## 11 CSR 50-2.402  MAS Software Functions

(1)  General.

    (A)  The microcomputer software shall control the inspection sequence and equipment processes.  This software, at a minimum, shall require the inspector mechanic to proceed in the following sequence when performing a vehicle inspection:

    1.    Enter the inspector mechanic access code number;
    2.    Enter vehicle identification number, owner's name, address and county;
    3.    Conduct the visual under hood inspection and enter the results;
    4.    Connect the revolution per minute (RPM) pickup;
    5.    Perform the emissions inspection;
    6.    Enter the low emissions tune-up data, if applicable;
    7.    When the inspection is complete, print the inspection report if desired; and
    8.    If the vehicle completes the inspection, the inspector mechanic information, vehicle identification information and the inspection results shall be printed on the vehicle inspection certificate (VIC).

    (B)  A description of these tasks is detailed in sections (2)**))**(16).

(2)  Station Number and Inspector Mechanic Access Codes.

    (A)  The Missouri Analyzer System (MAS) shall be designed to require the entry of his/her license number and a special four (4) digit access code by the inspector mechanic before a state inspection can begin.  The access code shall neither be displayed nor printed except as part of an MVI state audit.  This special access code number shall be linked to the inspector mechanic's license number.  The analyzer shall be designed to automatically abort the inspection if the inspector mechanic has not been issued an appropriate license number.  A message shall be displayed indicating that the test has been aborted because the inspector mechanic has been aborted because the inspector mechanic has not obtained the proper license number from the State Highway Patrol (SHP).  The abort code (E) indicating that the inspector mechanic is not licensed to perform this inspection shall be entered automatically by the MAS and recorded on the test record.

    (B)  The MAS shall have the capacity for storage of at least fifteen (15) inspector mechanic access codes and fifteen (15) corresponding inspector mechanic license numbers.  The MAS shall have the capacity for storage of at least fifteen (15) SHP inspector codes and names.

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    (C)  The microcomputer shall be designed to allow the station number, inspector mechanic's license number and each inspector mechanic's access code to be changed only by SHP representatives, under controlled access conditions acceptable to the state.  Changing these numbers shall be done from the keyboard, via modem or some other means the states finds acceptable.  The station number will be automatically recorded on the test report along with the inspector mechanic's license number.

    (D)  The inspector mechanic's license number and the station license shall be printed on the vehicle inspection certificate.

(3)  Applicable Model Years.

    (A)  The MAS shall not accept any vehicle older than 1971 for an emissions inspection.

    (B)  Any attempt to make an entry shall cause the MAS to display "DO NOT TEST VEHICLES OLDER THAN 1971 FOR EMISSIONS."

(4)  Vehicle Weights.

    (A)  If the manufacturer's gross vehicle weight rating (GVWR) is less than or equal eighty-five hundred (8500) pounds and the vehicle type is C, then the MAS shall automatically record a vehicle type B (light duty trucks).

    (B)  If the licensed gross vehicle weight (GVW) is six thousand (6000) pounds and the vehicle type is C, then the MAS shall automatically record a vehicle type B (light duty trucks). The GVW is the vehicle weight category indicated by license plate purchased for the vehicle.

(5)  Vehicle Make Entries.

    (A)  The analyzer software must be designed to accommodate all vehicle make names.  The software shall include a list of all vehicle make names going back to 1971 (see 11 CSR 50-2.403 for current list of make names).  The full name of each vehicle make must be displayed and printed on the VIC, but only the first twenty (20) characters of each name shall be recorded on the test record.  The software shall be designed to first display a list of vehicle makes.  The inspector mechanic shall then be instructed to select a vehicle make using the cursor and scrolling through the list or by typing in the first letter or

two of the vehicle make so that the cursor goes directly to the first vehicle make with that letter, or a combination thereof, in it.

(B)   When a vehicle make or model name is not contained in the reference table, the inspector mechanic shall be instructed to enter the names (no abbreviations) through the keyboard.

(7)   Emissions Inspection.

(A)   The following test/sampling sequences shall be available in the software at the time of certification:

1.   There are six (6) major instructions to be included in the displays to be developed by the manufacturers for the emission testing sequence.

A.   The RPM detector must be attached to the vehicle.

B.   With the engine idling and transmission in neutral, the sample probe shall be inserted into the tailpipe a minimum of sixteen inches (16").

C.   The engine shall be operated at free idle with transmission in neutral.  Record exhaust concentrations after stabilized readings are obtained or at the end of thirty (30) seconds, whichever comes first.  The idle speed at the time of sampling shall be recorded to the test record as Idle RPM Mode. If the RPM reading is not the Idle RPM target plus or minus three hundred ($\pm$ 300), the inspection will be aborted with abort code R.  The dilution shall be measured as the sum of the CO plus the CO2 reading.

D.   The analyzer shall provide instruction for sampling a dual exhaust system if the inspector mechanic indicates the vehicle is equipped with a dual exhaust.  This process shall be repeated as necessary for multiple exhaust pipes.  Hardware which is capable of simultaneously sampling vehicles with multiple tailpipes may also be used.  However, if this type of hardware is not used, exhaust concentrations from each pipe shall be measured within the thirty (30)-second period if stable readings cannot be obtained from both pipes before the thirty (30) seconds have elapsed.  If this is not possible, the entire emission sampling procedure beginning with subsection (7)(A) shall be repeated for the second exhaust pipe.  Neither multiple readings nor simultaneous sampling hardware is necessary for exhaust systems

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in which the exhaust pipes originate from a common point. Results from multiple exhaust pipes shall be numerically averaged.

(B)  Accommodations shall be made to allow for additional test sequences and sampling periods, which can be added at a later date.

(C)  The different test sequences are designed to make the emission inspection test procedure correlate better with the federal test procedure.  Most of the different test sequences will be designed to prevent incorrectly failing pattern failures (errors of commission).  The analyzer should be designed to automatically run the appropriate test sequence after vehicle identification information is entered.  Additional test sequences selected by the state may be provided to the manufacturers as soon as they become available prior to publishing the final specifications or in time to be included in the first software update after certification.  The test sequence number shall be documented on the test record.

(D)  When the vehicle has met RPM, flow rate and dilution conditions, the emissions test sequence shall begin and the display shall show the word TESTING and time remaining in the test sequence.  For each test mode, the analyzer shall record the emission readings to the test record at the end of the TESTING period.

(8)  Commencement of the Emissions Sampling Period.

(A)  Stability.  The sampling period shall commence as soon as stability is achieved.  Stability is achieved when all of the following conditions are satisfied:

1.  Readings averaged over a period of two (2) seconds for $CO + CO_2$ meet the dilution thresholds;

2.  Engine RPM has been within specified thresholds for at least one (1) second; and

3.  Sample flow rate is adequate to prevent triggering the low flow lockout.

(B)  Restart Conditions.  After stability has been achieved and sampling has been initiated, if any of the following conditions occur, the test mode must be restarted:

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1.    The dilution threshold is outside specified thresholds for greater than one (1) second;

2.    Engine RPM is outside specified thresholds for at least one (1) second; and

3.    Sample flow rate is not adequate to prevent triggering the low flow lockout.

(C)    Exceeding the RPM limits, not reaching the dilution thresholds or a low flow rate during a testing period shall automatically cause the testing period to restart for that mode. The analyzer shall allow the operator three (3) attempts before displaying a message asking the operator if s/he wants to abort the test.  The same message shall be displayed after each subsequent unsuccessful attempt.

(D)    If the emissions test must be aborted after the sampling period has started, the latest five (5)-second average (or the average if whatever portion of the first five (5) seconds of the sampling period has elapsed) shall be treated as the final value.  Emission readings shall be taken during all test modes and the final reading shall be recorded on the test record and the VIC.

(9)  Vehicle Preconditioning.

(A)    If a vehicle fails an emission inspection, the analyzer shall allow the inspector mechanic to select a preconditioning option.  The inspector mechanic may select preconditioning sequence #1 (subsection (9)(B)), preconditioning sequence #2 (subsection (9)(C)) or no preconditioning.  If no preconditioning is selected, the emission inspection result shall remain a failure and the inspection sequence shall proceed.

(B)    Preconditioning Sequence 1.  The analyzer will prompt the inspector mechanic through the steps of the preconditioning sequence and record the sequence number to the test record.

1.    Operate the vehicle at twenty-five hundred plus or minus three hundred (2500 ± 300) RPM for ninety (90) seconds with the transmission in neutral.

2.    At the end of the ninety (90) second period, allow the vehicle to return to idle and stabilize for ten (10) seconds, but do not turn the ignition switch off.

3.    Insert the probe into the tailpipe.

    4.    At the end of the ten (10)-second period, proceed to the emission inspection.

    (C)    Preconditioning Sequence 2.  The analyzer will prompt the inspector mechanic through the steps of the preconditioning sequence and record the sequence number to the test record.

    1.    Operate the vehicle at twenty-five hundred plus or minus three hundred (2500 ± 300) RPM for ninety (90) seconds with the transmission in neutral.

    2.    At the end of the ninety (90)-second period, allow the vehicle to return to idle and stabilize for ten (10) seconds and turn the ignition switch off.

    3.    Insert the probe into the tailpipe.

    4.    Leave the ignition off for ten (10) seconds, then restart the engine and proceed to the emission inspection.

    (D)  The manufacturer shall provide for the capability to utilize as many different preconditioning procedures as can be contained in the analyzer.  The preconditioning procedure number shall be documented on the test record.

    (E)  The analyzer software shall be designed to require the inspector mechanic to perform the preconditioning sequence before proceeding with the test.  The preconditioning period shall begin as soon as the RPM is stable (for a period of one (1) second) and is within the proper range.  The engine speed and the time remaining shall be displayed during the preconditioning period.

    (F)  When the preconditioning period is complete, the analyzer shall ensure that the engine RPM is reduced to idle for at least ten (10) seconds, but no more than thirty (30) seconds, or the preconditioning period will have to be restarted if the test aborted.  A message shall be displayed to the inspector mechanic indicating the allowable idling period and the amount of time remaining before the preconditioning sequence will have to be performed again.  The inspector mechanic shall be instructed to strike the ENTER key as soon as possible after ten (10) seconds of idling has occurred.

    (G)  Following the ten to thirty (10-30)-second idling period (terminated when the inspector mechanic strikes the ENTER key), the inspector mechanic shall be allowed an additional thirty (30) seconds maximum to perform the ignition key off/on sequence (if appropriate).  Insert the probe in the tailpipe and increase the engine RPM to twenty-five hundred plus or minus

three hundred (2500 ± 300).  A message shall be displayed advising the operator of the allowable time remaining before the emissions test has to be initiated, or the preconditioning sequence shall be performed again, or the test aborted.

(10) Engine RPM Detection.

    (A)  Prompts may be provided to assist the inspector mechanic in locating an RPM signal on vehicles equipped with direct ignition system (DIS).  Based on the vehicle identification information entered by the inspector mechanic, the analyzer shall advise the inspector mechanic regarding which vehicles require a primary pick up, which require that an alternate counting algorithm be used and which require the use of an auxiliary piece of equipment.  Analyzers shall be provided with all the software and hardware that is necessary to make them capable of reading engine speed on all vehicles.

    (B)  Prompts shall be provided if information is available in a Master Reference Table format for the type of vehicle being inspected.

    (C)  The analyzer shall record the engine RPM on the test record at the time the emission test results are determined.

(11) Dual Exhaust.

    (A)  For vehicles with dual exhaust, the analyzer supplier may provide a dual probe measurement system.  Alternatively, manufacturers may utilize an averaging algorithm which requires the operator to run two (2) emission tests.  Prompts shall be displayed telling the operator when to switch the probe to the other tailpipe if the averaging method is used.

(12) Emission Standards.

    (A)  Emission Limits.

    1.  Based on the vehicle information entered, the microcomputer shall choose the proper emission standards category (ESC) (see Appendix C at the end of 11 CSR 50-2.407) for the vehicle being tested.  The software shall provide for emission standards which would be selected on the basis of vehicle year and vehicle type (passenger vehicle or specially constructed vehicle).

2.    Each vehicle ESC will contain HC and CO, pass/fail values.  The MAS will use default values for CO + $CO_2$ dilution thresholds.  The default value is seven percent (7%).  ESC values and the criteria for selecting categories shall be designed in a manner that allows for easy modification or addition.

3.    Dilution measurements shall be based on the sum of CO and $CO_2$.  The default value is seven percent (7%).  The microcomputer shall prevent testing if the CO + $CO_2$ value, vehicle exhaust gas flow rate or the engine speed signal are outside the specified thresholds.  There shall be software capability for additonal standards categories in the MAS.  The values for HC and CO shall be changeable without modifying the entire software package.

(B)  Dilution and RPM Limits.  Dilution thresholds and RPM limits may both be contained in the Master Reference Table if it is published.

(13) Blind Test.  The MAS shall not allow any escape or reset to interrupt a test in progress.  Once emission analysis has begun, no results are to be displayed until after the test record is written to disk and a final pass/fail determination has been made.

(14) Data Storage and Recall Capability.  The analyzer shall have, as a minimum, the capability to recall and display any of the failed vehicle test records in MAS.DAT for retest.  Recall shall be initiated by typing or scanning in the vehicle identification number (VIN) or by typing in the owner's name, the date of the test or the certificate number.  Recall of the test record shall be made by cursor selection from the list of available vehicles.  The operator shall have the ability to transfer only the vehicle identification information (year, VIN, make and fuel type) on the test records recalled so that it can be used for subsequent tests.  The inspector mechanic shall be required to reenter the odometer and test type for subsequent tests.  The analyzer shall be capable of displaying the previous test results, but shall not be capable of allowing them to be changed.  The test record for this vehicle shall indicate that it was retested.

(15) Warranty Message on VIC.  Most major emission control components are covered by federal law for most emission related defects (except certain fuel metering and ignition parts), for five (5) model years or fifty thousand (50,000) miles.  The

analyzer shall print the following message on the vehicle inspection certificate for any vehicle which has failed the emissions test and meets one (1) of these criteria:

"YOUR VEHICLE MAY BE ELIGIBLE FOR WARRANTY REPAIRS.  VEHICLES ARE COVERED BY THE PERFORMANCE WARRANTY FOR TWO (2) YEARS OR TWENTY-FOUR THOUSAND (24,000) MILES AND BY THE DESIGN AND DEFECT WARRANTY FOR FIVE (5) YEARS OR FIFTY THOUSAND (50,000) MILES."

(16) Decision Criteria.  The MAS shall be programmed to print the VIC and record the test results (see the sample certificate layout in 11 CSR 50-2.405(1)(D)1.).

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CFR:    40 C.F.R. 52.1320(c)(80)(i)(A)

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Descriptions:         The EPA approved this new regulation which establishes requirements for the Missouri Analyzer System.

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Difference Between the State and EPA-Approved Regulation

The SIP does not include Section (6), Safety Inspection.