UtAH 91 ORIENTATION TRAINING PROGRAM

What is the purpose of the Vehicle Emission Inspection Maintenance (I/M)/Safety Program?

The purpose of the I/M and safety Program is to identify and repair vehicles that exceed the emission/safety standards.

How is this accomplished?

The most effective way to identify vehicles that exceed the standards is to use the Federal Test Procedure (FTP) and existing safety program. The FTP is the same process that was used to certify the vehicle for sale in the United States when it was originally manufactured. Unfortunately this is a very expensive and time consuming task. It is performed in a laboratory with controlled conditions (temperature, fuel, driving conditions, calibrated instruments, etc.).

SHOW VIDEO OF FTP

As you can see a great deal of effort is required to insure that the test is accurate and will show repeatability. It is estimated that the cost of this test runs between $1,000 and $2,000. Such a procedure would not be practical for the general public. A more practical, but less accurate, means of identifying dirty vehicles is to use an Engine Exhaust Analyzer. This is what we have been doing for the past years in the I/M Program. The goal of the I/M program is to have as close a correlation as possible between the FTP and the county sponsored emissions short test. In other words, we want to fail those vehicles that would normally fail a FTP and pass those vehicles that would pass a FTP. If we only probe the exhaust and take readings there is a significant chance that we will not identify dirty vehicles. If we insure that the testing procedures are followed, we increase the probability, and finally, if we incorporate a tampering inspection as part of the emissions test, the probability of duplicating the FTP is greatly increased. Thus, you can see the need for a computerized emission testing system such as the Utah 91 Analyzer. This then increases the probability that we will fail those vehicles that need repairs and pass those vehicles that do not. Of course there will be rare instances in which a vehicle will be failed (false failure) and there is nothing wrong with the vehicle; or, a vehicle will be passed (false pass) and the vehicle will actually need repairs. Also there is the possibility that you will identify a vehicle that may have an intermittent problem. This is the reason that the Health Department will continue to resolve situations in which a vehicle fails at one station and passes at another. Unfortunately, this will cause a great deal of concern on the part of the vehicle owner, especially if he has spent a lot of money on repairs that he didn't need. We hope that this type of incident will be few and far between; however, we felt that you needed to be aware of the fact that we still don't have a perfect system. We are confident that

it is much better than the one in existence now.

What changes will be involved with the Utah 91 Program?

The most dramatic change will involve the use of a computer to insure that the testing procedures are being followed. At first, we expect some frustration as you begin to use this program. Later, we believe that you will feel that this is an improvement, particularly because you will not be burdened with coding dots on inspection forms. The greatest challenge is to insure that only correct information is fed into the computer. You have probably heard the expression "garbage in garbage out". It will cause you much frustration if you are trying to recall a test and cannot find it because of inserting one wrong character in the Vehicle Identification Number (VIN).

BRIEFLY DESCRIBE THE UTAH 91 EMISSION TEST WITH OVERHEAD PROJECTOR
What changes will be involved with station audits in the new program?

Basically, the audit will involve reviewing hard copies of your emission tests during the initial phases of the new program. We need to insure that correct data is being entered in the computer. We will be using code books and application guides to insure that you have entered the correct engine displacement and emission control device data. The computer will keep track of the emissions and safety certificates and the calibration/leak check data. Also, it will record aborted tests from exhaust leaks and not maintaining the proper rpm. You can expect us to spend a significant amount of time reviewing your hard copies. We will try to do this in a secluded spot and not interfere with your business operations. We will then replace the computer disc and spot check the engine exhaust analyzer calibration. Later, after we have retrieved the data from the disc, we may need to return and correct any deficiencies that may be revealed by this process.

What significant changes will be involved with the testing process?

The most important change is that the vehicle owner has the option for a safety inspection in conjunction with the emission test. If they decide to have the safety inspection at another location, they will be required to submit two certificates during the registration process. The analyzer will print "Safety Certificate Required" in the section of the certificate normally used to record the safety certificate number. If the owner requests both a safety and emissions test, and the vehicle passes only the safety, you will be required to complete a Safety Certificate only.

What changes can we expect regarding waivers?

Certificates of Waiver will no longer be issued by I/M Stations. When the vehicle fails the initial test, the owner is informed of this and given a computer printout listing why the vehicle failed and what he must now do to obtain a Certificate to register h

vehicle. This may include repairing the vehicle so that it qualifies for a Certificate of Compliance or having emission related repairs performed by a Certified I/M Mechanic to qualify for a Certificate of Waiver. If the owner elects to obtain a Certificate of Waiver, the conditions set forth on the print out must be complied with and then the vehicle is retested at your station. You recall the initial test and retest the vehicle. If it still fails, you send the owner to the Vehicle Emissions Technical Center/Health Department I/M office with the paperwork indicating that the conditions for the waiver have been met. We will then review the information and, if in order, will issue the Certificate of Waiver. You should be aware that 1980 and older vehicles will be required to spend at least $100 in emission related repairs and 1981 and newer will be required to spend $200 in emission related repairs prior to being issued a Certificate of Waiver. You need to also be aware that the requirement to have the vehicle owner authorize repairs before they are actually performed is still part of the emission and safety programs.

What changes will occur for vehicles with other than the original engine?

When a vehicle has an engine other than that which was originally installed when it was manufactured, the owner still must comply with the tampering portions of the test according to the year and make of the vehicle. If the vehicle passes the tampering inspection but fails to meet the standards for the year of the vehicle, and this vehicle has been previously tested according to the year of the engine at the Technical Center, the owner can still go there for an emission test.
Effective July 1,1991, engine changes will only be allowed if the replacement engine is the same year or newer. Any vehicle that has not been entered into the computer indicating that it has been in program prior to this date will be required to meet this criteria. There is also a possibility that vehicles may have to install emission control devices in order to be allowed to be registered in their respective county.

What changes will occur relative to testing vehicles for dealerships?

Whenever you perform an emission test for a dealership, you will code in the county in which the vehicle will be registered and the certificate will indicate that it is valid for that county. If the vehicle is later sold to someone in a different county, another emission test will have to be performed for that county; otherwise, the Motor Vehicle Division (MVD) will not accept it. This will prevent someone from purchasing a vehicle that does not meet the tampering requirements for their county.

What records will each station be required to maintain?

In addition to safety records each emissions test will generate two copies of the emissions test. The one copy is for your records and

one for the owner. All other information regarding calibration leak checks, certified I/M Mechanics, I/m Station permit due date, etc. is in the computer and accessed by the Departments. The hard copies of the emissions tests and the copies of the Certificates c Compliance will be retained eighteen months from the date indicated on the form. When new I/M or Safety Certificates are purchased, the numbers will be entered in the computer as each certificate is used. The auditor will have a listing of all purchases made by your I/M Station; therefore, part of the audit will involve accounting for certificates issued, voided, or destroyed by the printer.
Three copies of the Certificate of Compliance will be generated. One copy is for the owner to register their vehicle, another is for the owner to retain in his vehicle, and the final copy is retained by the station.

If I am certified in one county does that mean I can test in all counties?

You will be able to perform emission tests for all counties in the program. We are presently developing a course that will be used by all counties involved in the I/M program. Once a mechanic has completed this course, he will be able to be certified in a county program after completing a orientation course designed to acquaint him with the rules and regulations of that particular county. He will only be able to perform emission tests after his I/M Mechanic number has been entered into the analyzer computer. He can perform tests for other counties using that analyzer; however, he will not be able to test in another county until his number is entered int the analyzer computer there.

How will I know when I am due to recertify or when my I/M Station Permit is due?

This will automatically appear on the analyzer screen 60 days prior to the due date. If you do not recertify before the date expires, you will be locked out from using the analyzer until this process has been completed and the auditor has updated the analyzer. You should be aware that there is a significant increase in the late fees charged for mechanics who allow their I/M Certificate to expire.

Can I receive any additional training for the later technology vehicles?

We have proposed that the price of the I/M Certificates be increased to $1 when the new program starts so that a portion of the I/M Certificate fees can be applied to developing a training course designed to teach repair techniques for the latest technology vehicles. This will be offered at a reasonable price to anyone who wants to attend.

Will there be any changes in the penalty schedule formerly used in the I/M Program?

The penalty schedule will remain initially the same for those who violate the I/M or Safety Program Rules and Regulations. We are in the process of evaluating a procedure that would require offenders of the emission program rules and regulations to attend a training course. The idea is to focus on reteaching those areas where the I/M Mechanic may have misunderstood the concepts of the program. You can expected to pay for the retraining that is associated with the assessment of penalties. Once this course is developed, you will have the option of taking it in lieu of a suspension. Another option being considered is for you to negotiate a consent agreement with the Health Department to pay a fine in lieu of taking the suspension. This will be done to allow a more equal penalty between high and low volume stations in which a high volume station is penalized more severely that a low volume station for violating the same regulation. This is due to the fact that the high volume station will lose more revenue during the same suspension period.

What changes will occur in the calibration gas?

The new Utah 91 analyzers will now be calibrated with a low and medium range calibration gas. This gas will be supplied with each new analyzer. The Gas will meet California BAR 90 requirements. We will no longer require EPA Protocol Calibration Gas that we have used in the past. We have been informed by the EPA that the new BAR 90 Calibration Gas is as accurate as the old EPA Protocol gas at a lower cost. Each Department will maintain a listing of where this gas can be purchased and who is authorized to market it.

Will I be given a chance to review how I am performing as an I/M and Safety Mechanic?

The computer printouts that are received from each I/M Station will provide a lot of information as to how you are performing with regard to emission/safety testing, emission reduction through repairs, and failure rates. This information will be reviewed with you by your auditor as part of the station audit. You should also be aware that the computer looks for indications of improper emission/safety testing i.e. a vehicle which fails with significant levels of hydrocarbons (HC) and carbon monoxide (CO), and then is immediately tested again and passed with almost no levels of these pollutants.

What about propane, dual fuel, and alternate fuel vehicles?

Beginning in July of this year all I/M Programs in Utah will require that propane and alternate fueled vehicles be tested. If the vehicle is dual fuel (a combination of propane, gasoline, or natural gas) it will be required to be tested with each type of fuel. Also, alcohol only vehicles (if available) will require emissions tests; however, we are still in the process of determining just how we will test these and other alternate fuel vehicles. Once it has been determined that a vehicle is operated on more than one type of fuel, you will program the computer with this information. It will ask you to code what the fuel types are and

then it will initiate the emissions test for gasoline. When that is completed, it will tell you to switch to the other type of fuel. Once this has taken place, the analyzer will retest the vehicle on the other fuel. The vehicle will be required to pass both types of fuel before the computer will print a certificate.

What significant changes will be in the new regulations governing the Utah I/M Programs?

We have prepared a handout that indicates the significant changes in the new I/M Program Regulations that will be used by each county involved in the I/M Program. We will give each I/M Station a copy and let you review it. If their are any questions we ask that you contact the respective Health Department and ask them to provide the information. We will indicate some of the major changes that effect all I/M Programs (i.e. cut point changes, tampering criteria, equipment requirements, calibration/leak check procedures, etc.)

What will happen if a mechanic is caught testing a vehicle that is different from the one entered into the analyzer computer?

There will be no leniency toward any mechanic would is found guilty of either violating, or participating in the violation of, this regulation. Every effort will be made to permanently remove individuals who do this from the I/M Program.

What will happen if a mechanic is found guilty of not following the analyzer testing procedures precisely as they are programed in the computer?

Every effort will be made to discipline anyone who does not support all aspects of the I/M Program. Each individual is responsible to insure that the I/M Program remains creditable and capable of providing a fair and accurate service to the public.

Question/Answer period.

UTAH 91 CERTIFICATION TRAINING PROGRAM

INTRODUCTION

COURSE OBJECTIVE: Mechanics who complete this course will:

I. BE FAMILIAR WITH:

A. the Federal Test Procedure (FTP) and how it correlates with the Short Test Procedure presently used in Utah.

B. air contaminates emitted from vehicles and the harmful effects they have.

C. a brief history of the Vehicle Emissions Inspection Maintenance (I/M) Program in Utah indicating how we arrived at where we are now.

D. the advantages and disadvantages of a centralized I/M program vs. a decentralized program.

E. other strategies being considered to reduce air pollution.

1. Ride sharing.

2. Mass transit.

3. No burning during air pollution episodes.

II. KNOW AND UNDERSTAND:

A. The theory and operation of an infrared engine exhaust analyzer.

1. Propane Equivalency Factor (PEF).

2. Calibration.

3. Temperature/humidity/relocation effects.

4. Upscale and downscale drift.

5. No unauthorized modifications.

B. I/M Program Regulations.

1. Vehicles affected.

2. Exemptions.

3. Required equipment.

a. signs.

b. tools.

c. reference manuals.

4. Audits.

5. Fees.

6. Approved analyzers.

7. Approved calibration gas.

8. I/M Station Permits.

9. I/M Mechanic Certificates.

10. Inspection procedure.

11. Calibration/leak test procedure.

12. Certificates of Waiver.

13. I/M Program Adjustments.

14. Engine changes.

15. Recertification.

16. Renewing I/M Station Permits.

17. Cutpoints.

18. Certificates of Compliance.

a. Security.

b. Purchase.

c. Accountability.

d. Loss or theft.

19. Undercover audits.

20. Penalties.

21. Appeals.

22. Records.

C. Emission control devices.

1. Catalytic converters.

   a. Oxidizing.

   b. Three way.

   c. Dual bed.

2. Air systems.

   a. Air pump.

   b. Pulse air.

3. Fuel (fill) neck restrictors.

4. Exhaust Gas Recirculation (EGR) valve.

5. Positive Crankcase Ventilation (PCV) valve.

6. Carbon canisters (evaporative emission system).

7. Thermostatic air cleaner.

8. Oxygen sensor (exhaust gas sensor).

9. Spark controls.

10. Computer controlled air fuel mixture.

D. Engine decal information.

   1. Tune up specifications.

   2. Air pollution control devices.

   3. Model year.

   4. Federal or california certification.

BODY

SHOW VIDEO OF FTP

I. The Federal Test Procedure (FTP) is required for every different model of vehicle (domestic or foreign) before it sold in the United States.

   A. This test requires several hours to set up and perform.

      1. Analytical instruments must be calibrated using laboratory techniques.

2. The vehicle must be brought in the previous day and left overnight for the temperature to stabilize.

3. All fuel is drained from the fuel tank and a special fuel is put in.

4. The FTP test results must be compensated for standard temperature and pressure.

5. Laboratory conditions must be controlled to insure that it conforms to the requirements of the Environmental Protection Agency (EPA).

B. The FTP test is extremely expensive.

1. The Colorado State University Laboratory has equipment costing over one million dollars.

2. The fee to run the FTP test is between $1000 to $2000.

C. From the above information it is apparent that the FTP test would not be a practical method of routine monitoring for public vehicles.

II. Short test.

A. This is the type of emission test that has been used in the I/M Program since it began in April 1984.

1. Usually takes around 10 minutes.

2. Until July 1, 1991 the cost was $9.00.

3. The analyzers initially used in the program cost around $5000. Now they are about twice that much.

4. Represents a practical method to routinely monitor vehicle emissions.

B. The short test correlates about 90% with the FTP test providing:

1. The test procedures are followed.

2. A diligent tampering check is used as pass/fail criteria.

III. Air contaminants emitted from vehicles and their effects.

A. Hydrocarbons (HC).

1. Results from unburned fossil fuel (or alcohol fuels) which results from engine cylinder misfire.

a. Results from ignition malfunction.

(1) fouled sparkplugs.

(2) cracked distributor.

(3) faulty spark plug wires.

b. Results from vaccuum leaks.

c. Results from improper timing (Usually too advanced).

d. Caused by cylinder wall quenching.

2. Reacts with Nitrous Oxides (NOx) in the atmosphere in the presence of sunlight to form ozone.

a. Powerful oxidant.

b. Causes paint and rubber deterioration.

c. Irritates the respiratory tract causing problems for elderly, small children, and people with chronic lung problems.

B. Carbon Monoxide (CO).

1. Poisonous gas.

2. Cannot be detected with the normal senses.

3. results from partially burned fuel (too much fuel to completely burn).

4. Caused by:

a. Improper air/fuel mixture.

b. Dirty oil or air cleaner filter.

c. defective power valve.

d. improper float level.

C. Nitrous Oxides (NOx)

1. Results from too much heat in the combustion chamber.

2. Responsible for production of ozone as indicated in A.2. above.

IV. History of the I/M Program.

A. Started in April of 1984 due to Salt Lake County violating the ambient air standards.

B. Required too prevent the loss of several million dollar in federal highway funds.

C. Designed to fail 20% of vehicles and attain the ambient air standards by December 1987. These goals were never attained.

D. Decentralized Program allowing garages and other auto service businesses to perform emission testing on public vehicles.

E. Idle test only.

F. Fail rate turned out to be around 11%.

G. Legislature passed bill in 1990 session requiring counties requiring emission testing to standardize programs so tests performed in one I/M county would be valid in another I/M county.

H. Goal set to have automatic data collection system by July 1, 1991.

I. Now all counties have Engine exhaust analyzers that are Bureau of Automotive (BAR) 90 certified with a Utah 91 Program.

1. Requires mechanics to follow test procedures.

2. Pass/Fail decision left up to machine.

3. Automatic data collection system which insures first test readings are retrieved for fail vehicles.

4. Additional cost of analyzer resulted in an increase in the fee that I/M Stations are allowed to charge for each emissions test ($14).

5. Each mechanic has own access code preventing another mechanic from performing test using his I/M Mechanic number.

6. Better certificate security as certificates are locked in analyzer and it is possible that only one individual can load machine.

7. Now possible to test vehicles from other counties as analyzer automatically selects the criteria for the county that is programed into the computer.

8. Standardized programs for all counties allow for J

Mechanics certified in one county to be recertified in another county without going through the certification course again.

a. Mechanics in each county are designated with an alphabetical code to indicate the county they are certified in.

(1) "S" for Salt Lake.

(2) "U" for Utah.

(3) "D" for Davis.

(4) "W" for Weber.

b. Each county assigns an I/M Mechanic number for each mechanic in their program.

(1) Assigned after check out.

(2) Mechanic cannot use analyzer until his number is entered into the machine.

V. Advantages of Centralized and Decentralized I/M Programs:

A. Centralized:

1. Most effective method of detecting tampering.

2. Usually lower cost to public.

3. Easier to audit (only a few stations).

4. I/M training not required for testing procedures.

5. Preferred by EPA.

B. Decentralized:

1. More convenient to public (many stations).

a. Repairs, if necessary can be performed at same location as test.

b. Safety and emissions can be both accomplished at same time.

c. More people benefit from funds generated by decentralized emission testing.

VI. Strategies which public is being encouraged to support to reduce air pollution.

A. Ride sharing: designed to reduce number of vehicle miles traveled by consolidating trips by single individuals into trips involving groups of people.

B. Mass Transit: efforts are being made to provide buses and rail facilities to reduce the number of vehicles driven in populated areas.

C. Burning: Trash and rubbish are no longer allowed to be burned in residential areas, but, must be hauled to the dump. Agriculture burning is only allowed with a special permit on days which do not have an air quality episode.

VII. Infrared (IR) Analyzers:

A. Operate on the principle of absorbance of IR energy.

1. Each analyzer has:

a. IR source.

b. Reference cell.

c. Sample cell.

d. sampling pump.

e. digital meter to indicate concentration of gas being analyzed.

(1) Hydrocarbons (HC).

(2) Carbon Monoxide (CO).

(3) Carbon Dioxide (CO_2).

(4) Oxygen (O_2).

f. Filters/water separators.

g. Sampling line.

B. Detect the concentrations of gases by comparing the amount of IR energy absorbed in the sample cell with that of the reference cell. This difference is converted to a electric signal which is then used to indicate the concentration of the gas.

C. Must be calibrated every 3 days and leak tested every 24 hours.

1. Only Bar 90 department approved calibration gas may be used.

a. Low range: 300 Parts Per Million (PP

Propane; 1.0 % CO.

b. Med range: 1200 PPM Propane; 4.0 % CO.

c. Propane Equivalency Factor (P.E.F.).

(1) A value around .500 that is multiplied by the propane concentration on the calibration cylinder to determine reading that should appear when the calibration gas is introduced into the analyzer bench.

(2) Must be labeled on each analyzer and updated if bench is replaced and P.E.F. changes.

(3) Determines the concentration of Hexane that would be indicated if measuring exhaust from a vehicle.

(a) Hexane calibration gas cannot be used because is does not remain a uniform concentration though out calibration cylinder.

(b) Propane calibration gas is the same concentration throughout calibration gas cylinder; therefore, it is used after applying P.E.F.

D. Effected by temperature, humidity, and relocation.

1. 41 degrees F. is lowest temperature allowed for analyzer.

2. High humidity from high pressure spray wash operations can effect calibration of analyzer. Analyzer must be protected from this type of operation.

3. Analyzer has sensitive computer electronics. Care must be used when moving machine from one location to another.

E. Up Scale/Down scale drift criteria corresponds to the reference scale selected.

1. 0 - 400 PPM HC; 0 - 2.0% CO scale: Up scale and downs scale drift is limited to plus or minus 12 PPM HC and plus or minus .06% CO.

2. 401 - 1000 PPM HC; 2.01 - 5.0% CO scale: plus or minus 30 PPM HC and plus or minus .15 CO.

3. 1001 - 2000 PPM HC; 5.01 - 10.0% CO scale; plus or

minus 80 PPM HC and .4% CO.

F. Analyzer modifications: No unauthorized modificatio to the analyzer or computer program are authorized.

1. In some cases, replacement sampling hose and flexible probes may be approved if it is determined that the new type does not effect the accuracy of the emission test.

2. Any request for additional computer monitors or any other modifications to the machine/computer must be submitted to the department and approved prior to being implemented.

VIII. I/M Program Regulations.

A. Vehicles that require emission testing.

1. 1968 and newer gasoline, propane, and ethanol/methanol powered vehicles.

2. Vehicles being registered after purchase.

3. Vehicles being registered after being brought in from another state or overseas.

B. Vehicles exempt from emission testing.

1. Any vehicle 1967 or older.

2. Agricultural implements of husbandry.

3. Motorcycles or motor driven cycle.

4. Maintenance or construction not registered for highway.

5. Vehicles that operate on diesel or electricity.

6. New vehicles never registered that have a Manufacturer's Statement of Origin (MSO).

C. Equipment required for I/M Stations.

1. Bar 90 analyzer with Utah 91 program.
2. Reference manuals covering the majority of foreign and domestic vehicles which provide:

a. Tune up data.

b. Vacuum hose diagrams.
c. Vehicle computer fault code information.

d. Flow charts for diagnosis and repair of computer vehicles.

2. Tools for I/M Program Adjustments, tune up, and diagnostic functions.

3. Propane enrichment kit.

4. Official I/M Station sign (except fleets).

5. Fee chart (with fees for I/M test and I/M Program Adjustments posted and clearly legible).

6. Department approved handbook that includes high altitude specifications.

7. Department approved calibration Gas.

8. Non-reactive tail pipe extender or probe adapter for baffled exhaust systems.

9. All forms, technical bulletins, and other informational materials required by the Department.

D. I/M Station and Mechanic Fees.

1. Initial permit: $250.

2. Annual permit renewal: $25.

3. Renewal of expired permit: $75.

4. I/M Station relocation fee: $50.

5. Certifying mechanic at new station: $20.

6. Annual I/M Mechanic renewal fee: $10.

7. Renewal of expired I/M Mechanic certificate: $30.

8. Certificates of Compliance: $1.

E. Public fees:

1. Each vehicle registered in Salt Lake County is required to pay a $1 Air Pollution Control Fee.

2. I/M Station may charge up to $14 for each emissions test.

3. I/M Stations/Mechanics are allowed to charge $5 for each I/M Program Adjustment. If the carburetor is sealed, and the customer authorized the repair, the customary fee may be charged to remove the

carburetor and take out the seal.

4. I/M Stations may charge up to $2 for duplicate certificates.

F. I/M Station Audits.

1. Required every three (3) months.

2. Must allow auditor access to analyzer.

3. Major concern is to verify that correct information is being programed into computer.

G. I/M Station Permits.

1. Valid for 12 months at the business where it was issued; and must be renewed annually.

2. Cannot be transferred, assigned, or used by any person except the original owner designated on the statement of understanding.

3. Must be posted in public view.

4. If cooperation, must have copy of the articles of incorporation designating person(s) authorized to conduct business involving I/M Program.

H. I/M Mechanic Certificates.

1. Issued upon completion of written and practical examinations demonstrating proficiency in required aspects of the I/M Program.

   a. Location and function of emission control devices.

   b. Relationship of I/M Program adjustments to HC and CO.

   c. Tune up adjustments with manufacturer's and high altitude specifications.

   d. Inspection procedures.

   e. Calibration/leak checks.

   f. 207 (b) Warranty provisions.

   g. General understanding of I/M Regulations.

2. Valid of 12 months and then mechanic must go through recertification process.

a. Written examination.

b. Practical examination.

I. Inspection Procedure.

1. Must be solely performed by Certified Emission Mechanic with the exception that data entry may be performed by someone else if approved by the Department.

2. Must notify vehicle owner in advance of emission test if unable, unqualified, or unwilling to perform required repairs if the vehicle fails.

3. Must be performed within reach of analyzer sample line.

4. Must protect analyzer from wind, moisture, temperature extremes, and other abuse.

5. Cannot test vehicle which could cause injury to people, equipment, or effect validity of the test (smokers).

6. Cannot test vehicle that cannot make it through the test without stalling.

7. Must verify information on registration card prior to using it for data entry into computer.

   a. If there is no Vehicle Identification Number (VIN), or a different VIN, you cannot test the vehicle until one is attached that matches the registration.

   b. If more than one VIN (motor homes), use the one that corresponds to the registration.

   c. Underhood decal may be used to verify year of vehicle.

8. Must determine emission control devices using under hood decal or approved reference.

   a. Engine decal is the most reliable source for information.

   b. Engine decal indicates whether Federal or California specifications.

9. Must check fuel inlet restrictor (if applicable) to verify that it has not been enlarged.

a. If 1984 and newer tampered inlet restrictor, you must repair inlet restictor and replace catalytic converter (unless converter is determined to be effective by the Department)

b. If 1983 and older, Certificate of Compliance can be issued as long as vehicle meets emission standards.

10. If vehicle fails, and the emission related parts are not available to repair the vehicle by the time the registration is due, the I/M Station will issue an affidavit stating this fact and when the parts will be available to the owner. The owner will then take this affidavit to the Technical Center for a temporary waiver that can be used to register the vehicle.

a. Owner must obtain certificate of compliance and bring, or mail, this to the Technical Center by expiration date of temporary waiver.

b. The Department is under no obligation to issue these waivers.

11. The I/M Mechanic must insure:

a. that the analyzer is warmed up and stabilized.

b. the vehicle is at normal operating temperature

(1) Check temperature gauge.

(2) Feel radiator hose associated with thermostat.

c. transmission is in park or neutral.

d. accessories are off.

e. emergency brake is applied.

f. exhaust evacuation system is installed (if indoors).

g. probe is at least 12 inches into tail pipe.

(1) if dual exhaust, must use adapter to test both sides simultaneously.

(2) must use baffle probe or non reactive tail pipe extender is necessary.

(3) must protect tailpipe if testing in windy conditions.

h. install tachometer lead.

(1) Different type for rotary, distributor-less, and quad four ignition systems.

(2) may indicate plug or coil.

(3) may be antenna type that lays on engine.

(4) if no rpm indication, cannot perform test.

i. follow prompts as indicated on computer screen.

j. when test is completed, obtain certificate and print out for customer. If vehicles fails, obtain printout and inform owner of waiver or warranty options (if applicable).

J. : Calibration/Leak Check Procedures.

1. Analyzer locks out if more than three days have elapsed since last calibration.

a. Select calibration page of computer program and follow prompts.

b. Analyzer can fail calibration if not enough pressure in cylinder.

c. Calibration information is entered on Audit Disc; however, you can obtain print out of calibration information is you desire.

2. Analyzer locks out if more than 24 hours have elapsed since last leak check.

a. Select leak check page and follow prompts.

b. If fails, locks out analyzer until repaired.

K. Certificates of Waiver.

1. Effective July 1, 1991, I/M Stations will not longer issue Certificates of Waiver. These will only be issued at the Technical Center.

2. I/M Stations/Mechanics must insure that vehicle complies with requirements for a waiver prior to sending them to the Technical Center.

a. 1968 - 1980 Vehicles.

(1) Must have I/M Program adjustments performed by a certified mechanic and

verified by a Waiver Affidavit.

(a) Underhood decal is most reliable source of tune up specifications.

(b) Underhood decal is most reliable source of tune up procedures.

(2) Must past tampering inspection for catalytic converter, air system, and fuel neck restrictor (if applicable).

(a) Underhood decal most reliable source to determine what devices were manufactured on the vehicle.

(b) If underhood decal is missing, VIN and application guide may be used to determine engine and devices by calling Technical Center.

(3) Must spent at least $100 in I/M Program Adjustments and emission related repairs.

(a) Emission related parts purchased and installed by the owner after the date of the initial test count toward this if accompanied by a receipt.

(b) Emission related parts and labor performed after the date of the initial test count toward this if accompanied by a repair order or invoice from a reputable business.

b. 1981 and newer Vehicles.

(1) Must spend at least $200 in emission related repairs performed after the date of the initial inspection.

(a) The cost of parts purchased and installed by the owner, provided that it is verified with a receipt.

(b) Parts and labor from a reputable business.

(2) Must have catalytic converter, fuel neck restrictor, and air system (if applicable) for vehicles 1981 to 1989.

(3) Must have emission control devices listed above plus carbon canister (evaporative

emission control system), EGR valve, PCV system, and gas filler cap for 1990 and newer vehicles.

c. All emission related repairs that apply to a Certificate of Waiver must apply to the repair of the problem which relates to why the vehicle fails to meet the emission standards.

d. Certificates of Waiver will not be issued to vehicles that qualify for warranty repairs. If the registration will expire prior to the completion of warranty repairs, refer to item VIII.,I,10 above.

e. Certificates of Waiver will not be issued to vehicles that have a significant increase in the emission readings after repairs are completed.

f. Costs associated with repairs for obvious tampering or exhaust leaks (other then legitimate catalytic converter replacement) cannot be included with those which are required for a Certificate of Waiver.

L. I/M Program Adjustments:

1. I/M Stations are allowed to charge up to $5 for each of the following:

a. Timing: Must be within plus 4 degrees to minus 2 degrees of high altitude specification or manufacturer's specification.

b. Dwell angle: Must be within plus or minus 2 degrees of manufacturer's specification.

c. Air/fuel mixture: Must be adjusted according to manufacturer's specification.

(1) Propane enrichment.

(2) CO Specification.

(3) Lean Drop

d. Idle speed: Must be within plus or minus 50 revolutions per minute (rpm) of manufacturer's specification.

e. Choke: Check for proper operation. If adjustable, insure that it is positioned to

proper index.

2. If vehicle has a sealed carburetor, I/M Stations are allowed to charge the customary fee to remove the carburetor and seal(s).

3. Vehicles that indicate increased emission levels after they are adjusted to manufacturer's specifications, may be readjusted to compensate for the abnormal condition. Example: If a lean drop adjustment results in excessive HC and low CO it is in a lean misfire. The air fuel mixture may be adjusted to obtain the lowest CO reading without increasing HC.

4. If I/M Program adjustments are not responsive, or they cannot be performed to the specifications, the vehicle must be repaired before the adjustments can be performed and the vehicle can qualify for a Certificate of Waiver.

M. Engine Changes.

1. All vehicles which have other than the original engine, and the owner elects to have the vehicle tested according to the year of the engine rather than the year of the vehicle, must:

   a. Take the vehicle to the Technical Center wit proof of the year of the engine.

   b. Insure that the vehicle passes the tampering inspection , if applicable.

   c. have previously been allowed to register the vehicle as an engine change as indicated by Technical Center records.

   d. meet requirements for a Certificate of Waiver, if applicable.

2. All vehicles requesting information regarding engine changes are instructed:

   a. Must be same engine displacement the same year or newer.

   b. Must have same emission controls as original engine.

   c. If other than same engine displacement, must have proof that EPA certification was granted for the vehicle with that displacement.

N. Recertification:

1. Required each year on the anniversary of the initial I/M Mechanic certification.

2. Must pass practical and written examinations with a score of 70% or better.

3. I/M Mechanic is notified 60 days prior to expiration by analyzer.

4. $10 fee if renewed prior to expiration.

5. $30 fee if renewed after expiration.

6. I/M Mechanic must retake certification course to be reinstated in I/M Program after certificate has expired more than one year.

7. Analyzer automatically locks out mechanic when certificate expires.

O. Renewal of I/M Station Permit.

1. Required each year after station pays initial $250 I/M Station permit.

2. Station notified 60 days prior to expiration.

3. Analyzer locks out if not renewed prior to expiration.

4. $25 fee if renewed prior to expiration.

5. $75 fee if renewed after expiration.

6. Must pay $250 fee if permit expires over one year.

P. I/M Program Cutpoints.

1. Changed July 1,1991 to standardize emission standards in all counties (see attachment # 1).

2. Represent a maximum allowable concentration of HC and CO for each year and type of vehicle.

3. Must not be used as a guideline to adjust vehicle.

4. Not required to be posted as printout lists the cutpoints for the vehicle tested.

Q. Certificates of Compliance.

1. Sold in packages of 100 each.

2. $1 fee for each certificate.

3. Capability exists for only one individual to load certificates into the analyzer.

4. Secured in locked cabinet of analyzer.

5. Analyzer locks out if certificate door is tampered with.

6. I/M Station must account for each certificate.

   a. Retain copy of damaged certificate for auditor.

   b. Analyzer asks I/M Mechanic to verify that certificate number is the same on the analyzer screen as that on the certificate.

   c. Each certificate number is retained in computer for duplicates or reprint.

7. I/M Station must report any loss or theft of Certificates of Compliance within 24 hours.

R. Undercover audits.

1. Required by EPA to undercover each station each year.

2. Undercover vehicle:

   a. may be set to pass emission standards for an I/M Station that has excessive fail rate.

   b. may be set to fail for a station which has has a low fail rate.

   c. may be tampered to determine is I/M Mechanics are checking air pollution control devices.

   d. may require I/M Program Adjustments to determine mechanics ability to adjust vehicle to manufacturer's specifications.

S. Penalties:

1. Administered according to penalty schedule.(see Attachment # 2).

2. Serious violations may result in immediate suspension.

   a. Programing fail vehicle, but testing another vehicle which passes.

b. Using a non certified mechanic to perform the official emissions test.

c. Failure to issue a Certificate of Compliance to a vehicle which complies with the requirements to receive one.

d. Issuing a Certificate of Compliance to a vehicle which does not comply with the requirements to receive one.

3. Minor violations result in a letter of notification of the specific violation.

4. Repeat minor violations result in suspension.

5. Department is considering options to the suspension of the I/M Mechanic Certificate or Permit.

a. Consent agreement where a station agrees to pay a certain amount of money rather than be suspended.

b. Mandatory retraining class in lieu of suspension.

T. Appeals.

1. I/M Station has 10 days to appeal any penalty imposed by the Department.

a. Must complete appeal form at Health Department.

b. Hearing on appeal is held within 10 days from the date initiated.

2. I/M Station is allowed to continue testing until a decision is made by the Director regarding the appeal.

a. Penalty may be reduced.

b. Penalty may be increased.

c. Penalty may be overturned.

3. I/M Station may request appeal from the Director of the Health Department if not satisfied with the decision of the Director of the I/M Program.

4. All statements made at an appeal hearing are subject to legal action if proven to be false or misleading.

5. Record of the appeal hearing is kept and made available to the person involved if requested.

6. The decision of the appeal hearing is made within 10 days of the hearing.

U. Records.

1. All required printouts and other records required by the Department must be maintained for 18 months.

2. Information regarding vehicle inspections is purged from the analyzer every 90 days.

IX. Emission control devices:

A. Catalytic converters:

1. Must be either EPA approved after market or original equipment.

a. Oxidizing:

(1) Converts HC to carbon dioxide (CO_2) and water (H_2O) by continuing the combustion process of the fuel as the exhaust enters the platinum or palladium converter bed.

(2) Converts CO to CO_2 and H_2O as indicated above.

(3) Converter bed may be monolith or pellet type.

b. Three way:

(1) Has a reduction section (rhodium) and a oxidation section (platinum and palladium).

(2) Requires air injection from the air pump between the two sections above.

(3) Reduces NOx in addition to HC and CO.

(a) Reduction section reduces NOx to Nitrogen (N_2) and O_2.

(b) Oxidation section changes HC and CO to H_2O, CO_2, and N_2.

c. Dual bed: This converter is essentially the same as the three way converter above except

that it does not have an air injection between the reduction and oxidation sections.

B. Air Systems:

1. Air injection pump:

a. A belt driven air pump injects air into the exhaust manifolds or downstream to continue the combustion process that originates in the combustion chamber.

b. A check valve prevents exhaust from back flowing into the air pump.

c. Air for the system usually comes from the air cleaner.

d. Some ford and foreign vehicles use a by pass valve to divert air for the catalytic converter during periods of prolonged idle to prevent the converter from damage due to overheating.

(1) requires preconditioning or engine shut off to reset valve.
(2) Utah 91 analyzers prompt mechanics to follow restart procedures for these vehicles.

2. Pulse air:

a. Air is drawn into the exhaust system during negative air pressure that occurs during alternate positive and negative cycles in the exhaust as the engine runs.

b. A check valve insures that the air flows only into the exhaust and that exhaust cannot back flow into the air cleaner.

c. Continues combustion process as in belt driven air pumps mentioned above.

C. Fuel (fill) neck restrictors:

1. Prevent the insertion of a leaded fuel nozzle into an unleaded fuel tank.

2. Must be measured with a fifteen sixteenth inch gauge to determine if tampered.

3. Aftermarket replacement restrictors, approved by the Department may be used to repair tampered restrictors.

D. Exhaust Gas Recirculation (EGR) valve.

1. Allows exhaust gas to recirculate into the combustion chamber during cruise to cool combustion temperatures inside the cylinder.

2. Vehicle experiences a rough idle and a normal cruise if defective.

3. Reduces amount of NOx which is formed by higher temperatures.

4. May cause erratic HC readings in cylinders if defective due to vacuum leaks resulting in a lean misfire.

5. Most tampering involves putting an obstruction in the vacuum line to the EGR which prevents the valve from opening during cruise.

E. Positive Crankcase Ventilation (PCV):

1. Allows fumes from the crankcase to circulate through the carburetor and burn in the combustion process rather than being emitted into the atmosphere.

2. Can effect HC and CO readings:

a. Wrong type could allow too much air, or not enough, effecting the air fuel mixture.

b. Removing PCV valve, and observing increased CO would indicate dirty oil.

3. Usually checked by removing valve and shaking to detect ball rattle.

F. Carbon (Evaporative emission control) canister:

1. Collects fuel vapors from the carburetor and fuel tank.

2. Vapors stored in the Carbon are drawn out during cruise and burned in the combustion process.

3. Vehicles may erroneously fail the 2500 rpm test due to the above condition.

a. Utah 91 Program has second chance capability to eliminate false failure.

b. Special test procedures must be used for some vehicles with automatic transmissions during second chance testing.

(1) 1984 - 1986 BMW's.

(2) 1986 - 1991 Peugeot 505's.

(3) 1987 BMW model 535 CSi, 734i, and L7.

(4) 1985 - 1988 Volvo 740's.

G. Thermostatic Air Cleaner (TAC):

1. A device that directs heated air from the exhaust manifold into the carburetor during cold weather to accelerate vehicle engine warmup.

2. TAC valve opens to allow cooler air to enter carburetor after engine is warm.

H. Oxygen (O2) Sensor:

1. A sensor that measures the amount of O2 in the exhaust and sends the information to the vehicle computer.

2. Computer takes information from the O2 sensor and directs fuel mixture control to adjust the carburetor to the proper setting according to the altitude and outside air pressure.

I. Spark Controls:

1. Air pollution control devices that regulate the timing to reduce emission levels during certain phases of engine operation.

2. Usually prevent increased levels of HC from the timing too advanced.

J. Computer Controlled Air Fuel Mixture: This was referred to in item IX.H.2. above.

CERTIFICATION COURSE LABORATORY

The certification course laboratory is composed of four sessions which go on simultaneously. The class is divided into four groups and rotate among the various sessions.

Session 1, Utah 91 emission test procedure: Each student will perform an emission test of his own vehicle, the mercury cougar, or an engine stand using the Utah 91 analyzer. This will be performed in the test mode so that a certificate will not be generated.

Session 2, I/M Program Adjustments: Each student will perform a dwell, timing, choke, idle speed, and air fuel adjustment on the ford engine. The air fuel adjustment will involve using a lean

drop, propane enriched, and CO specification derived from a CO2 conversion chart.

Session 3, Engine diagnostic demonstration: The lab instructc will demonstrate the effects of vacuum leaks, advanced timing, dirty oil, dirty air cleaner filter, defective PCV valve, and ignition malfunction to high HC and CO readings.

Session 4, Oxygen sensor and pollution control device demonstration: The lab instructor will demonstrate how to check the voltage on an oxygen sensor and the location/function of the following air pollution control devices:

1. EGR valve.
2. Oxygen sensor.
3. Throttle positioner sensor.
4. Stepper motor.
5. Carbon (Evaporative control) canister.
6. Throttle body injection.
7. Coolant temperature sensor.
8. Temperature gauge sensor.
9. Air pump.
10. Upstream air tubes.
11. Downstream air tubes.
12. PCV valve.
13. Air cleaner heated air door (TAC).
14. Exhaust heat riser.

CONCLUSION

The Vehicle Emission Inspection Maintenance (I/M) Program is designed to reduce the amount of air pollution generated from vehicles. This source of contamination is of particular concern because it is brought into our neighborhoods and communities rather than remaining at a constant location. With the availability of computer controlled analyzers, we have reduced the problem on I/M Mechanics not following the test procedures; however, we still must insure that air pollution control devices are being checked to insure that we have a creditable program. Failure to provide a creditable program could result in the EPA requiring us to go to

centralized program. This would not be in the best interests of those who are now, or will be, in the I/M Program. We solicit your cooperation in making this a respectable endeavor. We pledge our support and assure you that we will do our part to accomplish this goal.

LAB COURSE OUTLINE

I. Utah 91 Engine Exhaust Analyzers:

A. Theory of operation.

1. Major components.

a. Sample line.

(1) Filter.

(2) Water seperator.

b. Infared (IR) bench.

(1) IR eneregy source.

(2) Chopper motor.

(3) Reference Cell.

(4) Sample Cell.

c. Pump.

d. Electronics.

(1) HC readout.

(2) CO readout.

(3) CO2 readout.

(4) O2 readout.

2. Sample flow and exhaust analysis.

a. Engine exhaust is drawn into the analyzer by the pump, filtered, water removed, and then it enters the sample cell.

b. IR energy is transmitted into both the reference and the sample cells.

(1) Any contamination in the sample cell absorbs the IR energy causing a difference in the electric signal between the two cells.

(2) The difference in the electric potential is converted to a reading depending on the amount of contamination.

(a) If all the energy is absorbed, there is a maximum reading on the indicator.

(b) If no energy is absorbed, the indicator displays zero.

c. The chopper motor interupts the IR signal in order that the electrical signal can be updated as the concentration changes in the sample cell.

d. After the exhaust leaves the IR bench, it exits through the exhaust port on the analyzer.

B. Rountine Maintenance.

1. Calibration required every three days.

a. Must be with Bureau of Automotive Repair (BAR) approved gas.

(1) Low Range: 300 Parts Per Million (PPM) Propane; 1.0 % Carbon Monoxide (CO).

(2) Medium Range: 1200 PPM Propane; 4.0 % CO.

b. Analyzer will lock out if calibration goes beyond three days.

2. Leak Check required every 24 hours. (Analyzer locks out when overdue).

3. Filters/water seperator must be serviced on a regular basis (extra filters should be kept on hand).

4. Analyzer must be kept clean and maintained in a stable environment.

a. Temperature: 41 degrees F. to 110 degrees F.

b. Humidity: Can effect calibration.

c. Excessive Movement: May also effect calibration.

5. No authorized modifications

PRETEST EXAM #2

1. The reason that a richer mixture must be delivered when a cold engine is first started is:

   a. This allows a higher cranking speed
   b. Only part of the gasoline will vaporize when cold
   c. The thick engine oil must be thinned out
   d. None of the above

2. Oil may be lost from the engine by leaking in liquid form, burning in the combustion chamber, and by:

   a. Evaporating
   b. Passing as a mist through the PCV system
   c. Condensing
   d. Leaking from the transmission

3. In normal operation, coolant in the downflow radiator circulates:

   a. From top to bottom
   b. From bottom to top
   c. In a circular path in the radiator
   d. None of the above

4. The device in the cooling system that raises the boiling point of the coolant in the system is called the:

   a. Pressure cap
   b. Vacuum valve
   c. Thermostat
   d. Radiator

5. In the main system of the carburetor, the maximum amounts of fuel that can flow during driving conditions are controlled by:

   a. Main metering jets
   b. Idle air bleeds
   c. Fuel inlet check ball
   d. Accelerator pump

6. The high voltage side of the ignition system is known as:

   a. Primary voltage
   b. Secondary voltage
   c. Battery voltage
   d. Both A and B

7. Bypassing the ballast resistor of a point type ignition system will result in the following:

   a. Premature point failure
   b. Low charging rate
   c. Carbon tracking
   d. Starter solenoid failure

8. The accelerator pump operates:

   a. All of the time the engine is running
   b. During initial throttle openings
   c. Automatically when vacuum drops
   d. During wide open throttle operations

9. Engine troubles associated directly with cooling systems include:

   a. Hard starting and slow warm-up
   b. Slow warm-up and overheating
   c. Slow cranking and warm-up
   d. None of the above

10. Exhaust gas leakage into the cooling system is most likely to be caused by a defective:

   a. Cylinder headgasket
   b. Manifold gasket
   c. Water pump
   d. Radiator hose

11. The ease with which a gasoline vaporizes is called:

   a. Volatility
   b. Oxidation
   c. Octane rating
   d. Cetane rating

12. A high compression ratio can cause a problem because it increases:

   a. The temperature of the air/fuel mixture
   b. Harmful exhaust emissions levels
   c. High NOX levels
   d. All of the above

13. In the gasoline engine, the basic difference between the carbureted fuel system and fuel injected system is:

   a. In the type of fuel used
   b. How the fuel is metered
   c. The pressure applied to the fuel
   d. Both B and C

14. The portion of the carburetor that controls pressure to cause fuel to flow is called:

   a. Throttle plate(s)
   b. Air bleed
   c. Venturi
   d. Fuel nozzle

15. The turbo charger boosts engine power by:

    a. Increasing engine speed
    b. Increasing engine compression ratio
    c. Sending more air/fuel mixture into the combustion chambers
    d. Sending more liquid gasoline and steam into the cylinders

16. Gasoline fuel-injected systems can be classified in two ways, according to whether they are:

    a. Port or pulsed
    b. Continuous or controlled
    c. Throttle body or timed
    d. None of the above

17. The torque an engine develops is:

    a. The rate at which the engine works
    b. The rotary or twisting force that it applies
    c. The power available to do work
    d. The pressures developed during the power stroke

18. The more easily an engine can breathe, the higher the engine's:

    a. Volumetric efficiency
    b. Piston displacement
    c. Compression ratio
    d. Compression stroke

19. Engine oil can enter the combustion chamber around the valve stems and:

    a. Past the exhaust manifold gaskets
    b. Past the piston rings
    c. Both A and B
    d. Neither A nor B

20. The carburetor system that stores the gasoline to be used by other systems is called the:

    a. Power system
    b. Float system
    c. Main metering system
    d. Choke system

21. What happens when the accelerator pump inlet check ball is left out of a carburetor:

    a. Flooding during acceleration
    b. Hard starting and hesitation when the throttle is opened suddenly
    c. Hesitation or stalling when the throttle is closed suddenly
    d. Very rich mixtures during low-speed driving

22. In addition to providing lubrication and acting as a cooling agent, the engine oil must:

a. Clean, dry and absorb shocks
b. Oxidize, carbonize and burn
c. Absorb shocks, seal and clean
d. None of the above

23. The purpose of the crankcase ventilation is to:

a. Remove liquid gasoline and water
b. Remove vaporized water, gasoline and fumes
c. Cool the oil
d. Supply oxygen to the crankcase

24. The substance added to oil which helps keep the engine clean is called a:

a. Detergent
b. Soap
c. Solvent
d. Thinner

25. Common causes of excessive oil consumption include:

a. Heavy oil and tight bearings
b. High speed and worn engine parts
c. Short trips and cold weather
d. Frequent oil changes and weak valve springs

26. Two problems in high-compression engines are:

a. Air/fuel ratio and speed
b. Pre-ignition and detonation
c. Detonation and carbon deposits
d. Unleaded gasoline and diesel fuel

27. Knowing the bore and stroke of an engine, the technician can calculate the:

a. Compression ratio
b. Piston displacement
c. Volumetric efficiency
d. Continuation pressure

28. The typical firing order for an in-line six cylinder engine i

a. 1-3-2-6-5-4
b. 1-4-3-2-6-5
c. 1-5-3-6-2-4
d. 1-2-3-5-4-6

29. The methods of cooling engines are classified as:

a. Air cooled and liquid cooled
b. Water cooled and liquid cooled
c. Air cooled and oil cooled
d. None of the above

30. The basic function of valve overlap is:

a. To prevent valve burning
b. To improve volumetric efficiency
c. To provide smoother idle
d. To provide easier starting

31. Cranking vacuum test indicates the condition of the:

a. Carburetor and fuel pump efficiency
b. Vacuum diaphragm of the fuel pump
c. Mechanical condition of the engine
d. Crankcase vacuum

32. During the mechanical compression test, the engine should be allowed to crank through at least how many cycles:

a. One
b. Two
c. Three
d. Four

33. If the carburetor float level is too high:

a. All circuits of the carburetor will be affected
b. Only the idle circuit will be affected
c. Only the power circuit will be affected
d. Only wide open throttle circuits will be affected

34. When a four cycle engine is idling, the spark is timed to arrive at the spark plug just before the piston reaches TDC on the compression stroke. As the engine increases RPM, the spark must arrive:

a. Later than idle
b. Earlier than idle
c. Same as idle
d. At TDC

35. The ratio of the revolutions of the crankshaft to the revolution of the camshaft on a 4 cycle engine is:

a. 1 to 1
b. 2 to 1
c. 3 to 1
d. Depends on the number of cylinders in the engine

36. Higher compression ratios of an engine may cause:

a. Higher squeezing of the air/fuel mixture
b. Higher combustion pressures
c. Expansion of burning gases to greater volume during the power stroke
d. All of the above

37. A restricted or crimped fuel line from the tank to the fuel would cause:

a. Low pressure and low volume
b. High pressure and high volume
c. High pressure on needle and seat resulting in flooding
d. Low pressure and high volume

38. The carburetor air/fuel mixture should be adjusted _____ ignition timing has been set:

a. Before
b. After
c. Makes no difference
d. While

39. Too much tappet clearance will cause valves to:

a. Open late and close late
b. Open early and close late
c. Open late and close early
d. Open early and close early

40. What position are the valves in during the power stroke:

a. Intake closed and exhaust open
b. Intake open and exhaust closed
c. Both closed
d. Both open

41. The devise(s) for smoothing out the power impulses from the engine is the:

a. Crankshaft
b. Camshaft
c. Flywheel and harmonic balancer
d. Clutch

42. When an engine cranks but will not start, it is probably:

a. A fouled spark plug in the number two cylinder
b. A dirty air filter
c. An improperly adjusted voltage regulator
d. None of the above

43. On a contact point system, if the point spring tension is lc the engine may miss because of:

a. Point gap wide
b. Point arching
c. Point sticking
d. Point float

44. The distributor centrifugal (mechanical) advance action is governed by:

a. The engine vacuum
b. The speed of the engine
c. The breaker point gap
d. The engine load conditions

45. Distributor vacuum advance action is governed by:

a. The number of cylinders in the engine
b. Breaker plate movement
c. The load on the engine
d. The speed of the engine

46. Radio and T.V. suppression type resistor spark plug cables:

a. Increase the voltage required to fire the spark plugs
b. Are used only with resistor type spark plugs
c. Lower the voltage required to fire the spark plugs
d. Must have more than 100,000 ohm's resistance to be considered satisfactory

47. The carburetor operates on the principle of:

a. Atmospheric pressure
b. Fuel pump pressure
c. Differential pressure
d. Positive pressure

48. Total spark timing equals:

a. Initial timing minus mechanical advance
b. Mechanical advance minus initial timing
c. Vacuum advance plus initial timing
d. Basic plus vacuum plus mechanical advance

49. Compression losses at any point during engine operation may cause:

a. Rough idle
b. Hard starting
c. Engine miss
d. All of the above

50. The idle-stop solenoid prevents dieseling by:

a. Preventing excessively high idle speed
b. Completely closing the throttle plate when the engine is turned off
c. Decreasing the engine idle when the engine gets hot
d. Increasing engine idle speed when the air conditioner is operating