to-date list of working/support and span gas suppliers subject to a contract issued pursuant to 42-4-306(3)(a)(I)(C). A copy of such list shall be provided to each purchaser.

Provide for the Division-approved calibration gases for calibration of the Colorado Automobile Dealers Transient Mode Test Analyzer System.

A service and maintenance plan, including a description of services, service response times, periodic maintenance schedules and annual service agreement costs inclusive of all services necessary to comply with the Colorado Automobile Dealers Transient Mode Test Analyzer System Technical and Hardware Specification Document of January 27, 1997. Service agreement costs are to be listed annually and shall be for the remaining period of the AIR Program.

IX. APPROVAL OF THE COLORADO ON-BOARD DIAGNOSTIC (OBD) TEST ANALYZER SYSTEM

Any applicable on-board diagnostic emissions inspection required by the Air Program performed shall be performed utilizing an on-board diagnostic (OBD) test analyzer system approved by the state. Sources of vendors for the approved Colorado On-Board Diagnostic Test Analyzer System may be obtained from the Program Administrator, Mobile Sources Section, Air Pollution Control Division, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530.

X. THE COLORADO ON-BOARD DIAGNOSTIC (OBD) TEST ANALYZER SYSTEM

The design and performance specifications for the Colorado On-Board Diagnostic Test Analyzer System are outlined in the Society of Automotive Engineers J1979 Standard.

In addition to the specifications set out in J1979 Standard, additions and/or modifications to the operational, data collection, data recording and quality assurance auditing functions shall be outlined in a Colorado On-Board Diagnostic (OBD) Test Analyzer System Requirements Specification, to be submitted by the Division for Air Quality Control Commission approval no later than December 31, 2013.

XI. REQUESTS FOR APPROVAL OF CLEAN SCREEN TEST ANALYZER SYSTEMS

XI.A. REPEALED

XI.B. Calibration gas blends intended for Clean Screen Test Analyzer Systems shall be verified and approved subject to the requirements of Standards and Specifications for Calibration and Span Gas Suppliers including Gas Requirements for the Basic and Enhanced Inspection Test Programs. 1997, (Appendix B).

Concentrations of calibration gases noted above are to be determined pending system configuration, operating ranges and expected emissions readings.

State audit blends for Clean Screen Test Analyzer Systems shall be of varying concentrations of and shall conform to the above gas blending standards.

PART C Inspection Procedures and Requirements for Exhaust Emissions, Fuel Evaporation Control, Visible Smoke Emissions, Emissions Control Systems, On-Board Diagnostics (OBD); and Practices to Ensure Proper Emissions Related Adjustments and Repairs

I. PRE-INSPECTION REQUIREMENTS

- I.A. A licensed emissions mechanic, licensed emissions inspector or authorized emissions inspector must perform all aspects of the inspection. It is the responsibility of emissions mechanics and emissions inspectors to notify the Department of Revenue of their current place of employment and any subsequent transfer, and place of residence. The Contractor shall be responsible for its personnel and notifying the Department of all personnel assignments and adjustments in those assignments.

The emissions mechanic not employed by an "Inspection-Only Station" shall notify the customer prior to initiating an emissions inspection if he/she is unable to perform the required adjustments and/or repairs for that particular vehicle should that vehicle fail the inspection. Otherwise the emissions mechanic shall not conduct an inspection on a motor vehicle unless that emissions mechanic so notifies the customer or is able to perform the adjustment and/or repair procedures for that particular vehicle as prescribed by the manufacturer and specified by Section IV. of this Part C.

- I.B. Inspections may only be performed on the premises of the licensed address as prescribed in Part D Section I. A. 2. The entire inspection shall take place within the reach of the analyzer hose.

- I.C. In consideration of maintaining inspection integrity:

I.C.1. The temperature of the inspection area when utilizing one or more test analyzer systems as specified in Part B of this regulation shall be between 41°F and 110°F (5°C and 43°C) during the inspection. Inspection area temperatures must be accurately recorded, and monitored in a well-ventilated location away from vehicle engine and exhaust heat sources and out of direct sunlight. The inspection area includes the vehicle being inspected.

I.C.2. The test analyzer system and other inspection equipment shall be kept in an area within the facility that affords adequate protection from the weather.

I.C.3. A permanent location that meets all applicable requirements of this rule to provide for the inspection of vehicles is required. Electrical supply must be public utility designated for that area and meeting the analyzer manufacturer's requirements for to the test analyzer system is to be dedicated to this purpose. Full-time connectivity to a dedicated data transmission media meeting the analyzer manufacturer's requirements for the test analyzer system.

- I.D. Upon a physical verification of the vehicle identification number (VIN) and license plate number, the emissions mechanic or emissions inspector will enter this information into the program database in order to match this information with the state registration record. In the case of a match, the emissions mechanic or emissions inspector shall proceed. If no match is found, a new inspection record will be created. All non-Colorado registered vehicles and first time registrations with the State of Colorado will require the creation of a new inspection record by the emissions mechanic or emissions inspector.

- I.E. The emissions mechanic or emissions inspector shall ascertain from the inspection record data base if an initial inspection or an after-repairs inspection is to be conducted. If an after-repairs inspection is to be conducted, previous inspection data is required for comparison. Specific emissions related repair information as specified in Section VII (B) of this Part C shall be entered to the database. Inspections conducted within 60 days of the initial inspection date are to be considered an after-repairs inspection. Inspections conducted greater than 60 days from the initial inspection date are to be considered initial inspections. The emissions mechanic or emissions inspector shall accurately enter

vehicle, and last inspection information as required for vehicle emissions inspection records.

- I.F. The emissions mechanic or emissions inspector shall perform a cursory safety assessment of the motor vehicle prior to inspection. If in the opinion of the emissions mechanic or emissions inspector the vehicle is unsafe to inspect due to engine/drive-line metallic noises, or leaking fluids, the request for inspection may be refused.

II. EXHAUST EMISSIONS INSPECTION PROCEDURES

- II.A. All heavy-duty vehicles and all 1981 and older model year vehicles to be inspected at licensed inspection-only facilities or licensed enhanced inspection centers in the enhanced program area shall be administered an EPA approved idle short test as specified in 40 CFR, Part 51, Subpart S, Appendix B.

- II.A.1. The emissions mechanic or emissions inspector will use a certified TAS to select the appropriate idle short test cycle based upon the make, model year engine family and vehicle classification. These idle short tests include, but may not be limited to, a standard single speed idle test; the pre-idle 30-second pre-conditioning idle test with the high speed (2500 ± 300 RPM) pre-conditioning cycle before the idle mode; a standard two speed (3 - mode) idle test with the raised idle segment at 2500 ± 300 RPM; second chance raised idle pre-conditioning for 30 seconds just prior to the idle mode after an initial failure, and second chance restart in which the ignition is turned off for ten (10) seconds and then restarted to complete the emissions inspection procedure. All sampling modes shall (each) be thirty seconds in duration and raised engine speed modes be it for pre-conditioning or sampling, shall be $2500 \text{ RPM} \pm 300 \text{ RPM}$. As a pass/fail determination, the vehicle's emissions levels must be the same as or less than applicable limits at the designated engine speed(s) in order to pass.
- II.A.2. The entire vehicle shall be in normal operating condition and at normal operating temperature, which shall be determined by carefully feeling the top radiator hose while the engine is not operating, by checking the temperature gauge, and/or operating the vehicle prior to performing the idle emissions inspection. Vehicles are not to be idled for extended periods of time but rather inspected in an expeditious manner as soon as normal operating temperature is achieved. The vehicle shall be inspected in an as-received condition.
- II.A.3. The inspection shall be performed with the transmission in park or neutral and with all accessories off.
- II.A.4. The analyzer probe shall be inserted at least twelve (12) inches or as recommended by the analyzer manufacturer for a quality sample whichever is greater.
- II.A.5. For all vehicles equipped with a multiple exhaust system, the analyzer's dual exhaust procedure must be used.
- II.A.6. If a baffle or screen prevents probe insertion to an adequate depth, a suitable probe adapter or snug fitting hose that effectively lengthens the exhaust pipe may be used.
- II.A.7. The appropriate emissions limits specified in Part F of this regulation would be utilized by the certified test analyzer system. In selecting appropriate emissions

limits, for motor vehicles of model years 1978 and earlier having a gross vehicle weight (GVW) rating of greater than 6000 lbs., or of model years 1979 and newer having a gross vehicle weight rating of greater than 8500 lbs., the emissions mechanic or emissions inspector shall identify that particular vehicle's GVW rating by examining the vehicle information (metal) plate or sticker. These motor vehicles will be subject to the applicable emissions limits as listed in Part F of this regulation. If the vehicle information plate or sticker is missing, illegible or the GVW rating information is not otherwise available, the emissions mechanic or emissions inspector shall examine the engine exhaust emissions control information label which is permanently affixed to the engine and determine heavy-duty engine/vehicle federal certification status. Vehicle engines not labeled as having complied with applicable U.S. EPA heavy-duty regulations by the manufacturer are assumed to be light-duty vehicles and subject to the emissions limits listed in Part F of this regulation. Emissions limits for vehicles in which the engine has been changed shall be based upon whichever is newest, the vehicle or the replacement engine, as specified on a vehicle evaluation form (DR2365) or bar coded label generated by emissions technical center staff or designee.

- II.A.8. In the event the tachometer over-ride mode must be utilized to inspect a vehicle, an accurate auxiliary tachometer must be used to verify engine speeds mandated in Part C, Section II.A.1.
- II.A.9. The vehicle will be evaluated for the presence of visible smoke emissions. The evaluation is to be performed during all (engine) operating conditions of the inspection procedures prescribed in Part C, Sections II.A.1 through II.A.11.
- II.A.10. A Certification of Emissions Compliance shall be issued if the vehicle passes the emissions control systems inspection (for 1975 and newer model year vehicles only), the exhaust and evaporative emissions inspection, and there is no evidence of visible smoke emissions.
- II.A.11. If the vehicle fails the initial emissions inspection the owner is to have appropriate emissions related repairs or adjustments made and may return the vehicle to an AIR Program station, facility or center, as appropriate, for reinspection. Within ten (10) calendar days of the initial test, one free reinspection shall be provided to the motorist if the vehicle is returned to the same station or facility at which the initial test was performed. A motorist shall be entitled to one free after-repairs test at any contractor operated center within ten (10) calendar days of the initial test performed at a contractor operated center. If during repairs, it is determined the necessary parts are not available, the motorist may be issued a temporary Certificate of Emissions Control by Department of Revenue personnel. Proof of part(s) non-availability as described in Part C, Section III.D. of this part is required. Motorists pursuing a temporary Certificate of Emissions Control must facilitate final vehicle inspection and compliance with adopted regulation.
- II.B. All model year 1982 and newer light-duty vehicles, except vehicles required to be OBD tested pursuant to Part C, Section II.C. to be inspected at licensed enhanced inspection centers within the enhanced program area shall be administered an EPA approved transient loaded mode inspection procedure as specified in 40 CFR, Part 51 Subpart S Federal Register as amended to incorporate OBD testing August 6, 1996.
 - II.B.1. Vehicles shall be inspected in an as-received condition.
 - II.B.2. The inspection shall be performed with all accessories off.

- II.B.3. The appropriate emissions limits as specified in Part F of this regulation shall be selected by the TAS based upon the model year and vehicle classification.
- II.B.4. Light-duty vehicles of model year 1995 and older found to be safe but unable to be dynamometer tested shall be administered an idle short test as specified in 40 CFR, Part 51, Subpart S, Appendix B. OBD equipped light-duty vehicles that are unable to be tested on the dynamometer shall be tested using the OBD test procedures in Part C, Section II.C. to include meeting passing criteria in Part F, Section VII. Eligibility for an alternative test procedure shall be determined by the Division based upon:
 - II.B.4.a. The vehicle wheelbase greater than 125 inches
 - II.B.4.b. The vehicle wheelbase less than 92 inches
 - II.B.4.c. The vehicle driveline, traction control system, and/or brake system, which have not been modified from the original configuration, cannot be accommodated on the dynamometer.
 - II.B.4.d. The vehicle is "Handicapped" plated and fitted with hand controls or similar apparatus to facilitate operation of the vehicle.
- II.B.5. Heavy-duty vehicles to be inspected at licensed enhanced inspection centers within the enhanced program area shall be administered an appropriate EPA approved idle short test as specified in Section II (A) of this Part C.
- II.B.6. The inspector may refuse to conduct the transient driving cycle dynamometer inspection procedure if the tires on the drive wheels are worn such that the cords are visible or sidewalls are peeling or blistered.
- II.C. Effective January 1, 2015, light-duty vehicles, to include light-duty trucks in their eighth through eleventh model year, and all light-duty vehicles, to include light-duty trucks of model year 1996 and newer that are unable to be tested on an IM 240 test, are to be inspected at licensed enhanced inspection centers and shall be administered an EPA approved on-board diagnostic test as specified in 40 CFR, 85.2222.
 - II.C.1. Vehicles shall be inspected in an as-received condition.
 - II.C.2. The on-board diagnostic inspection shall be conducted with the key-on/engine running.
 - II.C.3. The on-board diagnostic test analyzer system shall determine what monitors are supported by the diagnostic system and the readiness status for applicable monitors.
 - II.C.3.a. If the readiness evaluation indicates that a vehicle has more than one unset (not ready) readiness monitor, and the malfunction indicator light (MIL) is commanded off, the vehicle shall be subjected to an IM 240 emissions inspection immediately.
 - II.C.3.b. If the vehicle's on-board diagnostics are unable to communicate electronically with the Colorado OBD Test Analyzer System, the vehicle will be subjected to an IM 240 emissions inspection immediately.

- II.C.3.c. The readiness requirement, outlined in this Part C, Section II.C.3.a. may be waived to accommodate for specific vehicles with known readiness design problems, in accordance with applicable technical service bulletins, EPA guidance, or division technical findings, as approved by the Division.
- II.C.4. The OBD test analyzer system shall evaluate the malfunction indicator light status and record status information in the vehicle test record.
- II.C.5. All diagnostic trouble codes resulting in malfunction indicator light commanded-on status shall be recorded in the vehicle test record.
- II.C.6. If the vehicle meets the passing criteria for the OBD inspection as listed in Part F, Section VII. Of this regulation, the vehicle passes the on-board diagnostic inspection.
- II.C.7. Vehicles in an OBD “not ready” status, or vehicles unable to communicate with the OBD Test Analyzer System that default to an IM 240 test as described in Part C, Section II.B. shall be subject to pass/fail for the applicable IM 240 pass/fail standards in Part F, Section III. of this regulation.
- II.C.8. If the malfunction indicator light is not commanded on and the vehicle passed the mil visual inspection, as outlined in this Part C, Section III.B., the vehicle shall pass the on-board diagnostic portion of the emissions inspection even if diagnostic trouble codes are present.
- II.C.9. The division may require no more than five percent, at random, of all OBD tested vehicles to undergo an IM 240 test at the time of the OBD testing. The failure of the vehicle to pass IM 240 shall be reported to the motorist, but shall not be used to fail the vehicle.

III. EMISSIONS CONTROL SYSTEMS INSPECTION PROCEDURES

Motor vehicles shall be configured as required for sale or use within the United States pursuant to 40 CFR, Part 86, Subpart A; unless specific documentation in the form of a state issued vehicle evaluation form (DR2365) or an EPA (EPA form 3520) or DOT exemption is submitted. To ensure compliance with this requirement, ~~the emissions mechanic or emissions inspector shall inspect all model year 1975 through 1995 and newer~~ model year vehicles and assess the integrity of the emissions control system in accordance with the procedures set forth in this Section III. Effective January 1, 2015, the emissions mechanic or emissions inspector shall inspect all model year 1975 through 1995 model year vehicles and assess the integrity of the emissions control system in accordance with the procedures set forth in this Section III.

- III.A. All model year 1975 through 1995 model year vehicles shall be visually inspected for the presence and operability of the air system, catalytic converter system(s) and oxygen (O₂) systems. If these parts or systems are not operating as designed, inoperable or have been removed or otherwise tampered with, the vehicle will not qualify for a Certification of Emissions Control. In assessing whether the proper emissions control systems are present, the emissions mechanic or emissions inspector shall examine the emissions control information decal within the engine compartment to determine the appropriate emissions control systems for that particular vehicle. If an emissions control information decal is missing, incomplete, illegible or is not appropriate for the specific vehicle, the emissions mechanic or inspector may contact a state emissions technical center for

guidance, use other reference materials or refer the vehicle to a state emissions technical center for further evaluation.

For the period December 1, 2012 through December 31, 2015, in place of the visual inspection, the emissions control systems for model year 1996 and newer vehicles may be inspected using the vehicle's on-board diagnostic (OBD) systems. To utilize this alternative inspection procedure, the emissions inspector must interrogate the vehicle's OBD system using Division approved procedures and equipment. If the emissions inspector is unable to interrogate the OBD system, or if the interrogation reveals either that the malfunction indicator light (MIL) is commanded on or that any OBD monitors are not set, the vehicle shall be visually inspected in accordance with the procedures set forth in Subsection III.A.

III.B. An assessment of the emissions control system malfunction/service-maintenance indicator(s) performance shall be conducted by the emissions mechanic or emissions inspector on those vehicles so equipped.

For those vehicles equipped with "check engine" dash indicator lights or similar emissions control systems malfunction or service-maintenance indicator(s), the following procedure if applicable will be performed to assess the integrity of the system:

- Ignition Off, Engine Off = indicator(s) off
- Ignition On, Engine Off = indicator(s) on or displayed
- Ignition On, Engine Running = indicator(s) off

The failure of the system to respond as described above shall be reported to the motorist, but shall not be used to fail the vehicle.

III.C. The repair/replacement of catalytic converters must incorporate the same type, style and location on the exhaust system relative to engine as originally designed by the vehicle manufacturer. If a new original equipment manufacturer (OEM) part is not used, only an EPA "accepted" after-market component appropriate to that application may be used. Verification of the correct application and certification status must be performed at the time of reinspection. The submittal and review of repair receipts as specified in Subsection VII.B of this section is required in order to substantiate proper repairs of applicable emissions control system.

III.D. If the necessary part(s) will not be available prior to the month of expiration of the present vehicle registration, and the owner obtains a signed form or statement to that effect from a manufacturer's dealer for that make vehicle, or from an automotive parts supplier which in the normal course of business supplies part(s) for that vehicle, Department of Revenue personnel after verification may issue a temporary Certification of Emissions Control. The form or statement provided must specifically identify by part numbers and description, the necessary part(s). The owner then has until the expiration of the temporary certification to complete the necessary repairs or replacement.

IV. ON-BOARD DIAGNOSTIC INSPECTION PROCEDURES

Effective January 1, 2015, ~~Light~~light-duty vehicles to include light-duty trucks of model year 1996 through those vehicles that have reached their eleventh model year old equipped with California on-board diagnostic (OBDII) or EPA on-board diagnostic systems (EPA, OBD) shall be evaluated to determine

operability and integrity of the applicable system(s). The OBD system will be connected to the TAS and interrogated. Fault codes and diagnostics shall be reported to the motorist with other emissions inspection information but with the exception of dynamometer incompatible vehicles as noted in Part C, Section II.B.4. shall not be used to fail the vehicle.

V. EVAPORATIVE FUEL CONTROL INSPECTION PROCEDURES

Model year 1975 and newer vehicles shall be inspected for the presence and integrity of the gasoline cap(s). The gasoline cap(s) of such vehicles inspected in the nine county Front Range enhanced program area as defined in Section 42-4-304(9)(a)., shall also be inspected for sealing integrity as specified in Part F, Section IV of this regulation.

Vehicles with a missing gasoline cap(s) shall not qualify for issuance of a Certificate of Emissions Control. Motorists whose vehicles have gasoline cap(s) demonstrating excessive leakage shall be notified of the deficiency, repair/replacement and a full retest shall be mandatory.

VI. FREE REINSPECTION

Vehicles which fail any or all elements of an emissions inspection are eligible for one free reinspection within ten (10) calendar days if presented to the same station or facility as initially inspected and failed. In the case of the contractor operated enhanced inspection center network, the ten (10) day free reinspection shall be honored at any enhanced inspection center.

VII. REPAIR INFORMATION

Any after-repairs reinspection of a vehicle initially failed calls for the submittal of a completed official AIR Program emissions repair form.

VIII. CERTIFICATION OF EMISSIONS CONTROL

In order to obtain a Certificate of Emissions Control, the vehicle must meet the following conditions:

VIII.A. Certification of Emissions Compliance may be issued if:

VIII.A.1. The vehicle emissions levels are the same as or less than the applicable emissions limits; or

VIII.A.2. For vehicles in model years seven through ten subject to an on-board diagnostic inspection, the OBD system meets the passing criteria established in Part F, Section VII. of this regulation, and

VIII.A.3. There are no smoke emissions visible from the vehicle engine crankcase and/or tailpipe, and

VIII.A.4. For 1975 through 1995 model years, the vehicle passes the emissions control systems inspection, and

VIII.A.5. Under enhanced inspection requirements, the vehicle owner/operator of a 1995 or newer model year vehicle shall demonstrate compliance with any federal emissions recall-pursuant to 40 CFR Part 85.1902 (d) or remedial repair plan pursuant to Section 207 (C) of the federal Clean Air Act for which owner notification occurs after 01 January 1995.

VIII.B. A Certification of Emissions Waiver may be issued if:

VIII.B.1. The vehicle passes the emissions control systems inspection (1975 and newer model year vehicles only) required by Part C, Section III. A, B and C.; and

VIII.B.2. Basic Program

For model year 1981 and earlier at least seventy-five dollars (\$75) has been spent on emissions related adjustments and repairs as specified in Part C, Sections IX and X provided that proof of repair costs for that specific vehicle has been provided to Department of Revenue personnel or designee in the form of an itemized bill, invoice, work order, manifest, or statement in which emissions related parts and/or repairs, are specifically identified.

For model years 1982 and newer, at least two hundred dollars (\$200) has been spent on emissions related adjustments and repairs as specified in Part C, Sections IX and X, provided that proof of repair costs for that specific vehicle has been provided to Department of Revenue personnel or their designee in the form of an itemized bill, invoice, work order, manifest, or statement in which emissions related parts and/or repairs, are specifically identified.

VIII.B.3. Enhanced Program

For model year 1968 and newer, at least ~~four hundred and fifty~~seven hundred fifteen dollars (~~\$450~~\$715) or as adjusted annually by the Consumers Price Index for Urban Consumers (CPIU) of the previous year as compared to ~~1989-2003~~ has been spent on emissions related adjustments and repairs as specified in Part C, Sections IX and X, provided that proof of repair costs for that specific vehicle has been provided to Department of Revenue personnel or their designee in the form of an itemized bill, invoice, work order, manifest, or statement in which emissions related parts and/or repairs, are specifically identified. The Division shall adjust the amount that must be expended by the motorist in order to qualify for a Certificate of Emissions Waiver, which amount shall be established for each calendar year through 2004 by the Division pursuant to the criteria specified in Section 42-4-310(1)(d)(VI), C.R.S.

For model year 1967 and earlier at least seventy-five dollars (\$75) has been spent on emissions related adjustments and repairs as specified in Part C, Sections IX and X provided that proof of repair costs for that specific vehicle has been provided to and verified by the emissions inspector in the form of an itemized bill, invoice, work order, manifest, or statement in which emissions related parts and/or repairs, are specifically identified.

If no emissions reduction is achieved, the motorist is to be referred to the Department of Revenue or its designee pursuant to Sections IX. G. and X. of this Part C.

VIII.B.4. An emissions reduction as determined either by the Division-approved Colorado 94 of Colorado BAR 97 Test Analyzer System has resulted due to emissions related repairs and the applicable cost limit has been met. Proof of these emissions related repairs are required and to be retained by the AIR Program station, facility or center until purged by state program personnel. The vehicle must have passed the emissions control systems inspection and there were no smoke emissions visible from the vehicle engine crankcase or exhaust system.

VIII.B.5. Engine operational parameter verification.

VIII.B.5.a. All engine parameter adjustments for idle speed, proper air/fuel ratio and cold enrichment, as well as proper ignition dwell and timing (if applicable), have been set to or verified as being set to manufacturers specification by a licensed mechanic or registered repair facility/technician.

VIII.B.5.b. For those 1981 and newer vehicles equipped with computer based, engine management systems, also known as closed loop, feedback controls shall have the following additional sensors/systems verified to be operating within vehicle manufacturer specifications.

VIII.B.5.b.(1) As applicable to the vehicle being inspected, the oxygen sensor, throttle position sensor, coolant temperature sensor, manifold absolute pressure sensor.

VIII.B.5.b.(2) The engine management control system will be scanned for default/malfunction codes with those systems or components identified corrected.

VIII.B.5.b.(3) Primary and secondary ignition system integrity shall be verified for correct operation.

VIII.B.5.b.(4) A fuel delivery system utilizing a carburetor will be inspected for leaks, idle speed control adjustments, float operation and cold enrichment. A fuel delivery system utilizing fuel injection, be it throttle body or multiport configuration, shall be checked for injector function, cold enrichment and injector spray patterns. Fuel injectors shall also be evaluated for proper volume and injection pulse width. Fuel system pressure shall be checked for residual and running pressure.

VIII.B.5.b.(5) A cylinder leak down procedure shall be performed on all cylinders of the engine with the results reported to the motorist.

VIII.B.5.b.(6) With the exception of item (5) above, component/system deficiencies found to be out of manufacturer's operational specification(s) will be corrected. The cost of such repairs shall be creditable towards issuance of a waiver.

VIII.C. If in the opinion of a registered emissions repair facility/technician, a vehicle which is properly adjusted to all manufacturers emissions related specifications and all emissions control systems appear to be operating as required, yet the vehicle continues to exceed one or more emissions limits and the repair expenditure limits have not been met, a waiver shall be issued upon physical verification of systems operation and vehicle performance by emissions technical center personnel.

VIII.D. For vehicles registered and operated in the enhanced area, upon verification by a Department of Revenue Motor Vehicle Emissions Compliance Inspector, a waiver not to exceed one inspection cycle may be granted to obtain necessary emissions related repairs on a vehicle in the case of economic hardship when the Certificate of Emissions Waiver requirements of this section have not been met. It must be verified that the vehicle owner in question is participating in an established and recognized public assistance program. The provisions of this Paragraph D shall only apply to a vehicle

once. To obtain a hardship waiver, the registered owner of the vehicle in question shall satisfy the following requirements:

VIII.D.1. The vehicle must fail for carbon monoxide, hydrocarbons, and/or oxides of nitrogen failures.

VIII.D. 2. The hardship waiver will not be approved for vehicles that are tampered, missing equipment, fail the evaporative inspection, or fail for visible smoke.

VIII.D. 3. The vehicle owner must be participating in an established and recognized public assistance program.

VIII.D. 4. The vehicle must be the sole means of transportation for the vehicle owner, and the ~~only vehicle registered in the owner's name~~owner must not have more than two vehicles registered in his/her name.

VIII.D. 5. Such extension may be granted only once per vehicle.

VIII.E. A Certificate of Emissions Waiver will not be issued to a vehicle that is eligible for the Emissions Control Systems Performance Warranty, 207(b) of the federal Clean Air Act. Per the provisions of the 207(b) Performance Warranty, the repair costs necessary for compliance with AIR Program emissions limits specified in Part F of this regulation will be borne by the vehicle manufacturer or his authorized dealer representative.

VIII.F. The emissions mechanic or emissions inspector shall generate the appropriate vehicle inspection report forms, electronic records, Certificate of Emissions Control, as required by the Department of Revenue or the Division and distribute to the motorist and the Departments of Health and Revenue. The emissions mechanic or emissions inspector will remove all expired Verification of Emissions Test windshield stickers. The vehicle inspection report is to be electronically identified by the issuing emissions mechanic or emissions inspector.

IX. ADJUSTMENT PROCEDURES

The emissions mechanic is to secure high altitude specifications for idle speed, idle mixture, ignition timing, dwell, and fast idle speed for the purpose of adjustment. If no high altitude specifications are available through the Department of Health or other reference sources refer to the emissions decal, other applicable specifications guide, or sea level specifications for proper specifications.

IX.A. With a dwell meter, check to determine if the ignition dwell is within the recommended tolerance of $\pm 2^\circ$ of specifications. Reset if the ignition dwell is not within tolerance.

IX.B. Connect tachometer to determine if idle speed is correct. If not, set to manufacturer's specifications with a tolerance of ± 50 rpm.

IX.C. With the engine idling at the correct speed, check ignition timing to determine if it is within $+4^\circ$ to -2° of the recommended setting, if no high altitude specifications are available.

IX.D. Using an infrared analyzer, propane enrichment kit, and/or tachometer, adjusts the idle air/fuel ratio using manufacturer's suggested procedures and specifications, if applicable.

IX.E. After completing the preceding steps, readjust idle speed to manufacturer's specifications, if not within tolerance.

- IX.F. Using the manufacturer's suggested procedure, check the fast idle speed and adjust to manufacturer's specifications.
- IX.G. If the vehicle continues to exceed applicable emissions limits, or continues to fail OBD, the vehicle must undergo specific emissions related adjustments and repairs. Adjustments and repairs must be accomplished to the point of compliance, or the applicable cost ceiling must have been met. If the applicable emissions related adjustment and repair requirements have been met but an emissions reduction has not resulted, the vehicle owner may be referred to a Department of Revenue Motor Vehicle Emissions Compliance Inspector to get a waiver. Repairs must have been reasonably calculated to achieve a reduction in emissions of those components of the inspection the vehicle failed, pursuant to manufacturer's specifications as required by Sections 42-4-306(7)(a)(II)(A) and 42-9-111, C.R.S.

X. EMISSIONS RELATED REPAIRS

- X.A. Emissions related repairs generally include only those adjustments to and maintenance and repair of the motor vehicle that are directly related to the reduction of exhaust emissions necessary to comply with the applicable emissions limits and procedures. The expenditure for emissions related repairs does not include the inspection fee as specified in Section 42-4-311, C.R.S. or expenses associated with the adjustments to and maintenance, replacement, and repair of air pollution control equipment on the vehicle if the need for such adjustment, maintenance, or repair pursuant to Part C, Section III is due to disconnection of, tampering with, or abuse to such air pollution control equipment. Air pollution control equipment is any part, assembly or system originally installed by the manufacturer for the sole or primary purpose of reducing emissions.
- X.B. Repairs and maintenance to the following systems shall qualify as emissions related repairs insofar as the purpose is to reduce exhaust emissions:
- Air Intake Systems
 - Ignition Systems
 - Fuel Control Systems
 - Emissions Control Systems
 - Basic Engine Systems
 - For microprocessor (O₂) based air/fuel control systems, cooling systems.
- X.C. Within the basic program, emissions related adjustments and repairs must have been performed by a licensed emissions mechanic or repair facility/technician registered with the Division pursuant to Part D of this regulation in order to be creditable to the repair cost waiver limits.

In order to be creditable to the enhanced repair cost limits, adjustments and repairs must have been performed by a repair facility/technician registered with the Division pursuant to Part D of this regulation.

Only the appropriate emissions failure related parts costs should apply to applicable waiver limits for repairs not performed at a licensed emissions inspection station or registered repair facility/technician.

XI. ENGINE CHANGES

- XI.A. For those vehicles in which the original engine has been replaced, the emissions limits and applicable emissions control equipment for the year and model of the vehicle body/chassis, as per registration/title or replacement engine, whichever is newest, shall apply. For those diesel powered vehicles which have been converted to operate on fuel(s) other than diesel; the emissions limits and applicable emissions control equipment for the year, make and model of the gasoline powered engine equivalent as originally manufactured, for the vehicle body/chassis, per the registration or replacement engine, whichever is newest, shall apply as determined by emissions technical center personnel or designee and specified on an official AIR Program vehicle evaluation form (DR2365).
- XI.B. For 1975 and newer vehicles in which the original engine has been replaced, if either the vehicle body/chassis original engine, as per registration/title or replacement engine as manufactured had a catalytic converter system, air injection reaction system, and/or microprocessor based air/fuel control system, these emission control systems must be present, intact and operational before a Certification of Emissions Control may be issued.
- XI.C. For those vehicles titled/registered as model year 1975 and newer, that were assembled by other than a licensed manufacturer such as kit-cars, registered/titled according to Section(s) 42-6-108 and/or 42-5-205, C.R.S. and assigned a state or manufacturer specific identification number, the applicable emissions control equipment and standards will be based upon a determination by technical center personnel of the vintage of the vehicle engine. The technical center personnel may issue an affidavit and the year of the engine shall be presumed to be that stated by the vehicle owner unless it is determined by state emissions technical center personnel or designee, after physical inspection of the vehicle engine, that the year of the engine is other than stated by the owner.

XII. CLEAN SCREEN INSPECTION PROGRAM PROCEDURES

- XII.A. Eligibility to participate
 - XII.A.1. Vehicles specified in Part A, Section IV.B., are eligible for participation in the Clean Screen Program.
 - XII.A.2. Clean Screen inspections applicable to the program are those performed within twelve months prior to an individual vehicle's registration renewal date.
 - XII.A.3. Vehicles are eligible for participation in the Clean Screen Program when the two most recent consecutive emissions readings observed during the 12-months prior to its registration date comply with the standards specified in Part F, Section VI. and: the most recent passing emissions reading occurred on a different day or at a different site location from the prior reading. Additionally, vehicles that are identified as low emitters on the low emitting vehicle index are eligible for participation in the clean screen program when the most recent emissions reading observed during the 12-months prior to their registration date complies with the standard specified in Part F, Section VI.
 - XII.A.4. The following vehicles are ineligible for participation in the Clean Screen Program:
 - XII.A.4.a. New Vehicles as specified in Section 42-4-310(b)(II)(A), C.R.S.
 - XII.A.4.b. Vehicles involved in a change of ownership.

XII.A.4.c. Vehicles owned by the United States government or any agency thereof pursuant to Section 42-4-310(l)(b)(I), C.R.S.

XII.B. All aspects of inspection must be performed by a licensed Clean Screen Inspector.

XII.C. Clean Screen Test Analyzer Systems

XII.C.1. Vehicles participating in the Clean Screen Program shall be tested as specified in this Part C utilizing a Clean Screen Test Analyzer System recognized by the Division as having complied with the performance and design requirements specified in Part B, Section IX. of this regulation.

XII.C.2. Clean Screen Test Analyzer Systems will be periodically calibrated and maintained as required in Part B, Section IX. of this regulation.

XII.C.3. The inspection data processing system(s) used by the Data Manger and Clean Screen Inspector will be that approved by the Division, and the Department of Revenue.

XII.D. Vehicle owners participating in the Clean Screen Program are not subject to the provisions of Part C, Sections I. through XI.

XII.E. Certification of Emissions Control.

In order to obtain a Certificate of Emissions Control the following conditions must be met:

XII.E.1. The vehicle emissions levels are the same as or less than the limits specified in Part F, Section VI.

XII.E.2. The most recent two consecutive emissions readings were observed within twelve months of the registration renewal date provided that the most recent passing emissions reading must have occurred on a different day or at a different site location from the prior reading.

XII.E.3. No non-complying emissions readings are observed between or subsequent to the last pair of complying readings.

XII.E.4. For vehicles that are identified as low emitters on the low emitting index the most recent emission reading was observed within 12-months of the registration renewal date. For these vehicles, identification as a low emitter on the low emitting vehicle index shall take the place of the second remote sensing reading otherwise required under Section XII.E.2., above.

PART D Qualification and Licensing of Emissions Mechanics, Emissions Inspectors, and Clean Screen Inspectors; Licensing of Emissions Inspection and Readjustment Stations, Inspection-Only Stations, Inspection-Only Facilities, Fleets, Motor Vehicle Dealer Test Facilities, Enhanced Inspection Centers; Qualification of Clean Screen Inspection Sites; and Registration of Emissions Related Repair Facilities and Technicians

I. LICENSING OF EMISSIONS INSPECTION AND READJUSTMENT STATIONS, INSPECTION-ONLY STATIONS, INSPECTION-ONLY FACILITIES, ENHANCED INSPECTION CENTERS, FLEET INSPECTION STATIONS AND MOTOR VEHICLE DEALER TEST FACILITIES

I.A. Emissions Site Requirements for the Licensing of Emissions Inspection and Readjustment Stations, Inspection-Only Stations, Inspection-Only Facilities, Fleet Inspection Stations and Motor Vehicle Dealer Test Facilities:

I.A.1. Applicability

All emissions inspection and readjustment stations, inspection-only stations, inspection-only facilities, fleet inspection stations, and motor vehicle dealer test facilities are required to meet all applicable standards pursuant to this Part D and the Department of Revenue's adopted regulations in order to qualify for licensing for operation in Colorado's AIR Program.

To achieve the uniformity and security needed in test site locations; in order to meet federal EPA regulations contained in Federal Register vol. 57, Number 215, of the Federal Register and meet the statutory requirements contained in Sections 42-4-301 through 42-4-316, C.R.S.; the Air Quality Control Commission adopts this standard for emissions site requirements.

I.A.2. Standards for emissions inspection sites:

I.A.2.a. All facilities shall be a permanent type of structure.

I.A.2.b. All sites must be capable of receiving mail.

I.A.2.c. All test facilities shall have a minimum of two off-street parking spaces for staging to accommodate additional vehicles.

I.A.2.d. All test site facilities shall have a customer waiting area that provides for observation of the entire emissions inspection process. Observation can be, direct observation, observation by electronic equipment, or other methods that prove to be as effective with prior approval of the Department of Revenue.

I.A.2.e. All test sites shall be capable of conducting all aspects of the inspection process within the confines of a building or structure, and maintaining ambient air temperatures between 41 degrees and 110 degrees Fahrenheit in the inspection area as defined in Section I. C. 1. of Part C of this regulation. Inspections are not required to be performed within the confines of a structure or building provided ambient temperatures are within such parameters.

I.A.2.f. All test site facilities shall have an adequate exhaust removal system which shall be designed so as to not alter the inspection results and to assure safe ambient air quality of the inspection area as established by the Occupational Safety and Health Administration pursuant to 29 CFR, Part 1910, Subpart Z.

I.A.3. Pursuant to Sections 42-4-306(4)(a) and 42-4-307 (8)(a), C.R.S. as amended, the Division shall develop or contract for the development of a training program for emissions mechanics and emissions inspectors. The training program shall be comprehensive in nature and address all aspects of vehicle inspection procedures specified for this regulation.

- I.A.3.a. Participation by emissions inspectors intending to operate in the enhanced program area shall be required.
- I.A.3.b. Participation by emissions mechanics intending to operate in the basic program area shall be voluntary.
- I.A.3.c. Training classes shall be funded by tuition charged to the participants.
- I.A.3.d. The following tuition rates and fees shall apply
 - I.A.3.d.(1) The training class fee shall be no greater than \$150 per participant.
 - I.A.3.d.(2) The instructor's fee for presenting a class shall not exceed \$400.
 - I.A.3.d.(3) The training manual for those emissions mechanics who choose not to participate in a training class shall be no greater than \$25.
- I.A.3.e. These same training provisions shall be applicable to the requalification provisions of Section II.B. of this Part D.

I.B. The following tools, reference manuals and diagnostic equipment shall be available for performance of inspections; and within the basic program, emissions related adjustments and repairs.

- I.B.1. Division approved calibrated and spanned Test Analyzer System (TAS) or On-Board Diagnostic Test Analyzer System (OBD TAS).
 - I.B.1.a. As a provision of continued license to perform AIR Program inspections, the TAS must be updated as required, pursuant to this regulation.
 - I.B.1.b. The station or facility owner or operator shall maintain a full service/maintenance contract with the equipment manufacturer or equipment manufacturer's designee valid for the duration of the program but renewable on an annual basis
- I.B.2. Rules for the operation of AIR Program inspection stations provided by the Colorado Department of Revenue.
- I.B.3. Tachometer capable of reading 4,6 and 8 cylinders, 0-6,000 RPM minimum at no greater than 10 RPM of actual speed.
- I.B.4. Emissions control systems applications guide as incorporated into the TAS, and oxygen sensor/check engine light, systems maintenance guide in either printed or electronic medium.
- I.B.5. Dwell meter.
- I.B.6. Ignition timing light.
- I.B.7. Propane enrichment kit for idle mixture adjustment and diagnostics.

- I.B.8. Commercially available reference manuals giving idle speed, idle mixture, mixture control dwell or fuel injection duration, timing, dwell, fast idle speed specification, high altitude specifications and information covering the emissions control systems description, diagnostic and repair procedures for the year models of vehicles involved in the AIR Program. In either printed or electronic medium.
- I.B.9. Sufficient hand tools including but not limited to suitable computer scanner diagnostic link, digital volt/ohm meter, vacuum pump and other automotive diagnostic equipment for proper performance of the inspections, adjustments and emissions related repairs as applicable to the licensed entity.
- I.B.10. Division approved span gas and equipment for performing gas span checks and calibrations.
- I.B.11. Suitable non-reactive tail pipe extenders or probe adapter for inspecting vehicles with screened or baffled exhaust systems, or exhaust systems with multiple tail pipes.
- I.B.12. The analyzer manufacturer's maintenance and calibration manual must be retained in the inspection area.
- I.B.13. (Reserved)

I.B.14. Items #5, 6, 7, 8 and 9 above are not required for licensing as an inspection-only station or inspection-only facility.

I.B.15. Items #2 through 11 above are not required for a vehicle fleet self inspection station pursuant to 42-4-309 C.R.S.

- I.C. A licensed emissions mechanic or emissions inspector who has successfully completed a hands-on proficiency check administered by the Department of Revenue in accord with the Commission regulations and those of the Department of Revenue, and the criteria specified in Part D of this regulation is or will be available to make a proper inspection. Enhanced inspection centers shall be open 8:30 am - 7:30 p.m. weekdays, and Saturday 8:00 a.m. - 1:00 p.m.
- I.D. An emissions inspection-only station and inspection-only facility, must so indicate same by posting a sign in a readily visible location, and that no emissions related adjustments or repair services are available should the vehicle fail the inspection procedure.
- I.E. A person to whom there are twenty (20) or more vehicles registered, or to whom said number of vehicles are leased for not less than six continuous months, or are consigned for sale, may be licensed as a "fleet inspection station" or as a dealer licensed under Article 6 of Title 12, C.R.S., a motor vehicle dealers test facility and conduct inspections of that fleet or those vehicles inventoried or consigned for retail sale. As a fleet inspection station or motor vehicle dealer test facility, no inspections may be conducted for the employees or general public, but only on vehicles owned, leased by the business, or consigned or held in inventory for sale. A Certificate of Emissions Control issued by a fleet emissions inspection station will be valid for 12 months, one vehicle registration cycle.
 - I.E.1. Under the self-inspection provisions of Section 42-4-309, C.R.S. for fleets of twenty (20) or more vehicles, the retail sale of a fleet vehicle within the enhanced

program area requires full compliance with applicable inspection procedures as performed by an enhanced inspection center or an (enhanced) inspection-only facility.

- I.E.2. At the time of initial licensing and annually thereafter, the vehicle fleet shall be declared by completing a listing of all eligible vehicles by make, model year, light-heavy duty classification, vehicle identification number, license plate number, and if applicable unit number and state of registration on forms provided by the Division.
- I.F. All AIR Program inspection stations, facilities and centers are required to post in a conspicuous location in a clearly legible fashion a sign indicating the fees charged for inspections and in the basic program area, and maximum fees for emissions related adjustments and repairs required for the issuance of a Certificate of Emissions Control.
- I.G. All AIR Program inspection stations, facilities and centers are required to be linked via dedicated service line to the program data/communications network.
 - I.G.1. Basic program inspection services providers and independent inspection-only facilities in the enhanced area shall be linked to the data network via dedicated voice quality telephone lines with a dial-up back-up telephone line.
 - I.G.2. Enhanced inspection centers shall be linked via dedicated data quality lines with dedicated voice quality lines as dial-up back-up.
- I.H. All sites must provide for reasonable access in order for Departments of Revenue (or if applicable, Health) staff to conduct periodic quality control and audit functions as necessary.
- I.I. Upon request for a license as an emissions inspection and readjustment station, inspection-only station, fleet inspection station, motor vehicle dealer test facility, or inspection-only facility, applicants shall complete forms approved by the Department of Revenue which shall include but not be limited to a declaration of any past violations of AIR Program statute Section 42-4-301 through 42-4-316, C.R.S. as amended or any rule or regulation pursuant to such law.

II. QUALIFICATION AND LICENSING OF EMISSIONS MECHANICS AND EMISSIONS INSPECTORS

II.A. Qualification of Emissions Mechanics and Emissions Inspectors

- II.A.1. Application for qualification as an emissions mechanic and emissions inspector shall be filed with the Air Pollution Control Division. The Division shall administer issuance of letters of qualification. Applications for such letters of qualification shall be completed on forms provided by the Division. Before an applicant may be given a letter of qualification, he must comply with the requirements of this Section II. The Division will notify applicants of the evaluation requirements prior to testing.
- II.A.2. An applicant must demonstrate knowledge, skill, and competence concerning the conduct of emissions inspections, and within the basic program area the adjustment and repair of vehicles to manufacturers' specifications. Such knowledge, skill and competence will be shown by passing a written and skills

proficiency qualification test including, but not limited to, knowledge of the following:

- II.A.2.a. Operation and purpose of emissions control systems.
- II.A.2.b. Relationship of exhaust and evaporative HC and CO to timing and air/fuel ratio control.
- II.A.2.c. Adjustment and repair to manufacturers' and applicable high altitude specifications.
- II.A.2.d. Rules and regulations of AIR Program and proper inspection procedures.
- II.A.2.e. Contemporary diagnostic and engine tune-up procedures.
- II.A.2.f. The provisions of the Emissions Control Systems Performance Warranty pursuant to Section 207 (A) and (b) of the federal Clean Air Act as it applies to the AIR Program.
- II.A.2.g. Visual inspection of the required emissions control equipment for 1975 and newer vehicles.
- II.A.2.h. Operation of and proper use, care maintenance, calibration and gas span checking of the Division-approved inspection equipment.
- II.A.2.i. Proper use of, security, and distribution of inspection forms, Certificates of Emissions Control, and supplemental inspection documents.
- II.A.2.j. Emissions related adjustment and repair requirements for all vehicles failing the initial emissions inspection.
- II.A.2.k. Inspecting for visible smoke emissions.
- II.A.2.l. (Reserved)
- II.A.2.m. Cause and effect of air pollution.
- II.A.2.n. Purpose, goal and function of the AIR Program.
- II.A.2.o. Exhaust and evaporative emissions inspection procedures and rationale for use.
- II.A.2.p. Public relations and motorist assistance.
- II.A.2.q. Safety procedures in the inspection lane or bay.

II.B. Requalification Requirements for all Emissions Mechanics and Emissions Inspectors

- II.B.1. Upon the determination by the Commission of the necessity of technically updating the qualifications for emissions mechanics or emissions inspectors and, upon development or approval of retraining courses and retesting requirements for emissions mechanics to demonstrate said qualification, emissions mechanics, or holders of certificates of qualification, shall be required to requalify biennially.

II.B.2. Emissions mechanics and emissions inspectors shall be required to requalify within ninety days from the date of written notification by the Department of Revenue. Said notice shall be mailed to the address of record in the office of the Department of Revenue charged with licensing of emissions mechanics and inspectors, which notice shall inform the person of the necessity of requalification and the nature of such skills, systems, and procedures requiring the retraining for the continued performance of the emissions inspection. The notice shall give the name and location of training sources approved or accredited for purposes of retraining, the necessity of requalification by a certain date, and the nature and evidence of documentation to be filed with the Department of Revenue evidencing such requalification, and state that failure to requalify within said period of time shall result in suspension or revocation of the emissions mechanic's or emissions inspector's license or certification as described in the Department of Revenue rules and regulations.

II.B.3. The Division shall issue a letter of requalification to any person who has requalified to the satisfaction of the Division and according to the requalification regulation of the Department of Revenue.

II.C. Transmittal of Letters of Qualification and Issuance of Emissions Mechanic's and Emissions Inspector's Licenses

The Division shall provide a listing of all letters of qualification or letters of requalification for emissions mechanics or emissions inspectors to the Department of Revenue, and, upon application by any person qualified, the Department of Revenue shall issue an emissions mechanic's or emissions inspector's license or renewal license in accord with the regulations of that department.

II.D. Lapse of Certificate of Qualification for Emission Mechanic.

A person to whom the Division has issued a letter of qualification, who has not been issued an emissions mechanic's or emissions inspector's license within six (6) months from the date of issuance of the most recently issued letter of qualification shall be deemed to have forfeited said qualification and shall be required to reapply if a new letter of qualification is requested.

II.E. Program License Application Performance Review Criteria

II.E.1. Applicability

Pursuant to Sections 42-4-306(4)(c) and 42-4-308(1)(b), C.R.S. the Commission is authorized to establish minimum performance criteria for licensed emissions inspectors, mechanics, and stations. Based on these performance criteria, Section 42-4-312, C.R.S. grants authority to the Executive Director of the Department of Revenue to suspend or revoke a license on a finding of a pattern of violations.

In order to meet federal act requirements and to provide consistent criteria for the Department of Revenue's review of performance based evaluations that may result in a denial of the license application, the Executive Director of the Department of Revenue or the designee shall apply criteria contained in this Section E.

II.E.2. Standards

The following criteria shall be used by the Department of Revenue's Executive Director or his designee in the review of any emissions license application for a mechanic, inspector,

inspection and readjustment station, inspection-only station, inspection-only facility, fleet station, or motor vehicle dealer test facility.

Performance

Based on violations and penalties provided in Section 42-4-313(4)(b)(1), C.R.S. the following criteria will be used for the review of any emissions license application listed in this section:

- II.E.2.a. Any substantiated violation of intentional passing of a failing vehicle.
- II.E.2.b. Any substantiated violation of performance of emissions tests by an unlicensed mechanic, inspector, or station.
- II.E.2.c. Any substantiated violation of performance of an emissions test on falsified emissions test equipment.
- II.E.2.d. Any substantiated violation of failing of passing vehicles.
- II.E.2.e. Any substantiated violation of flagrant misuse of emissions program control documents.
- II.E.2.f. Any substantiated pattern of non-compliance with AIR Program regulations.
- II.E.2.g. Any substantiated violation of false statements on any emissions license application in an attempt to conceal problems such as: administrative hearings held for program violations, any probation of any emissions license held previously or currently held, any suspension or revocation of any emissions license held previously or currently.

For the purposes of emissions license application review, past performance may entail complete program history review of any person, persons, or officers of a corporation, or partners of any partnership that hold or held a license with the AIR Program.

- II.E.2.h. As a prerequisite to licensing of an emissions mechanic or emissions inspector, a hands-on proficiency check to address the criteria described in Section II. A. 2. of this Part D will be administered by the Department of Revenue in accord with the regulations of the Commission. This evaluation will be conducted at the emissions mechanic's or emissions inspector's place of employment and on an exhaust gas analyzer or test analyzer system that would be used to conduct inspections.

In order to provide for continuity and consistency with training, testing and licensing activities conducted per this Part D, the development and maintenance of the hand-on proficiency check will be coordinated between the Department of Revenue and the Division.

III. REGISTRATION OF EMISSIONS RELATED REPAIR FACILITIES

- III.A. Automotive Emissions Related Repair Facilities May Voluntarily Register with the Division.

- III.A.1. The repair facility/technicians agree to have the effectiveness of their emissions related repairs and repair costs monitored by the Division on an on-going basis.
 - III.A.2. Repair facility/technicians agree to have repair effectiveness listing provided to those motorists whose vehicles fail any element of the inspection procedures specified in Part C of this regulation.
 - III.A.3. The facility shall complete and process AIR Program repair report forms as approved by the Division. Repair report form processing equipment may incorporate PC based bar code technology such that one-dimensional "3 of 9" and two dimensional "PDF 417" symbology can be read and written. The system must be capable of supporting form generation software provided by the state. The printer shall be an ink jet printer or equivalent capable of printing the bar code symbology stated. Refer to Section 2.14 of the TAS specifications attached as Appendix A of this regulation for microcomputers specifications. The Division shall determine performance equivalence.
- III.B. As an aid to motorists seeking emissions related repair assistance, a means will be established whereby a listing of registered repair facilities whose repair effectiveness would be made available and presented to the motorist at the time of inspection failure. Repair effectiveness shall include but may not be limited to:
- a. Number of vehicles repaired and retested
 - b. Percent passing on first retest
 - c. Percent requiring additional repairs and retests
 - d. Percent issued waivers

The listing shall document any recognized professional automotive accreditation or memberships that may include but not be limited to the National Institute for Automotive Service Excellence, or Automotive Service Association. The listing may also indicate the vehicle make(s) or vehicle classification that the repair facility specializes in.

- III.C. Repair facilities may request removal from the listing or temporary placement on an inactive listing while measures are being taken to improve repair effectiveness.
- III.D. It is further suggested that:
- III.D.1. The repair facility/technicians will seek out appropriate training when repair effectiveness deficiencies are identified.
 - III.D.2. Repair facilities will hire and retain technicians certified under "Automotive Service Excellence" tests number A-1, A-6, A-8, and L-1 and that technicians will maintain these levels of certifications.
 - III.D.3. That the repair facility be adequately equipped and maintain a level of diagnostic and repair equipment necessary to perform emissions related repairs based upon the criteria set forth by the Automotive Service Association of Colorado, Incorporated.
 - III.D.4. The Department of Revenue performs a site evaluation of facilities that apply to assess compliance and confirm qualifications.

III.D.5. The facility has or could comply with the provisions established in Part D of this regulation and have not been subject to the penalties prescribed by Section 42-9-111, C.R.S.

III.E. The Division will monitor and periodically report to individual repair facilities their repair effectiveness and average costs as compared to other registered repair facilities.

III.F. The Division shall make repair effectiveness data available to the general public upon request as well as periodically to the Department of Revenue.

III.G. The Division may request a site evaluation of any registered repair facility by the Department of Revenue for reasons of diminished repair effectiveness or noted consumer complaints.

III.H. The Division shall identify the level(s) of repair effectiveness that would result in inadequate emission(s) reductions and negatively impact consumer protection.

IV. REQUIREMENTS FOR CLEAN SCREEN/REMOTE SENSING SITES

IV.A. Applicability

Clean Screen Inspection Sites must meet all applicable standards pursuant to this Part D and the Department of Revenue's regulations in order to qualify for operating in Colorado's Clean Screen Program.

IV.B. Standards for emissions inspection sites

All sites shall comply with all applicable state and local codes/ordinances and maintain appropriate permits for that specific municipality and location.

IV.C. All Clean Screen Sites must provide reasonable access in order for Department of Revenue (and if applicable, Division) staff to conduct periodic quality control and audit functions as necessary.

IV.D. Applicants for a license as a Clean Screen Emissions Inspector shall complete forms approved by the Department of Revenue which shall include, but not be limited to, a declaration of any past violations of AIR Program statute Sections 42-4-301 through 42-4-316, C.R.S., as amended or any rule or regulation pursuant to such law.

V. QUALIFICATION OF CLEAN SCREEN EMISSIONS INSPECTORS

V.A. Clean Screen Emissions Inspector applicants shall apply for letters of qualification on forms provided by the Division. The Division shall issue letters of qualification to applicants who comply with the requirements of this Section V. The Division will notify applicants of the evaluation requirements specified in Part D, Section V.B. prior to testing.

V.B. An applicant for a letter of qualification or requalification must demonstrate knowledge, skill, and competence concerning the operation of Clean Screen emissions inspections. Such knowledge, skill and competence will be demonstrated on actual Clean Screen equipment and by passing a skills proficiency qualification test including, but not limited to, knowledge of the following:

V.B.1. Operation of and proper use, care, maintenance, calibration and gas span checking of the Division-approved Clean Screen Test Analyzer System.

V.B.2. Safety procedures for the Clean Screen Inspection Site.

V.B.3. Proper setup and breakdown of the Clean Screen equipment

VI. REQUALIFICATION REQUIREMENTS FOR ALL CLEAN SCREEN EMISSIONS INSPECTORS

VI.A. Upon the determination by the Division of the necessity of updating the technical qualifications for Clean Screen Emissions Inspectors, holders of certificates of qualification shall be required to requalify biannually. The Division may waive this requirement should it be unnecessary.

VI.B. Clean Screen Emissions Inspectors shall be required to requalify within ninety days from the date of electronic notification by the Department of Revenue.

VI.C. The Division shall issue a letter of requalification to any licensed Clean Screen Emissions Inspector who meets the requirements of Section Part D, Section V.B.

VII. TRANSMITTAL OF LETTERS OF QUALIFICATION AND ISSUANCE OF CLEAN SCREEN INSPECTOR LICENSES

The Division shall provide a listing of all letters of qualification or letters of requalification for Clean Screen Inspectors to the Department of Revenue, and upon application by any person qualified, the Department of Revenue may issue a Clean Screen Inspector's license or renewal license in accordance with the regulations of that department.

VIII. LAPSE OF CERTIFICATE OF QUALIFICATION FOR CLEAN SCREEN INSPECTOR

A person to whom the Division has issued a letter of qualification, who has not been issued a Clean Screen Inspector license within six (6) months from the date of issuance of the most recently issued letter of qualification shall be deemed to have forfeited said qualification and shall be required to reapply if a new letter of qualification is requested.

IX. PROGRAM LICENSE APPLICATION PERFORMANCE REVIEW CRITERIA

IX.A. Applicability

Pursuant to Sections 42-4-306(4)(c) and 42-4-308(1)(b), C.R.S., the Commission is authorized to establish minimum performance criteria for licensed Clean Screen Inspectors and Data Management Contractor(s). Based on these performance criteria, Section 42-4-312, C.R.S., grants authority to the executive director of the Department of Revenue to suspend or revoke a license.

In order to provide consistent criteria for the Department of Revenue's review of performance based evaluations that may result in a denial of a license application, or revocation of a license, the executive director of the Department of Revenue or the designee shall apply criteria contained in Sections IV through VII of this Part D.

IX.B. Requirements

The Department of Revenue's executive director or his designee in the review of any emissions license application shall use the following criteria for a Clean Screen Inspector, or Clean Screen Data Manager.

Performance

Based on violations and penalties provided in Section 42-4-313(4)(b)(1), C.R.S., the following criteria will be used for the review of any license application listed in the section:

- IX.B.1. Any violation of intentional passing of a failing vehicle.
- IX.B.2. Any violation of performance of Clean Screen inspections by an unlicensed inspector, or at an unapproved/unlicensed site.
- IX.B.3. Any violation of performance of a Clean Screen inspection on a falsified Clean Screened Test Analyzer System.
- IX.B.4. Any violation of flagrant misuse of Clean Screen inspection data, control documents, vehicle owner information, or vehicle registration data.
- IX.B.5. Any pattern of non-compliance with AIR Program regulations, including Clean Screen provisions.
- IX.B.6. Any violation of false statements on any license application.
- IX.B.7. As a prerequisite to licensing of a Clean Screen Inspector, a hands-on proficiency check to address the criteria described in Section V of this Part D will be administered by the Department of Revenue in accord with the regulations of the Commission. This evaluation will be conducted at a mutually agreed upon location and on an approved Clean Screen Test Analyzer System that would be used to conduct inspections.

In order to provide for continuity and consistency with qualifying and licensing activities conducted per this Part D, the development and maintenance of the hands-on proficiency check will be coordinated between the Department of Revenue and the Division.

XX

PART H Statements of Basis, Specific Statutory Authority and Purpose

XXXI. AMENDMENTS

ADOPTED NOVEMBER 21, 2013

This revision to Regulation Number 11 is to amend language that will clarify provisions contained in the existing regulation concerning model year exemptions and program implementation dates, updating the listed repair waiver cost limit from \$450 to the currently used \$715 limit, modifying qualification criteria used to grant an economic hardship waiver, and incorporating a new Test Analyzer Specification for On-board Diagnostics in Appendix A.

This Statement of Basis, Specific Statutory Authority, and Purpose complies with the requirements of the Colorado Administrative Procedures Act, Section 24-4-103, C.R.S., and the statutory authority provided in Sections 42-4-301 through 42-4-316, C.R.S.

Basis and Purpose

The Commission's November 2013 amendments are intended to clarify, amplify, and streamline the rule in support of previous recent changes to the Automobile Inspection and Readjustment Program. The proposed modifications are considered minor and will not result in any significant change in program costs or air quality benefits.

The basis of these modifications is to address any ambiguities that may exist in the interpretation of new program changes, as well as add a new Test Analyzer Specification for On-board Diagnostics as required by Regulation Number 11, Part B, Section X.

Federal Requirements

The current inspection and maintenance program, except in the North Front Range, is contained in Colorado's ozone State Implementation Plan (SIP). Any revision to the program requires that air quality credits achieved from the program are not lost.

In general, EPA rules require certain nonattainment areas implement Inspection and Maintenance programs as part of a SIP. Under the Clean Air Amendments of 1990, the Denver metropolitan area was required to implement an "Enhanced" IM Program, specifically for carbon monoxide. Since that time, the state has come into attainment with carbon monoxide, but the program remains a necessary element of Colorado's ozone SIP. The North Front Range area of the program operates as a state-only program

Specific Statutory Authority

Sections 42-4-306 and 42-4-310, C.R.S. authorize the Air Quality Control Commission ("Commission") to promulgate rules for inspection of motor vehicle emissions. Section 42-4-306(8) authorizes the Commission to exempt motor vehicles from emission inspections. Section 42-4-306(3)(b)(V)(B) authorizes the Commission to promulgate rules for alternative motor vehicle emission inspections, including on-board diagnostics (OBD) inspections. 42-4-306(6)(a) authorizes the Commission to promulgate rules on inspection procedures, including those related to OBD and evaporative gases.

Findings Pursuant to 25-7-110.8, C.R.S.

The revision of the rule is to clarify provisions contained in rule or that are administrative in nature. These changes do not increase the regulatory burden on the motoring public, while maintaining the current air quality benefits received from the program, in a cost effective manner, at similar or minimally reduced costs to the current program.

The rule revision is based on reasonably available, validated, reviewed, and sound scientific methodologies. All validated, reviewed, and sound scientific methodologies and information made available by interested parties has been considered. Evidence in the record supports the finding that the rule shall result in a continued demonstrable reduction in air pollution. The rule revision is the most cost-effective alternative, provides the regulated community flexibility, and achieves the necessary reduction in air pollution. The revised rule will maximize the air quality benefits of the regulation in the most cost-effective manner.

XX

APPENDIX A Technical Specifications

~~(Technical Specifications)~~

~~COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT~~

~~SPECIFICATIONS FOR COLORADO 94 ANALYZER~~

~~HARDWARE SPECIFICATIONS~~

Revised Sept 09, 1994

INTRODUCTION

The Colorado AIR Program is in the process of modifying its current automotive inspection and maintenance program to comply with the Clean Air Amendments of 1990. Colorado's current program is based upon BAR 84 inspection technology utilizing a decentralized program format encompassing nine Front Range counties. In order to achieve compliance with the Clean Air Amendments of 1990, Colorado will change to a program format that will have a contractor based operation conducting the IM 240 emissions test and a population of independent inspectors conducting inspections utilizing a new Colorado 94 emissions analyzer. The contractor is based in the "enhanced" program area, basically the Denver metropolitan area and will inspect 1982 and newer vehicles. Independent inspection facilities will inspect vehicles of all years within the "basic" program area as well as being able to inspect 1981 and older vehicles within the "enhanced" area.

The demands for more accurate analytical information as well as a more automated inspection process with real-time data transfer has superseded the capabilities of BAR 84 technology. Current BAR 90 analytical technology is acceptable, but other system enhancements are necessary to meet Colorado's inspection needs. These enhancements and other technical details are described in the remainder of this document.

1.0 GENERAL

1.1 Design Goals

The specifications that have been developed are designed utilizing a personal computer system. The analyzer system must be capable of performing uniform and consistent emission tests for Colorado's Automotive Inspection and Readjustment (AIR) Program. Features of the analyzer include: vehicle emissions measurements of hydrocarbon (HC), carbon monoxide (CO), carbon dioxide (CO₂) and oxygen (O₂); engine RPM measurements, exhaust dilution determinations, pressure test system for EVAP; data entry; data retrieval tables; a dedicated printer (for vehicle inspection certificates) and an additional printer for diagnostics and general purpose printouts; data recording on double sided high density 1.44 megabyte (Mb) 3.5" floppy diskette and a 120Mb (or greater) hard drive; modem for "on-line real time" data transmission; CRT information display to the inspector; bar code (2D) reader and printing capabilities; and fully menu driven, interactive simple microprocessor controlled operation.

Additional, automatic features required include: gas calibrations, zero and span checks, pressure calibrations, gas auditing procedure; leak checks, HC hang-up checks, audit menus (i.e., data read system), test sequencing, and low-flow checks. The analyzer shall be designed and constructed to provide reliable and accurate service in the automotive environment. The software used in the analyzer shall consist of a process control system as well as data look-up files. Security shall be provided to prevent unauthorized modifications to the software or test data and recording unauthorized entry (tampering) and locking out of the inspection process when detected.

The emissions analyzer software shall be designed for maximum operational simplicity.

It shall also be capable of providing emission-reading characteristics, independent of the inspection function, which can be used for vehicle diagnostic.

1.2 Useful Life

The useful life of the analyzer shall be a minimum of five years.

1.3 Nameplate Data

A nameplate including the following information shall be permanently affixed to the housing of the analyzer:

Name and Address of Manufacturer

Model Description

Serial Number

Date of Assembly

The manufacturer shall affix a stick-on type label to the analyzer that contains a toll-free telephone number for customer service. This number can also be included in a service software message.

1.4 Manuals

Each analyzer shall be delivered with the following manuals:

- A. Reference Operating Instructions
- B. Operation Instruction Manual
- C. Maintenance Instruction Manual (limited)
- D. Initial Start-up Instructions

Colorado 94 Analyzer manufacturers may consolidate manuals. The manuals shall be constructed of durable materials and shall not deteriorate as a result of normal use over a five-year period. The analyzer housing shall provide convenient storage for each manual in a manner that will:

- E. Allow easy use.
- F. Prevent accidental loss or destruction.

1.5 Certification Documentation

The analyzer software shall be fully documented. Two copies of the documentation listed below shall be submitted to the Colorado Department of Public Health and Environment as part of the certification application.

- A. Complete program listings. Program listings may be on diskette. They are not required to be submitted with the application for certification.
- B. Functional specifications.
- C. Functional flowcharts of the software.
- D. Example inputs and outputs from all processes.
- E. Detailed interface information on system components including the identification of protocol and output specifications.

- F. All DOS file layouts with file names, file types, file security, field names, field types, field sizes, and field editing criteria.

Documentation provided by the vendor to meet this requirement will be treated as proprietary information by the Colorado Department of Public Health and Environment.

Prior to certification of any Colorado 94 emissions analyzer for sale in Colorado, the manufacturer of such analyzer shall provide the Division with software source codes and all other technical information (including, but not limited to all working codes, schematics and drawings) necessary to operate, maintain, calibrate and repair such analyzer in the event that the manufacturer or its agent ceases providing adequate maintenance, calibration and repair services in Colorado. The manufacturer shall keep such information current, and will provide the Division with copies of any and all changes. So long as such maintenance, calibration and repair, services are available from the manufacturer or its agent, the Division shall protect such information as confidential commercial data if it is clearly marked as such. In the event that the manufacturer becomes insolvent or stops providing adequate maintenance, repair or calibration services in Colorado all such information shall be the property of the Division and may be released to a third party as necessary to repair, calibrate and maintain the analyzers.

1.6 Warranty Coverage/Mandatory Service Contract

A written warranty coverage agreement, signed by an authorized representative of the equipment manufacturer and the vehicle inspection station owner, which provides a complete description of coverage for all systems and components and all manufacturer provided services listed in Section 1.8, must accompany the sale or lease of each Colorado 94 emissions analyzer.

An extended service contract must be available upon the expiration of the manufacturers original warranty period. Original manufacturer's warranty shall be a minimum of one year from the date of purchase. The "service contract" shall be offered in one-year increments and is a mandatory condition of inspection station operation. The "service contract" agreement shall include the inspection station owner's name, inspection station address, telephone number, inspection station identification number, analyzer serial number and detailed terms of the agreement. The agreement must extend for at least one year with the expiration date entered to software file and monitored by the system clock. Approaching expiration messages must be displayed at daily system start-up beginning thirty days prior to expiration and messaging "30 days until expiration, 29 days etc." Failure to renew the "service contract agreement" will cause the analyzer to automatically "lock-out" from any official inspection process. Renewals shall be offered at the inspection station owner's request and governed by "good business" practices between the parties involved. Service contract agreements must be available by the manufacturer for the mandated life of the Colorado AIR Program. Cost disclosures and detailed descriptions of coverage's must be available in printed form and distributed to all Colorado 94 users. Cost disclosure shall also be made for "consumable" inventory items 1.8B. This information would most appropriately be presented with the original manufactures warranty.

1.7 Tampering Resistance

Controlled access design shall be the responsibility of the manufacturer and is subject to approval by the Colorado Department of Public Health and Environment. Analyzer service personnel, inspectors or others shall be prohibited, to the Colorado Department of Public Health and Environment satisfaction, from creating or changing any test results, programs or data files contained in the analyzer. Manufacturers shall utilize special BIOS partitions, or other appropriate software and hardware provisions, deemed necessary to protect the I/M files and programs. The protection features shall prevent access to the secured floppy disk drive and those portions of the hard disk containing I/M programs and test data or files.

The emission analyzer and the sampling system shall be made tamper-resistant to the Colorado Department of Public Health and Environment satisfaction. At a minimum, the manufacturer shall develop tamper-resistant features to prevent unauthorized access through the cabinet. Microswitches, keyed locks, or software algorithms requiring the use of a password, which can be changed by the Colorado Department of Public Health and Environment would all be acceptable provided the physical or logical design effectively prevents unauthorized access.

Manufacturers may offer analyzers with additional floppy disk drives that can run optional software application programs.

If tampering occurs, a software lockout algorithm shall be activated which aborts any existing test sequence and prevents further inspections until an authorized AIR Program official clears the lockout.

The lockout system shall be designed so that an AIR Program official from the audit menu can activate it. Only AIR Program Auditors may remove lockouts put in place from the audit menu. Manufacturers shall develop a system by which their service technicians shall be prevented from clearing "tamper" lockouts.

Optional software packages shall not interfere with the normal operation of the I/M inspection and testing software, and shall not compromise the tamper-resistant features of the analyzer.

Manufacturer field service representatives will not have access to DOS, unless assurances acceptable to the Colorado Department of Public Health and Environment have been provided that insure, integrity of the system will not be jeopardized.

1.8 Manufacturer Provided Services

The manufacturer shall agree to provide the following services to the inspection station as part of the manufacturer's original warranty and thereafter as a portion of the service contract agreement. The cost of a service agreement is to be listed on a year-by-year basis. Future charges cannot exceed the amount published.

- A. Delivery, installation, calibration, and verification of the proper operating condition of a Colorado 94 emissions analyzer.
- B. Quarterly (90 days) examination, calibration, and routine maintenance of the analyzer and sampling systems. Full systems support and repair, including loaner units. Upon initial sale or loan, provide "extra" printer medium (1 ea.) sample filter(s)(2), sample hose (1) and sample probes (1). Maintain the "extra" consumable inventory upon examination and provide a software history file for the replacement of consumables accessible to AIR Program officials. Consumables and the cost(s) thereof must be disclosed in the service agreement.
- C. Instruct all certified inspectors employed by the inspection station at the time of installation in the proper use, maintenance, and operation of the analyzer. The analyzer shall contain a feature that will allow an inspector to go through the complete inspection procedure without generating an official inspection record. This function will be used for evaluating inspector performance, by AIR Program officials, or by the manufacturer for demonstration purposes. The "training mode" shall not require the use of an inspector's access code or allow access to secured areas of hardware or software. The display shall show a message throughout the inspection that this is not an official inspection. Vehicle inspection

reports shall indicate to the satisfaction of the Colorado Department of Public Health and Environment that they are for training only. No official Certificate of Compliance will be generated during the training exercise.

- D. On-site service response by a qualified repair technician within two (2) business days, (48 hours) excluding Sundays and national holidays, of a request from the inspection station. The names, toll-free telephone numbers, and service facility addresses of all manufacturer representatives responsible for equipment service shall be provided to the inspection station. A service representative shall be available at all times during normal working hours. Sundays and national holidays are not included. All system repairs, component replacements, and/or analyzer adjustments, shall be accomplished on-site within 48 hours after a service request has been initiated. If the completion of this work is not possible within this time period, a Colorado 94 loaner unit shall be provided until the malfunctioning unit is properly repaired and returned to service. Service representatives shall have a software driven menu option that allows the transfer of inspection station, inspector information and other applicable data files from one analyzer to another without manual inputs and without transfer of previous test files.

- E. Updates of the "Functional" software will be limited to once per year at no cost.

Updates of operational software i.e., file based information will be on an "as required" basis. All forms of software updating will utilize modem technology for the updating process. File updates are at no cost and every effort will be made to minimize them.

- F. The analyzer software shall be designed so that AIR Program officials can insert a floppy disk, prepared by the manufacturer, into the Program system host, and update the existing software version, via modem. A system of manual updating by program officials utilizing the auditor's menu shall also be available. Look-up up tables and message screens shall be designed sufficiently separate from the main operations software so that it is not possible, to interfere in any way with the operations of the analyzer.

The Colorado Department of Public Health and Environment will require the manufacturer to render updates as necessary in the first year of the program to ensure the program meets all design criteria. Thereafter software updates will be limited to once per year at no cost. Since modem software updating will be utilized, there are no costs to the analyzer owner. A software version number, consisting of a four character alpha-numeric code made up of the last two digits of the year followed by a two character version number, shall be recorded in the analyzer and included on each vehicle test record. The analyzer manufacturer shall not modify any existing software version without obtaining written approval from the Colorado Department of Public Health and Environment.

The Colorado Department of Public Health and Environment may require the manufacturers to conduct on-site or laboratory testing of in-use analyzers in order to document continued compliance. When an analyzer is removed from the field, for repair or testing, manufacturers shall supply the inspection station from which it was removed with a temporary replacement unit meeting all program requirements. Manufacturers shall pay for all necessary shipping and transfer costs for the replacement of the analyzer selected for compliance testing. Manufacturers shall also pay for any required testing performed by their personnel or by an independent company.

The manufacturers shall provide training to AIR Program officials on all operational, maintenance, and quality control features of the analyzers, including full access to and

use of inspection menus, audit menus and calibration menus, as well as optional programs offered to inspectors. Such training shall be conducted at the manufacturer's expense as a condition of certification and thereafter at reasonable intervals upon written request by the Colorado Department of Public Health and Environment

1.9 Certification Requirements

The manufacturer shall submit a formal certificate to the Colorado Department, of Public Health and Environment that states that any analyzer sold or leased by the manufacturer or its authorized representatives for use in the Colorado AIR Program will satisfy all design and performance criteria described in these specifications. The manufacturer shall also provide sufficient documentation to demonstrate conformance with these criteria including a complete description of all hardware components, the results of appropriate performance testing, and a point-by-point response to specific requirements. Previous certification by the California Bureau of Automotive Repair (BAR) is necessary for the analytical bench.

In addition, a full description of the company's service procedures and policies, as well as sample contracts, warranties, and extended service agreements, shall be provided as part of the certification application to ensure proper maintenance of all analyzers throughout their useful life. One fully functional analyzer shall be presented for evaluation and one additional fully functional analyzer for the certification process. If certified these units will remain in AIR Program possession for continued in-use evaluation for the life of the AIR Program. In the event that 1 % of overall unit sales exceed this two-unit base, in-use evaluation will require 1 % of overall unit sales for in use evaluation.

2.0 CONSTRUCTION DESIGN

2.1 Materials

All materials used in the fabrication of the analyzer and the appropriate housing assembly shall be new and of industrial quality and durability. Contact between non-ferrous and ferrous metals shall be avoided where possible. Suitable protective coatings shall be applied where galvanic action is likely. All mechanical fasteners shall have appropriate locking features. Use of self-tapping screws shall be limited. All parts subject to adjustment or removal and reinstallation shall not be permanently deformed by the adjustment or removal-reinstallation process and this process shall not cause deformations to adjoining parts. Only materials that are not susceptible to deterioration when in contact with automobile exhaust gases shall be used.

2.2 Construction

The analyzer shall be complete and all necessary parts and equipment required for satisfactory operation shall be furnished. A suitable means of storing the probes and sample hose shall be provided. A means of storing the "spares" inventory shall be included. All parts shall be manufactured and assembled to permit the replacement and/or adjustment of components and parts without requiring the modification of any parts or the basic equipment design. Where practical, components and/or subassemblies shall be modularized. The analyzer cabinet finish shall be baked enamel or another durable finish.

2.3 Mobility

The analyzer unit shall be designed for easy and safe movement over rough surfaces and/or graded surfaces (15° incline). The center of gravity and wheel design shall be such that the analyzer can negotiate a vertical grade separation of one-half inch (1/2") without overturning when being moved in a prescribed manner. Industrial grade, swivel casters shall be used to

permit 360° rotation of the unit. The caster wheels shall be equipped with oil resistant tires and foot operated brakes capable of preventing movement on a 15° incline.

2.4 Electrical Materials/Construction

Unless otherwise specified, all electrical components and wiring shall conform to standards established by the Underwriters Laboratories, Standard for Electrical and Electronic Measuring and Testing Equipment (U.L-1244).

The analyzer shall operate from an 115VAC, 60 hertz (Hz) supply. An input voltage variation of ± 12 volts shall not change analyzer performance more than 1 % of full scale. The analyzer must operate on a 15 AMP breaker. The power cable shall be equipped with a standard three-prong connector at the inlet, and shall have a National Electrical Code rating of SO, SJO or better with an overall length not to exceed 25 feet. Each emissions analyzer shall incorporate safety devices to prevent conditions hazardous to personnel or detrimental to equipment. The system shall be grounded to prevent electrical shock, and adequate circuit overload protection shall be provided. The analyzer shall incorporate an internal surge protector.

2.5 Sampling System

The sampling system consists of two subsystems: (1) external sampling system; and (2) internal sampling system. The external system shall include a sample probe, sample hose twenty-five feet (25') in length, a water trap, and a filtration system. The internal subsystem shall include but not necessarily be limited to, a sample pump and bypass pump, or an equivalent system approved by the Colorado Department of Public Health and Environment.

The sample probe shall incorporate a positive means of retention to prevent it from slipping out of the tailpipe when in use. A thermally insulated, securely attached handgrip shall be provided on the probe in such a manner that easy probe insertion using one hand is ensured.

The probe shall also have a smooth surface near the probe tip before the flexible portion of the probe to be used for sealing of the span gas adaptor necessary for field or on-board leak checking (vacuum or gas) or response time checking equipment. For standardization, it is recommended that the sealing surface be one-half inch (1/2") in outside diameter and one-half to one inch (1/2" to 1") long. A probe tip cap shall be provided for the sample system leak check. A probe tip adapter or assembly shall be included for use with spark arrester type tail pipes.

The interconnecting hose shall be of such design and weight that the inspector can easily handle it. The hose shall be of non-kinking construction and fabricated of materials that will not be affected by or react with the exhaust gases. Molecular HC hang-up shall be minimized. The hose connection to the analyzer shall be reinforced at the point of maximum bending. The system shall be designed with a water trap in the bypass sample stream. The water trap shall be continually self-draining. The trap bowl shall be constructed of a durable transparent material. The water trap should be located as low as possible on the analyzer so that condensed water in the sample hose will drain into them. However, the trap must be placed in a position readily visible to the inspector. The sample for the analyzer shall be obtained from the top of the water trap. The sampling system shall be equipped with a suitable particulate filter upstream of the optical bench. There may be a secondary filter located in the sample hose, serviceable by the inspector. This filter must have sufficient capacity to filter the samples obtained during the routine testing of vehicles in the inspection station. Threaded connections must be used to attach the filter to the sample hose. A prompt shall be provided to the inspector indicating when the filter should be changed based on an indication of low flow (automatic lock-out) or other criteria approved by the Colorado Department of Public Health and Environment

The pumps shall contain corrosion resistant internal surfaces. The pumps shall have a minimum operational life of 2,000 hours without failure.

The sample pump system may be a single pump, multiple pumps, or a multiple stage pump or an equivalent system approved by the Colorado Department of Public Health and Environment. The sample pump shall have integral motor overload protection and be permanently lubricated. The bypass system shall be connected in the sample system so that any water condensed in the water trap is removed and dumped outside the system.

2.6 Storage Temperature

While in storage, the analyzer and all components thereof shall be undamaged from ambient air temperatures ranging from 0° F to 120° F.

2.7 Operating Temperature

The analyzer and all components shall operate within calibration limits in ambient air temperatures ranging from 41° F to 110° F.

2.8 Humidity Conditions

The analyzer shall be designed for use inside a building that is vented or open to outside ambient humidity. The analyzer, including all components of the analytical, sampling, and computer systems, shall operate within the required performance specifications at ambient conditions of up to 80% percent non-condensing relative humidity throughout the required temperature range, assuming the components are reasonably protected by the inspector from direct contact with water, or other condensing moisture. Failure of any component due to exposure to temperature and humidity extremes within this limits specified during actual use shall be corrected at the manufacturer's expense.

2.8.1 Temperature Control

Analyzer components that affect sensitivity and calibration shall have their internal temperatures controlled to maintain design temperature when exposed to prevailing ambient conditions. If internal operating temperatures are exceeded the analyzer will automatically lockout from any official inspection process.

2.9 Barometric Pressure Compensation

Barometric pressure compensation shall be provided. Compensation shall be made for elevations up to 6,000 feet (mean sea level). At any given altitude and temperature, errors due to barometric pressure changes of \pm two inches (2") of mercury shall not exceed the accuracy limits specified in this specification. Manufacturers shall describe in writing how compensation will be accomplished. The method used shall be acceptable if approved by the Colorado Department of Public Health and Environment.

2.10 Operational Design

A. Analytical System

These analyzers shall utilize non-dispersive infrared systems for measuring hydrocarbons (HC), carbon monoxide (CO), and carbon dioxide (CO₂). Oxygen (O₂) shall also be measured and ambient air will be used for calibration purposes.

B. Readout Display/CRT Screen

The screen shall contain numerical HC (as hexane), CO, CO₂ and O₂ displays and a pass/fail indication at the completion of the inspection process. Pressure purge shall be a pass/fail indication, with pressure/time values recorded to file.

The numerical display shall be of a digital format. The resolution of the emissions display shall be as follows:

HC: XXXX ppm (as hexane)

CO: XX.XX%

CO₂: XX.X%

O₂: XX.X%

The **MINIMUM** display increments shall be 1 ppm HC, 0.01 % CO, 0.1% CO₂, and 0.1% O₂. The displays shall be capable of full-scale readings of 2000 ppm HC (as hexane), 9.99% CO, 16.0% CO₂ and 25.0% O₂.

CRT display is to be employed for an exhaust sample validity (sample dilution). This indication will signal excess dilution in the exhaust system based upon measurement of CO + CO₂ emissions.

The analyzer shall be capable of selecting the pass/fail values (limits) based on vehicle model year, vehicle type, or other criteria. The system shall be designed in such a manner that the standards and vehicle groups may be readily revised by a modem software update.

Specific emissions limits and vehicle model year groupings are available in this Regulation Number 11, Part F: maximum allowable emissions limits for motor vehicle exhaust, evaporative and visible emissions for Light-Duty and Heavy-Duty vehicles.

2.11 Automatic Calibrations

The analyzer shall be designed to require an automatic two-point gas calibration for HC, CO, and CO₂, and an automatic electrical zero and span check. (O₂ shall be measured by ambient air.) The automatic gas calibration shall be conducted every 24 or 72 hours, activated by the internal clock. The option of 24 HOUR calibration will be software selectable, with the default @ 72 hours. Electrical zero and span check (automatic) shall be required prior to each test sequence. User-friendly prompts shall be provided to the inspector to indicate every step needed to properly perform the required gas calibration (including when it is necessary to turn the gas cylinder valve on and off).

If the system is not calibrated, or the system fails the calibration or the zero and span check, an error message or fault indication shall be displayed and the analyzer shall be locked out to prevent the performance of an emissions inspection. Lockout will remain until the system is properly calibrated and passes a calibration check and zero and span check.

The calibration record will contain before and after calibration readings. The gas calibration shall ensure that accuracy specifications are satisfied and that linearity is correct at the required span points. The gas calibration and leak check procedures shall require no more than five (5) minutes

to complete. The analyzer shall provide adequate prompts on the display to guide the inspector through the calibration procedure in a manner that minimizes the amount of calibration gas used.

The system shall have the capability of printing historical calibration data for specified date ranges by the AIR Program Auditor. (Audit menu, calibration history)

For HC, CO and CO₂, analyzer manufacturers shall limit gas usage during the gas calibration procedure to two liters per point. The analyzer shall also be designed to keep the loss of calibration gas to an absolute minimum (less than 0.5 liters in 24 hours) if the calibration gas valve(s) is/are not shut off. Manufacturers shall provide an evaluation of this capability, consisting of at least four (4) analyzers, with their certification application materials and shall demonstrate this feature during certification.

The analyzer shall be equipped with a gas calibration port for the purpose of performing a probe to calibration port comparison for audit purposes. Gas auditing shall be accomplished by introducing standard gases into the analyzer either through the calibration port or through the probe. Span gases utilized for calibration shall be within two percent (2%) of the following points: Ambient air may be used to calibrate the O₂ sensor.

(HC)	300	ppm propane
	1.0	% carbon monoxide (CO)
	6.0	% carbon monoxide (CO ₂)
	Bal.	Nitrogen (N ₂)
(HC)	1200	ppm propane
	4.0	% carbon monoxide (CO)
	12.0	% carbon monoxide (CO ₂)
	Bal.	Nitrogen (N ₂)

The standard gases used to calibrate, and audit the analyzers shall satisfy the criteria included in the Federal Clean Air Act, Section 207 (b) and described in Subpart W of Part 85 of Chapter I, Title 40 of the Code of Federal Regulations. In order to ensure that the quality of the standard gases used in the program meet these specifications, all standard gases purchased by the inspection facility for use in the analyzer must conform to the requirements established in 1990 by the California BAR for Test Analyzer System Calibration Gases. Calibration gases must be purchased from a vendor that has Colorado gas blender certification, REF. Colorado Regulation Number 11, Appendix B. These requirements include the testing and certification of the concentration, accuracy, precision, and purity of the standard gases to within the referenced limits and the labeling of individual gas canisters describing these and other specified parameters.

Automatic EVAP Pressure Calibration

The pressure test system is to be calibrated every 24 or 72 hours and zero/span checked before each inspection. Pressure calibration checks should be performed simultaneously with the gas calibration procedure. Calibration and/or zero span checks must pass or the analyzer must lockout from further testing until the discrepancies are corrected. All calibrations will be stored to

the Cal.Dat file. Pressure system calibrations shall be performed in a maximum time period of 5 minutes, calculated independently from the gas calibration and leak check. The optional 24-hour option shall be selectable and defaulted to 72 hours.

A. Automatic Leak Check

An automatic leak checking system shall be provided that will allow the vacuum side of the system to be checked for leakage. Appropriate valves, lines, and switches shall be installed to permit this operation. Minimal activity by the inspector, such as setting the probe in a holder or capping the probe, is permitted, provided errors resulting from improper inspector action would be identified by the computer and would require corrective actions. Improper action would cause the system to fail a leak check, and automatically lockout. User-friendly prompts shall be provided to the inspector to indicate every step needed to properly perform the required leak check (including when it is necessary to turn the gas cylinder valve on and off).

A system leak check shall be accomplished every 4 or 24 hours and in conjunction with the gas calibration performed every 24/72 hours, activated by the internal clock. The 4-hour option shall be software selectable with the 24 hours as the default value. Four-hour leak checks are required only for those facilities performing more than 4000 inspections per year. The analyzer shall not allow an error of more than $\pm 3\%$ of reading using mid-range Colorado certified span gas to perform the leak check. Fittings and connectors used on the sample hose and probe shall be constructed to inhibit the bypass of the leak check. A maximum of two liters of calibration gas may be used to perform the leak check. If the system is not leak checked, or the system fails a leak check, an error message or fault indication shall be displayed, and the analyzer will be locked out to prevent the performance of an emission inspection, until the system is properly leak checked and passes.

B. Automatic HC Hang-Up Check

The analyzer shall be designed for using ambient air induced through the sample probe, prior to each test sequence. The analyzer shall have a CRT prompt/indicator. "Hang-up" activation shall cause the analyzer to automatically sample ambient air through the sample line and probe. The system shall continue to sample room air for a maximum of **150** seconds or until the HC response is below 20-ppm hexane.

If the HC hang-up does not drop below 20 ppm within **150** seconds, a message shall be displayed indicating possible dirty filters or sample line. If after **150** seconds HC levels are not below specified values, the test shall be discontinued until HC hang-up is corrected. When the level stabilizes below this value, an indication that testing may begin shall be displayed. The analyzer shall be locked out from operating until the HC level is met.

C. Vehicle Diagnostics

During analyzer warm-up, emissions diagnostics and other gas reading functions shall be prohibited. After successful warm-up and for the purpose of vehicle diagnosis or repairs, the analyzer shall have a menu selection that will allow the analyzer to continuously monitor the vehicle exhaust.

The automatic data collection system shall be prevented from operating anytime the analyzer is not being used in the official emissions inspection mode.

D. Dilution

The analyzer manufacturer shall document to the satisfaction of the Colorado Department of Public health and Environment that the flow rate on the analyzer shall not cause more than 10% dilution during sampling of the exhaust at normal idle (10% dilution defined as sample of 90% exhaust and 10% ambient air). Manufacturers shall utilize the procedures specified by the BAR for demonstrating this dilution criterion. The analyzer shall be equipped with a feature to identify vehicle exhaust system leaks and sample dilution. The preferred method for identifying leaks is monitoring the CO & CO₂ levels in the exhaust. Other additional techniques that can demonstrate improved sensitivity to leaks may also be used.

DILUTION VALUES:

All light duty vehicles: 6%

All heavy-duty vehicles: 5%

If the CO + CO₂ reading is less than the limit, the inspector shall be prompted to check the exhaust system for leaks and to make sure that the sample probe is all the way into the tailpipe. If the excessive dilution is detected after the initiation of the test sequence, the analyzer output shall display "SAMPLE DILUTION". If dilution continues the inspector shall be required to "Abort Test". The system shall store the "Abort Test" indication.

E. Engine Tachometer

A digital display tachometer shall be CRT displayed for the purpose of measuring engine speed. The tachometer operation shall be by two means; (1) radio frequencies "RF" type transmitter/receiver that requires no direct vehicle connection and can detect engine RPM on vehicles utilizing "DIS" systems. (2) a cable type connection capable of detecting engine RPM from all forms of current O.E.M. ignition technology. Tachometer performance shall be no less than; RPM with a 0.5 second response time and an accuracy of $\pm 3.0\%$ of actual RPM. During an official inspection process, the software will prompt the inspector to shut the engine off while connecting the RPM probe (only if a cable connection is being made). A software "HELP" screen will be available to assist the inspector in locating an RPM signal. This information may be supplied or reviewed by the Colorado Department of Public Health and Environment. Based on the vehicle identification information available to the inspector, the analyzer will prompt the inspector as to which vehicles require a specific type or method of connection of the tachometer pick-up. Analyzers shall be provided with all the software and hardware that is necessary to make them capable of reading engine RPM from all O.E.M. ignition technologies in use at the time of certification, Possible updates may be required to enable future ignition systems to be monitored for engine RPM.

F. Analytical Bench Accuracy

Each analyzer shall meet the following analytical accuracy requirement:

<u>Channel</u>	<u>Range</u>	<u>Accuracy</u>
HC ppm	0-400	± 12 ppm

<u>Channel</u>	<u>Range</u>	<u>Accuracy</u>
	401-1000	±30 ppm
	1001-2000	±80 ppm
CO%	0-2.00	±0.15 %
	2.01-5.00	2.040%
CO2%	04.0%	±0.6
	4.1-14.0	±0.5%
	14.1-16.0	±0.6%
O2%	0-10.0	±0.5%
	0-10	±1.3%

The analyzer display resolution electronics shall have sufficient resolution and accuracy to achieve the following:

HC	1 ppm	HC
CO	0.01 %	CO
CO2	0.1%	CO2
O2	0.1%	O2

G. Drift

If zero and/or calibration drift cause the infrared signal levels to move beyond the adjustment range of the analyzer, the inspector shall be locked out from testing and instructed to call for service.

H. Warm-Up

The analyzer shall reach stabilized operation in an inspection station environment within 15 minutes at ° 41 degrees Fahrenheit from "power on". The instrument shall be considered "warmed-up" when the zero and span readings for HC, CO, and CO2 have stabilized, within ± 3% of full range of low scale, for five minutes without adjustment.

Functional operation of the gas-sampling unit shall remain disabled through a system lockout until the instrument meets stability and warm-up requirements. If the analyzer does not achieve stability with 15 minutes, from "power-on", it shall be locked out from I/M testing and a message shall be displayed instructing the inspector to call for service.

During the warm-up, the Main Menu shall be displayed unless an optional functional menu or menus are offered. The analyzer system shall lock out all bench related functions during warm-up. During warm-up, a message under the main menu shall be prominently displayed as follows: "Warm-up in progress - checking for stability". During the initial entry into the "warm-up" period, and before any other menu can be selected, the software will automatically enter a "bulletin display" function and display any messages or bulletins forwarded from the AIR Program host system via modem transfer in the past 72 hours. This screen will reference the inspector.dat file and require each inspector to enter their access code as verification of receipt, before allowing that inspector to Proceed with an inspection. No inspector can enter into an official inspection without having "logged on" as having seen the Bulletin screen. When stability is achieved and the warm-up requirements are satisfied, access to gas bench functions shall be permitted.

I. System Response Time Requirements

The response time from the probe to the display shall not exceed eight (8) seconds to 90% of a step change in input, nor will it exceed 12 seconds to 95% of a step change in input. For the O2 sensor, the response time shall be no more than fifteen (15) seconds to 90% of full scale.

J. Optical Correction Factors

The hexane/propane equivalency factor (PEF) shall be limited to values between 0.49 and 0.52. If an optical bench is used that can demonstrate accuracy of propane/hexane identification within specification, using a range greater or lesser than indicated, it will be considered. Factor confirmation shall be made on each analyzer assembly by measuring both N-hexane and propane on assembly line quality checks. The PEF shall be permanently stored in non-volatile memory. The PEF shall be displayed on the monitor on request by inquiry through the menu system. The optical bench shall be marked with a permanent "stamped" type tag identifying its PEF.

The signal strength from the source to the detector for all channels shall be monitored such that when the signal degrades beyond the adjustment range of the analyzer, the analyzer shall be locked out from operation, i.e. fail calibration.

K. Interference Effects

The effect of extraneous gas interference on the HC, CO, and CO2 analyzers shall not exceed ± 10 ppm HC, $\pm 0.05\%$ CO, and $\pm 0.20\%$ for CO2.

The instrument design shall insure that readings do not vary as a result of electromagnetic radiation and induction devices normally found in the inspection 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.

2.12 Gas Calibration File

At the conclusion of each gas calibration the required data shall be placed in the CAL.DAT file.

2.13 Microcomputer Specifications

A. A standard microcomputer must be included in the analyzer and is to be used to control all analyzer functions. Each vendor is to develop DOS executable programs for each required function. These programs shall:

1. control each of the analyzer functions and time of function;
2. examine and obtain values from all of the analyzer sensors;
3. read and write information to diskette in standard DOS format; and
4. copy the analyzer, inspection station identification information from the hard disk onto each new floppy diskette when formatted.

The Colorado Department of Public Health and Environment reserves the right to add additional programs and functional performance requirements, up to the technical limits of the hardware, to improve the I/M program.

Sufficient flexibility shall be provided in the design of the microcomputer system to allow expansion of the analyzer to include, but not be limited to, the following additional capabilities:

1. connect and recover data from vehicle on-board diagnostic systems (OBD) meeting SAE specifications when they become available;
2. monitor vehicle recall data; identify, record and process data as required when an official EPA/SAE format is identified.
3. accommodate additional input channels in both analog and digital form. Two free slots, 16 bit capability.

The manufacturer may offer additional features that utilize the microcomputer as a stand-alone personal computer by providing optional software to perform various non-I/M functions. Such offerings must not interfere with the inspection requirements, or in any manner affect or allow the inspector to tamper with the inspection-related computer programming or data files.

The analyzer shall be equipped with an internal clock that operates independently from the power source and will provide accurate and automatic date and time information for the following functions:

- a. each test performed;
- b. automatic gas calibration and pressure test check (72 hours); (24 hour) optional
- c. automatic leak check (4 or 24 hours and every 24/72 hours for automatic gas calibration), and leak check combination.
- d. audit sequence:

All equipment and software submitted for Colorado certification must be the full and current configuration proposed for sale. Partial, dated, or incomplete models are not acceptable.

Acceptance of the microcomputer portion of the Colorado 94 Analyzer system will be dependent upon the satisfactory performance of the full-proposed configuration meeting all the requirements of this specification.

The proposed hardware configuration must be fully supported by all software and/or operating systems listed in the acceptance requirements or elsewhere in these specifications. Performance tests to prove compatibility will be conducted. The vendor will bear all shipping and equipment preparation charges for the certification testing.

2.14 Standard Hardware: Minimum Required Configuration

1. Operating System

DOS Version 6.2 or most current

2. Processor

The microprocessor must be fully compatible with the Intel 80486 microprocessor. Upgradable to Pentium technology.

3. RAM Memory

The system must contain at least 2 MB of user available RAM. (expandable to 16 MB)

4. Power Up Sequence

The system must include a power up sequence that provides a self-diagnostic routine to check the on-line presence of critical PC components (including, at a minimum, the processor, firmware ROM, hard disk controller, keyboard, clock, modem, printers, bar code reader I/O ports, setup RAM and memory).

5. Video

The CRT display must be at least 12" in diagonal measure and operate in a VGA mode.

The software shall automatically blank the screen or use a screen saver mode, if no keyboard entry is made for 10 minutes. The display shall return when the inspector strikes any key.

6. Floppy Disk

Each unit must come with an IBM compatible floppy disk drive that will permit full usage of 2sHD 1.44 Mb 3.5" removable media. The drive must be located in a secured area accessible only to authorized AIR Program Service representatives. That secured drive must also include an approved method to limit logical access. Colorado Department of Public Health and Environment will test the system for drive security and it should not

provide access to the secured floppy except through the approved security procedure. The secured floppy drive shall be designated the "A" drive.

7. Hard Disk

Each unit must come with at least 120 megabytes of hard disk storage. The vendor may use up to 40 megabytes for their programs and data provided at least a full 80 megabytes of usable storage is available for Colorado Department of Public Health and Environment and user information. The hard disk is to be self-parking (where applicable), shock mounted, and able to operate reliably in the inspection environment. The hard disk must also include a Colorado Department of Public Health and Environment approved method of limiting access to data and programs. The hard disk containing programs and data files shall be designated the "C" drive.

8. I/O Ports

The unit must include sufficient I/O ports of proper configuration to allow the connection of all required options and the capability to add additional I/O boards.

9. Keyboard

The Colorado 94 Analyzer keyboard must be fully interfaced with the microcomputer and have all of the necessary normal, numeric, cursor, control, shift, alternate, and function keys needed to operate a standard IBM PC compatible microcomputer, preferably 101 keys should be provided.

10. Bar Code Scanner

The bar code scanner shall be equivalent to the PDF 1000 "HV" (High Visibility) Scanner from Symbol Technologies. Performance specifications are included in Technical Specification Appendix A. The PDF 1000 "HV" is a scanner capable of reading both 1-D and PDF-417(2-D) bar codes.

11. Hard Disk Expansion

System must include a hard disk interface that will fully support a second internal disk drive of the same type as the original type drive or a functional equivalent approved by the Colorado Department of Public Health and Environment that does not compromise tamper-resistance.

12. Additional Storage

3.5" 1.44 Mb Floppy Disk Drive IBM Optical disk drive, floptical, CD ROM reader etc., these options would be for manufacturer offered look up tables, service information or other options requiring additional storage capability.

13. Communications

Hayes compatible modem at 14,400B, M.N.P. Level 5. Error correction: Microcom networking protocol (M.N.P.) levels 1-4 and V.42 data compression: M.N.P. level 5 and V.32BIS/V.42BIS. Protocol will be provided within the operational software package. Modem communications will be necessary during the inspection process for V.I.N. verification, multiple "I" Test Control, vehicle recall etc., from the Network System Host Computer.

2.15 Required Printers

A. Diagnostic printer:

A 24 pin impact printer shall be supplied which is dedicated to the task of printing designated information on a VEHICLE DIAGNOSTIC FORM, or other repair type information. Continuous, fanfold, preprinted (ghost printed certificates) will be used. The printer shall print information on the certificate using 12 characters per inch and 80 characters per line.

B. Certificate Printer:

The certificate printer is to be a "thermal transfer" technology printer, capable of producing PDF 417, two dimensional bar code and Code 39, one-dimensional bar code. As of date, Standard Register produces a model of printer that meets or exceeds all requirements necessary to print upon the required certificate. This model is a PT650 Thermal/Thermal Transfer Printer. Specifications of the certificate printer shall be Standard Register FT650 or equivalent. With equivalency being defined as successful completion of printing, security, storing and dispensing of the required certificate. Final acceptance of alternative printers lies with written State approval.

Standard Register PT650 technical specifications are included in the Technical Specification Appendix B.

PHYSICAL SPECIFICATIONS OF CERTIFICATE:

Physical specifications of the certificate, to include print fields, physical design, materials and sizing are to be determined by the Department of Revenue.

C. Certificate Security:

The inspection certificate printer and certificate storage area shall be located in a secured area. Access to the area securing the printer and certificates shall be available only to the licensed inspector at the station. The certificate storage area shall have a redundant security system utilizing both a hardware lock and a software lock that meets Colorado Department of Public Health and Environment approval. Certificates will be prevented from being "pulled" through the printer. A form of printer locking must be utilized. The secured area containing certificates and the certificate printer, shall be designed so that the same key can be used to open any access doors that secure any optional storage media. If any of these doors are opened, a microswitch (or equivalent) shall be used which prevents the printing of certificates and records each event with time and date to an entry.dat file.

The purpose of the software lock is to restrict access to the printer with the following exceptions: loading and aligning certificates prior to printing, clearing paper misfeed or jam problems, etc., and to provide a record of the personnel performing those functions.

The area containing the certificates shall be located so that proper routing is maintained on the certificates as they are fed through the printer.

If tampering occurs, a software lockout algorithm shall be activated which aborts any existing test sequence and prevents further emission testing until an AIR Program official clears the lockout.

There shall be easy access to the vehicle diagnostic report printer so that the inspector can easily replace paper, clear paper jams and change ribbons.

2.16 Clock/Calendar

The analyzer unit shall have a real time clock/calendar which shall make available the current date and time. Date will be in month, day, year format and time will be in 24-hour format. The AIR Program system host computer shall update both time and date during each transfer of data via the system modem.

The date/time, along with the time the test started and when it ended, is to be included on the test record. The start time is when the inspector's access code is entered and the end time is when the analyzer data is written to the test file.

If the clock/calendar fails or becomes unstable (as referenced to the program host system during modem data transfer), the analyzer unit shall be locked out from I/M testing and a message shall be displayed indicating that service is required.

Resetting of the clock, independent of the host updating, shall require controlled access.

2.17 Lockout Notification

The analyzer shall alert the inspector of any lockout situation by prominently displaying a message on the CRT. Any lockout condition will be stored to file.

2.18 Vehicle Diagnosis

The analyzer shall be capable of menu selection that will allow the analyzer to be used as an ordinary garage type emissions analyzer for general automotive repair work and diagnostics.

2.19 Software Loading

The inspector shall not have to load the microcomputer's operating or applications software to operate the analyzer. On each POWER ON of the analyzer, the analyzer shall automatically do all microcomputer component self-diagnostics, memory checking, and loading of all necessary operating software without inspector intervention. Upon satisfactory computer component check out, the applications software is to present a menu of available analyzer operations. All offered features are to be menu-driven. For each feature, a context sensitive, on-line help facility is to be provided which can be accessed preferably with a single keystroke.

3.0 DISPLAY PROMPTS AND PROGRAMMING CRITERIA REQUIREMENTS

Operational software requirements will be available from the Division upon request.

ATTACHMENT I TO THE TECHNICAL SPECIFICATION APPENDIX A PDF 1000 Scanner

This document is contained in the Air Pollution Control Division's Emissions Technical Center Procedures Manual and is incorporated by reference.

PDF 1000 SCANNER

PERFORMANCE CHARACTERISTICS

Type: ~~Raster scanning, retro-collective~~

Scan Element Low mass, single mirror, resonant

Light Source: 675 nm. Laser diode

Pattern Size: At 9 in. (22.8 cm) from the nose of the scanner, the pattern is 7 in. (17.8 cm) horizontally and 2.6 in. (6.6 cm) vertically

Scan Rate: 560 scans/sec. 280 Hz \pm 10 Hz (horizontal)

Frame Rate: 22 frames/sec. 11 Hz \pm 1 Hz (vertical)

Optical Resolution Can decode a 6.6 mil X-dimension symbol (PDF417); Y-dimension must be 3X

Haz Size of PDF 417: 5.9 in. (15cm) wide x 2.3 in. (5.8 cm) high (928 code words, at security level 0-8)

PHYSICAL CHARACTERISTICS

Pitch Tolerance: \pm 30" ("front and back")

Skew: \pm 15" plane parallel to symbol ("side to side")

Rotational Tolerance: \pm 3" (assuming 3:1 codeword module aspect ratio)

Dead Zone/Optical Throw Print: \pm 2" (1-D symbologies) or \pm 9" (PDF417) from beam direction

Print Contrast Resolution (min): 25% (1-D symbologies) or 35% (PDF417) absolute dark/light reflectance differential, measured at 675 nm

Ambient Light Immunity: 8000 ft-candles (86100 LUX) of sunlight

Humidity: 5 to 95% relative humidity (non-condensing)

Shock: Unit functions normally after 4ft (1.2m) drop to concrete

Environmental Scaling: MIL-STD-810d windblown dust and rain

Operating Temperature: 14° to 104° F (-10° to 40°C)

Storage Temperature: -40° to 140° F (-40° to 60°C)

Coil Cable Length: 6 ft. (183cm)

Weight 10.4 oz (295gm) without cable

Dimensions: 7.2 in. (18.2 cm) H x 4.2 in. (10.7cm) Lx L7 in. (4.3 cm) W

Laser Class: CDRH Class II, IEC 825 Class II

PL 140 Decoder/Interface

Decode Capabilities: 2-D symbology PDF417 (up to 928 code words at security level 0-8). 1-

~~D-Symbologies: UPC-A, UPC-E, EAN-8, EAN-13, Code 39, Code 39 Full ASCII, Code 128, Interleaved 2 of 5, Codabar.~~

~~Memory: 64K x 32-bit PROM; 32K x 32-bit RAM (128K ram OPTION); 256 X 16 bits EEPROM for system parameters~~

~~Humidity: 5-95% relative humidity (non-condensing)~~

~~Shock: 4 ft. (1.2m) drop to concrete~~

~~Environmental Sealing: Environmentally sealed against dust and rain (with battery pack attached)~~

~~Operating Temperature: 14° to 104° F (-10° to 40° C)~~

~~Storage Temperature: -40° to 140° F (-40° to 60°C)~~

~~Weight: 11.2 oz. (318 gm) With batter pack 27.8 oz. (788.13 gm)~~

~~Dimensions: 4.0 in. (10.2 cm) high x 4.0 in. (10.2cm) long x 1.4 in. 13.6 cm wide (2.8 in (7.1 cm wide with batter pack)~~

~~Agency Approvals: FCC Class A, UL, CSA, VDE~~

~~Power Requirements: DC Power: 11 VDC from wall transformer or 6 VDC from Battery Pack. Wall transformer power requirements: 115 VAC @ .15A, 220/240 VAC @ .075A, 100V @ .15A. Pack will support several thousand scans per 8-hour shift. Actual number depends on PDF417 symbol size and mix of 1D bar codes scanned.~~

ATTACHMENT II TO THE TECHNICAL SPECIFICATION APPENDIX A Thermal Transfer Printer

This document is contained in the Air Pollution Control Division's Emissions Technical Center Procedures Manual and is incorporated by reference.

THERMAL TRANSFER PRINTER

STANDARD FEATURES

- ~~On line/Off line Operation~~
- ~~Thermal/Thermal Transfer~~
- ~~Extremely High doc density (203 dots/inch. 8 dots/mm)~~
- ~~Print speed 6 inches plus per second~~
- ~~Media width 5.25~~
- ~~Print width 5.10"~~
- ~~Large maximum media size 5.25-W X 60-L~~
- ~~User-selectable bar code ratios~~

- Internal take-up mechanism
- External rewind mechanism
- Print material: Label and lag stock
- Label presentation
- Print head temperatures software selectable
- Easy-load ribbon
- Alpha-numeric keypad
- LCD Display 2X20
- 512K of on-board Ram Expandable to 8 MB
- Rotation of text and bar codes 90, 180 and 270 including human readable
- Date and Time Clock
- Label back feed for cutting and dispensing modes
- Intelligent Formats

PRINT MODES

Three print modes are standard

- Batch -- printing one or more labels with or without backing paper
- Rewind -- printing a batch of labels and rewinding
- Present Mode -- Present sensor stops each label for presentation before delivering the next label

BAR CODES

- Code 39
- Interleave 2 of 5
- Codabar
- Code 128 A, B, and C subsets
- UPC-A and E
- UPC addendum codes 2 and 5 digit
- UPC random weight
- EAN 13 and 8

- ~~Code93~~
- ~~Universal shipping contained symbology (with fixed or random weight codes) code 39 variations to produce all industry standards such as LOGMARS, HIBCC, and AIAG~~
- ~~Bar code modulus ("x" dimensions): 5 mil to 10 mil in picket or ladder orientation~~
- ~~Bar codes printed with or without human readable interpretation~~

FONT STYLES

- ~~12 Scalable Fonts On-Board~~
- ~~Downloadable font support~~
- ~~Downloadable graphics~~
- ~~Inverse text support~~
- ~~International language support different language character sets~~
- ~~Inverse image support~~

MEDIA SPECIFICATIONS

- ~~Media type: Roll-fed, die-cut continuous or fan-fold labels, tags or tickets~~
- ~~Material: plain paper thermal transfer or thermal sensitive paper~~
- ~~Sensing: adjustable transmissive sensor for die-cut labels or tags.~~
- ~~Reflective sensor for use with black marks~~
- ~~Programmable top of form~~
- ~~Maximum media width: 5.25"~~
- ~~Minimum media width: 0.50"~~
- ~~Maximum media length: 60.0"~~
- ~~Minimum media length: 0.50"~~
- ~~Thickness: 0.0023" to 0.012" (including liner)~~
- ~~Supply roll capacity: 8"(203mm)~~
- ~~Internal rewind capacity: 6"(152mm)~~
- ~~External rewind capacity: 8"(203mm)~~
- ~~Fanfold stock internal and external capabilities~~

PRINT HEADS

- Standard width: 5.1" (128mm) 8 dot/mm (203 dots/inch, 8 dots/M)
- Optional widths available
- Optional Dot Densities available

PRINT SPEED

- Standard speed :6"(152mm) plus per second
- Programmable print speeds of 1.5" (38 mm) 3"(72mm) up to 6"(152mm) plus per second

COMMUNICATION INTERFACE

- RS-232C, RS-422, RS-185
- Centronics parallel interface
- Robust XON/XOFF, CTS, DTR handshake
- Programmable 7 or 8 bit length
- Multidrop protocol
- Bidirectional Printer to Host

OPTIONS

- Ribbon Saver
- Cutter mechanism and Tray
- Font Data Cards (up to 1MB)
- Application Cards (up to 1 MB)
- Graphics Display
- Full Alphanumeric keyboard
- Scanner Support
- User Data Support Cards (up to 1MB)
- Twinax & Coax IBM Interfaces

MECHANICAL

- Height: 10"(254mm)
- Width: 11"(279mm)
- Depth: 16"(406mm)

- Weight: 35 lbs. (16 kg)

ELECTRICAL

- Power 110/220 VAC + or - 10% 50/60 Hz at 2 amps maximum 100 VAC on request
- Built to ULCSA and TUV GS safety standards and VDE Class B and FCC Class A emissions standard

ENVIRONMENTAL

- Operating Temperature: 32° F to 100° F (0° to 40° C)
- Storage Temperature: -40° F to 140° F (-40° C to 60° C)
- Humidity: 10% to 90% non-condensing
- Ventilation: Free air movement
- Dust: non-conducting, non-corrosive

ATTACHMENT III TO TECHNICAL SPECIFICATION, APPENDIX A Colorado Automobile Dealers Transient Mode Test Analyzer System

This document is contained in the Air Pollution Control Division's Emissions Technical Center Procedures Manual and is incorporated by reference.

COLORADO AUTOMOBILE DEALERS TRANSIENT MODE TEST ANALYZER SYSTEM

TRANSIENT MODE TEST SYSTEM TECHNICAL AND HARDWARE SPECIFICATIONS

COLORADO AUTOMOBILE DEALERS TRANSIENT MODE TEST ANALYZER SYSTEM

(IG-240)

TEST SYSTEM TECHNICAL AND HARDWARE SPECIFICATIONS

JANUARY 27, 1997

INTRODUCTION

This document contains technical specifications for a Colorado Automobile Dealers Transient Mode IG-240 Test Analyzer System. The technical specifications of the system are based upon the Environmental Protection Agency High-Tech I/M Test Procedures dated June 1996, Emission Standards, Quality Control Requirements and Equipment Specifications: IM-240 and Functional Evaporative System Tests technical guidance document EPA-AA-RSPD-IM-96-1, dated June 1996. The technical concept allows for the use of technologies of similar application but of a lower monetary cost. Utilizing lower cost technologies and identifying equipment required to directly address the requirements of the Colorado Enhanced Inspection Program, the system can perform transient loaded mode testing in the Motor Vehicle Dealer Test Facility pursuant to Section 42-4-309 (3)(B), C.R.S.

In review of these specifications, sections may indicate that they are *not applicable*. Not applicable indicates that the content of that section does not apply to the Colorado system. Not applicable sections remain within this specification, as they provide insight into the systems total capability with hardware often sharing functionality with another test process. This specification is intended to act as a guide to

~~hardware requirements, provides insight into the application of the hardware, and provides testing and quality control requirements and to provide a general overview of the operating system software requirements. Numerical references to methodology or procedures refer to sections so indicated within the code of federal regulations (40 CFR 85.2 July 1996) (EPA):~~

~~This attachment III establishes equipment specifications, test procedures and test standards. In order to qualify for the Colorado Automobile Dealers Transient Mode IG-240 Test Analyzer System must comply with the equipment specifications, must be capable of performing all applicable elements of the test procedure, and must be capable of measuring, calculating, displaying and recording each test standard.~~

~~Table of Contents~~

~~Introduction~~

~~Test Standards~~

- ~~(a) — Transient Mode Emissions Limits~~
- ~~(b) — Transient Test Score Calculations~~
- ~~(c) — Evaporative System Pressure Test Standards~~

~~Transient Mode and Evaporative System Purge Test Procedures~~

- ~~(a) — General Requirements~~
- ~~(b) — Pre-inspection and Preparation~~
- ~~(c) — Equipment Positioning and Settings~~
- ~~(d) — Vehicle Conditioning~~
- ~~(e) — Vehicle Emission Test Sequence~~
- ~~(f) — Emission Measurements~~

~~Evaporative System Pressure Test Procedures~~

- ~~(a) — General Requirements~~
- ~~(b) — Pre-inspection and Preparation~~
- ~~(c) — Canister End Pressure Test — **NOT APPLICABLE**~~
- ~~(d) — Fuel Inlet Pressure Test -- **NOT APPLICABLE**~~
- ~~(e) — Fuel Cap Leak Test — Pressure Decay Method~~
- ~~(f) — Fuel Cap Leak Test — Flow Rate Method.~~

~~Colorado Automobile Dealers Transient Mode Equipment Specifications~~

- ~~(a) — Dynamometer Specifications~~

~~(b) — Constant Volume Sampler~~

~~(c) — Analytical Instruments~~

~~(d) — Colorado Specific Hardware~~

Evaporative System Inspection Equipment

~~(a) — General Requirements~~

~~(b) — Evaporative Purge System — **NOT APPLICABLE**~~

~~(c) — Evaporative System Pressure Test Equipment~~

Transient Mode Test Quality Control Requirements and Acceptance

Testing Procedures

~~(a) — General Requirements~~

~~(b) — Dynamometer~~

~~(c) — Constant Volume Sampler~~

~~(d) — Analysis System~~

~~(e) — Gases Calibration, Working and Span Gases Shall Conform to Regulation Number 11, Appendix~~

~~(f) — Quality Control Data Files~~

Test Report

~~(a) — Acceptance Test Reporting for Transient Mode Evaluation~~

Terms

~~(a) — Definitions~~

~~(b) — Abbreviations~~

Test Standards

~~(a) Transient Mode Emissions Limits — Regulation Number 11, Part F “Maximum Allowable Emissions Limits”~~

EMISSIONS LIMITS

<u>M/Y</u>	<u>CO</u>	<u>HG</u>	<u>NO_x</u>
------------	-----------	-----------	-----------------------

<u>M/Y</u>	<u>CO</u>	<u>HC</u>	<u>NO_x</u>
<u>LDV:</u>			
1982	65	5	8
1983-84	50	5	8
1985	25	5	8
1986-90	25	4	6
1991-94	20	4	6
1995 & newer	20	4	4
<u>LDT 1-2:</u>			
1982-83	107	8	12
1984-85	80	8	12
1986-90	67	6	9
1991 & newer	53	6	9

Emissions limits are subject to periodic revision and as such provisions must be made for ease of adjustments

(b) — Transient Test Score Calculations

(1) — Composite Scores. The composite scores for the test shall be determined by dividing the sum of the mass of each exhaust component obtained in each second of the test by the number of miles driven in the test. The first data point is the sample taken from t=0 to t=1. The composite test value shall be calculated by the equation in (b)(1)(i):-

(i)

~~Transient Test Score Calculations — Composite Scores~~

$$\text{Composite gpm} = \frac{\sum_{\text{sec}=0}^s \text{grams of emissions}}{\sum_{\text{sec}=0}^s \text{miles traveled}}$$

Where: s = duration of test in seconds for fast pass
= 239 seconds for complete IM240

~~(2) Second-by-Second Mass Calculations. The mass of each exhaust component shall be calculated to five significant digits for each second of the test using the following equations:~~

~~(i) Hydrocarbon mass: $\text{HC}_{\text{MASS}} = V_{\text{MIX}} * \text{DENSITY}_{\text{HC}} * \text{HC}_{\text{CORC}}$~~
~~_____~~
~~_____ 1000000~~

~~(ii) Carbon Monoxide mass: $\text{CO}_{\text{MASS}} = V_{\text{MIX}} * \text{DENSITY}_{\text{CO}} * \text{CO}_{\text{CORC}}$~~
~~_____~~
~~_____ 1000000~~

~~(iii) Oxides of Nitrogen mass: $\text{NOx}_{\text{MASS}} = V_{\text{MIX}} * \text{DENSITY}_{\text{NO2}} * K_{\text{H}} * \text{NO}_{\text{CORC}}$~~
~~_____~~
~~_____ 1000000~~

~~(iv) Carbon Dioxide mass: $\text{CO2}_{\text{MASS}} = V_{\text{MIX}} * \text{DENSITY}_{\text{CO2}} * \text{CO2}_{\text{CORC}}$~~
~~_____~~
~~_____ 100~~

~~(3) Meaning of Terms.~~

~~(i) HC_{MASS} = Hydrocarbon emissions in grams per second.~~

~~(ii) $\text{Density}_{\text{HC}}$ = Density of hydrocarbons is 16.33 grams per cubic foot assuming an average carbon to hydrogen ratio of 1:1.85 at 68° F and 760 mm Hg pressure.~~

~~(iii) HC_{CORC} = Average hydrocarbon concentration per second of the dilute exhaust sample measured as described in Section 85.2226(c)(4), and corrected for background, in ppm carbon equivalent, i.e., equivalent propane * 3.~~

~~(A) $\text{HC}_{\text{CORC}} = \text{HC}_e - \text{HC}_d (1 -)$ Where:~~

~~(B) HC_e = Hydrocarbon concentration of the dilute exhaust sample as measured in ppm carbon equivalent.~~

~~(C) HC_d = Background hydrocarbon concentration of the dilution air, sampled as described in Section 85.2221(b)(5), as measured in ppm carbon equivalent.~~

$$(D) \quad DF = \frac{13.4}{CO_{2e} + (HC_e + CO_e) * 10^{-4}} \text{ calculated on a second-by-second basis}$$

(iv) ~~V_{mix} = The CVS flow rate in cubic feet per second corrected to standard temperature and pressure.~~

(v) ~~CO_{mass} = Carbon monoxide emissions in grams per second.~~

(vi) ~~$Density_{CO}$ = Density of carbon monoxide is 32.97 grams per cubic foot at 68 °F and 760 mm Hg pressure.~~

(vii) ~~CO_{conc} = Average carbon monoxide concentration per second of the dilute exhaust sample measured as in Section 85.2226(c)(4), and corrected for background, water vapor, and CO₂ extraction, in ppm.~~

$$(A) \quad CO_{conc} = \frac{CO_e - CO_d \left(1 - \frac{1}{DF}\right)}{DF}$$

(B) ~~CO_e = Carbon monoxide concentration of the dilute exhaust in ppm.~~

(C) ~~CO_d = Background carbon monoxide concentration of the dilution air, sampled as described in Section 85.12221(b)(5), in ppm.~~

(viii) ~~NO_{xmass} = Oxides of nitrogen emissions in grams per second.~~

(ix) ~~$Density_{NO_2}$ = Density of oxides of nitrogen is 54.16 grams per cubic foot assuming they are in the form of nitrogen dioxide at 68 °F and 760 mm Hg pressure.~~

(x) ~~NO_{xconc} = Average concentration of oxides of nitrogen per second of the dilute exhaust sample measured as described in Section 85.2226(c)(4), and corrected for background in ppm.~~

$$(A) \quad NO_{xconc} = \frac{NO_{xe} - NO_{xd} \left(1 - \frac{1}{DF}\right)}{DF}$$

(B) ~~NO_{xe} = Oxides of nitrogen concentration of the dilute exhaust sample as measure in ppm.~~

(C) ~~NO_{xd} = Background oxides of nitrogen concentration of the dilution air, sampled as described in Section 85.2221(b)(5), measured in ppm.~~

(xi) ~~K_H = humidity correction factor.~~

$$(A) \quad K_H = \frac{1}{1 + 0.0047 (H - 75)}$$

(B) ~~H = Absolute humidity in grains of water per pound of dry air.~~

$$(C) \quad H = \frac{(43.478)R_a * P_d}{P_B - (P_d * \frac{R_a}{100})}$$

(D) ~~R_a = Relative humidity of the ambient air, percent.~~

(E) ~~P_d = Saturated vapor pressure, mm Hg at the ambient dry bulb temperature. If the temperature is above 86° F, then it shall be used in lieu of the higher temperature, until EPA supplies final correction factors.~~

(F) ~~P_B = Barometric pressure, mm Hg.~~

(xii) ~~$CO2_{mass}$ = Carbon dioxide emissions in grams per second.~~

(xiii) ~~Density_{CO2} = Density of carbon dioxide is 51.84 grams per cubic foot at 68°F and 760 mm Hg.~~

(xiv) ~~$CO2_{conc}$ = Average carbon dioxide concentration per second of the dilute exhaust sample measured as described in Section 85.2226(c), and corrected for background in percent.~~

$$(A) \quad CO2_{conc} = CO2_e * CO2_d (1 - \frac{1}{DF})$$

(B) ~~$CO2_d$ = Background carbon dioxide concentration of the dilution air, sampled as described in Section 85.2224(b)(5), measured in percent.~~

(C)(d) ~~Evaporative System Pressure Test Standards~~

(1) ~~Visual Check.~~ The vehicle shall fail the evaporative system visual check if any part of the system is missing, damaged, improperly connected, or disconnected as described in Section 85.2222(b).

(2) ~~Canister End Pressure Test Standards.~~ **NOT APPLICABLE** The vehicle shall fail the pressure test if the system cannot maintain a pressure above eight inches of water for up to two minutes after being pressurized to 14 ± 0.5 inches of water. The vehicle shall also fail if it does not possess a check valve, as identified in the Look-up Table, and if no pressure drop is detected when the fuel cap is loosened as described in Section 85.2222(c)(4).

(3) ~~Fuel Inlet Pressure Test.~~ **NOT APPLICABLE**

(i) ~~Pass/Fail Determination.~~ Flow rate, fill pressure, and decay pressure shall be measured at 2 Hz, averaged over 1 second intervals, and curve fitted using a least squares technique. If the volume compensated pressure drop is more than the pressure loss determined from starting and ending pressures in the Pressure Decay Reference Equation in Section 85.22C5(c)(3)(ii), the vehicle shall fail. Otherwise the vehicle shall pass. If not using volume compensation, the vehicle shall fail if the loss in pressure exceeds 6 inches of water.

- (ii) ~~Pressure Decay Reference Equation. This equation provides pressure loss values equivalent to a loss of pressure from 14 to 8 inches of water when the starting pressure is other than 14 inches of water.~~

$$P = 40 * (0.9967 - 2.7 * 10^{-6} * t)^t$$

~~Where:~~

~~P = Starting or ending pressure, in inches of water,~~

~~t = Time, in seconds.~~

- (iii) ~~Fast Pass. Fast pass determinations may be made anytime during the pressure decay between 20 and 120 seconds if the measured pressure exceeds the corresponding Pressure Test Reference Equation cut point, from Section 85.2205 (c)(3)(ii), by 1 inch of water pressure. The cut point is determined by adding 1 inch of water to the pressure value at a time t. The pressure at time t corresponds to the pressure at the equivalent "start time" plus the time in seconds between 20 and 120 when the fast pass determination is made. The State may propose and the Division may approve other fast pass algorithms provided they minimize false results.~~

- (iv) ~~Pressure Drop. For vehicles without vapor control valves (burp valves), the clamp(s) shall be removed from the hose(s) and the system shall be monitored for a gradual pressure drop. If no pressure drop is detected, the vehicle shall fail the test. If the Pressure Test Look-up Table identifies the vehicle as possessing a vapor control valve, the system shall not be monitored for a loss of pressure.~~

~~(4) Fuel Cap Test. (Part F, Subpart IV of Regulation Number 11)~~

- (i) ~~Pressure Decay Method. If pressure decays by 6 inches of water or more during the 10-second period, the vehicle shall fail the fuel cap integrity test.~~
- (ii) ~~Flow Rate Method. The fuel cap leak rate shall be compared 1:0 an orifice with a National Institute of Standards and Technology traceable flow rate which will result in a pass/fail flow rate threshold of 60 cubic centimeters per minute of air at 30 inches of water column. If the leak rate exceeds 60 cubic centimeters per minute at a pressure of 30 inches of water column, the cap shall fail the test.~~

Transient Mode and Evaporative System Purge Test Procedures

(a) General Requirements

- (1) ~~Data Collection. The following information shall be determined for the vehicle being tested and used to automatically select the dynamometer inertia and power absorption settings:~~
- (i) ~~Vehicle type: LDGV, LDGT1, LDGT2, and others as needed,~~
- (ii) ~~Chassis model year,~~
- (iii) ~~Make,~~
- (iv) ~~Model,~~

~~(v) Number of cylinders, or cubic inch displacement of the engine~~

~~(vi) Transmission type.~~

~~(2) Ambient Conditions. The ambient temperature, absolute humidity, and barometric pressure shall be recorded continuously during the transient or as a single set of readings up to 4 minutes before the start of the transient driving cycle.~~

~~(3) Restart. If shut off, the vehicle shall be restarted as soon as possible before the test and shall be running at least 30 seconds prior to the transient driving cycle.~~

~~(b) Pre-inspection and Preparation~~

~~(1) Accessories. All accessories (air conditioning, heat, defogger, radio, automatic traction control if switchable, etc.) shall be turned off (if necessary, by the inspector).~~

~~(2) Leaks. The vehicle shall be inspected for exhaust leaks. Gas measurement of carbon dioxide or other gases shall be acceptable. Vehicles with leaking exhaust systems shall be rejected from testing.~~

~~(3) Operating Temperature. The vehicle temperature gauge, if equipped and operating, shall be checked to assess temperature. If the temperature gauge indicates that the engine is not at normal operating temperature, the vehicle shall be inspected and shall get a second-chance emission test if it fails the initial test for any criteria-exhaust component. Vehicles in overheated condition shall be rejected from testing.~~

~~(4) Tire Condition. Vehicles shall be rejected from testing if the tire cords, bubbles, cuts, or other damage are visible. Vehicles shall be rejected that have space-saver spare tires on the drive axle. Vehicles may be rejected that do not have reasonably sized tires. Vehicle tires shall be visually checked for adequate pressure level. Drive wheel tires that appear low shall be inflated to approximately 30 psi, or to tire sidewall pressure, or manufacturer's recommendation.~~

~~(5) Ambient Background. Background concentrations of hydrocarbons, carbon monoxide, oxides of nitrogen, and carbon dioxide (HC, CO, NO_x, and CO₂, respectively) shall be sampled as specified in Section 85.2226(b)(2)(iv) to determine background concentration of constant volume sampler dilution air. The sample shall be taken for a minimum of 15 seconds within 120 seconds of the start of the transient driving cycle, using the same analyzers used to measure tailpipe emissions except as provided in Section 85.2221(f)(3). Average readings over the 15 seconds for each gas shall be recorded in the test record. Testing shall be prevented until the average ambient background levels are less than 20 ppm HC, 30 ppm CO, and 2 ppm NO_x, or outside ambient air levels (not influenced by station exhaust), which ever are greater.~~

~~(6) Sample System Purge. While a system is in operation, the CVS shall continuously purge the CVS hose between tests, and the sample system shall be continuously purged when not taking measurements.~~

~~(7) Negative Values. Negative gram per second readings shall be integrated as zero and recorded as such.~~

~~(c) Equipment Positioning and Settings~~

- (1) ~~Purge Equipment. **NOT APPLICABLE** If an evaporative system purge test is to be performed:~~
- (i) ~~The evaporative canister shall be checked unless the canister is inaccessible. A missing or obviously damaged canister shall result in failure of the visual evaporative system check.~~
 - (ii) ~~The evaporative system shall be visually inspected for the appearance of proper hose routing and connection of hoses, unless the canister is inaccessible. If any evaporative system hose is disconnected, then the vehicle shall fail the visual evaporative system check. All hoses disconnected for the test shall be reconnected after a purge flow test is performed.~~
 - (iii) ~~The purge flow measurement equipment shall be connected in series between the evaporative canister and the engine, preferably on the canister end of the hose. For vehicles equipped with a service port for evaporative functional testing, the measurement equipment shall be connected to the port.~~
- (2) ~~Roll Rotation. The vehicle shall be maneuvered onto the dynamometer with the drive wheels positioned on the dynamometer rolls. Prior to test initiation, the rolls shall be rotated until the vehicle laterally stabilizes on the dynamometer. Drive wheel tires shall be dried if necessary to prevent slippage during the initial acceleration.~~
- (3) ~~Cooling System. Testing shall not begin until the test cell cooling system is positioned and activated. The cooling system shall be positioned to direct air to the vehicle cooling system, but shall not be directed at the catalytic converter.~~
- (4) ~~Vehicle Restraint. Testing shall not begin until the vehicle is restrained. Any restraint system shall meet the requirements of Section 85.2226(a)(5)(ii). In addition, the parking brake shall be set for front wheel drive vehicles prior to the start of the test.~~
- (5) ~~Dynamometer Settings. Dynamometer power absorption and inertia weight settings shall be automatically chosen from a Division supplied electronic look-up table that will be referenced based upon the vehicle identification information obtained in (a)(1). Vehicles not listed shall be tested using default power absorption and inertia settings as follows:~~

DYNAMOMETER DEFAULT SETTINGS

vehicle type	number of cylinders	track road load horsepower	test inertia weight
All	3	12.1	2000
All	4	12.8	2500
All	5	14.5	3000
All	6	14.5	3000
LDGV	8	16.2	3500
LDGT	8	17.7	4000

vehicle type	number of cylinders	track road load horsepower	test inertia weight
LDGV	10	16.2	3500
LDGT	10	19.2	4500
LDGV	12	17.7	4000
LDGT	12	20.7	5000

- (6) ~~Exhaust Collection System.~~ The exhaust collection system shall be positioned to insure complete capture of the entire exhaust stream from the tailpipe during the transient driving cycle. The system shall meet the requirements of Section 85.2226(b)(2).

(d) ~~Vehicle Conditioning~~

- (1) ~~Second-chance Retest.~~ A vehicle shall get a second-chance emission test if it fails the initial test and all criteria exhaust components are at or below 2.0 times the applicable standards.
- (2) ~~Program Evaluation.~~ **NOT APPLICABLE** Vehicles being tested for the purpose of program evaluation under Section 51.353(c) shall receive two full transient emission tests (i.e., a full 240 seconds each). Results from both tests and the test order shall be separately recorded in the test record. Emission scores and results provided to the motorist may be from either test.
- (3) ~~Discretionary Preconditioning.~~ Any vehicle may be preconditioned using any of the following methods:
- (i) ~~Non-loaded Preconditioning.~~ Increase engine speed to approximately 2500 rpm, for up to 4 minutes, with a tachometer.
 - (ii) ~~Loaded Preconditioning.~~ Drive the vehicle on the dynamometer at 30 miles per hour for up to 240 seconds at road load.
 - (iii) ~~Transient Preconditioning.~~ After maneuver the vehicle onto the dyno, drive a transient cycle consisting of speed, time, acceleration, and relative load as determined by the Division.

(e) ~~Vehicle Emission Test Sequence~~

- (1) ~~Transient Driving Cycle.~~ The vehicle shall be driven over the following cycle:

Time	Speed	Time	Speed	Time	Speed	Time	Speed	Time	Speed
0	0	48	25.7	96	0	144	24.6	192	54.6
1	0	49	26.1	97	0	145	24.6	193	54.8

Time	Speed	Time	Speed	Time	Speed	Time	Speed	Time	Speed
2	0	50	26.7	98	3.3	146	25.1	194	55.1
3	0	51	27.5	99	6.6	147	25.6	195	55.5
4	0	52	28.6	100	9.9	148	25.7	196	55.7
5	3	53	29.3	101	13.2	149	25.4	197	56.1
6	5.9	54	29.8	102	16.5	150	24.9	198	56.3
7	8.6	55	30.1	103	19.8	151	25	199	56.6
8	11.5	56	30.4	104	22.2	152	25.4	200	56.7
9	14.3	57	30.7	105	24.3	153	26	201	56.7
10	16.9	58	30.7	106	25.8	154	26	202	56.3
11	17.3	59	30.5	107	26.4	155	25.7	203	56
12	18.1	60	30.4	108	25.7	156	26.1	204	55
13	20.7	61	30.3	109	25.1	157	26.7	205	53.4
14	21.7	62	30.4	110	24.7	158"	27.3	206	51.6
15	22.4	63	30.8	111	25.2	159	30.5	207	51.8
16	22.5	64	30.4	112	25.4	160	33.5	208	52.1
17	22.1	65	29.9	113	27.2	161	36.2	209	52.5
18	21.5	66	29.5	114	26.5	162	37.3	210	53
19	20.9	67	29.8	115	24	163	39.3	211	53.5
20	20.4	68	30.3	116	22.7	164	40.5	212	54
21	19.8	69	30.7	117	19.4	165	42.1	213	54.9
22	17	70	30.9	118	17.7	166	43.5	214	55.4
23	14.9	71	31	119	17.2	167	45.1	215	55.6
24	14.9	72	30.9	120	18.1	168	46	216	56
25	15.2	73	30.4	121	18.6	169	46.8	217	56

Time	Speed	Time	Speed	Time	Speed	Time	Speed	Time	Speed
26	15.5	74	29.8	122	20	170	47.5	218	55.8
27	16	75	29.9	123	20.7	171	47.5	219	55.2
28	17.1	76	30.2	124	21.7	172	47.3	220	54.5
29	19.1	77	30.7	125	22.4	173	47.2	221	53.6
30	21.1	78	31.2	126	22.5	174	47.2	222	52.5
31	22.7	79	31.8	127	22.1	175	47.4	223	51.5
32	22.9	80	32.2	128	21.5	176	47.9	224	50.5
33	22.7	81	32.4	129	20.9	177	48.5	225	48
34	22.6	82	32.2	130	20.4	178	49.1	226	44.5
35	21.3	83	31.7	131	19.8	179	49.5	227	41
36	19	84	28.6	132	17	180	50	228	37.5
37	17.1	85	25.1	133	17.1	181	50.6	229	34
38	15.8	86	21.6	134	15.8	182	51	230	30.5
39	15.8	87	18.1	135	15.8	183	51.5	231	27
40	17.7	88	14.6	136	17.7	184	52.2	232	23.5
41	19.8	89	11.1	137	19.8	185	53.2	233	20
42	21.6	90	7.6	138	21.6	186	54.1	234	16.5
43	23.2	91	4.1	139	22.2	187	54.6	235	13
44	24.2	92	0.6	140	24.5	188	54.9	236	9.5
45	24.6	93	0	141	24.7	189	55	237	6
46	24.9	94	0	142	24.8	190	54.9	238	2.5
47	25	95	0	143	24.7	191	54.6	239	0

(2) ~~Driving Trace.~~ The inspector shall follow an electronic, visual depiction of the time/speed relationship of the transient driving cycle (hereinafter, the trace). The visual depiction of the trace shall be of sufficient magnification and adequate detail to allow

~~accurate tracking by the driver and shall permit the driver to anticipate upcoming speed changes. The trace shall also clearly indicate gearshifts as specified in Section 85.2221(e)(3).~~

- ~~(3) Shift Schedule. For vehicles with manual transmissions, inspectors shall shift gears according to the following shift schedule:~~

<i>Shift Sequence-gear</i>	<i>Speed-miles per hour</i>	<i>Nominal Cycle Time seconds</i>
1-2	15	9.3
2-3	25	47.0
De-clutch	15	87.9
1-2	15	101.6
2-3	25	105.5
3-2	17	119.0
2-3	25	145.8
3-4	40	163.6
4-5	45	167.0
5-6	50	180.0
De-clutch	15	234.5

~~Gearshifts shall occur at the points in the driving cycle where the specified speeds are obtained. For vehicles with fewer than six forward gears the same schedule shall be followed with shifts above the highest gear disregarded.~~

- ~~(4) Speed Excursion Limits. Speed excursion limits shall apply as follows:~~

- ~~(i) The upper limit is 2 mph higher than the highest point on the trace within 1 second of the given time.~~
- ~~(ii) The lower limit is 2 mph lower than the lowest point on the trace within 1 second of the given time.~~
- ~~(iii) Speed variations greater than the tolerances (such as may occur luring gear changes) are acceptable provided they occur for no more than 2 seconds on any occasion.~~

- (iv) ~~Speeds lower than those prescribed during accelerations are acceptable provided the vehicle is operated at maximum available power during such accelerations until the vehicle speed is within the excursion limits.~~
- (v) ~~Exceedances of the limits in Section 85.2221(i) through Section 85.2221(iii) shall automatically result in a void test. Tests shall be aborted if the upper excursion limits are exceeded. Tests may be aborted if the lower limits are exceeded.~~

~~(5) Speed Variation Limits.~~

- (i) ~~A linear regression of feedback value on reference value shall be performed on each transient driving cycle for each speed using the method of least squares, with the best fit equation having the form: $y = mx + b$, where:~~
 - (A) ~~y = The feedback (actual) value of speed;~~
 - (B) ~~m = The slope of the regression line;~~
 - (C) ~~x = The reference value; and~~
 - (D) ~~b = The y-intercept of the regression line.~~
- (ii) ~~The standard error of estimate (SE) of y on x shall be calculated for each regression line. A transient driving cycle lasting the full 240 seconds that exceeds the following criteria shall be void and the test shall be repeated:~~
 - (A) ~~SE = 2.0 mph maximum.~~
 - (B) ~~$m = 0.96$ - 1.01 .~~
 - (C) ~~$r^2 = 0.97$ minimum.~~
 - (D) ~~$b = \pm 2.0$ mph.~~
- (iii) ~~A transient driving cycle that ends before the full 240 seconds that exceeds the following criteria shall be void and the test shall be repeated:~~
 - (A) ~~SE = (NOT APPLICABLE)~~
 - (B) ~~$m =$ (NOT APPLICABLE)~~
 - (C) ~~$r^2 =$ (NOT APPLICABLE)~~
 - (D) ~~$b =$ (NOT APPLICABLE)~~

~~(6) Distance Criteria. The actual distance traveled for the transient driving cycle and the equivalent vehicle speed (i.e., roll speed) shall be measured. If the absolute difference between the measured distance and the theoretical distance for the actual test exceeds 0.05 miles, the test shall be void.~~

~~(7) Vehicle Stalls. Vehicle stalls during the test shall result in a void and a new test. More than 3 stalls shall result in test failure.~~

- (8) ~~Dynamometer Controller Check.~~ For each test, the measured horsepower, and inertia if electric simulation is used, shall be integrated from 55 seconds to 81 seconds (divided by 26 seconds), and compared with the theoretical road-load horsepower (for the vehicle selected) integrated over the same portion of the cycle. The same procedure shall be used to integrate the horsepower between 189 seconds to 201 seconds (divided by 12 seconds). The theoretical horsepower shall be calculated based on the observed speed during the integration interval. If the absolute difference between the theoretical horsepower and the measured horsepower exceeds 0.5 hp, the test shall be void. Alternate error checking methods may be used if shown to be equivalent and approved by the Division.
- (9) ~~Inertia Weight Selection.~~ Operation of the inertia weight selected for the vehicle shall be verified as specified in Section 85.2226(a)(4)(iii). For systems employing electrical inertia simulation, an algorithm identifying the actual inertia force applied during the transient driving cycle shall be used to determine proper inertia simulation. For all dynamometers, if the observed inertia is more than 1 % different from the required inertia, the test shall be void.
- (10) ~~CVS Operation.~~ The CVS operation shall be verified for each test for a CFV-type CVS by measuring either the absolute pressure difference across the venturi or measuring the blower vacuum behind the venturi for minimum levels needed to maintain choke flow for the venturi design. The operation of an SSV-type CVS shall be verified throughout the test by monitoring the difference in pressure between upstream and throat pressure. The minimum values shall be determined from system calibrations. Monitored pressure differences below the minimum values shall void the test.
- (11) ~~Fuel Economy.~~ For each test, the health of the overall analysis system shall be evaluated by checking a test vehicle's fuel economy for reasonableness, relative to upper and lower limits, representing the range of fuel economy values normally encountered for the test inertia and horsepower selected. For each inertia selection, the upper fuel economy limit shall be determined using the lowest horsepower setting typically selected for the inertia weight, along with statistical data, test experience, and engineering judgment. A similar process for the lower fuel economy limit shall be used with the highest horsepower setting typically selected for the inertia weight. For test inertia selections where the range of horsepower settings is greater than 5 horsepower, at least two sets of upper and lower fuel economy limits shall be determined and appropriately used for the selected test inertia. Tests with fuel economy results in excess of 1.5 times the upper limit shall result in a void test.

(f) ~~Emission Measurements~~

- (1) ~~Exhaust Measurement.~~ The emission analysis system shall sample and record dilute exhaust HC, CO, CO₂, and NO_x during the transient driving cycle as described in Section 85.2226(c).
- (2) ~~Purge Measurement.~~ **NOT APPLICABLE** The analysis system shall sample and record the purge flow in standard liters per second and total volume of flow in standard liters over the course of the actual driving cycle as described in -- Section 85.2227(b).
- (3) ~~Integrity Measurement.~~ The analysis system shall measure and record the integrity of the fuel cap as described in Section 85.2227(c).

Evaporative System Pressure Test Procedures — NOT APPLICABLE

(a) General Requirements

- ~~(1) The on-vehicle pressure tests described in Section 85.2222(c) and (d) shall be performed after any tailpipe emission test to be performed on a vehicle. Fuel cap tests described in Section 85.2222(e) and (f) may be performed before or after the tailpipe emission test.~~
- ~~(2) The pressure test shall be conducted in a manner that minimizes changes in temperature, since pressure measurements are affected by changes in the vapor space temperature.~~
- ~~(3) The Look-up Table identifies which on-vehicle pressure test to perform on a given vehicle. Vehicles receiving the canister end pressure test specified in Section 85.2222(c) do not need to receive any other pressure tests. Vehicles receiving the fuel inlet pressure test specified in Section 85.2222(d) should also be given one of the fuel cap pressure tests specified in Sections 85.2222(e) and (f).~~
- ~~(4) Alternative procedures may be used if they are shown to be equivalent or better to the satisfaction of the Division. Any damage done to the evaporative emission control system during this test shall be repaired.~~

(b) Pre-inspection and Preparation

- ~~(1) The evaporative canister(s) shall be visually checked to the degree practical. A missing or obviously damaged canister(s) shall fail the visual evaporative system check.~~
- ~~(2) The evaporative system hoses shall be visually inspected for the appearance of proper routing, connection, and condition, to the degree practical. If any evaporative system hose is misrouted, disconnected, or damaged, the vehicle shall fail the visual evaporative system check.~~
- ~~(3) If the fuel cap is missing, obviously defective or the wrong style cap for the vehicle, the vehicle shall fail the visual evaporative system check.~~

(c) Canister End Pressure Test NOT APPLICABLE

- ~~(1) Equipment Set-up. Test equipment shall be connected to the fuel tank canister hose at the canister end. The fuel cap shall be checked to ensure that it is properly, but not excessively tightened, and shall be tightened if necessary.~~
- ~~(2) Pressure Value. The system shall be pressurized to 14 ± 0.5 inches of water without exceeding 26 inches of water system pressure.~~
- ~~(3) Stability. Close off the pressure source, seal the evaporative system and monitor pressure decay for up to two minutes.~~
- ~~(4) Depressurization. Loosen the fuel cap after a maximum of two minutes and monitor for a sudden pressure drop, indicating that the fuel tank was pressurized.~~
- ~~(5) Reconnection. The inspector shall carefully ensure that all items disconnected or loosened in the course of the test are properly reconnected at the conclusion of the test.~~

(d) Fuel Inlet Pressure Test NOT APPLICABLE

- (1) ~~Equipment Set-up.~~ The vapor vent line(s) from the fuel tank to the canister(s) shall be clamped off as close to the canister(s) as practical without damaging evaporative system hardware. If the line(s) cannot be clamped (for example a rigid line), they shall be removed at the canister(s) and capped or plugged. Dual fuel tanks shall be checked individually if pressurizing from the fill pipe interface of only one fuel tank cannot access the complete vapor control system. A fuel inlet adapter, as specified in Section 85.2227(c), appropriate to the style of fuel inlet on the vehicle (not the fuel cap on the vehicle) shall be selected based on a software prompt and shall be installed on the vehicle's fuel inlet.
- (2) ~~Pressure Value.~~ The fuel tank shall be pressurized to a value at or slightly above the minimum test pressure specified in the Look-up Table.
- (3) ~~Stability.~~ Pressure stability shall be maintained for a period of 10 seconds prior to the start of the pressure decay measurement. Pressure shall not increase by more than 0.5 inches of water during the first 20 seconds of the decay measurement. Alternate definitions of stability may be proposed by the state and approved by the Administrator provided they minimize the risk of false results.
- (4) ~~Volume Compensation.~~ (Optional) Pressure decay measurements are affected by the vapor volume (fuel tank level) in the fuel tank. Volume-compensated pressure decay measurements will increase test repeatability, and are therefore recommended. Measure the volume-compensated pressure decay for up to 120 seconds after stability is achieved, using the equation in Section 85.2222(d)(5). This equation is based on normalizing the pressure decay measurements to a vapor volume of 50 liters. The Division may approve other methods of compensation for differences in fuel tank vapor volume.

(5)

$$P = P_0 * K \left(t * \frac{V}{V_s} \right)$$

Where:

~~P =~~ Pressure, in inches of water at time t, compensated for differences in fuel tank vapor space volume.

~~P₀ =~~ The stabilized pressure at the start of the decay portion of the pressure test, in inches of water.

~~k =~~ A constant derived from curve fitting the pressure/time data from the decay portion of the pressure test, using the equation:

$$P = P_0 * k^t$$

~~t =~~ Time measured from the start of the decay portion of the pressure test, in seconds.

~~V_s =~~ Reference volume of the fuel vapor space, 50 liters.

~~V =~~ Volume of the fuel vapor space, in liters, calculated using the following equation:

$$\frac{AEV}{AEV}$$

$$V = \frac{(P_b * 13.6 + \frac{AEV}{AEV + AEPL})}{2}$$

Where:

P_b = Barometric pressure, in inches of Hg.

AEV = Pressure increase during the fill period, in inches of water.

AEV = The flow meter measured volume of gas which pressurizes the vapor space, in liters at 20 C and 1 atmosphere.

$AEPL$ = The loss in pressure due to the presence of a leak during the fill process, in inches of water.

Evaporative System Pressure Test Procedures — Fuel Inlet Pressure Test Equation

$$AEPL = \frac{t}{t=0} P_0 k \left[\frac{\ln P_t - \ln P_0}{\ln k} - 1 \right] - P_0 * k \left[\frac{\ln P_t - \ln P_0}{\ln k} - 1 \right]$$

Where:

= Summation of the second-by-second pressure loss during the fill period.

P_0 = The stabilized pressure at the start of the decay portion of the pressure test, in inches of water.

k = A constant derived from curve fitting the pressure/time data from the decay portion of the pressure test, using the equation:

$$P = P_0 * k^t$$

P_t = Pressure values reported in one second intervals during the fill period, in inches of water.

(e) Fuel Cap Leak Test — Pressure Decay Method

- (1) The fuel cap shall be removed from the fuel Met and installed on a test rig with a nominal 1 liter head space and be pressurized to 28±1.0 inch of water.
- (2) The pressure decay shall be monitored as specified in this Regulation Number 11, Part F, Subpart IV.
- (3) The fuel cap shall be replaced on the fuel inlet and tightened appropriately.

(f) Fuel Cap Leak Test — Flow Rate Method

- (1) ~~The fuel cap shall be removed from the fuel inlet and installed on the flow test device using the adapter appropriate for the fuel cap, as specified in Section 85.2227(c).~~
- (2) ~~The fuel cap flow rate shall be monitored as specified in this Regulation Number 11, Part F, Subpart IV.~~
- (3) ~~The fuel cap shall be replaced on the fuel inlet and tightened appropriately.~~

Colorado Automobile Dealers Transient Mode Test Analyzer System Equipment Specifications

(a) ~~Dynamometer Specifications~~

(1) ~~General Requirements.~~

- (i) ~~The dynamometer structure (e.g., bearings, rollers, pit plates, etc.) shall accommodate all light-duty vehicles and light-duty trucks up to 8500 pounds GVWR.~~
- (ii) ~~Road load horsepower and inertia simulation shall be automatically selected based on the vehicle parameters in the test record.~~
- (iii) ~~Alternative dynamometer specifications or designs may be proposed to the state and approved based upon a determination that, for the purpose of properly conducting an approved Transient Mode inspection, the evidence supporting such deviations will not cause improper vehicle loading.~~

(2) ~~Power Absorption.~~

- (i) ~~Coefficients. The coefficients A_v , B_v , and C_v , from vehicle track coast down testing, and referenced in the equations in this section are those specified during new car certification, or as specified by a vehicle class designator determined by the Division. Coefficients shall be calculated to a minimum of five (5) significant digits by the equations specified in Section 85.2226(a)(2)(i)(A) through Section 85.2226(a)(2)(i)(C). Power fractions determined from track coast down data shall be calculated to a minimum of two (2) significant digits as specified in Section 85.2226(a)(2)(i). In the absence of new car certification coefficients information or a vehicle class designator identifying a power fraction, the default power fractions in Section 85.2226(a)(2)(i)(J) shall be used.~~

(A) ~~$A_v = * (TRLHP_{@50\text{ mph}}) \text{ hp/mph}$~~

(B) ~~$B_v = * (TRLHP_{@50\text{ mph}})^2 \text{ hp/mph}^2$~~

(C) ~~$C_v = * (TRLHP_{@50\text{ mph}})^3 \text{ hp/mph}^3$~~

- (D) ~~Where A_vPF , B_vPF , and C_vPF are power fractions (PF), and indicate the fraction of the total power reflected by each coefficient A_v , B_v , and C_v .~~

(E) ~~$A_vPF + B_vPF + C_vPF = 1$~~

- (F) ~~Derivation of A_vPF , B_vPF , and C_vPF from known track coast down curves shall be computed as follows:~~

(1)

$$A_v PF = \frac{A_v(50)}{-(A_v(50) + B_v(2500) + C_v(125,000))}$$

(2)

$$B_v PF = \frac{B_v(2500)}{-(A_v(50) + B_v(2500) + C_v(125,000))}$$

(3)

$$C_v PF = \frac{C_v(125,000)}{-(A_v(50) + B_v(2500) + C_v(125,000))}$$

(4) Default values:

$$A_v PF = 0.35$$

$$B_v PF = 0.10$$

$$C_v PF = 0.55$$

- (ii) Vehicle Loading. The true vehicle loading used during the transient driving cycle shall follow the equation in Section 85.2226(a)(2)(iii) between 10 and 60 mph. The dynamometer

controls shall set the dynamometer loading to achieve the coast-down target time (± 1 second) with the vehicle on the dynamometer using the vehicle-specific inertia test weights. A conversion equation or table of target time versus horsepower for the dynamometer design shall be used. Target time shall be converted to horsepower by the equation Section 85.2226(a)(2)(iv) or pre-defined horsepower values may be used.

(iii) $TRLHP_{@Obmph} = \{A_v * Obmph\} + \{B_v * Obmph^2\} + \{C_v * Obmph^3\}$

A_v, B_v, C_v = Coefficients specified in Section 85.2226(a)(2)(i) for vehicle track coast-down curves.

$Obmph$ = Observed mph

$TRLHP$ = Track Road Load Horsepower, which includes loading contributions from the power absorber, parasitic losses, and tire/roll interface losses.

(iv)

$$\text{Track Road-Load Horsepower} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_1^2 - V_2^2)}{550 * ET}$$

~~ET = Elapsed time for the vehicle on the road to coast down from 55 to 45 mph, and from 22 to 18 mph~~

~~ETW = Inertia weight in pounds~~

~~V₁ = Initial velocity in feet/second (i.e., velocity at either 55 or 22 mph)~~

~~V₂ = Final velocity in feet/second (i.e., velocity at either 45 or 18 mph)~~

- ~~(v) In practice, the true vehicle loading is derived from equations of "force" (i.e., F=MA). In determining vehicle load on a dynamometer, applied loads in units of force tangential to the roll surface are not dependent on the roll diameter used, whereas applied loads in units of torque or horsepower are dependent on the roll diameter. The equation in Section 85.2226(a)(2)(vi) may be used to convert track road-load horsepower values in Section 85.2226(a)(2)(iii) to units of force.~~

~~(vi) $TRLF_{@Obmph} = \{A_f\} + \{B_f * Obmph\} + \{C_f * Obmph^2\}$~~

~~TRLF = Track Road-Load Force (in units of pounds)~~

~~A_f = 375 * A_v (A_v in HP/mph² units)~~

~~B_f = 375 * B_v (B_v in HP/mph³ units)~~

~~C_f = 375 * C_v (C_v in HP/mph units)~~

~~A_f, B_f, C_f = Equivalent force coefficients to the coefficients specified in Section 85.2226(a)(2)(i) for vehicle track coast down curves.~~

- ~~(vii) Range and Curve of Power Absorber. The range of power absorber at 50 mph shall be sufficient to cover track road-load horsepower (TRLHP) values between 4 and 35 horsepower. The absorption shall be adjustable across the required horsepower range at 50 mph in 0.1 horsepower increments. The accuracy of the power absorber shall be ± 0.25 horsepower or ± 2% of point whichever is greater.~~

- ~~(viii) Parasitic Losses (General Requirements). The parasitic losses in each dynamometer system (such as windage, bearing friction, and system drive friction) shall be characterized between 10 and 60 mph upon initial acceptance. There shall be no sudden discontinuities in parasitic losses below 10 mph. Further, when added to the lowest possible loading of the power absorber (dynamometer motoring is considered a negative load), the parasitic losses must be sufficiently small such that proper loading will occur between 10 and 60 mph for a vehicle with a 50 mph track road-load horsepower value of 4 horsepower. The parasitic horsepower losses shall be characterized either digitally in five mph increments and linearly interpolated in-between, or the data at 10 mph~~

increments shall fit the equation in Section 85.2226(a)(2)(ix) to within 2 percent of point.

(ix) ~~$$PLHP = \{A_p * (Obmph)\} + \{(B_p) * (Obmph)^2\} + \{(C_p) * (Obmph)^3\}$$~~

~~PLHP = Dynamometer parasitic losses.~~

~~A_p , B_p , and C_p are curve coefficients necessary to properly characterize the dynamometer parasitic losses for the inertia weight(s) used.~~

(x) ~~Parasitic Losses (Low Speed Requirements). The coast down time of the dynamometer between 8 and 12 mph shall be greater than or equal to the value calculated by the equation in Section 85.2226(a)(2)(xi) when the dynamometer is set for a 2000 pound vehicle with a track road load horsepower of 4 horsepower at 50 mph.~~

(xi) ~~Low Speed Loading. The following procedure is used to determine if a dynamometer system is correctly loading a vehicle with an ETW of 2000 pounds and a TRLHP of 6.0 horsepower at low speeds. Use "default" coefficients from Section 85.2226(a)(2)(i)(F)(4). Dynamometer must be warmed up prior to this procedure.~~

(A) ~~Select vehicle with a driven axle weight between 1200 and 1300 pounds (sandbags or other ballast may be used to achieve this weight). Record vehicles driven axle weight to the nearest pound.~~

(B) ~~Calculate the actual tire/roll interface losses (ATRL) using the following sub-procedure.~~

(1) ~~Determine PLHP for dynamometer system being tested.~~

(2) ~~Calculate GTRL using equations from Sections 85.2226(a)(2)(xiii) and (xv) or (xvi).~~

(3) ~~Calculate IHP using the following formula:~~

~~$$IHP = TRLHP - PLHP - GTRL$$~~

(4) ~~Set dynamometer based on IHP calculated in step C above.~~

(5) ~~Perform dynamometer coast down with vehicle selected in step 1 correctly positioned on rolls. Record coast down time from 12 mph to 8 mph.~~

(6) ~~Calculate new TRLHP based on 12 mph to 8 mph coast~~

(7) ~~Calculate actual tire/roll interface losses (ATRL) using the following equation.~~

~~$$ATRL = TRLHP - PLHP - IHP$$~~

(C) ~~Using calculated ATRL determine new IHP using the following formula:~~

~~$$IHP = TRLHP - PLHP - ATRL$$~~

- (D) ~~Set dynamometer based on IHP calculated in step 3 above.~~
- (E) ~~Perform dynamometer coast down with vehicle selected in step 1 correctly positioned on rolls. Record coast down time from 12 mph to 8 mph.~~
- (F) ~~The maximum, average, and minimum time limits for the on-dynamometer coast down window at 10 mph shall be calculated by the following equations.~~

~~Colorado Automobile Dealers Transient Mode Equipment Specifications—Dynamometer Specifications~~

$$DT_{\text{Maximum}} @ 10 \text{ mph} = \frac{\left[\frac{0.5 * ETW}{32.17405} \right] * (V_{12}^2 - V_8^2)}{550 * (TRLHP @ 10 \text{ mph})}$$

$$DT_{\text{Average}} @ 10 \text{ mph} = \frac{\left[\frac{0.5 * ETW}{32.17405} \right] * (V_{12}^2 - V_8^2)}{550 * (TRLHP @ 10 \text{ mph} - 0.088 \text{ HP})}$$

$$DT_{\text{Minimum}} @ 10 \text{ mph} = \frac{\left[\frac{0.5 * ETW}{32.17405} \right] * (V_{12}^2 - V_8^2)}{550 * (TRLHP @ 10 \text{ mph} + 0.088 \text{ HP})}$$

- (xii) ~~Tire/Roll Interface Losses. Generic tire/roll interface losses shall be determined for each dynamometer design used, and applied to obtain proper vehicle loading. A means to select or determine the appropriate generic tire/roll interface loss for each test vehicle shall be employed. Dynamometer design parameters include roll diameter, roll spacing, and roll surface finish. Generic tire/roll interface losses may be determined by the acceptance procedures in Section 85.2234(b)(4). Alternatively, generic values determined by the Division, or by a procedure accepted by the Division, may be used. The equation in Section 85.2226(a)(2)(xiii) may be used to quantify tire/roll interface losses. Coefficients for equation in Section 85.2226(a)(2)(xiii) shall be calculated to a minimum of five (5) significant digits by the equations specified in Section 85.2226(a)(2)(xiii)(A) through Section 85.2226(a)(2)(xiii)(I). Tire loss power fractions determined from track coast down data shall be calculated to a minimum of two (2) significant digits as specified in Section 85.2226(a)(2)(xiii)(J). In the absence of new car certification information or a vehicle class designator identifying a tire loss power fraction, the default tire loss power fractions indicated equations Section 85.2226(a)(2)(xiii)(E) through Section 85.2226(a)(2)(xiii)(I) shall be used as specified in Section 85.2226(a)(2)(xiii)(J).~~

$$(xiii) \text{ ~~GTRL}_{@ \text{Obmph}} = \{A_t * (\text{Obmph})\} + \{B_t * (\text{Obmph})^2\} + \{C_t * (\text{Obmph})^3\}~~}$$

~~GTRL_{@ Obmph} = Generic Tire/Roll Interface losses at the observed mph~~

Where: A_t , B_t , and C_t are curve coefficients necessary to properly characterize the tire/roll interface losses.

(A) ~~$A_t = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}$~~

(B) ~~$B_t = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^2$~~

(C) ~~$C_t = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^3$~~

(D) ~~$A_{t8} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}$~~

(E) ~~$B_{t8} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^2$~~

(F) ~~$C_{t8} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^3$~~

(G) ~~$A_{t20} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}$~~

(H) ~~$B_{t20} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^2$~~

(I) ~~$C_{t20} = * (GTRL_{@ 50 \text{ mph}}) \text{ hp/mph}^3$~~

(J) ~~Where:~~

(1) ~~A_t , B_t , and C_t are curve coefficients necessary to properly characterize the tire/roll interface losses.~~

(2) ~~A_{t8} , B_{t8} , and C_{t8} are curve coefficients when using twin 8.625 inch diameter rolls.~~

(3) ~~A_{t20} , B_{t20} , and C_{t20} are curve coefficients when using twin 20.0 inch diameter rolls.~~

(4) ~~A_t PF, B_t PF, and C_t PF indicate the fraction of the total tire loss power fraction reflected by each coefficient A_t , B_t , and C_t .~~

(5) ~~A_t PF + B_t PF + C_t PF = 1~~

(6) ~~Derivation of A_t PF, B_t PF, and C_t PF from known track or dynamometer data shall be computed as follows:~~

~~Colorado Automobile Dealers Transient Mode Equipment Specifications—Dynamometer Specifications~~

$$A_t \text{PF} = \frac{A_t (50)}{\{ A_t (50) + B_t (2500) + C_t (125,000) \}}$$

$$B_t \text{PF} = \frac{B_t (2500)}{\{ A_t (50) + B_t (2500) + C_t (125,000) \}}$$

$$C_t \text{PF} = \frac{C_t (125,000)}{\{ A_t (50) + B_t (2500) + C_t (125,000) \}}$$

~~(xiv) In the absence of new car certification $GTRL_{@ 50 \text{ mph}}$ or a vehicle class designator, the $GTRL_{@ 50 \text{ mph}}$ shall be calculated~~

~~(A) by the equation in Section 85.2226(a)(2)(xv) when using twin 8.625-inch diameter rolls~~

~~(B) by the equation in Section 85.2226(a)(2)(xvi) when using twin 20.0-inch diameter rolls~~

~~(xv) For 8.625" dynamometers:~~

$$\text{GTRL}_{@ 50 \text{ mph}} = (-0.378193) + \{(0.0033207) * (\text{DAXWT})\}$$

~~Where: DAXWT = Axle weight on the drive tires~~

~~$GTRL_{@ 50 \text{ mph}}$ = Losses for 8.625 inch diameter roll~~

~~(xvi) For 20" dynamometers:~~

$$\text{GTRL}_{@ 50 \text{ mph}} = (0.241645) + \{(0.0020844) * (\text{DAXWT})\}$$

~~Where: DAXWT = Axle weight on the drive tires~~

~~$GTRL_{@ 50 \text{ mph}}$ = Losses for 20.0 inch diameter roll~~

~~(xvii) Indicated Horsepower. The power absorption for each test shall be selected at 50 mph. The indicated power absorption (IHP) at 50 mph after accounting for parasitic and generic tire losses shall be determined by the equation in Section 85.2226(a)(2)(xv).~~

$$\text{(xviii) } IHP_{@ 50 \text{ mph}} = \text{TRLHP}_{@ 50 \text{ mph}} - \text{PLHP}_{@ 50 \text{ mph}} - GTRL_{@ 50 \text{ mph}}$$

~~(xix) In systems where the power absorption is actively controlled, the indicated horsepower at each speed between 0 and 60 mph shall conform to the equation in Section 85.2226(a)(2)(xvii). Approximations for a smooth curve with no discontinuities may be used between 0 and 10 mph.~~

$$\text{(xx) } IHP_{@ 0 \text{ mph}} = \text{TRLHP}_{@ 0 \text{ mph}} - \text{PLHP}_{@ 0 \text{ mph}} - GTRL_{@ 0 \text{ mph}}$$

~~(3) Rolls.~~

~~(i) Size and Type. The dynamometer shall be equipped with twin rolls. The rolls shall be coupled side to side. In addition, the front and rear rolls shall be coupled. The dynamometer roll diameter shall be between 8.5 and 21.0 inches. The spacing between the roll centers shall comply with the equation in Section 85.2226(a)(3)(ii) to within +0.5 inches and -0.25 inches. The parasitic and generic tire/roll interface losses for the specific roll diameter, spacing, and surface finish used shall be determined as indicated in Section 85.2226(a)(2)(viii), (a)(2)(ix), and Section 85.2226(a)(2)(xii) as necessary to properly load vehicles as defined in Section 85.2226(a)(2)(ii) and Section 85.2226(a)(2)(iii). The dynamometer rolls shall accommodate an inside track width of 30 inches and an outside track width of at least 100 inches.~~

~~(ii) Roll Spacing = $(24.375 + D) * \text{SIN } 31.5153$~~

~~D = dynamometer roll diameter.~~

~~Roll spacing and dynamometer roll diameter are expressed in inches.~~

- ~~(iii) Design. The roll size, surface finish, and hardness shall be such that tire slippage on the first acceleration of the transient driving cycle is minimized under all weather conditions; that the specified accuracy of the distance measurement is maintained; and that tire wear and noise are minimized.~~

~~(4) Inertia.~~

- ~~(i) Mechanical Inertia Simulation. **NOT APPLICABLE** The dynamometer shall be equipped with mechanical flywheels providing test inertia weights between at least 2000 to 5500 pounds, in increments of no greater than 500 pounds. The tolerance on the base inertia weight and the flywheels shall be within 1 % of the specified test weights. The proper inertia weight for any test vehicle shall be selectable.~~

- ~~(ii) Electric Inertia Simulation. Electric inertia simulation, or a combination of electric and mechanical simulation may be used in lieu of mechanical flywheels, provided that the performance of the electrically simulated inertia complies with the following specifications. Exceptions to these specifications may be allowed upon a determination by the Division that such exceptions would not significantly increase vehicle loading or emissions for the purpose of properly conducting an approved IG-240 test.~~

- ~~(A) System Response. The torque response to a step change shall be at least 90% of the requested change within 100 milliseconds after a step change is commanded by the dynamometer control system, and shall be within 2 percent of the commanded torque by 300 milliseconds after the command is issued. Any overshoot of the commanded torque value shall not exceed 25 percent of the torque value.~~

- ~~(B) Simulation Error. An inertia simulation error (ISE) shall be continuously calculated any time the actual dynamometer speed is above 10 MPH and below 60 MPH. The ISE shall be calculated by the equation in Section 85.2226(a)(4)(ii)(C), and shall not exceed 1 percent of the inertia weight selected (IWS) for the vehicle under test.~~

~~(C) $ISE = (IWS - I_t) / (IWS) * 100$~~

~~(D) $I_t = I_m +$~~

~~Where:~~

~~I_t = Total inertia being simulated by the dynamometer (kg)~~

~~$I_t \text{ (lb force)} = I_t \text{ (kg)} * 2.2046$~~

~~I_m = Base (mechanical inertia of the dynamometer (kg)~~

~~V = Measured roll speed (m/s)~~

~~F_m = Force measured by the load cell (translated to the roll surface) (N)~~

F_H = Road load force (N) required by IHP at the measured roll speed (V)

t = Time (sec)

- (iii) ~~Inertia Weight Selection. **NOT APPLICABLE** For dynamometer systems employing mechanical inertia flywheels, the test system shall be equipped with a method, independent from the flywheel selection system that identifies which inertia weight flywheels are actually rotating during the transient driving cycle.~~

(5) ~~Other Requirements.~~

- (i) ~~Test Distance and Vehicle Speed. The total number of dynamometer roll revolutions shall be used to calculate the distance traveled. Pulse counters may be used to calculate the distance directly if there are at least 16 pulses per revolution. The measurement of the actual roll distance for the composite and each phase of the transient driving cycle shall be accurate to within ± 0.01 mile. The measurement of the roll speed shall be accurate to within ± 0.1 mph. Roll speed measurement systems shall be capable of accurately measuring a 3.3 mph per second acceleration rate over a one second period with a starting speed of 10 mph.~~
- (ii) ~~Vehicle Restraint. The vehicle shall be restrained during the transient driving cycle. The restraint system shall be designed to minimize vertical and horizontal force on the drive wheels such that emission levels are not significantly affected.~~
- (iii) ~~Vehicle Cooling. The test system shall provide for a method to prevent overheating of the vehicle. The cooling method shall direct air to the cooling system of the test vehicle. The cooling system capacity shall be 5400 \pm 300 SCFM within 12 inches (30.5 cm) of the intake to the vehicle's cooling system. The cooling system design shall avoid improper cooling of the catalytic converter.~~
- (iv) ~~Four Wheel Drive. **OPTIONAL** If used, four wheel drive dynamometers shall insure the application of correct vehicle loading as defined in Section 85.2226(a)(2) and shall not damage the four wheel drive system of the vehicle. Front and rear wheel rolls shall maintain speed synchronization within 0.2 mph.~~
- (v) ~~Augmented Braking. **NOT APPLICABLE** Fully automatic augmented braking shall be used from seconds 85 through 95 and after second 223 of the driving cycle. Fully automatic augmented braking may be used in other deceleration periods of the driving cycle with the approval of the Division. During the periods of augmented braking the operator shall be made aware that augmented braking is occurring and shall be trained not to use the vehicle accelerator during these periods. It shall be automatically interlocked such that it can be actuated only while the vehicle brakes are applied. Simultaneous engine acceleration is systematically prevented through periodic quality assurance.~~

(b) ~~Constant Volume Sampler~~

(1) ~~General Design Requirements.~~

- (i) ~~Venturi Type. A constant volume sampling (CVS) system of the critical flow venturi (CFV), sub-sonic venturi (SSV), or square edged orifice (SEO) type shall be used to collect vehicle exhaust samples. The CVS system and components shall generally conform to the specifications in Section 86.109-90.~~

- (ii) ~~CVS Flow Size.~~ The CVS system shall be sized in a manner that prevents condensation in the dilute sample over the range of ambient conditions to be encountered during testing. A minimum 325 SCFM CVS system and heated lines or sample conditioning system (dryer) may be used to eliminate condensation and to increase measured concentrations for better resolution. Should the heated sample lines be used, the sample line and components (e.g., filters, etc.) shall be heated to a minimum of 120° F and a maximum of 250°F, which shall be monitored during the transient driving cycle.
- (iii) ~~CVS Compressor.~~ The CVS compressor flow capacity shall be sufficient to maintain proper flow in the main CVS venturi with an adequate margin. For CFV CVSs the margin shall be sufficient to maintain choke flow. The capacity of the blower relative to the CFV flow capacity shall not be so large as to create a limited surge margin.
- (iv) ~~Materials.~~ All materials in contact with exhaust gas shall be unaffected by and shall not affect the sample (i.e., the materials shall not react with the sample, and neither shall they taint the sample as a result of out gassing). Acceptable materials include stainless steel, Teflon, silicon rubber, and Tedlar.
- (v) ~~Alternative Approaches.~~ Alternative CVS specifications, materials, or designs may be allowed upon a determination by the Division, that for the purpose of properly conducting an approved short test, the evidence supporting such deviations will not significantly affect the proper measurement of emissions.

(2) ~~Sample System.~~

- (i) ~~Sample Probe.~~ The sample probe within the CVS shall be designed such that a continuous and adequate volume of sample is collected for analysis. The system shall have a method for determining if the sample collection system has deteriorated or malfunctioned such that an adequate sample is not being collected, or that the response time has deteriorated such that the tune correlation for each emission constituent is no longer valid.
- (ii) ~~CVS Mixing Tee.~~
 - (A) ~~Design and Effect.~~ The mixing tee for diluting the vehicle exhaust with ambient air shall be at the vehicle tailpipe exit as in Section 86.109-90(a)(2)(iv). The dilution mixing tee shall be capable of collecting exhaust from all light-duty vehicle and light-duty truck exhaust systems. The design used shall not cause static pressure in the tailpipe to change such that the emission levels are significantly affected. A change of ± 1.0 inch of water, or less, shall be acceptable.
 - (B) ~~Locating Device.~~ The mixing tee shall have a device for positively locating the tee relative to the tailpipe with respect to distance from the tailpipe, and with respect to positioning the exhaust stream from the tailpipe(s) in the center of the mixing tee flow area. The locating device, or the size of the entrance to the tee shall be such that if a vehicle moves laterally from one extreme position on the dynamometer to the other extreme, that mixing tee will collect all of the exhaust sample.
- (iii) ~~Dual Exhaust.~~ For dual exhaust systems, the design used shall insure that each leg of the sample collection system maintains equal flow. Equal flow will be

~~assumed if the design of the "Tee" intersection for the dual CVS hoses is a "Y" that minimizes the flow loss from each leg of the "Y," if each leg of the dual exhaust collection system is approximately equal in length (± 1 foot), and if the dilution area at the end of each leg is approximately equal. In addition, the CVS flow capacity shall be such that the entrance flow velocity for each leg of the dual exhaust system is sufficient to entrain all of the vehicle's exhaust from each tailpipe.~~

- ~~(iv) **Background Sample.** The mixing tee shall be used to collect the background sample. The position of the mixing tee for taking the background sample shall be within 12 lateral and 12 longitudinal feet of the position during the transient driving cycle, and approximately 4 vertical feet from the floor.~~
- ~~(v) **Integrated Sample.** A continuous dilute sample shall be provided for integration by the analytical instruments in a manner similar to the method for collecting bag samples as described in Section 86.109.~~

~~(c) **Analytical Instruments**~~

~~(1) **General Requirements.**~~

- ~~(i) The emission analysis system shall automatically sample, integrate, and record the specified emission values for HC, CO, CO₂, and NO_x. Performance of the analytical instruments with respect to accuracy and precision, drift, interferences, noise, etc. shall be similar to instruments used for testing under Section 86 Subparts B, D, and N. Analytical instruments shall perform in this manner in the full range of operating conditions in the system environment.~~
- ~~(ii) Alternative analytic equipment specifications, materials, designs, or detection methods may be allowed upon a determination by the Division, that for the purpose of properly conducting an approved short test, the evidence supporting such deviations will not significantly affect the proper measurement of emissions.~~

~~(2) **Detection Methods and Instrument Ranges.**~~

- ~~(i) **Total Hydrocarbon Analysis.** A flame ionization detector shall determine total hydrocarbon analysis. If a 325 SCFM CVS is used, the analyzer calibration curve shall cover at least the range of 0 ppmC to 4,000 ppmC. Use of a different CVS flow capacity shall require an adjustment to these ranges. Appropriate documentation supporting any adjustment in ranges shall be available. Such documentation shall also address the ability of any altered ranges to accurately measure all cutpoints, including cutpoints for vehicles older than those specified in Section 85.2205(a) that may be used in the specific I/M program for which the altered ranges are proposed to be used. The calibration curve must comply with the quality control specifications in Section 85.2234(d).~~
- ~~(ii) **Carbon Monoxide Analysis.** CO analysis shall be determined using a non-dispersive infrared analyzer. If a 325 SCFM CVS is used, CO analysis shall cover at least the range of 0 ppm to 20,000 ppm (2%). ppm. Use of a different CVS flow capacity shall require an adjustment to these ranges. Appropriate documentation supporting any adjustment in ranges shall be available. Such documentation shall also address the ability of any altered ranges to accurately measure all cutpoints, including cutpoints for vehicles older than those specified in Section 85.2205(a) that may be used in the specific I/M program for which the~~

~~altered ranges are proposed to be used. The calibration curve must comply with the quality control specifications in Section 85.2234(d).~~

~~(iii) Carbon Dioxide Analysis. CO₂ analysis shall be determined using an NDIR analyzer. If a 325 SCFM CVS is used, CO₂ analysis shall cover at least the range of 0 ppm to 80,000 ppm (8%). Use of a different CVS flow capacity shall require an adjustment to these ranges. Appropriate documentation supporting any adjustment in ranges shall be available. Such documentation shall also address the ability of any altered ranges to accurately measure all cutpoints, including cutpoints for vehicles older than those specified in Section 85.2205(a) that may be used in the specific I/M program for which the altered ranges are proposed to be used. The calibration curve must comply with the quality control specifications in Section 85.2234(d).~~

~~(iv) Oxides of Nitrogen Analysis. NO_x analysis shall be determined using chemiluminescence. The NO_x measurement shall be the sum of nitrogen oxide and nitrogen dioxide. If a 325 SCFM CVS is used, the NO_x analysis shall cover at least the range of 0 ppm to 1000 ppm. Use of a different CVS flow capacity shall require an adjustment to these ranges. Appropriate documentation supporting any adjustment in ranges shall be available. Such documentation shall also address the ability of any altered ranges to accurately measure all cutpoints, including cutpoints for vehicles older than those specified in this Regulation Number 11, Part F, that may be used for which the altered ranges are proposed to be used. The calibration curve must comply with the quality control specifications in Section 85.2234(d).~~

~~(3) System Response Requirements. The governing requirement for system response is the ability of the integration system to measure vehicle emissions to within $\pm 5\%$ of that measured from a bag sample simultaneously collected over the same integration period, on both clean and dirty vehicles. Historically, continuously integrated emission analyzers have been required to have a response time of 1.5 seconds or less to 90% of a step change, where a step change was 60% of full scale or better. System response times between a step change at the probe and reading 90% of the change have generally been less than 4-10 seconds. Systems proposed that exceed these historical values shall provide an engineering explanation as to why the slower system response of the integrated system will compare to the bag reading within the specified 5%.~~

~~(4) Integration Requirements.~~

~~(i) The analyzer voltage responses, CVS pressure(s), CVS temperature(s), dynamometer speed, and dynamometer power shall be sampled at a frequency of no less than 5 Hertz, and the voltage levels shall be averaged over 1 second intervals.~~

~~(ii) The system shall properly tune correlate each analyzer signal, CVS signals and dynamometer signals to the driving trace (test time). The driving trace update rate from the computer shall be at a rate to produce a smooth transition from one data point to another.~~

~~(iii) The one-second average analyzer voltage levels shall be converted to concentrations by the analyzer calibration curves. Corrected concentrations for each gas shall be derived by subtracting the pre-test background concentrations from the measured concentrations, according to the method in Section 85.2205(b). The corrected concentrations shall be converted to grams for each second using the equations specified in Section 85.2205(b) to combine the~~

concentrations with the CVS flow over the same interval. The grams of emissions per test phase shall be determined using the equations in Section 85.2205(b).

- (iv) When multiple analyzers are used for any constituent, the integration system shall simultaneously integrate both analyzers. The integrated values for the lowest analyzer in range shall be used for each second.
- (v) For all constituents, the background concentration levels from the lowest range analyzer shall be used, including the case where multiple analyzers may have been used.

(5) Analytical System Design.

- (i) **Materials.** All materials in contact with exhaust gas prior to and throughout the measurement portion of the system shall be unaffected by and shall not affect the sample (i.e., the materials shall not react with the sample, and neither shall they taint the sample as a result of out gassing). Acceptable materials include stainless steel, Teflon, silicon rubber, and Tedlar.
- (ii) **Bag Ports.** All analysis systems shall have provisions for reading a sample bag. A portable pump for sampling such bags is permitted.
- (iii) **System Filters.** The sample system shall have an easily replaceable filter element to prevent particulate matter from reducing the reliability of the analytical system. The filter element shall provide for reliable sealing after filter element changes. If the sample line is heated, the filter system shall also be heated.
- (iv) **Availability of Intermediate Calculation Variables.** Upon request prior to a test, all intermediate calculation variables shall be available to be downloaded to electronic files or hard copy. These variables shall include those that calculate the vehicle emission test results, perform emission analyzer and dynamometer function checks, and perform quality assurance and quality control measurements.

(d) Colorado Automobile Dealers Transient Mode Test Analyzer System Specific Hardware

General Design Requirements.

- (i) **Computer System.** Minimum CPU system to include; 90MHZ Pentium processor, Memory 16MB, Secondary Cache 256 KB, Video Type SVGA, Video Card 2 MB memory, 15" Color Monitor (drivers aid), Diskette drive A 1.44 MB, Hard-disk drive C 4.6 GB, Parallel Port (1), Serial Port (1), Mouse Port (1), 104 Key Keyboard, Expansion Slots (4). Port configurations noted may not reflect the necessary number or type to support subsystem requirements or options.
- (ii) **Modem.** Minimum requirement. Hayes compatible able to operate at 14.400B M.N.P. level 5. Error correction, Microcom networking protocol (M.N.P.) levels 1-4 with V.42 data compression. M.N.P. level 5 - V.32BIS/V.42BIS.
- (iii) **Printer. Vehicle Inspection Report.** 24 pin impact printer operating at 12 characters per inch and 80 characters per line.
- (iv) **Printer. Diagnostic Report, (customer option)** 24-pin impact printer operating at 12 characters per inch and 80 characters per line.

- ~~(v) — Printer. Certificate/Sticker. A Standard Register PT-640, thermal transfer printer.~~
- ~~(vi) — Barcode Scanner. Symbol Technologies PDF 1000 HV or equivalent.~~
- ~~(1) — Fuel cap Tester. An internal or external unit capable of performing either the pressure decay method or flow rate method of fuel cap testing as defined in Evaporative System Test Procedures, Sections (e) and (f).~~
- ~~(2) — System Security. Access to the analytical system, computer system, official state documents shall be prevented by locked enclosure and monitored by micro switches or other similar means to assure that unauthorized access is denied. Detection of unauthorized access shall result in automatic inspection system lock out.~~
- ~~(3) — Manufacturer Options installed to operate independent of an official inspection processes may be utilized and configured into the hardware as necessary. An example would be a CD-ROM for vehicle diagnostics or software supported programs.~~

Evaporative System Inspection Equipment

~~(a) — General Requirements~~

- ~~(1) — Equipment Design. Automated and computerized test systems shall be used for the evaporative system tests. Pass/fail decisions shall be made automatically. The systems shall be tamper resistant and designed to avoid damage to the vehicle during installation, testing, and removal.~~
- ~~(2) — Alternative Systems. Alternative purge or pressure test equipment, specifications, materials, or designs, may be proposed and approved upon a determination by the Division that, for the purpose of properly conducting an approved Transient Mode test, the evidence supporting such deviations will not appreciably or adversely affect the proper determination of system integrity, the proper measurement of purge, or the proper operation of the vehicle.~~

~~(b) — Evaporative Purge System NOT APPLICABLE~~

- ~~(1) — General Requirements. The evaporative purge analysis system shall measure the instantaneous purge flow in standard liters/minute, and shall compute the total volume of the flow in standard liters over the transient driving cycle.~~
- ~~(2) — Specifications. The purge flow measuring system shall comply with the following requirements.~~
 - ~~(i) — Flow Capacity. A minimum of 50 liters per minute.~~
 - ~~(ii) — Pressure Drop. Maximum of 16 inches of water at 50 liters per minute for the complete system including hoses necessary to connect the system to the vehicle.~~
 - ~~(iii) — Totaled Flow. 0 to 100 liters of volume~~
 - ~~(iv) — Response Time. 410 milliseconds maximum to 90% of a step change between approximately 2 and 10 liters per minute measured with air.~~
 - ~~(v) — Accuracy.~~

- ~~(A) — ±2.0 liters per minute between 10 and 50 liters per minute (rate)~~
- ~~(B) — ±0.15 liters per minute between 0 and 10 liters per minute (rate)~~
- ~~(C) — ±4% of 50 standard liters total flow volume between 10 and 50 liters total flow volume over one minute.~~
- ~~(D) — ±1.5% of 10 standard liters between 0 and 10 liters total volume flow over one minute.~~

~~(vi) — Noise. The maximum noise shall be less than 0.001 liters per second~~

~~(vii) — Calibration Gas. Air~~

~~(3) — Automatic Operation. Vehicle purge flow shall be monitored with a computerized system at a minimum sample rate of 1 Hz, shall automatically capture average (if sampled faster than 1 Hz) second-by-second readings, and shall automatically derive a pass/fail decision. In determining the total volume of flow, the monitoring system shall not count signal noise as flow volume. The test sequence shall be automatically initiated when the transient driving cycle test is initiated.~~

~~(4) — Adaptability. The purge flow system shall have sufficient adapters to connect in a leak-tight manner with the variety of evaporative systems and hose deterioration conditions in the vehicle fleet. The purge measurement system shall not substantially interfere with purge flow.~~

~~(c) — **Evaporative System Pressure Test Equipment ITEMS 1-4 NOT APPLICABLE**~~

~~(1) — General Requirements.~~

~~(i) — Pressure Gas. Nitrogen (N₂), or equivalent non-toxic, non-greenhouse, inert gas, shall be used for pressurizing the evaporative system.~~

~~(ii) — Automatic Operation. The process for filling the evaporative system, monitoring compliance, recording data, and making a pass/fail decision shall be automatic. After the determination that the evaporative system has been filled to the specific pressure level, and upon initiation of the test, the pressure level in the evaporative system shall be recorded at a frequency of no less than 1 Hertz until the conclusion of the test.~~

~~(iii) — Test Abort. The system shall be equipped with an abort system that positively shuts off and relieves pressure. The abort system shall be capable of being activated quickly and conveniently by the inspector should the need arise.~~

~~(2) — Adapters and Clamps.~~

~~(i) — Canister Hose Adapters. The system shall have sufficient adapters to connect in a leak-tight manner with the variety of evaporative systems and hose deterioration conditions in the vehicle fleet.~~

~~(ii) — Fuel Inlet Adapters. Fuel inlet adapters that fit on the vehicles fuel inlet in a manner similar to the fuel cap and designed to admit a pressurized source of gas into the fuel tank shall be used for the fuel inlet pressure test specified in 85.222(d). Inlet specific adapters shall be available for at least 95 percent of the~~

~~fuel inlets that are used on U.S. light duty vehicles and light duty trucks for the model years Specified in Part F of this Regulation. Varying internal volumes of the adapter assemblies shall not affect the accuracy of the test results. Adapters shall be made available within two years of the introduction of new model year vehicles.~~

- ~~(iii) **Hose Clamp.** The hose clamp used for the fuel inlet pressure test shall be designed to apply only enough pressure to close the hose without damaging it. The nose of the clamp shall be smooth surfaced or otherwise designed to avoid abrasion of the vehicle hose.~~
- ~~(3) **Pressure Gauge.** The device for measuring pressure in the vehicle's evaporative system shall have a minimum range of 0 to 50 inches of water and an accuracy of ± 0.3 inches of water (2 % of 15) or better.~~
- ~~(4) **Flow Meter.** A flow meter with a range of at least 0 to 10 liters per minute and $\pm 5\%$ accuracy shall be used for the measurement of flow.~~
- ~~(5) **Fuel Cap Tester.** The tester shall provide a visual or digital signal that the required air supply pressure is within the acceptable range and the flow comparison test is ready to be conducted. The tester shall incorporate an upstream maintainable filter. If the tester is battery powered, it must be equipped with an automatic shutoff and a low-battery indicator. A NIST traceable reference passing fuel cap of nominal 52-56 cubic centimeters per minute, and a NIST traceable reference failing fuel cap of nominal 64-68 cubic centimeters per minute shall be supplied with the tester for daily test verification. Leak rate measurements shall be accurate to ± 3 cubic centimeters per minute.~~
- ~~(6) **Flow Standard.** The flow standard shall be a square edged circular orifice with a NIST traceable flow rate that in combination with the comparison circuitry will produce a pass/fail threshold of 60 cubic centimeters at 30 inches of water column. Transducers used in the comparison circuitry shall have accuracy traceable to NIST. The supply pressure may be obtained using room air and any convenient low-pressure source. The tester shall control the supply pressure and prevent over pressurization.~~

~~Quality Control Requirements and Acceptance Testing Procedures~~

~~(a) **General Requirements**~~

- ~~(1) **Minimums.** The frequency and standards for quality control specified here are minimum requirements, unless modified as specified in Section 85.2234(2). Greater frequency or tighter standards may be used as determined by the Division.~~
- ~~(2) **Statistical Process Control.** Reducing the frequency of the quality control checks, modifying the procedure or specifications, or eliminating the quality control checks altogether may be allowed if the Division determines, for the purpose of properly conducting an approved short test, that sufficient Statistical Process Control (SPC) data exist to make a determination, that the SPC data support such action, and that taking such action will not significantly reduce the quality of the emission measurements. Should emission measurement performance or quality deteriorate as a result of allowing such actions, the approval shall be suspended, and the frequencies, procedures, specifications, or checks specified here or otherwise approved shall be reinstated, pending further determination by the Division.~~

- ~~(3) — Modifications. The Division may modify the frequency and standards contained in this section if found to be impractical.~~

~~(b) — Dynamometer~~

~~(1) — Coast Down Check.~~

- ~~(i) — The calibration of each dynamometer shall be checked on a weekly basis by a dynamometer coast-down equivalent that in Section 86.118-78 (for reference see EOD Test Procedures TP-302A and TP-202) between the speeds of 55 to 45 mph, and between 22 to 18 mph. All rotating dynamometer components shall be included in the coast-down check for the inertia weight selected.~~
- ~~(ii) — The base dynamometer and the base plus each prime inertia weight flywheel, if any, shall be checked with at least two horsepower settings within the normal range of the inertia weight. For dynamometers that use electrical inertia simulation and have a base inertia outside of the range of 3000 pounds to 4500 pounds, the coast-down check shall be conducted with at least two horsepower settings at the base inertia, and two settings at either 2500 pounds or 4500 pounds, whichever is furthest from the base inertia weight. For both mechanical flywheel dynamometers and electrical inertia simulation dynamometers, the horsepower settings selected shall correspond to a vehicle/engine category that matches the inertia weight selected for the coast-down test. Where the base inertia, or the base inertia plus the smallest flywheel results in a coast-down inertia of less than 2250 pounds, only one horsepower setting is required for the check.~~
- ~~(iii) — The coast-down procedure shall be of a self-motoring method. If the difference between the measured coast-down time and the theoretical coast-down time is greater than ± 1 second on the 55 to 45 mph coast-down as calculated by Section 85.2234(b)(1)(iii)(A) or (B), official testing shall automatically be prevented, and corrective action shall be taken to bring the dynamometer into calibration. Official testing shall also automatically be prevented, and corrective action shall be taken to bring the dynamometer into calibration, if the difference between the measured coast-down time and the theoretical coast-down time for 22 to 18 mph is outside of the time window calculated by Section 85.2234(b)(1)(iii)(C) or (D). For tests using inertia weights of 8500 lbs. and above, if the difference between the measured coast-down time and the theoretical coast-down time is outside of the time window calculated by Section 85.2234(b)(1)(iii)(O) or (D) for the 22 mph to the 18 mph coast-down when substituting 0.27 HP for the allowable force error (equivalent to 5.0 pounds force at 20 mph), official testing shall automatically be prevented, and corrective action shall be taken to bring the dynamometer into calibration.~~
- ~~(A) — The off-dynamometer target coast-down time at 50 mph ($DBT_{@50\text{ mph.g}}$) for dynamometers with 8.265-inch rolls shall be calculated as follows:~~

$$DET_{@ 50 \text{ mph} - 8} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{55}^2 - V_{45}^2)}{550 * (TRLHP_{@ 50 \text{ mph}} - GTRL_{@ 50 \text{ mph} - 8})}$$

~~(B) The off-dynamometer target coast-down time at 50 mph (DBT_{@50 mph-20}) for dynamometers with 20.0-inch rolls shall be calculated as follows.~~

~~Transient Mode Test Quality Control Requirements and Acceptance Testing Procedures~~

$$DET_{@ 50 \text{ mph} - 20} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{55}^2 - V_{45}^2)}{550 * (TRLHP_{@ 50 \text{ mph}} - GTRL_{@ 50 \text{ mph} - 20})}$$

~~(C) The maximum and minimum time limits for the off-dynamometer coast-down window at 20 mph (DTMax_{@20 mph-8}, DTMin_{@20 mph-8}) for dynamometers with 8.265-inch rolls shall be calculated by the following equations. The TRLHP and GTRL used in these calculations shall be determined from the same vehicle/engine category used to determine the 50 mph off-dynamometer target coast-down time. If the calculated maximum value (DTMax_{@20 mph-8}) exceeds twice the target value calculated for a specific vehicle/engine category (DT Ave_{@20 mph-8}), or if the maximum value is a negative number, a value equal to twice the target value shall be substituted for the maximum time limit.~~

~~Transient Mode Test Quality Control Requirements and Acceptance Testing Procedures~~

$$DT_{Max @ 20 \text{ mph} - 8} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{22}^2 - V_{18}^2)}{550 * (TRLHP_{@ 20 \text{ mph}} - GTRL_{@ 20 \text{ mph} - 8} - 0.17 \text{ HP})}$$

$$DT_{Ave @ 20 \text{ mph} - 8} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{22}^2 - V_{18}^2)}{550 * (TRLHP_{@ 20 \text{ mph}} - GTRL_{@ 20 \text{ mph} - 8})}$$

$$DT_{Min @ 20 \text{ mph} - 8} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{22}^2 - V_{18}^2)}{550 * (TRLHP_{@ 20 \text{ mph}} - GTRL_{@ 20 \text{ mph} - 8} + 0.17 \text{ HP})}$$

(D) — ~~The maximum and minimum time limits for the off-dynamometer coast-down window at 20 mph (DT_{Max@20mph-20}–DT_{Min@20-mph-20}) for dynamometers with 20.0-inch rolls shall be calculated by the following equations. The TRLHP and GTRL used in these calculations shall be determined from the same vehicle/engine category used to determine the 50 mph off-dynamometer target coast-down time.~~

~~Transient Mode Test Quality Control Requirements and Acceptance Testing Procedures~~

$$DT_{Max @ 20 \text{ mph} - 20} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{22}^2 - V_{18}^2)}{550 * (TRLHP_{@ 20 \text{ mph}} - GTRL_{@ 20 \text{ mph} - 20} - 0.17 \text{ HP})}$$

$$DT_{Min @ 20 \text{ mph} - 20} = \frac{\left[\frac{0.5 * ETW}{32.2} \right] * (V_{22}^2 - V_{18}^2)}{550 * (TRLHP_{@ 20 \text{ mph}} - GTRL_{@ 20 \text{ mph} - 20} + 0.17 \text{ HP})}$$

(E) — ~~Where:~~

~~DET_{@ 50 mph-dd} = Off-dynamometer target coast-down time (seconds) at 50 mph for a dynamometer with a roll diameter corresponding to the designator "dd"~~

~~DT_{Max@20 mph-dd} = Upper off-dynamometer target coast-down time limit (seconds) at 20 mph for a dynamometer with a roll diameter corresponding to the designator "dd"~~

~~DT_{Ave @20 mph-dd} = Off-dynamometer target coast-down time (seconds) at 20 mph for a dynamometer with a roll diameter corresponding to the designator "dd"~~

~~DT_{Min @ 20 mph-dd} = Lower off-dynamometer target coast-down time limit (seconds) at 20 mph for a dynamometer with a roll diameter corresponding to the designator "dd"~~

~~TRLHP_{@ 50 mph} = Track Road Load Horsepower at 50 mph for a specific vehicle engine category selected for the coast down check.~~

~~TRLHP_{@ 20 mph} = Track Road Load Horsepower at 20 mph for the corresponding specific vehicle engine category selected for the 50 mph coast down check.~~

~~GTRL_{@ 50 mph-dd} = Generic Tire/Roll Horsepower loss at 50 mph for a dynamometer with "dd" roll size, and corresponding to the specific vehicle engine category selected for the 50 mph coast down check.~~

~~GTRL_{@ 20 mph-dd} = Generic Tire/Roll Horsepower loss at 20 mph for a dynamometer with "dd" roll size, and corresponding to the specific vehicle engine category selected for the 50 mph coast down check.~~

~~ETW = Equivalent Test Weight (i.e., inertia weight) in pounds corresponding to the specific vehicle engine category selected for the 50 mph coast down check.~~

~~V_{xx}² = Velocity in feet per second corresponding to the mph value "xx"~~

~~0.17 HP = Horsepower representation of an allowable force error of 3.3 pounds-force at 20 mph. This allowable force error is approximately equivalent to a ± 2 -second tolerance in the off-dynamometer target coast-down time at 50 mph for a dynamometer with 8.625" rolls when using a TRLHP computed from the EPA on-dynamometer target coast-down time. This force error is approximately equivalent 1.0 a ± 1.25 -second tolerance in the off-dynamometer target coast-down time at 50 mph for a dynamometer with 20.0" rolls.~~

- ~~(iv) — The clock used to check the coast-down time shall be accurate to 0.1 percent of reading between 10 and 1000 seconds with a resolution of 0.01 seconds.~~
- ~~(v) — The results of each dynamometer coast-down check performed shall be automatically computed and recorded on electronic media with a date and time stamp.~~

- (2) ~~Roll Speed.~~ Roll speed and roll counts shall be checked each operating day by an independent means (e.g., photo tachometer). Deviations of greater than ± 0.2 mph or a comparable tolerance in roll counts shall require corrective action. Alternatively, a redundant roll speed transducer independent of the primary transducer may be used in lieu of the daily comparison. Accuracy of redundant systems shall be checked monthly.
- (3) ~~Warm-Up.~~ Dynamometers shall be in a warmed up condition for use in official testing. Warm-up is defined as sufficient operation that allows the dynamometer to meet the coast down time (within 3 seconds) identified for the specific dynamometer during calibration. The reference coast down time shall be the value for 55 to 45 mph with the lightest inertia weight and lowest horsepower for that weight used during weekly calibrations. Alternatively, the reference coast down time shall be the value for 22 to 18 mph with the lightest inertia weight and lowest horsepower for that weight used during weekly calibration, with a time standard of $\pm 20\%$. Comparing the measured parasitic losses at least 25 mph to reference values established during calibration may check warm-up.
- (4) ~~Acceptance Testing.~~ Upon initial installation and prior to beginning official testing, the performance of each dynamometer and dynamometer design shall be verified for compliance with the requirements in Section 85.2226(a). Specific acceptance verification requirements are described in Section 85.2234(b)(4)(i) through Section 85.2234(b)(4)(v).
- (i) ~~Coast Down/Vehicle Loading Check Following Installation.~~ The coast down performance of each dynamometer shall be checked to verify the ability of the dynamometer and dynamometer load setting system to meet dynamometer target coast down times prior to beginning official testing. The performance shall be checked by the procedure defined in Section 85.2234(b)(4)(i)(A) through Section 85.2234(b)(4)(i)(J), or by a comparable procedure approved by the Division.
- (A) ~~The dynamometer shall be warmed-up by the dynamometer manufacturer's procedure.~~
- (B) ~~At least three vehicle/engine categories shall be selected from the Look-Up table for vehicle loading. The vehicle/engine categories should cover the range of expected test vehicles.~~
- (C) ~~The dynamometer shall be set for the first vehicle/engine category selected based on the variables used to uniquely index the vehicle engine category (e.g., model year, manufacturer, model, number of cylinders, engine size, and transmission type).~~
- (D) ~~The dynamometer shall be coasted down from 65 mph to 5 mph with the settings pre-selected in Section 85.2234(b)(4)(i)(C).~~
- (E) ~~The 55 mph to 45 mph, and the 22 mph to 18 mph coast down times shall be recorded for the data collected in Section 85.2234(b)(4)(i)(D).~~
- (F) ~~The dynamometer shall be coasted down from 65 mph to 5 mph after having been adjusted for each of the other two vehicle engine categories, and the 55 mph to 45 mph, and the 22 mph to 1 mph coast down times shall be recorded for each coast down.~~

- ~~(G) The coast-downs specified in Section 85.2234(b)(4)(i)(C) through Section 85.2234 (b)(4)(i)(F) shall be replicated for a total of three coast-down tests for each vehicle inertia category. The replications of the coast-downs for each vehicle engine category shall be run in random sequence.~~
- ~~(H) The off-dynamometer target coast-down tune at 50 mph ($DET_{@ 50 \text{ mph-}dd}$) for each vehicle/engine category shall be calculated as specified in Section 85.2234(b)(l)(iii)(A) or (B) for the applicable dynamometer roll size.~~
- ~~(I) The upper and lower off-dynamometer coast-down time limits at 20 mph ($DT_{Max. @ 20 \text{ mph-}dd}$ $DT_{Min. @ 20 \text{ mph-}dd}$) for each vehicle/engine category shall be calculated as specified in Section 85.2234(b)(l)(iii)(C) or (D) for the applicable dynamometer roll size.~~
- ~~(J) The dynamometer vehicle loading is considered acceptable if each measured 55 mph to 45 mph coast-down tune for each vehicle/engine category tested is within ± 1 second of the off-dynamometer target coast-down time determined in (b)(4)(i)(H) above, and if each measured 22 mph to 18 mph coast-down tune for each vehicle/engine category tested is within the off-dynamometer target coast-down time limits determined in (b)(4)(i)(I) above.~~
- ~~(ii) Vehicle Loading Check of Dynamometer Design. For each dynamometer design used, the Division shall obtain and maintain a report verifying the ability of the dynamometer design to properly load vehicles as specified in Section 85.2226(a). The dynamometer manufacturer may prepare the report. The report shall identify how each requirement in Section 85.2226(a) is performed by the specific dynamometer design used. In addition, where specific performance levels or characterizations are specified (e.g., Section 85.2226 (a)(2)(viii), Section 85.2226(2)(x), Section 85.2226(4)(ii) and Section 85.2226(a)(5)), test data with supporting analysis verifying compliance shall be included. At a minimum, the test data shall include a comparison and analysis of the expected coast-down times versus the actual vehicle on-dynamometer coast-down times for at least three vehicles spanning the range of drive-axle weights and horsepower. Actual track coast-down data and curves shall be available for the makes and models of vehicles selected from which the expected coast-down times shall be derived. The analysis shall also graphically compare the track horsepower curves to curves generated from the on-dynamometer coast-down testing. Reasons for variations in time, equivalent to one horsepower, between the expected coast-down times and the actual vehicle on-dynamometer coast-down times, or variations between the curves of more than one horsepower shall be explained in the report.~~
- ~~(iii) Alternative Coast Down/Vehicle Loading Check. This procedure may be used in lieu of the procedures in Section 85.2234(b)(4)(i). The coast-down performance of each dynamometer shall be checked with at least two categories of vehicles to verify the ability of the dynamometer and dynamometer load-setting system to meet dynamometer target coast down times. The coast down performance of each dynamometer design used shall be checked with at least 6 categories of vehicles to determine the ability of the dynamometer design to properly load the vehicle over the required speed range as defined in Section 85.2226(a)(2). The performance of the design shall be checked by the procedure defined Section~~

~~85.2234(b)(4)(ii)(A) through Section 85.2234(b)(4)(ii)(L), or by a comparable procedure proposed by the Division.~~

- ~~(A) — The dynamometer shall be warmed-up by the dynamometer manufacturer's procedure, and the tires and drive train on the test car shall be warmed-up by operating the vehicle at 50 mph for 20 minutes. The tire pressure in the test vehicles shall be at 45 psi.~~
- ~~(B) — The dynamometer indicated power (IHP) and inertia weight for the vehicle should be selected for the test vehicle.~~
- ~~(C) — The test vehicle shall be coasted down from 65 mph to 5 mph on the dynamometer with the settings pre-selected in Section 85.2234(b)(4)(i)(B).~~
- ~~(D) — The 55 mph to 45 mph, and the 22 mph to 18 mph coast down times shall be recorded for the data collected in Section 85.2234(b)(4)(i)(C).~~
- ~~(E) — The test vehicle shall again be coasted down from 65 mph to 5 mph on the dynamometer with the dynamometer power absorber reset to a load of zero.~~
- ~~(F) — A speed versus horsepower equation of the form in Section 85.2226(a)(2)(iii) shall be determined for the data collected in Section 85.2234(b)(4)(i)(E).~~
- ~~(G) — The test vehicle shall be removed from the dynamometer, and the dynamometer shall be coasted down from 65 mph to 5 mph with the dynamometer power absorber set to a load of zero.~~
- ~~(H) — A speed versus horsepower equation of the form in Section 85.2226(a)(2)(ix) for parasitic losses (PLHP) shall be determined for the data collected in Section 85.2234(b)(4)(i)(G).~~
- ~~(I) — The tire/roll interface losses shall be determined by subtracting the horsepower curve determined in Section 85.2234(b)(4)(i)(H) from the horsepower curve determined in Section 85.2234(b)(4)(i)(F). The tire loss curve (GTRL) shall be in the form specified in Section 85.2226(a)(2)(xiii).~~
- ~~(J) — Repeat the steps in Section 85.2234(b)(4)(i)(B) through Section 85.2234(b)(4)(i)(I) to obtain a total of three sets of data for each test vehicle. The dynamometer and vehicle may be warmed-up as needed to meet the requirements in Section 85.2234(b)(4)(i)(A).~~
- ~~(K) — For each test vehicle, compute the average 55 mph to 45 mph coast down time, the average 22 mph to 18 mph coast down time, and the average tire/roll interface loss curve as measured in Section 85.2234(b)(4)(i)(B) through Section 85.2234(b)(4)(i)(J).~~
- ~~(L) — The dynamometer vehicle loading is considered acceptable if, for each test vehicle, the average values determined in Section 85.2234(b)(4)(i)(K) are within ± 1 second of the 55 mph to 45 mph for the target time specified in Section 85.2226(a)(2)(ii), are within ± 7 percent of~~

the 22 mph to 18 mph that is calculated from Section 85.2226(a)(2)(iii) and Section 85.2226(a)(2)(iv), and within ± 15 percent of a generic tire/roll loss curve for the category of vehicle.

- (iv) ~~Load Measuring Device Check.~~ The load measuring device on each dynamometer shall be checked by a dead-weight method (or equivalent) at least six points across the range of loads used for vehicle testing. Physical checking weights shall be traceable to NIST standards to within ± 0.5 percent. Equivalent methods shall document the method used to verify equivalent accuracy. The accuracy of the interpreted value used for calculation or control shall be within ± 1 percent of full scale.
- (v) ~~Vehicle Inertia Loading.~~ The actual inertia applied to the vehicle by each inertia weight, in combination with the base inertia, shall be verified for each dynamometer to insure compliance with the requirements in Section 85.2226(a)(4)(i) or Section 85.2226(a)(4)(ii) as applicable.
- (vi) ~~Parasitic loss check between 8 and 12 mph.~~ The coast down tune of each dynamometer between 8 and 12 mph shall be verified for compliance with the requirements of Section 85.2226(a)(2)(x).
- (vii) ~~Speed and Distance Check.~~ The performance of the speed and distance measuring system of each dynamometer shall be verified for compliance with the requirements of Section 85.2226(a)(5)(i). The ability to resolve acceleration as specified in Section 85.2226(a)(5)(i) need only be generically verified for the design used. If more than one design is used, each design shall be verified.
- (viii) ~~Warm-up System Check.~~ The dynamometer warm-up system shall be checked for compliance with the requirements in Section 85.2234(b)(3) by conducting a coast down check immediately following completion of the warm-up specified by the dynamometer manufacturer or the system. The design of the warm-up system should be checked across the range of temperatures experience in-use, and particularly at the lower speeds.
- (5) ~~Coast-down Times.~~ Following acceptance, 55 to 45 mph, and 22 to 18 mph coast-down times shall be determined for quality control purposes with the vehicle off the dynamometer for each inertia weight and for at least 2 horsepower settings within the normal range of the inertia weight as required in Section 85.2234(b)(1)(ii). These quality control values shall be determined when the dynamometer has been set to meet either the coast-down target times with the vehicle on the dynamometer (i.e., 55 to 45 mph and 22 to 18 mph), or the equation coefficients. The Division, may however, select different vehicle/engine categories to check coast-down times as in Section 85.2234(b)(4)(i) for audit purposes.

(c) ~~Constant Volume Sampler~~

- (1) ~~Flow Calibration.~~ The flow of the CVS shall be calibrated at six flow rates upon initial installation, 6 months following installation, and every 12 months thereafter. The flow rates shall include the nominal rated flow rate and a rate below the rated flow rate for both critical flow Venturis and subsonic Venturis, and a flow rate above the rated flow for sub-sonic Venturis. The flow calibration points shall cover the range of variation in flow that typically occurs when testing. A complete calibration shall be performed following repairs to the CVS that could affect flow.

- (2) ~~System Check.~~ CVS flow calibration at the nominal CVS design flow shall be checked once per operating day using a procedure that identifies deviations in flow from the true value. A procedure equivalent to that in Section 86.119(c) shall be used. Deviations greater than $\pm 4\%$ shall result in automatic lockout of official testing until corrected.
- (3) ~~Cleaning Flow Passages.~~ The sample probe shall be checked at least once per month and cleaned if necessary to maintain proper sample flow. CVS venturi passages shall be checked once per year and cleaned if necessary.
- (4) ~~Probe Flow.~~ The indicator identifying the presence of proper probe flow for the system design (e.g., proportional flow for CFV systems, minimum flow for time correlation of different analyzers) shall be checked on a daily basis. Lack of proper flow shall require corrective action.
- (5) ~~Leak Check.~~ The vacuum portion of the sample system shall be checked for leaks on a daily basis and each time the system integrity is violated (e.g., changing a filter).
- (6) ~~Bag Sample Check.~~ On a quarterly basis, vehicle exhaust shall be collected in sample bags with simultaneous integrated measurement of the sample. At least one bag each for Phase 1 and for Phase 2 of the transient test cycle shall be conducted. Differences between the two measurement systems greater than 10% shall result in system lockout until corrective action is taken. For the purposes of acceptance testing, the differences shall be no greater than 5 %.
- (7) ~~Response Time Check.~~ The response time of each analyzer shall be checked upon initial installation, during each check for compliance with Section 85.2234(c)(6), after each repair or modification to the flow system that would reasonably be expected to affect the response time, and as determined by the Division. The check shall include the complete sample system from the sample probe to the analyzer. Statistical process control shall be used to monitor compliance and establish fit for use limits based on the requirements in Section 85.2226(c). At a minimum, response time measurements that deviate significantly from the average response time for all CVS systems designed to the same specification in the program shall require corrective action before testing may resume.
- (8) ~~Mixing Tee Acceptance Test.~~

 - (i) ~~The design of the mixing tee shall be evaluated by running the transient driving cycle on at least two vehicles, representing the high and low ends of engine displacement and inertia. Changes in the static tailpipe pressure with and without CVS, measured on a second-by-second basis within 3 inches of the end of the tailpipe, shall not exceed ± 1.0 inch of water.~~
 - (ii) ~~The ability of the mixing tee design to capture all of the exhaust as a vehicle moves laterally from one extreme position on the dynamometer to the other extreme shall be evaluated with back-to-back testing of three vehicles, representing the high and low ends of engine displacement and inertia. The back-to-back testing shall be done with the mixing tee at the tailpipe and with an airtight connection to the tailpipe (i.e., the mixing tee will be effectively moved downstream, as in typical FTP testing). The difference in carbon-balance fuel economy between the mixing tee located at the vehicle and the positive connection shall be no greater than 6%.~~
 - (iii) ~~The design of the dual exhaust system shall be evaluated with back-to-back testing of three vehicles, representing the high and low ends of engine~~

displacement and inertia, with an airtight connection to the tailpipe (i.e., the mixing tee will be effectively moved downstream, as in typical FTP testing, for these qualification tests). The difference in carbon-balance fuel economy between the two methods shall be no greater than 5%.

(d) Analysis System

(1) Calibration Curve Generation.

- (i) Upon initial installation, calibration curves shall be generated for each analyzer. If an analyzer has more than one measurement transducer, each transducer shall be considered as a separate analyzer in the analysis system for the purposes of curve generation and analysis system checks.
- (ii) The calibration curve shall consider the entire range of the analyzer as one curve.
- (iii) A ten (10) point equal distribution calibration curve is required of each analyzer. The calibration zero gas shall be used to set the analyzer to zero.
- (iv) Gas dividers may be used to obtain the intermediate points for the general range classifications specified.
- (v) The calibration curves generated shall be a polynomial of the best fit and no greater than 4th order, and shall fit the data within 2.0% at each calibration point as specified in Section 86.121-90, Section 86.122-78, Section 86.123-78, and Section 86.124-78.
- (vi) Each curve shall be verified for each analyzer with a confirming calibration standard between 40-80% of full scale that is not used for curve generation. Each confirming standard shall be measured by the curve within 2.5%.

(2) **Spanning Frequency.** The zero and up-scale span points shall be checked at 2 hour intervals following the daily mid-scale curve check specified in Section 85.2234(d)(4) and adjusted if necessary. If the up-scale span point drifts by more than 2.0% from the previous check or, for the first check performed after the daily calibration check described in Section 85.2234(d)(4), from the daily check official testing shall be prevented and corrective action shall be taken to bring the system into compliance. If the zero point drifts by more than 2 ppm HC, 1 ppm NO_x, 10 ppm CO, or 40 ppm CO₂, official testing shall be prevented and corrective action shall be taken to bring the system into compliance. Or, the unit may be zeroed prior to each test.

(3) **Limit Check.** The tolerance on the adjustment of the up-scale span point shall be 0.4% of point. A software algorithm to perform the zero and span adjustment and subsequent calibration curve adjustment shall be used. Cumulative software up-scale zero and span adjustments greater than $\pm 10\%$ from the latest calibration curve shall cause official testing to be prevented and corrective action shall be taken to bring the system into compliance.

(4) **Daily Calibration Checks.** The curve for each analyzer shall be checked and adjusted to correctly read zero using a working zero gas, and an up-scale span gas within the tolerance in Section 85.2234(d)(3), and then by reading a mid-scale span gas within 2.5% of point, on each operating day prior to vehicle testing. If the analyzer does not read the mid-scale span point within 2.5% of point, the analyzer shall automatically be

prevented from official testing. The up-scale span gas concentration for each analyzer shall correspond to approximately 80% of full scale, and the mid-point concentration shall correspond to approximately 15% of full scale.

- (5) ~~Weekly NO_x Converter Checks.~~ The converter efficiency of the NO₂ to NO converter shall be checked on a weekly basis or as determined by the Division. The check shall be equivalent to Section 86.123-78 (for reference see EOD Form 305-01) except that the concentration of the NO gas shall be in the range of 100-300 ppm. Alternative methods may be used if approved by the Division.
- (6) ~~Weekly NO/NO_x Flow Balance.~~ The flow balance between the NO and NO_x test modes shall be checked weekly or as determined by the Division. The check may be combined with the NO_x converter check as illustrated in EPA NVFEL Form 305-01.
- (7) ~~Monthly Calibration Checks.~~ The basic calibration curve shall be verified monthly by the same procedure used to generate the curve in Section 85.2234(d)(l), and to the same tolerances.
- (8) ~~FID Check.~~
 - (i) ~~Upon initial operation, and after maintenance to the detector, each FID shall be checked, and adjusted if necessary, for proper peaking and characterization using the procedures described in SAE Paper Number 70141 or by analyzer manufacturer recommended procedures.~~
 - (ii) ~~The response of each FID to a methane concentration of approximately 50 ppm CH₄ shall be checked once per month. If the response is outside of the range of 1.00 to 1.30, corrective action shall be taken to bring the FID response within this range. The response shall be computed by the equation in Section 85.2234(d)(9)(iii).~~
 - (iii) ~~Ratio of Methane Response =~~
- (9) ~~Integrator Checks.~~ Upon initial operation, emissions from a vehicle with transient cycle test values between 60% and 400% of the 1984 LDGV standard shall be simultaneously sampled by the normal integration method and by the bag method in each system. The data from each method shall be put into a historical database for determining normal and deviant performance for each test system. Specific deviations between the integrator and bag readings exceeding $\pm 10\%$ shall require corrective action.
- (10) ~~Cross-Checks.~~ **NOT APPLICABLE** On a quarterly basis, and whenever gas bottles are changed, each analyzer in a given facility shall analyze a sample of a test gas. The test gas shall be independent of the gas used for the daily calibration check in Section 85.2234(d)(4), in independent bottles. The same test gas, or gas mixture shall be used for all analyzers. The concentration of the gas shall be one of three values corresponding to approximately 0.5 to 3 times the cut point (in gpm) for 1984 and later model year vehicles for the constituent. One of the three values shall be at the lower end of the range, another shall be at the higher end of the range, and the other shall be near the middle of the range. The values selected shall be rotated in a random manner for each crosscheck. A gas divider may determine the value of the checking sample. The deviation in analysis from the concentration of the checking sample for each analyzer shall be recorded and compared to the historical mean and standard deviation for the analyzers at the network and at all facilities. Any reading exceeding 3 sigma shall cause the analyzer to be placed out of service.

~~(11) Interference, Laboratory Testing. The design of each CO, CO₂, and NO_x analyzer shall be checked for water vapor interference prior to initial service. The interference limits in this paragraph shall apply to analyzers used with a CVS of 700 SCFM or greater. For analyzers used with lower flow rate CVS units, the allowable interference response shall be proportionately adjusted downward.~~

~~(i) CO Analyzer. A gas mixture of 4% CO₂ in N₂ bubbled through water with a saturated mixture temperature of 40°C shall produce a response on the CO analyzer of no greater than 15 ppm at 40°C. Also, a gas mixture of 4 percent CO₂ in N₂ shall produce a response on the CO analyzer of no greater than 10 ppm at 40°C.~~

~~(ii) CO₂ Analyzer. A calibration zero gas bubbled through water with a saturated mixture temperature of 40°C shall produce a response on the CO₂ analyzer of no greater than 60 ppm.~~

~~(iii) NO_x Analyzer. A calibration zero gas bubbled through water with a saturated mixture temperature of 40°C shall produce a response on the NO_x analyzer of no greater than 1 ppm. Also, a gas mixture of 4 percent CO₂ in either N₂ or air shall produce a response on the NO_x analyzer of no greater than 1.0 ppm at 40°C.~~

~~(12) Interference — Field Testing. Each CO, CO₂, and NO_x analyzers shall be checked for water vapor interference prior to initial service, and on a yearly basis thereafter. The in-field check prior to initial service and the yearly checks shall be performed on a high ambient temperature summer day (or simulated conditions). For analyzers used with lower flow rate CVS units, the allowable interference response shall be proportionately adjusted downward. The allowable interference level shall be adjusted to coincide with the saturated mixture temperature used. For the CO analyzer, a rejection ratio of 9,000 to 1 shall be used for this calculation. A ratio of 2000 to 1 shall be used for CO₂ analyzers. A ratio of 90,000 to 1 shall be used for NO_x analyzers.~~

~~(e) **Gases**~~

~~Calibration, Working and Span Gases Shall Conform to Regulation Number 11, Appendix B~~

~~(f) **Quality Control Data Files for Individual Test Systems.** In general, quality files control for individual test systems shall include parameters that will allow the cause for abnormal performance of a test system to be pinpointed to individual systems or components. Test system control charts shall include at a minimum:~~

~~(i) Overall number of voided tests~~

~~(ii) Number of voided tests by type~~

~~(iii) Level of difference between theoretical and measured coast-down times~~

~~(iv) Level of difference between theoretical and measured CVS flow~~

~~(v) Level of up-scale span change from last up-scale span (not required if software corrections are tracked)~~

~~(vi) Level of mathematical or software correction to the calibration curve as a result of an up-scale span change (if used)~~

- ~~(vii) — Level of difference between the analyzer response to the daily crosscheck, and the test gas concentration~~
- ~~(viii) — Level of difference between the integrated measurements and the bag measurements~~
- ~~(ix) — The system response time~~
- ~~(x) — Level of the FID-CH₄ response ratio~~
- ~~(xi) — Level of the ambient background concentrations~~
- ~~(xii) — The average, median, 10th-percentile and 90th-percentile of the composite emissions (HC, CO, CO₂, and NO_x) measured over the defined periodic basis~~
- ~~(xiii) — Average number of passing vehicles, and average number of failing vehicles over the defined periodic basis~~
- ~~(xiv) — Level of difference between theoretical or measured values for other parameters measured during quality assurance procedures~~

Test Report

~~(a) — Acceptance Test Reporting for System Evaluation~~

- ~~(1) — Test Types and Standards. The test report shall indicate the types of tests performed on the vehicle and the test standards for each. Test standards shall be displayed to the appropriate number of significant digits as in Section 85.2205(a). The reported standards shall be the composite test standards.~~
- ~~(2) — Test Scores. The test report shall show the scores for each test performed. Test scores shall be displayed to the same number of significant digits as the standards.~~
- ~~(3) — Transient Mode Test Scores. The reported score for the Transient Mode shall be in units of grams per mile and shall be selected based upon the following:~~
 - ~~(i) — If the emissions of any exhaust component of the composite Transient Test are below the applicable standard in Part F of this regulation, then the vehicle shall pass for that constituent and the composite score shall be reported.~~
 - ~~(ii) — If the emissions of any exhaust component on the composite Transient Test exceed the applicable standard in Part F of this regulation, but are below the Phase 2 standard, then the vehicle shall pass for that component and the Phase 2 score shall be reported.~~

Terms

~~(a) — Definitions~~

- ~~(1) — Track coast-down target time: The new vehicle certification track coast-down time between 55 and 45 mph.~~
- ~~(2) — Road load horsepower: The power required for a vehicle to maintain a given constant speed taking into account power losses due to such things as wind resistance, tire losses, bearing friction, etc.~~

~~(3) Tier 1: New gaseous and particulate tailpipe emission standards for use in certifying new light duty vehicles and light duty trucks phased in beginning with the 1994 model year.~~

~~(1) CVS hose: The hose, connecting to the tailpipe of the vehicle that carries exhaust and dilution air to the stationary portion of the CVS system.~~

~~(1) The Division: Colorado Department of Public Health and Environment, Air Pollution Control Division.~~

~~(5)(b) Abbreviations~~

~~(1) CFV: Critical flow venturi~~

~~(2) CH₄: Methane~~

~~(3) CO₂: Carbon dioxide~~

~~(4) CO: Carbon monoxide~~

~~(5) CRM: Certified reference material~~

~~(6) CVS: constant volume sampler~~

~~(7) FID: Flame ionization detector~~

~~(8) gpm: Grams per mile~~

~~(9) GVWR: Gross Vehicle Weight Rating~~

~~(10) HC: Hydrocarbons~~

~~(11) HDGT: Heavy-Duty Gasoline-powered Truck greater than 8500 pounds GVWR~~

~~(12) hp: horsepower~~

~~(13) Hz: cycles per second (Hertz)~~

~~(14) I/M: Inspection and Maintenance~~

~~(15) IW: Inertia weight~~

~~(16) LDGT1: Light-Duty Gasoline-powered Truck from 0 to 6000 pounds GVWR~~

~~(17) LDGT2: Light-Duty Gasoline-powered Truck from 6001 to 8500 pounds GVWR~~

~~(18) LDGV: Light-Duty Gasoline-powered Vehicle~~

~~(19) LVW: Loaded Vehicle Weight~~

~~(20) mph: Miles per hour~~

~~(21) NDIR: non-dispersive infrared~~

~~(22) NIST: National Institute for Standards and Technology~~

- (23) ~~NO₂: Nitrogen dioxide~~
- (24) ~~NO: Nitrogen oxide~~
- (25) ~~NO_x: Oxides of nitrogen~~
- (26) ~~NVFEL: National Vehicle and Fuel Emissions Laboratory~~
- (27) ~~Obmph: Observed dynamometer speed in mph of the loading roller, if rolls are not coupled~~
- (28) ~~PLHP: Parasitic horsepower loss at the observed dynamometer speed in mph~~
- (29) ~~ppm: parts per million by volume~~
- (30) ~~ppmC: parts per million, carbon~~
- (31) ~~psi: Pounds per square inch~~
- (32) ~~RFP: Request for Proposal~~
- (33) ~~RLHP: Road Load Horsepower~~
- (34) ~~rpm: revolutions per minute~~
- (1) ~~SCFM: standard cubic feet per minute~~
- (1) ~~SEO: square edged orifice~~
- (37) ~~SPC: Statistical process control~~
- (38) ~~SRM: Standard reference material~~
- (39) ~~SSV: Subsonic venturi~~
- (40) ~~TRLHP: Track road load horsepower~~

ATTACHMENT IV ~~TO THE TECHNICAL SPECIFICATION APPENDIX A~~ Specifications for Colorado 97 Analyzer

~~COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT~~

~~SPECIFICATIONS FOR COLORADO 97 ANALYZER~~

INTRODUCTION

Colorado's current enhanced I/M program contains a two-speed idle (TSI) emissions testing component, the Colorado 94 Test Analyzer System that is based upon BAR 90 technology. The TSI program utilizes a decentralized, independent inspection only format encompassing the ~~seven-nine Denver Metro Area (DMA)~~ Front Range counties. The DMA program is expanding to the North Front Range counties of Weld and Larimer in 2010. This inspection only population of independent inspectors will conduct inspections utilizing a new Colorado 97 emissions analyzer.

The demands for more accurate analytical information as well as a more automated inspection process with real-time data transfer has superseded the capabilities of BAR 90 (Colorado 94) technology. System enhancements are necessary to meet Colorado's inspection needs. These enhancements and other technical details are described in this document.

1.0 GENERAL

It is expected that the Colorado 97 software will be Colorado 94 software upgraded to BAR 97 and SAE J1978 and J1979 compliance.

1.1 Design Goals

The specifications that have been developed are designed utilizing a personal computer system. The analyzer system must be capable of performing uniform and consistent emission tests for Colorado's Automotive Inspection and Readjustment (AIR) Program. Features of the analyzer include: vehicle emissions measurements of hydrocarbon (HC), carbon monoxide (CO), carbon dioxide (CO₂) and oxygen (O₂); engine RPM measurements, exhaust dilution determinations, pressure test system for EVAP; OBD II monitor readiness and diagnostic trouble code retrieval; data entry; data retrieval tables; a dedicated printer (for vehicle inspection certificates; data recording on hard drive or removable media ; modem for "on-line real time" data transmission; monitor information display to the inspector; bar code reader and printing capabilities; and fully menu driven, interactive simple microprocessor controlled operation.

Additional, automatic features required include: gas calibrations, zero and span checks, pressure calibrations, gas auditing procedure; leak checks, HC hang-up checks, audit menus (i.e., data read system), test sequencing, and low-flow checks. The analyzer shall be designed and constructed to provide reliable and accurate service in the automotive environment. The software used in the analyzer shall consist of a process control system as well as data look-up files. Security shall be provided to prevent unauthorized modifications to the software or test data and recording unauthorized entry (tampering) and locking out of the inspection process when detected.

The emissions analyzer software shall be designed for maximum operational simplicity.

It shall also be capable of providing emission-reading characteristics, independent of the inspection function, which can be used for vehicle diagnostic.

1.2 Useful Life

The useful life of the analyzer shall be a minimum of five years.

1.3 Nameplate Data

A nameplate including the following information shall be permanently affixed to the housing of the analyzer:

Name and Address of Manufacturer

Model Description

Serial Number

Date of Assembly

The manufacturer shall affix a stick-on type label to the analyzer that contains a toll-free telephone number for customer service. This number can also be included in a service software message.

1.4 Manuals

Each analyzer shall be delivered with the following manuals:

- A. Reference Operating Instructions
- B. Operation Instruction Manual
- C. Maintenance Instruction Manual (limited)
- D. Initial Start-up Instructions

Colorado 97 Analyzer manufacturers may consolidate manuals. The manuals shall be constructed of durable materials and shall not deteriorate as a result of normal use over a five-year period. The analyzer housing shall provide convenient storage for each manual in a manner that will:

- E. Allow easy use.
- F. Prevent accidental loss or destruction.

1.5 Certification Documentation

The analyzer software shall be fully documented. Two copies of the documentation listed below shall be submitted to Colorado Department of Public Health and Environment as part of the certification application.

- A. Complete program listings. Program listings may be on disk. They are not required to be submitted with the application for certification.
- B. Functional specifications.
- C. Functional flowcharts of the software.
- D. Example inputs and outputs from all processes.
- E. Detailed interface information on system components including the identification of protocol and output specifications.
- F. All file layouts with file names, file types, file security, field names, field types, field sizes, and field editing criteria.

Documentation provided by the vendor to meet this requirement will be treated as proprietary information by Colorado Department of Public Health and Environment.

Prior to certification of any Colorado 97 emissions analyzer for sale in Colorado, the manufacturer of such analyzer shall provide the Division with software source codes and all other technical information (including, but not limited to all working codes, schematics and drawings) necessary to operate, maintain, calibrate and repair such analyzer in the event that the manufacturer or its agent ceases providing adequate maintenance, calibration and repair services in Colorado. The

manufacturer shall keep such information current, and will provide the Division with copies of any and all changes. So long as such maintenance, calibration and repair, services are available from the manufacturer or its agent, the Division shall protect such information as confidential commercial data if it is clearly marked as such. In the event that the manufacturer becomes insolvent or stops providing adequate maintenance, repair or calibration services in Colorado all such information shall be the property of the Division and may be released to a third party as necessary to repair, calibrate and maintain the analyzers.

1.6 Warranty Coverage/Service Contract

A written warranty coverage agreement, signed by an authorized representative of the equipment manufacturer and the vehicle inspection station owner, which provides a complete description of coverage for all systems and components and all manufacturer provided services listed in Section 1.8, must accompany the sale or lease of each Colorado 97 emissions analyzer.

An extended service contract shall be available upon the expiration of the manufacturers original warranty period. Original manufacturer's warranty shall be a minimum of one year from the date of purchase. The "service contract" shall be offered in one-year increments. The "service contract" agreement shall include the inspection station owner's name, inspection station address, telephone number, inspection station identification number, analyzer serial number and detailed terms of the agreement. The agreement must extend for at least one year and if purchased, the expiration date must be entered to software file and monitored by the system clock. Approaching expiration messages must be displayed at daily system start-up beginning thirty days prior to expiration and messaging "30 days until expiration, 29 days etc." Renewals shall be offered at the inspection station owner's request and governed by "good business" practices between the parties involved. Service contract agreements must be available by the manufacturer for the mandated life of Colorado AIR Program. Cost disclosures and detailed descriptions of coverage's must be available in printed form and distributed to all Colorado 97 users. Cost disclosure shall also be made for "consumable" inventory items 1.8B. This information would most appropriately be presented with the original manufactures warranty.

1.7 Tampering Resistance

Controlled access design shall be the responsibility of the manufacturer and is subject to approval by Colorado Department of Public Health and Environment. Analyzer service personnel, inspectors or others shall be prohibited, to Colorado Department of Public Health and Environment satisfaction, from creating or changing any test results, programs or data files contained in the analyzer. Manufacturers shall utilize special BIOS partitions, or other appropriate software and hardware provisions, deemed necessary to protect the I/M files and programs. The protection features shall prevent access to the secured floppy disk drive and those portions of the hard disk containing I/M programs and test data or files.

The emission analyzer and the sampling system shall be made tamper-resistant to the Colorado Department of Public Health and Environment satisfaction. At a minimum, the manufacturer shall develop tamper-resistant features to prevent unauthorized access through the cabinet. Microswitches, keyed locks, or software algorithms requiring the use of a password which can be changed by the Colorado Department of Public Health and Environment would all be acceptable provided the physical or logical design effectively prevents unauthorized access.

Manufacturers may offer analyzers with additional disk drives that can run optional software application programs.

If tampering occurs, a software lockout algorithm shall be activated which aborts any existing test sequence and prevents further inspections until an authorized AIR Program official clears the lockout.

The lockout system shall be designed so that an AIR Program official from the audit menu can activate it. Only AIR Program Auditors may remove lockouts put in place from the audit menu. Manufacturers shall develop a system by which their service technicians shall be prevented from clearing "tamper" lockouts.

Optional software packages shall not interfere with the normal operation of the I/M inspection and testing software, and shall not compromise the tamper-resistant features of the analyzer.

Manufacturer field service representatives will not have access to DOS, unless assurances acceptable to Colorado Department of Public Health and Environment have been provided that insure, integrity of the system will not be jeopardized.

1.8 Manufacturer Provided Services

The manufacturer shall agree to provide the following services to the inspection station as part of the manufacturer's original warranty and thereafter as a portion of the service contract agreement. The cost of a service agreement is to be listed on a year-by-year basis. Future charges cannot exceed the amount published.

- A. Delivery, installation, calibration, and verification of the proper operating condition of a Colorado 97 emissions analyzer.
- B. Quarterly (90 days) examination, calibration, and routine maintenance of the analyzer and sampling systems. Full systems support and repair, including loaner units. Upon initial sale or loan, provide "extra" printer medium (1 ea.) sample filter(s) (2), sample hose (1) and sample probes (1). Maintain the "extra" consumable inventory upon examination and provide a software history file for the replacement of consumables accessible to AIR Program officials. Consumables and the cost(s) thereof must be disclosed in the service agreement.
- C. Instruct all certified inspectors employed by the inspection station at the time of installation in the proper use, maintenance, and operation of the analyzer. The analyzer shall contain a feature that will allow an inspector to go through the complete inspection procedure without generating an official inspection record. This function will be used for evaluating inspector performance, by AIR Program officials, or by the manufacturer for demonstration purposes. The "training mode" shall not require the use of an inspector's access code or allow access to secured areas of hardware or software. The display shall show a message throughout the inspection that this is not an official inspection. Vehicle inspection reports shall indicate to the satisfaction of Colorado Department of Public Health and Environment that they are for training only. No official Certificate of Compliance will be generated during the training exercise.
- D. On-site service response by a qualified repair technician within two (2) business days, (48 hours) excluding Sundays and national holidays, of a request from the inspection station. The names, toll-free telephone numbers, and service facility addresses of all manufacturer representatives responsible for equipment service shall be provided to the inspection station. A service representative shall be available at all times during normal working hours. Sundays and national holidays are not included. All system repairs, component replacements, and/or analyzer adjustments, shall be accomplished on-site within 48 hours after a service request has been initiated. If the completion of this work is not possible within this time period, a Colorado 97 loaner unit shall be provided until the malfunctioning unit is properly repaired and returned to service. Service

representatives shall have a software driven menu option that allows the transfer of inspection station, inspector information and other applicable data files from one analyzer to another without manual inputs and without transfer of previous test files.

- E. Updates of the "Functional" software will be limited to once per year at no cost.

Updates of operational software, i.e., file based information will be on an "as required" basis. All forms of software updating will utilize modem technology for the updating process. File updates are at no cost and every effort will be made to minimize them.

- F. The analyzer software shall be designed so that AIR Program officials can insert a disk, prepared by the manufacturer, into the Program system host, and update the existing software version, via modem. A system of manual updating by program officials utilizing the auditor's menu shall also be available. Look-up up tables and message screens shall be designed sufficiently separate from the main operations software so that it is not possible, to interfere in any way with the operations of the analyzer.

Colorado Department of Public Health and Environment will require the manufacturer to render updates as necessary in the first year of the program to ensure the program meets all design criteria. Thereafter software updates will be limited to once per year at no cost. Since modem software updating will be utilized, there are no costs to the analyzer owner. A software version number, consisting of a four character alpha-numeric code made up of the last two digits of the year followed by a two character version number, shall be recorded in the analyzer and included on each vehicle test record. The analyzer manufacturer shall not modify any existing software version without obtaining written approval from Colorado Department of Public Health and Environment.

Colorado Department of Public Health and Environment may require the manufacturers to conduct on-site or laboratory testing of in-use analyzers in order to document continued compliance. When an analyzer is removed from the field, for repair or testing, manufacturers shall supply the inspection station from which it was removed with a temporary replacement unit meeting all program requirements. Manufacturers shall pay for all necessary shipping and transfer costs for the replacement of the analyzer selected for compliance testing. Manufacturers shall also pay for any required testing performed by their personnel or by an independent company.

The manufacturers shall provide training to AIR Program officials on all operational, maintenance, and quality control features of the analyzers, including full access to and use of inspection menus, audit menus and calibration menus, as well as optional programs offered to inspectors. Such training shall be conducted at the manufacturer's expense as a condition of certification and thereafter at reasonable intervals upon written request by Colorado Department of Public Health and Environment

1.9 Certification Requirements

The manufacturer shall submit a formal certificate to Colorado Department, of Public Health and Environment that states that any analyzer sold or leased by the manufacturer or its authorized representatives for use in Colorado AIR Program will satisfy all design and performance criteria described in these specifications. The manufacturer shall also provide sufficient documentation to demonstrate conformance with these criteria including a complete description of all hardware components, the results of appropriate performance testing, and a point-by-point response to specific requirements. Previous

certification by the California Bureau of Automotive Repair (BAR) is necessary for the analytical bench.

In addition, a full description of the company's service procedures and policies, as well as sample contracts, warranties, and extended service agreements, shall be provided as part of the certification application to ensure proper maintenance of all analyzers throughout their useful life. One fully functional analyzer shall be presented for evaluation and one additional fully functional analyzer for the certification process. If certified these units will remain in AIR Program possession for continued in-use evaluation for the life of the AIR Program. In the event that 1 % of overall unit sales exceed this two-unit base, in-use evaluation will require 1 % of overall unit sales for in use evaluation.

2.0 HARDWARE SPECIFICATIONS

2.1 General

Colorado 97 hardware shall be compliant with the BAR 97 Section 2 specification, the August 2008 revision available at:

http://www.smogcheck.ca.gov/70_siteWideInfo/Library/09_IndustryResources.html

And/or current SAE on-board diagnostic "J" standards including but not limited to J1978 and J1979 available from SAE.

NOTE: The Colorado 97 is not an ASM system. ASM hardware, i.e. the dynamometer and NOx sensor, are not needed. By extension, ASM software is also unnecessary.

2.2 Span Gases

The Colorado 97 shall use the same span gases utilized for calibration of the Colorado 94 TAS namely:

AIR 94 Low Range:

300 ppm propane

1.0% carbon monoxide

6.0% carbon monoxide

Balance: oxygen-free nitrogen

AIR 94 Mid Range:

1200 ppm propane

4.0% carbon monoxide

12.0% carbon monoxide

Balance: oxygen-free nitrogen

2.3 Audit Gases

Audit gases shall be those described in Colorado Air Quality Control Commission Regulation Number 11.

3.0 SOFTWARE COMPONENTS

3.1 Communication and Data Field Specification

Operational software requirements at a minimum must support the existing Colorado 94 Communication Protocol and Data Field Specification. See Appendix A. For inquiries referencing the Communication and Data Field Specification, please contact the Colorado Air Pollution Control Division.

3.2 Society of Automotive Engineers (SAE) "J" Standards

The Colorado 97 shall be compliant with current SAE on-board diagnostic "J" standards including but not limited to J1978 and J1979.

3.3 OBD II

The Colorado 97 must be capable of accessing OBD II readiness monitors and diagnostic trouble codes. The operational software requirements will be available from the Division upon request.

3.4 Forms

The Colorado 97 shall be capable of completing the current, ~~pre-printed, continuous form-fed print on demand~~ Vehicle Inspection Report (VIR) form. Examples of the VIR ~~and the Vehicle Repair Form (VRF) are in Appendix B~~ are following this Section 3.0.

3.5 Upgrades

Software shall be updated/upgraded per Section 1.8 ~~above~~ of this Attachment IV.

~~Colorado 94 Communications and Data Fields Specification~~

Colorado Department of Health Specifications for Colorado 94 Analyzer

Communications Specifications

Released By: James L. Delanty 21 February 1996
Date

Approved By: _____
Date

NOTICE TO ALL PERSONS RECEIVING THIS DOCUMENT

This document is the property of Envirotest Systems Corp. and is delivered on the express condition that it is not to be disclosed, reproduced in whole or in part, or used for the manufacture for anyone other than Envirotest Systems Corp. without its written consent; and that no right is granted to disclose or so use any information contained in the said document. This restriction does not limit the right to use information obtained from another source.



ES 20126
Version
1.10

Vehicle Inspection Report - ~~Passing~~ Form-~~Front~~

DR 2071A (01/31/12)



VEHICLE INSPECTION REPORT

A2510FEL9H

STATE OF COLORADO



RESULTS

Overall Result	Emissions	Equipment Inspection	On Board Diagnostics	Smoke	Total Amount Paid
PASS	PASS	PASS	PASS	PASS	0.00

VEHICLE INFORMATION				OFFICIAL USE ONLY	
DATE: 26-OCT-2011 11:29:41	YEAR: 2007	STATION: 5025E	TEST: 2		
VIN:	MAKE: CHR	LANE: 01	TVFY: B8B6		
PLATE:	MODEL: PT CRUISER	ODOMETER: 22000	VVFY: E7BA		

EMISSIONS TEST INFORMATION				EQUIPMENT INSPECTION	
	READINGS	LIMITS	RESULTS		
HC GPM	0.0099	4.0000	PASS	Catalytic Converter Presence:	PASS
CO GPM	0.0011	20.0000	PASS	Air Injection System Presence:	PASS
CO2 GPM	204.1342			Oxygen Sensor Presence:	PASS
NOx GPM	0.0002	9.0000	PASS	Gas Cap Presence:	PASS
				Gas Cap Integrity:	

ON BOARD DIAGNOSTICS	
Check Engine Light: PASS	Check Engine Light Command Status: Off
Diagnostic Trouble Codes:	P0100, Mass or Volume Air Flow Circuit Malfunction
	P0200, Injector Circuit Malfunction
	P0201, Injector Circuit Malfunction - Cylinder 1
	P0206, Random/Multiple Cylinder Misfire Detected
	P0302, Cylinder 2 Misfire Detected

CONSUMER INFORMATION

Congratulations, your vehicle has passed the emissions inspection. If you are renewing your registration by mail, follow the instructions regarding the renewal process located on the back side of your renewal notice. If you are renewing your registration in person, the Certificate of Emissions Control, located below, must accompany all supporting documents at the time of registration. After 24 hours, you may renew your registration online at www.colorado.gov/renewplates. If the Certificate of Emission Control is lost, a new inspection is required at the owner's/operator's expense. For questions, comments and complaints contact Air Care Colorado at 303-456-7090 or the Department of Revenue at 303-205-5603 and if located outside the Denver Metro Area, call 888-200-8827. Retain this document in the vehicle as proof of emission compliance.

PLEASE REMOVE THE "CERTIFICATE OF EMISSIONS CONTROL", LOCATED BELOW, AND INCLUDE IT WITH YOUR RENEWAL CARD AND REGISTRATION PAYMENT. DO NOT STAPLE THIS DOCUMENT OR PAYMENT TO YOUR RENEWAL CARD.

CUT HERE

		State of Colorado		A2510FEL9H	
<h1>VOID</h1>					
DATE	26-OCT-2011	VIN			
YEAR	2007	MAKE		PT	CRUISER
PLATE		FACILITY	5025E	INSPECTOR	55555



VEHICLE INSPECTION REPORT

05127310

STATE OF COLORADO

RESULTS

Overall Result	Emissions	Evaporative Systems	Equipment Inspection	Smoke	CFC's	Recall	OBD Codes	Total Amount Paid

VEHICLE INFORMATION

VIN		STATE	LICENSE PLATE	YEAR	MAKE		ODOMETER
PROGRAM	INSPECTOR #	LANE #	STATION #	START TIME	END TIME	DATE	

CONSUMER INFORMATION

EMISSIONS TEST INFORMATION				EVAPORATIVE SYSTEMS TEST INFORMATION			
			LIMITS	RESULTS	PRESSURE	PURGE	FUEL CAP RESULTS
					INCHES/H ₂ O		
					LIMITS		
					READINGS		
					RESULTS		

EQUIPMENT INSPECTION INFORMATION

IF YOUR VEHICLE PASSED OR WAS ISSUED A WAIVER

Your vehicle inspection results are shown on this "VEHICLE INSPECTION REPORT". If you are renewing your registration by mail, follow the instructions regarding the renewal process located on the back side of your renewal notice. If you are renewing your registration in person, the Certificate of Emissions Control must accompany all supporting documents at the time of registration. If the Certificate of Emissions Control is lost, a new inspection is required at the owner's/operator's expense.

IF YOUR VEHICLE FAILED THE INSPECTION

Your vehicle inspection results are shown on this "VEHICLE INSPECTION REPORT". If your vehicle failed its first inspection, you are entitled to one free reinspection within 10 calendar days if returned to the same independent inspection station. If the first inspection was performed at an Envirotest center, the reinspection can be performed at any one of Envirotest's centers. The information recorded on this "VEHICLE INSPECTION REPORT" is extremely valuable to a repair technician when having your vehicle repaired. The "VEHICLE REPAIR FORM" (VRF), located on the back **must** be completed by the person performing the repairs. The VRF **must also** accompany the vehicle at the time of reinspection. If your vehicle fails the reinspection, you may be entitled to a waiver. Waiver eligibility information is available at the inspection stations or by calling the Department of Revenue at (303) 205-5603.

"QUALITY EMISSIONS REPAIRS ALWAYS BEGIN WITH A GOOD DIAGNOSIS BY A QUALIFIED REPAIR TECHNICIAN."

HIGH HC READINGS	HIGH CO READINGS	HIGH NOx READINGS
HIGH HC READINGS ARE A RESULT OF UNBURNED OR PARTIALLY BURNED FUEL.	HIGH CO READINGS OCCUR WHEN THE AIR/FUEL MIXTURE IS TOO RICH.	HIGH NOx READINGS ARE THE RESULT OF HIGH COMBUSTION TEMPERATURES AND/OR HIGH COMBUSTION PRESSURES. (ENHANCED AREA ONLY)

INSPECTION TYPE

DATE

INSPECTOR #

MAKE

VIN #

FACILITY #

LICENSE #

MODEL

YEAR

05127310

PLEASE REMOVE THIS PORTION AND INCLUDE IT WITH YOUR RENEWAL CARD AND REGISTRATION PAYMENT. DO NOT STAPLE THIS DOCUMENT OR PAYMENT TO YOUR RENEWAL CARD.

Vehicle Inspection Report – ~~Failing~~ Form-~~Back~~ (Vehicle Repair Form)

DR 2071B (01/18/21)



VEHICLE INSPECTION REPORT

B1610DLP9I

STATE OF COLORADO



RESULTS

Overall Result	Emissions	Equipment Inspection	On Board Diagnostics	Smoke	Total Amount Paid
FAIL	FAIL	FAIL	ADVISE	FAIL	0.00

VEHICLE INFORMATION				OFFICIAL USE ONLY	
DATE: 20-SEP-2012 10:32:06	YEAR: 2001	STATION: 5016E	TEST: 1		
VIN:	MAKE: FORD	LANE: 01	TVFY: F161		
PLATE: TEST1	MODEL: FOCUS	ODOMETER: 12345	VVFY:		

EMISSIONS TEST INFORMATION				EQUIPMENT INSPECTION	
	READINGS	LIMITS	RESULTS		
HC GPM	3.8625	1.2000	FAIL	Catalytic Converter Presence:	FAIL
CO GPM	27.1893	15.0000	FAIL	Air Injection System Presence:	FAIL
CO2 GPM	433.8854			Oxygen Sensor Presence:	FAIL
NOx GPM	2.9067	1.5000	FAIL	Gas Cap Presence:	PASS
				Gas Cap Integrity:	FAIL

ON BOARD DIAGNOSTICS	
Check Engine Light: FAIL	Check Engine Light Command Status: On
Diagnostic Trouble Codes:	
	0115, Engine Coolant Temperature Circuit Malfunction
	0130, O2 Sensor Circuit Malfunction (Bank 1 Sensor 1)
	0172, System too Rich (Bank 1)

CONSUMER INFORMATION		
Your vehicle has failed to comply with required State regulations for emissions inspection. All items listed as failure must be addressed prior to your next inspection. For questions, comments and complaints contact Air Care Colorado at 303-456-7090 or the Department of Revenue at 303-205-5603 and if located outside the Denver Metro Area, call 888-200-8827. You are entitled to one free reinspection within 10 calendar days, the reinspection can be performed at any one of Air Care Colorado's centers. The information recorded on this report is extremely valuable to a repair technician when having your vehicle repaired. If your vehicle fails the reinspection, you may be entitled to a waiver. Waiver eligibility information, to include hardship waivers, is available at the inspection station or by calling the Department of Revenue at 303-205-5603.		
HIGH HC READINGS	HIGH CO READINGS	HIGH NOx READINGS
HIGH HC READINGS ARE A RESULT OF UNBURNED OR PARTIALLY BURNED FUEL.	HIGH CO READINGS OCCUR WHEN THE AIR/FUEL MIXTURE IS TOO RICH.	HIGH NOx READINGS ARE THE RESULT OF HIGH COMBUSTION TEMPERATURES AND/OR PRESSURES.

CUT HERE

VEHICLE REPAIR FORM	
This form must be completed by the person performing the repairs AND accompany the vehicle at the time of reinspection.	
Mark here if some or all repairs were warranty or recall related: <input type="checkbox"/>	Parts Costs: \$
Repaired by Vehicle Owner: <input type="checkbox"/> Repaired by Repair Facility: <input type="checkbox"/>	Labor costs: \$
Repair Date:	Miscellaneous Costs: \$
Name of Repair Facility:	Diagnostic Costs: \$
Name of Person Filling Out Form:	Total Repair Costs: \$
Technician Number:	
Facility Number:	
Signature:	
VIN:	

VEHICLE REPAIR FORM

ATTENTION: THIS FORM MUST BE FILLED OUT AND SIGNED BEFORE THE VEHICLE CAN BE REINSPECTED!

The Vehicle Repair Form must be filled out and signed by the person performing repairs before the vehicle will qualify for an after repairs inspection. All the items listed DO NOT need to be filled out, just the items indicating what repairs were addressed on the vehicle. Place one X per item, (from corner to corner) in the appropriate box. Mark only one box per repair item listed.

SUGGESTED BUT NOT REPAIRED		REPAIRED		REPLACED		SUGGESTED BUT NOT REPAIRED		REPAIRED		REPLACED		SUGGESTED BUT NOT REPAIRED		REPAIRED		REPLACED	
CHECKED/OK		REPAIRED		REPLACED		CHECKED/OK		REPAIRED		REPLACED		CHECKED/OK		REPAIRED		REPLACED	
FUEL SYSTEMS REPAIRS						EGR SYSTEMS						IGNITION SYSTEM					
AIR FILTER	1:A	B	C	D	E	VACUUM	29:A	B	C	D	E	COIL/COIL PACKS	56:A	B	C	D	E
FUEL FILTER	2:A	B	C	D	E	VALVE	30:A	B	C	D	E	DISTRIBUTOR	57:A	B	C	D	E
VACUUM LEAKS	3:A	B	C	D	E	PASSAGES	31:A	B	C	D	E	ROTOR/CAP	58:A	B	C	D	E
FUEL LEAKS	4:A	B	C	D	E	ELECTRICAL	32:A	B	C	D	E	TIMING	59:A	B	C	D	E
FUEL FILLER RESTRICTOR	5:A	B	C	D	E	EVAP. CANISTER SYSTEM						SPARK PLUGS	60:A	B	C	D	E
CARBURETION						VACUUM/ROUTING	33:A	B	C	D	E	SPARK PLUG WIRES	61:A	B	C	D	E
CARBURETOR ADJUSTMENT	6:A	B	C	D	E	VALVE	34:A	B	C	D	E	PICK UP COIL	62:A	B	C	D	E
CARBURETOR Q/H	7:A	B	C	D	E	FUEL CAP	35:A	B	C	D	E	MODULE	63:A	B	C	D	E
CARBURETOR R/R	8:A	B	C	D	E	ELECTRICAL	36:A	B	C	D	E	MECHANICAL	64:A	B	C	D	E
CHOKE MECHANICAL	9:A	B	C	D	E	FUEL TANK	37:A	B	C	D	E	SECONDARY LEADS	65:A	B	C	D	E
CHOKE ELECTRICAL	10:A	B	C	D	E	CANISTER	38:A	B	C	D	E	ENGINE MECHANICAL REPAIRS					
TAC	11:A	B	C	D	E	COMPUTER SYSTEMS REPAIRS						SEALS/GASKETS	66:A	B	C	D	E
M / C SOLENOID	12:A	B	C	D	E	ECM/PROB	39:A	B	C	D	E	INTERNAL	67:A	B	C	D	E
FUEL INJECTION						MEMORY RESET	40:A	B	C	D	E	BEARING	68:A	B	C	D	E
PRESSURE REGULATOR	13:A	B	C	D	E	SENSORS	41:A	B	C	D	E	HEADS	69:A	B	C	D	E
THROTTLE BODY	14:A	B	C	D	E	O2	42:A	B	C	D	E	SEALS/GASKETS	70:A	B	C	D	E
FUEL DISTRIBUTOR	15:A	B	C	D	E	TEMPERATURE	43:A	B	C	D	E	MECHANICAL	71:A	B	C	D	E
INJECTOR(S)	16:A	B	C	D	E	AIR FLOW	44:A	B	C	D	E	VALVETRAIN	72:A	B	C	D	E
MECHANICAL	17:A	B	C	D	E	THROTTLE POSITION	45:A	B	C	D	E	CAM SHAFT	73:A	B	C	D	E
ELECTRONIC	18:A	B	C	D	E	DEMAND	46:A	B	C	D	E	CHAIN/BELT	74:A	B	C	D	E
COLD START VALVE	19:A	B	C	D	E	BRK/THROTTLE	47:A	B	C	D	E	ADJUSTMENT	75:A	B	C	D	E
WARM UP REGULATOR	20:A	B	C	D	E	KNOCK	48:A	B	C	D	E	TRANSMISSION	76:A	B	C	D	E
EMISSIONS SYSTEMS REPAIRS						VEHICLE SPEED	49:A	B	C	D	E	MECHANICAL	77:A	B	C	D	E
CATALYTIC CONVERTER	21:A	B	C	D	E	OTHER	50:A	B	C	D	E	ELECTRICAL	78:A	B	C	D	E
AIR INJECTION SYSTEM	22:A	B	C	D	E	ELECTRICAL SYSTEM REPAIRS						HYDRAULIC	79:A	B	C	D	E
BELT	23:A	B	C	D	E	BATTERY	51:A	B	C	D	E	COOLING SYSTEMS REPAIRS					
PUMP/VALVES	24:A	B	C	D	E	ALTERNATOR	52:A	B	C	D	E	THERMOSTAT	80:A	B	C	D	E
PLUMBING	25:A	B	C	D	E	WIRING	53:A	B	C	D	E	RADIATOR	81:A	B	C	D	E
ELECTRICAL	26:A	B	C	D	E	BROKEN WIRES	54:A	B	C	D	E	FAN	82:A	B	C	D	E
VACUUM/ROUTING	27:A	B	C	D	E	CONNECTORS	55:A	B	C	D	E	ELECTRICAL	83:A	B	C	D	E
PCV SYSTEM	28:A	B	C	D	E	CORROSION						VEHICLE FLUIDS					
VALVE						SHORTED						CRANKCASE OIL					
VACUUM												COOLANT					
												FUEL					

REPAIR DATE: / /

MARK HERE IF SOME OR ALL OF THE REPAIRS ARE WARRANTY OR RECALL RELATED: A: ☐

REPAIRED BY: OWNER ☐

OTHER: B: ☐

TECHNICIAN NUMBER C:

FACILITY NUMBER D:

REPAIR FACILITY PHONE NUMBER:

NAME OF REPAIR FACILITY:

ACTUAL PARTS COSTS PAID TO BRING VEHICLE INTO COMPLIANCE

ACTUAL LABOR COSTS PAID TO BRING VEHICLE INTO COMPLIANCE

ACTUAL MISCELLANEOUS REPAIR COSTS PAID TO BRING VEHICLE INTO COMPLIANCE

ACTUAL DIAGNOSTIC COSTS PAID TO BRING VEHICLE INTO COMPLIANCE

TOTAL EMISSIONS RELATED REPAIR COSTS PAID TO BRING VEHICLE INTO COMPLIANCE

F: \$

G: \$

H: \$

I: \$

J: \$

NAME OF PERSON PERFORMING REPAIRS (PLEASE PRINT OR TYPE):

SIGNATURE OF PERSON PERFORMING REPAIRS:

Vehicle Inspection Report Form-Completed



VEHICLE INSPECTION REPORT

05127255

STATE OF COLORADO

HW 2500
HP 9.8

1 not used

RESULTS

Overall Result	Emissions	Evaporative Systems	Equipment Inspection	Smoke	CFC's	Recall	OBD Codes	Total Amount Paid
PASS	PASS	PASS	PASS	PASS	N/A		ADVISE	0.00

VEHICLE INFORMATION

VIN		STATE	LICENSE PLATE	YEAR	MAKE		ODOMETER
3G1JF52T1WS803479		CO	563KNB	1998	CHE		93501
PROGRAM	INSPECTOR #	LANE #	STATION #	START TIME	END TIME	DATE	
E	10363	01	5016E	09:00:57	09:23:45	03-NOV-2009	

CONSUMER INFORMATION

Congratulations, your vehicle is compliant with all State regulations for this emissions inspection. See the box titled "IF YOUR VEHICLE PASSED OR WAS ISSUED A WAIVER" for further instructions. If you are renewing your registration you may renew on line at www.colorado.gov/renewplates, after 24 hours of successfully completing an emissions inspection.

EMISSIONS TEST INFORMATION

	READINGS	LIMITS	RESULTS		PRESSURE	PURGE	FUEL CAP RESULTS
HC GPM	0.3301	1.2000	PASS	UNITS	INCHES/H ₂ O		
CO GPM	2.2816	15.0000	PASS	LIMITS	6.00		
CO2 GPM	390.5470			READINGS			
NOx GPM	0.8752	1.5000	PASS	RESULTS	PASS		PASS

EQUIPMENT INSPECTION INFORMATION

Catalytic Converter - PASS
Fuel Filler Restrictor - N/A
Air Injection System - N/A
Oxygen Sensor - PASS
Check Engine Light - PASS

IF YOUR VEHICLE PASSED OR WAS ISSUED A WAIVER

Your vehicle inspection results are shown on this "VEHICLE INSPECTION REPORT". If you are renewing your registration by mail, follow the instructions regarding the renewal process located on the back side of your renewal notice. If you are renewing your registration in person, the Certificate of Emissions Control must accompany all supporting documents at the time of registration. If the Certificate of Emissions Control is lost, a new inspection is required at the owner's/operator's expense.

IF YOUR VEHICLE FAILED THE INSPECTION

Your vehicle inspection results are shown on this "VEHICLE INSPECTION REPORT". If your vehicle failed its first inspection, you are entitled to one free reinspection within 10 calendar days if returned to the same independent inspection station. If the first inspection was performed at an Envirotec center, the reinspection can be performed at any one of Envirotec's centers. The information recorded on this "VEHICLE INSPECTION REPORT" is extremely valuable to a repair technician when having your vehicle repaired. The "VEHICLE REPAIR FORM" (VRF), located on the back **must** be completed by the person performing the repairs. The VRF **must also** accompany the vehicle at the time of reinspection. If your vehicle fails the reinspection, you may be entitled to a waiver. Waiver eligibility information is available at the inspection stations or by calling the Department of Revenue at (303) 205-5603.

"QUALITY EMISSIONS REPAIRS ALWAYS BEGIN WITH A GOOD DIAGNOSIS BY A QUALIFIED REPAIR TECHNICIAN."

HIGH HC READINGS	HIGH CO READINGS	HIGH NOx READINGS
HIGH HC READINGS ARE A RESULT OF UNBURNED OR PARTIALLY BURNED FUEL.	HIGH CO READINGS OCCUR WHEN THE AIR/FUEL MIXTURE IS TOO RICH.	HIGH NOx READINGS ARE THE RESULT OF HIGH COMBUSTION TEMPERATURES AND/OR HIGH COMBUSTION PRESSURES. (ENHANCED AREA ONLY)

TST: 1 FEE: 0.00 LAT: 0.00 TAX: 0.00 DIS: 0.00
CSH: 0.00 CHK: 0.00 CDT: 0.00 CPN: 0.00
IN2: 10363 IN3: 10363 CYL: 4 RMON: 09 RYR: 2010
GVW: NVW: 2729 DSP: 2.4 FUL: GAS
TVFY: BE51 RVFY: VVFY:
OCT: 01 REC: 0 MAK: CHEV MDL: CAVALIER
TRC: N WNB: 104.1 DEX: N ECH: N EYR:
VTY: P TRA: A DRV: F ABS: Y 2STK: N

INSPECTION TYPE

XXXXXXXXX 05127255
DATE XXXXXXXXXXXX FACILITY # XXXX
INSPECTOR # XXXXX LICENSE # XXXXXX
MAKE XXXXX MODEL XXXXXXXX YEAR XXXX
VIN # XXXXXXXXXXXXXXXXXXXX

PLEASE REMOVE THIS PORTION AND INCLUDE IT WITH YOUR RENEWAL CARD AND REGISTRATION PAYMENT. DO NOT STAPLE

ATTACHMENT V Specifications for Colorado On-Board Diagnostic (OBD) Stand-Alone Analyzer

APPENDIX B Standards and Specifications for Calibration/Span Gas Suppliers

STATE OF COLORADO

~~DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT~~
~~COLORADO AIR PROGRAM~~
~~STANDARDS AND SPECIFICATIONS FOR CALIBRATION/SPAN GAS SUPPLIERS~~
~~INCLUDING~~
~~GAS REQUIREMENTS FOR THE BASIC AND ENHANCED INSPECTION~~
~~TEST PROGRAMS~~
~~1997~~

INTRODUCTION

This Appendix B describes the standards and specifications for the suppliers of span and calibration gases to the Colorado AIR Program, including facility requirements and documentation required of potential suppliers.

CONTENTS

SECTION 1: Definitions

~~———— BASIC AND ENHANCED IDLE AIR PROGRAM~~

SECTION 2: ~~Basic and Enhanced Idle Air Program -~~ Technical ~~r~~Requirements

SECTION 3: Calibration/~~s~~Span ~~g~~Gas ~~a~~Approval & ~~l~~Labeling

SECTION 4: Cylinder ~~t~~Tracking ~~and &~~ ~~r~~Recall

~~———— ENHANCED IM & IG 240 AIR PROGRAM~~

SECTION 5: ~~Enhanced IM & IG 240 Air Program -~~ Technical ~~r~~Requirements

SECTION 6: ~~Calibration/span gas approval & labeling~~Colorado Approval Process

~~———— AIR PROGRAM/BASIC AND ENHANCED~~

SECTION 7: Blender ~~f~~Facility ~~r~~Requirements & ~~d~~Documentation

~~———— ATTACHMENT I ————~~

Program Contact/Addresses/Phone Numbers

~~———— ATTACHMENT HII ————~~

“Colorado Approved” Label Samples

SECTION 1 DEFINITIONS

AIR: Colorado's “Automotive Inspection & Readjustment” Program.

ANALYTICAL ACCURACY: The relative percent deviation of the stated concentration of the components of a gas blend from the “true” value as determined by comparison with Colorado AIR Program standards.

$$(\% \text{ DEV} = \text{STATED CONC} - \text{“TRUE” CONC} / \text{“TRUE” CONC} \times 100)$$

AUDIT GAS: Reference gas standards with direct traceability to NIST and/or EPA, to be used by AIR Program QA/QC personnel.

APCD: Colorado “Air Pollution Control Division”.

AUTHORIZED GAS BLENDER: A blender of precision gas products selected to provide such products pursuant to the requirements of 42-4-306(3)(A)(I)(C).

BALANCE GAS: The balance or makeup gas for Colorado AIR Program gases shall be as follows: for basic program tri-blend span gases, nitrogen shall be the balance gas. For the enhanced IM 240 program standards and span gases, air shall be the balance gas. The balance gas for mixtures containing nitric oxide (NO) shall be nitrogen.

BAR: California “Bureau of Automotive Repair”

BLEND TOLERANCE: Deviation between the requested or nominal concentration and the measured or certified concentration of a gas mixture.

CALIBRATION STANDARD: A precision blended gas used to generate calibration curves, with an analytical accuracy of +/- 1%, traceable to NIST gas standards. (Enhanced Program)

CALIBRATION/SPAN GAS: A blend of carbon monoxide (CO), carbon dioxide (CO₂), and propane, with a balance gas of nitrogen (NO₂), which is used to calibrate the Colorado 94 test analyzers. (Basic program)

CALIBRATION ZERO AIR: The gas used as a diluent for gas dividers or to establish analyzer zero during calibration curve generation. Impurities shall not exceed 0.1 ppm carbon response, 0.5 ppm CO, 1 ppm CO₂, 0.1 ppm NO_x, and 1 ppm moisture. Blended air shall have oxygen content between 20.6% and 21%

CALIBRATION ZERO NITROGEN: The gas used as a diluent for gas dividers or to establish analyzer zero during calibration curve generation shall have a minimum purity of 99.997% with impurities not to exceed 0.1 ppm carbon response, 0.5 ppm CO, 1 ppm CO₂, 0.1 ppm NO_x, 1 ppm moisture and 0.5 ppm O₂.

CAPSL: Colorado AIR Program Standards Lab.

CDPHE: Colorado Department of Public Health & Environment.

CERTIFIED GAS BLENDER: A blender of precision gas products, approved by the Colorado AIR Program. A certified blender has met or exceeded the requirements set forth by the CDPHE to provide a consistently high quality calibration and span gas to both the Basic and Enhanced Air Program.

CGA: Compressed Gas Association

CRM: Certified Reference Material

DOT: Department of Transportation

FID: HC analyzer using a flame ionization detector

FED FUEL: A mixture of 40% hydrogen (+/- 2%) and 60% helium

FID OXIDIZER: Zero grade air with oxygen content between 20.6% And 21 %

GOLD STANDARDS: NIST traceable air program standards named by EPA at the National Vehicle Fuels and Emission lab (NVFEL), Ann Arbor, Michigan

NIST: National Institute of Standards and Technology

STATE: The State of Colorado

SRM: Standard reference material. The highest integrity gas standard, prepared by, and only available from, NIST.

VETC: Vehicle Emission Technical Center, 15608 East 18th Avenue, Aurora, Colorado 80011.

WORKING SPAN GAS: Gases used in the enhanced IM 240 Air Program for high and mid-scale span checks and/or adjustments as well as analyzer cross-checks. These gases shall have an analytical accuracy of +/- 2%.

WORKING ZERO GAS: Air or nitrogen used in the daily zeroing of enhanced program analyzers. Impurities shall not exceed 1 ppm carbon response, 2 ppm CO, 0.04% CO₂, 0.3 ppm NO_x, and 1% moisture. Air shall have oxygen content between 20.6% and 21%. Nitrogen shall contain a maximum of 0.5% O₂.

SECTION 2 BASIC & ENHANCED IDLE AIR PROGRAM/TECHNICAL REQUIREMENTS

2.0 GENERAL

This section describes the calibration/span gas requirements, specifications for these gases, and types of cylinders allowed. Such specifications shall be included in any request for bids issued pursuant to 42-4-306(3)(a)(I)(c).

2.1 GAS REQUIREMENTS

The following identifies the calibration/span gas blends required for the Colorado basic & enhanced idle AIR Program:

CALIBRATION/SPAN GASES

AIR94LOW

300 ppm	Propane (as THC)
1.0 %	Carbon Monoxide
6.0 %	Carbon Dioxide
Balance	Nitrogen

AIR94MID

1200 ppm	Propane (<u>as THC</u>)
----------	---------------------------

4.0 % Carbon Monoxide

12.0 % Carbon Dioxide

Balance Nitrogen

2.2 GAS BLEND ACCURACIES

The combined errors due to blending and naming of the above calibration/span gases shall not exceed +/- 2% for each component.

2.3 ANALYTICAL ACCURACY

The analytical accuracies for idle air program gases are:

- (A) Calibration/span gas: +/-2% of nominal value
- (B) Audit gases: +/- 1% of nominal value

2.4 BLEND TOLERANCE

Zero blend tolerance is required for basic & enhanced idle AIR Program calibration span gases.

2.5 BLENDER REFERENCE STANDARDS

Each authorized gas blender shall present documentation of its own internal standards for approval. The state provides two methods for standard documentation:

- (I) Blender may prepare a reference cylinder of each gas blend intended for the AIR Program to be named vs. Colorado's gold standards. Cylinder(s) shall be sent to the state for naming and labeling. This standard will become the blender's reference standard for the analysis of production span gases.

NOTE: The associated costs of shipping reference cylinders to and from Colorado will be the responsibility of the blender. No shipping costs will be borne by the state.

- (II) Blenders certified by the State of California, Bureau of Automotive Repair, may elect to submit copies of their current certification including a listing of all SRM's, CRM's, or other reference gases accepted by bar, as pertaining to the analysis of I/M span gases. BAR acceptance of these standards will be sufficient to obtain approval of same for the AIR Program.

2.6 CYLINDERS

The cylinders to be used in the Colorado 94 analyzers in the field shall be low pressure, non refillable, disposable canisters.

High pressure, refillable cylinders will be used by AIR Program audit/QC teams and, in some cases, by analyzer manufacturers. Approval of span gas in high pressure cylinders will be on an individual basis. (See Section 3)

2.7 DISPOSABLE CYLINDERS

- (A) Disposable cylinders shall be in accordance with dot specification 39 for non refillable, disposable cylinders. (260 PSIG service pressure, 325 PSIG test pressure, 650 PSIG minimum burst pressure) [CFR Title 49, Part 178, Section 178.65, Oct 1, 1996]
- (B) Nominal size shall not exceed 750 cubic inches +/- 5% (approximately 9 inches inside diameter by 16 inches high, providing an equivalent water capacity of 27 lbs.) As a minimum, cylinders shall contain 7.5 cubic feet of gas blend at 260 PSIG cylinder pressure.
- (C) Cylinders shall be designed with an integral stand to facilitate upright storage.
- (D) Cylinder outlet shall be CGA 165, 1/4" SAE flare, 45 degree male. Shutoff valves shall be of the non refillable type.
- (E) Cylinders shall be equipped with a safety relief device in accordance with DOT regulations [CFR 49, 173.34,(D), Oct, 1996]. The safety relief device must comply with the requirements of the compressed gas association pamphlet S.1.1, 8th Edition, 1994.
- (F) Cylinders shall have a built in safety shield to protect the shut off valve.
- (G) No material shall be used in cylinder fabrication or assembly, or in cylinder charging equipment, which is incompatible with the gas blend as to cause contamination or degradation.
- (H) Blenders must comply with applicable DOT specifications for the shipment of cylinders. [CFR Title 49, Volume 2, Part 173, Subpart B, Oct, 1996].

2.8 HIGH PRESSURE REFILLABLE CYLINDERS

- (A) Refillable cylinders must be aluminum and made in accordance with DOT specifications 3AA or 3AL [CFR Title 49, Volume 2, Part 178, Subpart C, Oct, 1996], whichever is applicable.
- (B) All cylinders must comply with applicable DOT Regulations and requirements for safety and shipment. [CFR Title 49, Volume 2, Part 173, Subpart B, Oct, 1996]

2.9 LABELING

- (A) Caution labels shall be affixed to all cylinders and shall comply with applicable DOT and OSHA regulations.
- (B) "Colorado Approved" labels will be provided by the Colorado AIR Program (Section 3) and shall be affixed to the upper portion of the canisters.

2.10 EXPIRATION

Triblend span gas cylinders containing CO, CO₂, and propane in nitrogen, shall have an expiration date of 36 months after date of fill.

2.11 QUALITY ASSURANCE

All gas blenders shall have in place a fully documented and implemented quality assurance program as a prerequisite to certification. This QA program shall include, but not be limited to:

- (A) Regular equipment maintenance and calibration, performed in accordance with manufacturer guidelines, as a minimum.
- (B) Documentation of the analysis of each batch or lot of gas produced. A copy of the certificate of analysis from each batch or lot shall accompany each approval request.
- (C) Blender may choose to retain a cylinder from each batch/lot for internal documentation. However, one cylinder from each batch/lot **must** accompany each request for "Colorado Approved" labels. This sample cylinder will not be returned.
- (D) Documentation of maintenance and calibration of equipment and instrumentation shall be made available upon request.

2.12 BREACH OF TERMS

Each contract entered into pursuant to 42-4-306(3)(a)(I)(C), shall authorize the APCD to suspend the blender's authority to supply precision gas products to inspection and readjustment stations, inspection-only facilities, fleet inspection stations, motor vehicle dealer facilities and enhanced inspection centers in the event the gas blender violates the terms of the contract and this appendix B. The APCD may terminate such a suspension once the blender corrects the problems that led to the violation. An onsite inspection of the blender's facility by an APCD representative may be required to ensure that the relevant requirements are being observed.

SECTION 3 CALIBRATION/SPAN GAS APPROVAL & LABELING

3.0 GENERAL

Information in this section describes the calibration/span gas approval process as well as the procedure for obtaining "Colorado Approved" labels.

3.1 CALIBRATION SPAN GAS APPROVAL PROCEDURE

Batches or lots of span gas will be produced referencing procedures and specifications contained herein. Authorized blender shall analyze a representative number of cylinders from each batch or lot. Authorized blender shall then request from the CDPHE a number of Colorado approved labels corresponding to the number of cylinders in that batch or lot. The request for labels **must** include:

- (I) Analytical report to contain:
 - (A) Actual analysis of samples in batch
 - (B) Number of cylinders in batch
 - (C) Fill date
 - (D) Number of labels required
 - (E) Batch or lot number
- (II) One representative cylinder from each batch or lot of span gas produced to be verified by analysis and retained for future reference.

NOTE: This sample cylinder will **not** be returned. Cylinder will be archived by the state until the expiration date expires (36 months from fill date). This sample may be analyzed as a spot check or reference gas in matters concerning potential inquiries into batch integrity.

Upon approval, blender will be sent an appropriate number of "Colorado Approved" labels to be affixed to cylinders in that batch or lot.

Samples, along with request for "Colorado Approved" labels, should be sent to: CDPHE

VEHICLE EMISSION TECHNICAL CENTER

15608 E. 18TH AVENUE

AURORA, COLORADO 80011

ATTN: SPAN GAS VERIFICATION PROGRAM

3.2 CALIBRATION/SPAN GAS APPROVAL/HIGH PRESSURE CYLINDERS

Approval of calibration/span gases in high pressure cylinders will be done on an individual basis. Each cylinder seeking approval must be submitted for verification against AIR Program standards. A certificate of analysis shall accompany each cylinder and shall contain the following information:

- (A) Cylinder number
- (B) Components contained
- (C) Analytical results
- (D) Analytical accuracy
- (E) Statement of traceability
- (F) Analysis date
- (G) Fill date

Upon approval, blender will be notified that the cylinder is ready for pickup by the purchaser. Approved cylinder, with "Colorado Approved" label attached, may be picked up during normal business hours (8:00 am - 5:00 pm) Monday through Friday. Cylinders shall be sent to the above address.(See 3.1)

3.3 SHIPPING COSTS

Blenders shall provide for the shipping of all cylinders seeking Colorado approval for use in the AIR Program. The pick-up and delivery of individual high pressure cylinders is also the responsibility of the blender and/or the purchaser of that cylinder. These cylinders are expected to be picked-up within 30 days of notification of approval. No costs pertaining to the pick-up or delivery of span gases shall be borne by the state.

3.4 LABELING

"Colorado Approved" labels will be provided by the State of Colorado. These labels will include information necessary to track span gases throughout the system as well as identify each cylinder as Colorado approved. Information contained on the label will include:

- (A) Blender name
- (B) Blending facility
- (C) Batch or lot number
- (D) Identify "low" (yellow label) or "mid" (white label) SPAN GAS
- (E) Fill date
- (F) Expiration date
- (G) AIR Program number
- (H) Bar code containing cylinder tracking information

(For a sample of the "Colorado Approved" labels, see attachment II)

3.5 AIR PROGRAM NUMBER

"Colorado Approved" labels will contain an AIR Program number. Each certified blender will be assigned a letter code that will precede the numbering of batch cylinders. These coded numbers will be generated by the state and assigned to each cylinder as batches of span gas are produced. Cylinder numbers will be held on file for the life span of the cylinder to assist in tracking, auditing and accounting purposes.

SECTION 4 CYLINDER TRACKING & RECALL

4.0 GENERAL

This section describes the method of tracking calibration/span gas throughout the AIR Program area. This system protects the inspection stations and provides for a replacement, in an expedient manner, should a non-conforming calibration/span gas be discovered.

4.1 TRACKING CYLINDERS VIA BAR CODE

Each "Colorado Approved" label will contain a bar code to be scanned whenever a cylinder of calibration/span gas is put into service on a Colorado 94 analyzer or Motor Vehicle Dealer Transient Mode Test Analyzer System. Scanned information will be stored in a file, accessible through a host computer linking all inspection stations. AIR Program QA/QC personnel will be able to locate individual cylinders, track batches of span gas, etc., throughout the program area.

Label bar codes will be generated at the time of batch or lot approval and will contain information necessary to facilitate the tracking process. Blenders are required to continue to track internally, the whereabouts of "Colorado Approved" batches of calibration/span gas prior to retail sale. In the event of a recall of a batch of non-conforming calibration/span gas, the blender, through procedure described herein (see 4.2), will begin recall. In-use calibration/span gas affected will be identified by bar code; information through system host and replacement procedures will begin.

4.2 RECALL PROCEDURE

In the event a non-conforming cylinder of calibration/span gas is discovered at an AIR Program inspection station, the following recall procedure will begin:

- (A) Suspected non-conforming span gas confiscated by AIR Program Q/C personnel;

- (B) Cylinder brought to the Colorado AIR Program Standards Lab (CAPSL) for analysis;
- (C) Exposed non-conforming cylinder cross referenced by air number go blender and batch;
- (D) Archived sample retrieved and analyzed vs. suspected non-conforming cylinder. Blender advised of results;
- (E) Through host system, the state identifies whereabouts of any non-conforming cylinders on line. Blender provided with a listing of affected inspection stations;
- (F) Blender shall immediately begin recall of all remaining unsold cylinders from batch in question and, simultaneously, begin process of supplying known conforming cylinder(s) to affected inspection stations by overnight service;
- (G) A total recall and replacement of all cylinders in affected batch must be completed within 10 days. A detailed report of the recall procedure and analysis of cause of the non-conforming product entering the system will be provided to the state within 15 days.
- (H) The state may elect to withhold certification of future batches until such time as blender shows problems have been corrected.
- (I) The state may also suspend the contract with the blender if information obtained suggests blending procedures were violated, pending a correction of the problems that caused the violation.

SECTION 5 ENHANCED IM & IG 240 AIR PROGRAM / TECHNICAL REQUIREMENTS

5.0 GENERAL

This section addresses the calibration gases, technical requirements, cylinder specifications and documentation required for IM & IG 240 testing.

5.1 GASES

Gases used in the calibration and support of IM & IG 240 testing shall conform to the provisions outlined in CFR Title 40, Part 86, Subpart B, Section 114, as revised July 1, 1992, for exhaust emission testing. Concentrations for **IM 240** gases are as follows:

5.2 CALIBRATION GASES/CURVE GENERATION

- (I) High tri-blends: (+/-1% analytical accuracy)
 - CO:9000 ppm
 - CO₂:3.6%
 - Propane:600 ppm
 - Balance: Air
- (II) High NO_x: (+/-1%)
 - NO_x:450 ppm

Balance: Nitrogen

5.2.1 MID-SCALE CALIBRATION GASES/CURVE CONFORMATION

(I) Mid tri-blend: (+1-1%)

CO:4500 ppm

CO₂:1.8 %

Propane:300 ppm

Balance: Air

(II) Mid NO_x tri-blend: (+/-1%)

NO_x:225 ppm

Balance: Nitrogen

5.2.2 CALIBRATION ZERO GASES

(I) Calibration zero AIR

HC : < 0.1 ppm

CO : < 0.5 ppm

CO₂ : < 1.0 ppm

NO_x : < 0.1 ppm

Moisture : < 1.0 ppm

O₂: 20.6 % - 21.0 %

(II) Calibration zero Nitrogen

Purity : 99.997 %

HC : < 0.1 ppm

CO : < 0.5 ppm

CO₂ : < 1.0 ppm

NO_x : < 0.1 ppm

Moisture : < 1.0 ppm

O₂ : < 0.5 ppm

5.3 DAILY SPAN GASES

- (I) High tri-blend span (+/-2% analytical accuracy)

CO : 8000 ppm

CO₂ : 3.2 %

Propane : 535 ppm

Balance : Air

- (II) NO_x mid span (+/-2%)

NO_x : 75 ppm

Balance : Nitrogen

5.4 WORKING ZERO GASES

- (I) Working zero AIR

HC : < 0.1 ppm

CO : < 2.0 ppm

CO₂ < 400 ppm

NO_x < 0.3 ppm

Moisture < 1.0 ppm

O₂ : 20.6-21.0 %

- (II) Working zero Nitrogen

Purity : 99.997%

HC : < 1.0 ppm

CO : < 2.0 ppm

CO₂ : < 400 ppm

NO_x : < 0.3 ppm

Moisture : < 1.0 ppm

O₂ : < 0.5 ppm

5.5 SUPPORT GASES

A variety of miscellaneous support gases are required for IM & IG 240 testing. Among these are:

<u>GAS</u>	<u>USAGE</u>
Propane : 99.5% (min)	CVS system flow checks
Methane : 50 ppm/AIR	FID check gas
FID Fuel: 40% H ₂ /60% HE	FID burner fuel
N ₂ : 200 ppm/N ₂	NO _x converter efficiency test gas
AIR : 18%-21%	NO _x ozonator gas

5.6 IG 240 GASES

Calibration, span, working and support gases required by IG 240 systems, are among the gases listed (5.2 thru 5.5). Additional gases of specific concentrations and blend make-up may be required pending final configuration of the IG system.

5.7 CYLINDERS

Calibration and working gas tri or quad-blends used for IM & IG 240 testing, must be supplied in aluminum cylinders as well as all no or NO_x blends. Other gases may be supplied in steel or aluminum cylinders as appropriate.

High pressure refillable cylinders shall be manufactured in accordance with DOT specifications 3AL or 3AA [CFR Title 49, Volume 2, Part 178, Subpart C, Oct 1, 1996], whichever is applicable.

Approved valves and relief devices, appropriate for the intended use, shall be used on all high pressure cylinders. [CFR Title 49, Volume 2, Subpart B, Section 173.124, Oct 1, 1996]

All cylinders shall have appropriate labeling to comply with all DOT regulations concerning transportation and safety. [CFR 49, Volume 2, Part 173, Subpart B, Oct 1, 1996].

5.8 MISCELLANEOUS

A full line of gas products shall be made available to the enhanced AIR Program contractor(s) to insure safe handling and storage of gas cylinders, such as regulators, carts, restraints, and leak detection equipment. The contractor(s), as well as state QA/QC personnel, may also request a variety of gas blends, tri-blends, and other specialty gas products associated with automotive emission testing. Blender must demonstrate the ability to provide the above gases, equipment and associated products, in order to be designated as an approved blender to the Colorado enhanced AIR Program.

5.9 CERTIFICATES OF ANALYSIS

Each calibration gas, working span gas, and calibration zero gas shall be documented by a certificate of analysis to include; cylinder number, components, analytical results, accuracy, traceability and analysis date. A batch analysis certificate stating purity may document zero grade air and nitrogen. (Zero AIR certificate must also provide documentation of oxygen content.)

The enhanced program contractor(s) must produce documentation of cylinder contents of the above upon request of state QA/QC personnel.

5.9.1 TRACKING CYLINDERS VIA BAR CODE

Each "Colorado Approved" label will contain a bar code to be scanned whenever a cylinder of calibration/span gas is put into service on a Colorado 94 analyzer or Motor Vehicle Dealer Transient Mode Test Analyzer System scanned information will be stored in a file, accessible through a host computer linking all inspection stations. AIR Program QA/QC personnel will be able to locate individual cylinders, track batches of span gas, etc., throughout the program area.

Label bar codes will be generated at the time of batch or lot approval and will contain information necessary to facilitate the tracking process. Blenders are required to continue to track internally, the whereabouts of "Colorado Approved" batches of calibration/span gas prior to retail sale. In the event of a recall of a batch of non-conforming calibration/span gas, the blender, through procedure described herein (see 4.2), will begin recall. In-use calibration/span gas affected will be identified by bar code information through system host and replacement procedures will begin.

SECTION 6 COLORADO APPROVAL PROCESS

6.0 CALIBRATION STANDARDS AND AUDIT GASES

All calibration standards used in the Colorado Enhanced IM & IG 240 AIR Program must be submitted by the contractor to the state for approval and labeling as "Colorado Approved". In addition, all audit gases utilized by AIR Program QA/QC teams will undergo the same verification and/or renaming process that will take place at the Colorado AIR Program standards lab (CAPSL) in Broomfield, Colorado. At CAPSL, each standard and/or audit gas will be read vs. program gold standards, named by EPA's NVFEL, in an effort to tie all primary gases to one source, regardless of manufacturer.

Each calibration standard and audit gas will receive a "Colorado Approved" label displaying the concentration of each major component as determined by analysis comparing such calibration standard or audit gas to the program gold standards. Labeled values are to be used in curve generation by the contractor and by audit teams to verify analyzer accuracy.

6.1 ZERO AIR/OXYGEN CONTENT

On a random basis, cylinders of zero air will be analyzed at CAPSL to verify oxygen content. As previously stated, the oxygen content of artificial blended air shall be 20.6 to 21 %. This is necessary to insure that an air cylinder used as a backup to a zero air generator (zag), will provide air as close to ambient in O₂ as possible, should a zag be taken offline. FID response has been shown to be greatly affected by the O₂ content of oxidizer air. Random analysis will provide verification that O₂ content in zero air is within specifications.

SECTION 7 BLENDER FACILITY REQUIREMENTS & DOCUMENTATION

7.0 GENERAL

- (A) A gas blender who intends to supply calibration/span gas to the Colorado AIR Program basic inspection stations and/or enhanced program contractor(s), must be selected by the Colorado Department of Public Health & Environment pursuant to 42-4-306(3)(A)(I)(C).
- (B) If a company has more than one facility that will be providing gases to Colorado, each must be included in the selection. The selection of one blending facility owned by a company does not imply or impart authority to other facilities within that company to supply precision gas products in Colorado.

- (C) The CDPHE shall be notified of a pending sale of a blending facility at least 60 days prior to change of ownership.
- (D) Contracts shall be for a one year period, but may be renewed annually.

7.1 CONTRACT PROPOSAL PACKET

The certification request packet shall contain information described in the following paragraphs. Information submitted should be as complete as possible. However, should some information be unavailable, so indicate and provide reasons, therefore, for AIR Program consideration.

7.2 CONFIDENTIAL AND COMMERCIAL INFORMATION

To the extent authorized by 24-72-101, C.R.S., the Colorado Department of Public Health & Environment shall maintain the confidentiality of any information which is included in the blender's bid and which is clearly marked as proprietary or confidential.

7.3 APPLICATION

The following items are to be included in blenders request for air program approved status:

- (A) COVER SHEET - An application cover sheet must be signed by the President or Chief Financial Officer of the gas blending company.
- (B) BLENDING FACILITY DESCRIPTION-Provide a complete description of the blending facility to include:
 - Facility location
 - Physical dimensions of lab and production areas
 - Number of employees
 - General description of blending facility and procedures
- (C) INSTRUMENTATION - Provide description of all instrumentation utilized in the blending and analysis of AIR Program calibration/span gases. Provide instrumentation brand, model, type (NDIR, FID, GC, etc.). As well as calibration and maintenance schedules and personnel responsible.
- (D) REFERENCE STANDARDS - Indicate the cylinder numbers, SRM/CRM numbers, concentrations and expiration dates for each NIST traceable reference standard to be used in the preparation and/or naming of AIR Program gases.
- (E) BUSINESS STATUS REPORT - Application for certification shall contain information to verify blending facility's status as a bona fide blender of precision gases. Include evidence that applicant is a registered corporation in Colorado and/or a registered out-of-state corporation.
- (F) DISTRIBUTORS AND MARKETING - Applicant shall provide a description of expected distribution and marketing plans for providing calibration/span gas to the basic AIR program. Include a current listing of the names, addresses and phone numbers of the distributors used by the applicant. Such information shall be updated as necessary and

notification of any change provided to the state in a timely manner. Lists of distributors will be made available to AIR Program inspection stations.

- (G) RECALL OF NON-CONFORMING GASES/BASIC PROGRAM - Certified blenders shall be responsible for the recall and replacement of non-conforming calibration/span gases. Blenders will be required to replace suspected non-conforming cylinders by overnight service. Should such a discovery extend past a single cylinder to a batch or lot, a total recall of all cylinders will take place. (See Section 4).

Applicant shall provide procedures intended for use should such a recall be necessary.

- (H) QUALITY ASSURANCE - Applicant shall include information regarding internal quality assurance program(s). Provide details of techniques, methodology and documentation utilized in QA program. Include calibration and maintenance schedules for all equipment and instrumentation used.

- (I) SAFETY REGULATIONS - Certification application must include assurance the applicant is in compliance with all applicable DOT and OSHA regulations and standards.

- (J) LIABILITY - Provide a copy of product liability insurance demonstrating adequate protection (minimum \$300,000) exists for catastrophic failure situations (e.g., cylinder or valve rupture, noxious gas leakage, etc.). Evidence of bonding coverage shall be provided upon request.

APPENDIX B

~~ATTACHMENT I TO THE CALIBRATION AND SPAN GAS CERTIFICATION PROCEDURES~~ ~~Program Contact/Addresses/Phone Numbers~~

~~ATTACHMENT I~~

~~PROGRAM CONTACT/ADDRESSES/PHONE NUMBERS~~

PROGRAM CONTACT; The main contact on matters concerning air program gases, requirements and specifications is:

COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT
VEHICLE EMISSION TECHNICAL CENTER
15608 EAST 18TH AVENUE
AURORA, COLORADO 80011
(303) 364-4135
ATTN: SPAN GAS VERIFICATION PROGRAM

OR

COLORADO AIR PROGRAM STANDARDS LAB
11609 TELLER STREET
BROOMFIELD, COLORADO 80020
(303) 404-0268

APPENDIX B

ATTACHMENT II TO THE CALIBRATION AND SPAN GAS CERTIFICATION PROCEDURES
"Colorado Approved" Label Samples

Appendix B — Attachment II

ATTACHMENT II


"COLORADO APPROVED" LABEL SAMPLES

(A) **Basic AIR Program:**


"AIR94LOW" Label
(yellow w/black)

COLORADO AIR PROGRAM
APPROVED CALIBRATION GAS

BLENDER: A GAS CO
FACILITY: ANYTOWN
BATCH/LOT: 12345
FILL DATE: 11/25/95
EXPIRES: 1/96
AIR# CAG95102951




GAS TYPE
AIR '94
LOW




"AIR94MID" Label
(white w/black)

COLORADO AIR PROGRAM
APPROVED CALIBRATION GAS

BLENDER: A GAS CO
FACILITY: ANYTOWN
BATCH/LOT: 12345
FILL DATE: 11/25/95
EXPIRES: 1/96
AIR# CAG95102951




GAS TYPE
AIR 94
MID



(B) **ENHANCED IM240 AIR Program:**

"Triblend Calibration Std"
(white w/black)



**COLORADO
AIR
PROGRAM
APPROVED**

III TRIBLEND / CAL STD

BLENDER: A GAS CO
CYL #: ABC 12345

CYLINDER CONTENTS:

CO: 9000 PPM


CO2: 3.60 %

THC: 1800 PPM

BALANCE: AIR

DATE CERTIFIED:
10/30/95

"Nox Calibration Std"
(white w/black)



**COLORADO
AIR
PROGRAM
APPROVED**

HI NOx / CAL STD

BLENDER: A GAS CO
CYL #: XY 98765

CYLINDER CONTENTS:

NOx: 450 PPM

BALANCE: NITROGEN

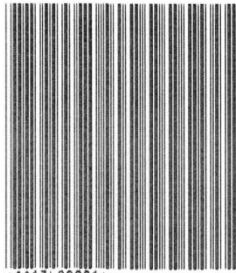
DATE CERTIFIED:
11/17/95



**Colorado
Approved
Calibration Gas**

AIR94 LOW

BLENDER AIR LIQUIDE
LOT # 031820131
FILL DATE 03/18/2013
EXPIRES 05/13/2016
AIR # CO13L00001



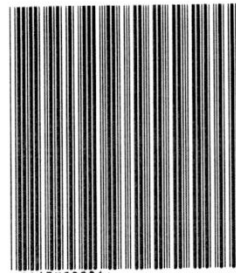
CO13L00001



**Colorado
Approved
Calibration Gas**

AIR94 MID

BLENDER AIR LIQUIDE
LOT # 031820132
FILL DATE 03/18/2013
EXPIRES 05/13/2016
AIR # CO13M00001



CO13M00001