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Module 17: Priorities in Vehicle Inspection

Purpose:

To focus on different international models for vehicle inspection and maintenance programs

Learning Outcomes:

- Describe the different models for vehicle inspection and maintenance programs
- Understand the role of an oversight agency
- Understand the differences between inspection and maintenance of motor vehicles
- Understand the differences between periodic and mandatory inspection models
- Understand the purposes of acceptance test procedures
- Understand the issues and policies associated with roadside inspections

Contents:

- A. Vehicle inspection models
- B. Oversight agency
- C. Inspection versus Maintenance
- D. Inspection Frequencies
- E. Acceptance Test procedures
- F. Roadside Inspections
- G. Vehicle Inspection Models
- H. Emissions Inspection Types
- I. Effectiveness of I/M

Format:

- 1. Slide Presentation**
- 2. Priorities in Vehicle Inspection**
- 3. Video Presentation**
- 4. Pre-trip Inspection**

5. Safety & Emissions Inspection Lane

References

Commercial Vehicle Inspections in Canada (CCMTA)
Vehicle Inspection Handbook (AAMVA)

1. Vehicle Inspection and Maintenance Models

Although regulating agencies are responsible for developing the inspection and maintenance standards for in-use vehicles, the same agencies should recognize the importance of the inspection and maintenance processes. The inspection process only identifies vehicles that are not in compliance with the standards; quantifiable benefits exist only if the non-compliant vehicles are repaired and the vehicles pass a subsequent retest.

There are three basic inspection models that have been operated with any success. These models are:

- Centralized inspection only model,
- Decentralized model; and
- Hybrid inspection model

1.1 Centralized Inspection only Model

A centralized inspection only model is ideal for the development of private/public sector partnerships in that the infrastructure, training and maintenance costs are borne by the private sector in return fixed length contract for performing the inspections. The public sector, normally through an oversight agency, has the responsibility of defining the inspection procedures and standards, quality assurance procedures, developing and training the repair personnel to perform effective repairs and quantifying the benefits of the program.

The private/public sector partnership can be structured in either of the following concepts:

- Build – own – operate
- Build – operate – transfer

The build – own – operate concept confers all the rights and responsibilities to the contractor in terms of administrative costs, personnel, training and long term maintenance. In return, the contractor is rewarded with a fixed-term contract that specifies the minimum annual inspection volumes, an amending formula for volume adjustments and supplantation clauses.

The build-operate-transfer concept is similar to the build-own-operate concept with the notable exception that the rights and responsibilities conferred on the contractor for the fixed-term contract is then reverted to the oversight agency or the government.

A centralized inspection model is effective where the vehicle population is concentrated within a relatively small geographic boundary. Some of the benefits of a centralized model are:

- Volume throughput
- Affordable inspection costs
- Ideal model for private/public partnership
- Convenience of inspections
- Effective communications plans
- Employment opportunities

Some major drawbacks of the centralized inspection model are:

- Providing enough stations, lanes and staffing to ensure convenience,
- Finding appropriate land that is within 10 km of 95% of motorists,
- Cost to governing body for administration; and
- Labour disputes can disrupt service delivery

The minimum requirements for each centralized inspection centre are:

- Minimum 0.2 hectares sites
- Strategically located to provide close proximity for motorists
- Zoned for “garage-light industrial” application

1.2 De-centralized Model

This model is best suited where the population is spread out through a large geographic area or where centralized inspection centres are not possible because of extremely high real estate costs.

Some benefits of a de-centralized model are:

- Capital costs borne by participating facilities
- Freedom of choice of centres
- Flexibility of business hours
- Market forces dictate the number of centres
- Market forces dictate the cost of inspections

There are some disadvantages associated with de-centralized models:

- Less effective at reducing vehicle emissions. The U.S. EPA deems decentralized programs are ½ the value of centralized programs
- Greater likelihood of fraudulent tests
- Inherent conflict of interest
- Increased government bureaucracy
- Greater degree of variability of motor vehicle safety test results

The de-centralized model itself can be separated into three distinct groups:

- Inspection only
- Inspection and repair

- Repair only

1.2.1 Inspection Only Centres

Inspection only centres in a de-centralized model have limited use unless there is sufficient volume to justify their existence. Alternatively, inspection only centres can survive through informal arrangements with other repair only centres if there is a business case for only one inspection centre.

1.2.2 Inspection/Repair Centres

This model is preferred in jurisdictions where there are strong automotive repair lobby groups. The inspection/repair model permits repair centres to perform the inspections, repair the defective vehicle and conduct a retest. Two distinct disadvantages of the inspection/repair model are:

- The potential for fraud
- Conflict of interest for the centre owner/operator

For emissions inspections especially, there is a greater potential for fraud in that failing vehicles can be “clean piped” by unscrupulous inspectors. The other extreme is to induce faults in vehicles so that they fail the inspection and then perform the repairs and retest. The potential also exists for “clean inspecting” defective vehicles by unscrupulous inspectors.

1.2.3 Repair Only Centres

Centres in this category are dedicated to performing repairs on vehicles that have failed the test. One of the primary reasons facilities choose to be repair- only centres is the fact there is very limited additional expenditures as the majority of the tools and equipment are on site as part of the business.

1.2.4 Hybrid Model

The hybrid model is a combination of centralized inspection-only centres and decentralized inspection and repair facilities. This model provides the most flexibility in terms of having adequate inspection centres to accommodate the number of inspections, population growth and any geographic isolation with a region. The oversight of a hybrid model poses some interesting challenges in that covert and overt audits will need to be performed to ensure compliance.

2. Oversight agency

An oversight agency needs:

- To have the expertise to design an inspection and maintenance program that accommodates all vehicles within the fleet and reflects the various technologies incorporated in inspection and maintenance equipment, vehicle design and maintenance procedures;
- To conduct outreach seminars to educate the public of the needs for inspection and maintenance programs;
- To liaise with the automotive repair sector to ensure adequate technicians with the required skills are available to repair the vehicles;
- To conduct objective evaluations of program effectiveness.

The oversight agency achieves its goal by:

- Prescribing the calibration requirements including the tolerances for normal variations;
- Conducting periodic and regular audits of inspection and repair centre equipment;
- Ensuring inspection repeatability including tolerances for normal variations;
- Providing referee actions for grey market vehicles;
- Analyzing inspection data for program effectiveness; and
- Conducting overt and covert audits.

3. Inspection versus Maintenance

The purpose of a motor vehicle inspection program is to identify vehicles that are not in compliance with the in-use standards. It may be argued that it is overkill to test ALL vehicles to identify approximately 12 to 15 percent of the total fleet that is not in compliance. Quantifiable benefits can only be attributed to effective repairs performed on the failed vehicles and the vehicles pass a subsequent reinspection.

The inspection process should be automated as much as possible, while at the same time, restricting the possibility of human error to a minimum. Objective criteria used for pass/fail determination should be embedded in the software to eliminate the possibility of the inspectors being able to influence the final results of the inspection. Security of all the inspection data is paramount and methods must be developed to ensure only key oversight agency staff has access to the data for analysis purposes.

Key components or systems within an inspection should be identified as “mission critical” and therefore do not have any means of subjectively influencing the results.

3.1 Maintenance

Effective maintenance practices require the correct combination of skilled personnel, training programs, the availability of the right tools, correct parts and equipment and the desire of the vehicle owner to adhere to regular maintenance schedules.

It is important that all vehicles repaired for the identified defects or deficiencies are required to undergo a reinspection. Analysis of the reinspection results can determine the effectiveness of the maintenance or repair aspects of the program.

Components or systems dealing directly with occupant protection and safety must be maintained according to manufacturer specification. In addition, no welding whatsoever is permitted on steering systems and components or brake systems. For commercial vehicles, welding is prohibited on any frame rail flanges or webs.

4. Inspection Frequencies

The requirement for inspection should be inextricably associated with some other regulatory requirement such as insurance or licence renewal. The inspection frequencies for the different types of vehicles should reflect the use of the vehicles and the estimated distance travelled during a calendar year. The following are suggestions for inspection frequencies and exemptions for the overall vehicle fleet:

Exemptions: Apply to all vehicles up to 2 years old and military-use vehicles. This does not apply to high usage vehicles; state owned vehicles, commercial vehicles or heavy-duty trucks.

Semi-annual Inspections: All taxis, light duty commercial vehicles and heavy-duty trucks should be subjected to this inspection cycle. The rationale here is that these vehicles travel considerable distances over the period of a year when compared to private vehicles

Annual Inspections: All passenger cars, multipurpose passenger vehicles and light duty trucks and motor cycles are subject to annual inspections.

Mandatory Inspections: These inspections apply to all vehicles that undergo a change of ownership. This inspection requirement will identify vehicles that are not in compliance with the inspection process and therefore have some safety or emissions-related defects which may be passed on to prospective owners.

5. Acceptance Test Procedures

An Acceptance Test Procedure (ATP) is a document that outlines the minimum acceptable performance and audit requirements for a process before formal acceptance by the oversight agency. The contractor must demonstrate the functionality of the system and associated applications to the satisfaction of the oversight agency.

Deficiencies found during the ATP are identified and appropriate remedial actions taken before the contractor conducts another demonstration. The ATP is an important milestone and a successful ATP means the commissioning of the equipment and all systems have been completed and the next stage in the process is being ready for the general public.

A successful ATP provides the oversight agency an added level of confidence in test repeatability and that proper procedures have been followed to ensure equipment have been calibrated to a known standard. The equipment durability has also been demonstrated during the ATP.

Regular equipment audits conducted at repair facilities by the oversight agency provide consumers with some confidence that the equipment at the repair facilities have met some objective criteria for fitness of use. The oversight agency can also conduct more stringent audits using specialized tools, equipment or gases.

6. Roadside Inspections

Roadside inspections are used to provide a snapshot of the condition of the vehicle fleet and driver behaviour. The condition of the vehicle fleet is established by randomly selecting motor vehicles to check for:

- Compliance with motor vehicle safety and emissions standards
- Valid registration and insurance documentation
- Valid driver licence
- Compliance with seat belt regulations
- Driving under the influence of alcohol and other prohibited substances
- General vehicle roadworthiness
- Vehicle loading and securement of loads

Inter-provincial reciprocity agreements will allow for the co-ordination of roadside inspections within the country.

7. Vehicle Inspection Models

All three models identified earlier are used by jurisdictions for the inspection of motor vehicles. The majority of jurisdictions enforce compliance with inspection requirements through the denial of insurance or registration on renewal.

In New Zealand, Australia and the UK, motor vehicles that pass a safety inspection have a “Certificate of Fitness” decal affixed to the windshield of the vehicles.

In North America, jurisdictions that have air quality problems are mandated to have some sort of emissions programs. “Non attainment” areas are required to implement enhanced emissions programs to qualify for federal highway funding. Two notable exceptions are Ontario and British Columbia, Canada. Both Canadian provinces have implemented emissions inspection and maintenance (I/M) programs because of regional concerns for air quality. There is not association between implementation of I/M programs and federal funding of any sort in Canada.

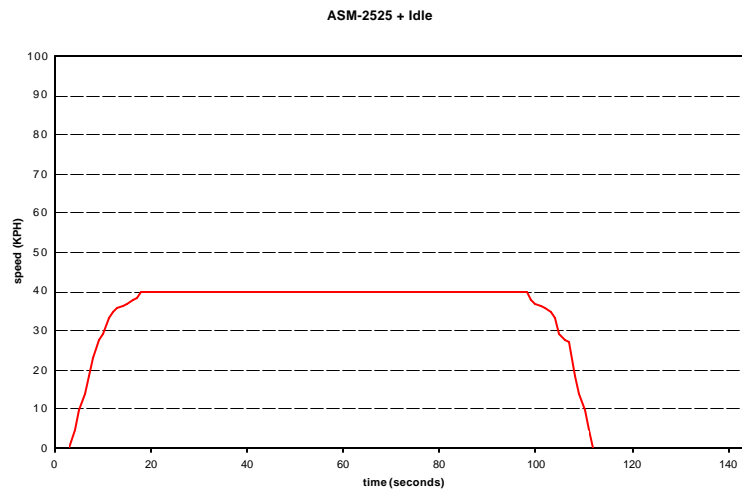
In British Columbia, it is a requirement to pass the emissions inspection as a condition of insurance renewal. Enforcement is through the denial of insurance. Electronic data transfer between inspection centres and the insurance corporation eliminates the visual requirement for decals. Safety inspections are mandatory for commercial vehicles such as taxis and heavy trucks. Compliance is through the placement of decal on the windshield. Enforcement is done via roadside inspections. Fleet operators can self-certify their vehicles under the stewardship of a Preventive Maintenance Program. British Columbia requires all used vehicles that are being registered for the first time to undergo a safety inspection. Structural defects found during the safety inspection may result in the vehicle being subjected to a structural integrity inspection.

8. Emissions Inspection Types

The following describes the various short tests that are currently in use throughout North America:

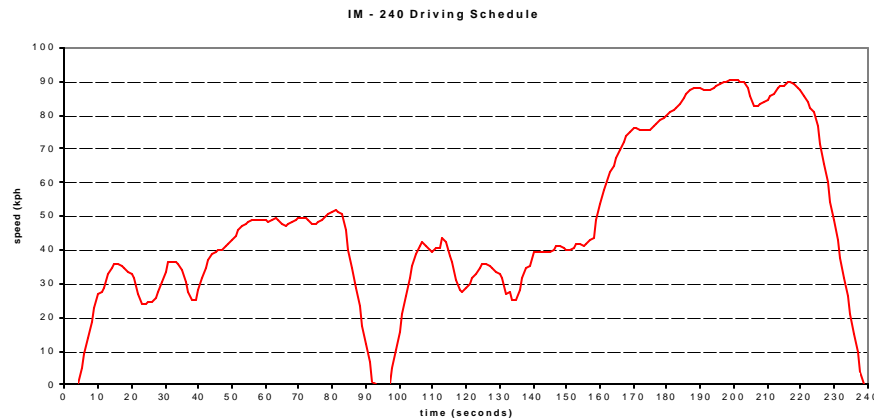
Acceleration Simulation Mode (ASM) 5015: test conducted on a dynamometer at a speed of 15 miles (24 km) per hour with a simulated load of 50% of the power required to accelerate the vehicle at 3.3 mph per second from an initial speed of 15 mph. The test is designed to simulate vehicle emissions during acceleration, but with power requirements much less than that required for the Federal Test Procedure (FTP) and real world driving demands.

Acceleration Simulation Mode (ASM) 2525: test conducted on a dynamometer at a speed of 25 miles (40 km) per hour with a simulated load of 25% of the power required to accelerate the vehicle at 3.3 mph per second from an initial speed of 25 mph. The test is designed to simulate vehicle emissions during acceleration, but with power requirements much less than that required for the Federal Test Procedure (FTP) and real world driving demands.

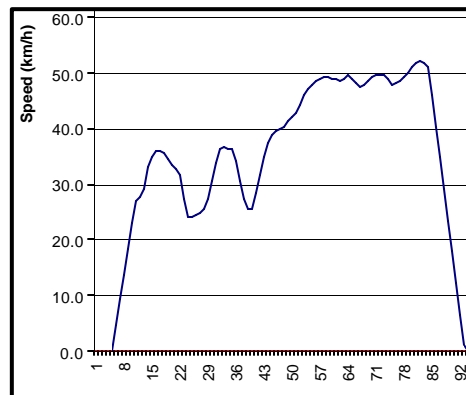


Acceleration Simulation Mode (ASM) 2545: test conducted on a dynamometer at a speed of 45 miles (72 km) per hour with a simulated load of 25% of the power required to accelerate the vehicle at 3.3 mph per second at 45 mph. The test is designed to simulate vehicle emissions during acceleration, but with power requirements much less than that required for the Federal Test Procedure (FTP) and real world driving demands.

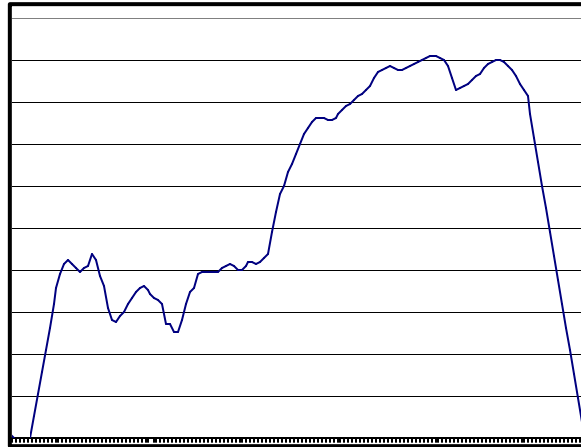
IM 240: A variable speed (transient) test developed by the EPA with strict protocols, procedures and equipment requirements to provide high correlation to the FTP and real world driving emissions.



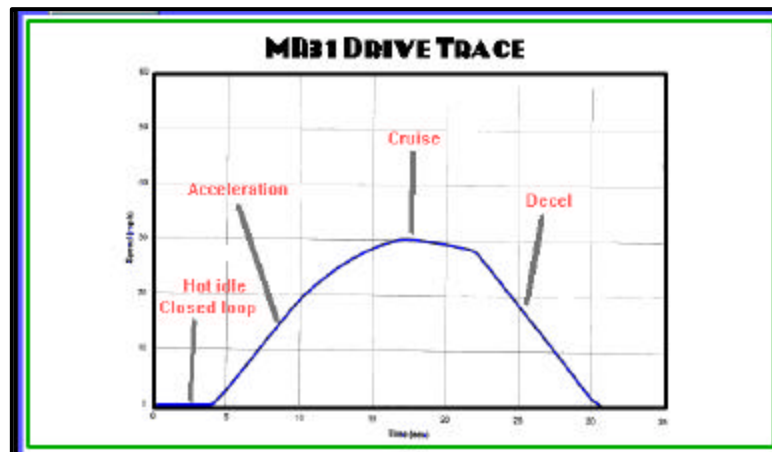
IM 93: A variant of the IM 240. This test was developed and implemented specifically for the Indiana program. This test replicates the first 93 seconds of the IM 240 test.



IM 147: This is another variant of the IM 240 and replicates the IM 240 from the 94th second to the end of the test cycle.



BAR 31: This test was developed by the Bureau of Automotive Repair (BAR) and is 31 seconds long. The test consists of an acceleration and deceleration phase accounting for the 31 seconds duration.



AZ 90: This test was developed and implemented for the Arizona program. It consists of acceleration and deceleration for a period of 90 seconds.

In July 1997, California replaced its two-speed idle procedure with the two-mode ASM 2525 + 5015 procedure as part of the Smog Check 2 program enhancement.

Different in-use vehicle emissions test procedures have different units of measurements and may or may not correlate directly to the FTP. Vehicle emissions are measured in raw concentrations or mass emissions depending on whether partial stream or dilute stream sampling technique utilized during the test cycle.

Partial stream sampling means that a sample probe is inserted into the exhaust stream to collect and analyze the exhaust emissions from the vehicle. The results obtained from a partial stream sample are normally expressed in raw or weighted concentrations such as parts per million (ppm) or percent (%). These concentration measurements, although accurate, are dimensionless and therefore have no direct correlation to the FTP.

Dilute stream sampling is the basic principle behind constant volume sampling. This means fluctuation in the exhaust stream at transient loads is compensated by the introduction of a constant volume of ambient air to stabilize the volume of the sample. The dilution also reduces the impact of water vapour on the analysis system as raw exhaust contains approximately 12% water vapour.

The following table identifies the differences between concentration and mass emissions:

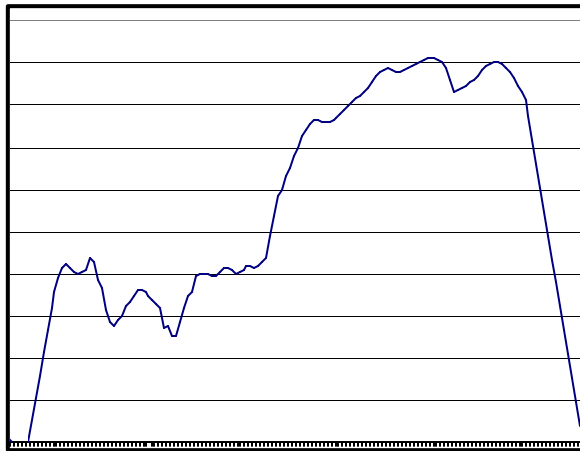
CONCENTRATION EMISSIONS	<i>MASS EMISSIONS</i>
Units of measure are parts per million or percentage (ppm or %); i.e., CO = 10,000 ppm or 1%	Units of measure are grams per mile (gpm or g/m) or grams per kilometre (g/km). It can also be measured in grams per second
Raw exhaust sample	Diluted exhaust sample
Actual analyzer reading	Calculated in conjunction with other variable
Provides <i>no</i> information on distance travelled or amount of time required to travel the distance	Measures distance and time of a driving cycle
Measures no information on total volume of exhaust	Controls volume by using a constant volume device.
Exhaust measurements may or may not be taken from vehicle under a load but loaded tests are usually at a fixed speed and load condition.	Total exhaust is sampled while engine is placed under inertia weight loads equivalent to the weight of the vehicle and the vehicle is driven through a variety of modes (accel, decel, etc.)

Diesel Fuelled Vehicle Testing

Although most jurisdictions have implemented IM programs for light duty gasoline vehicles, not all the jurisdictions have an IM program for diesel fuelled vehicles. The AirCare program has two distinct procedures for testing diesel-fuelled vehicles:

- Light duty diesel vehicles are subjected to a transient test representing the second phase of the IM 240 test and is dubbed the IM 147; and
- Heavy-duty vehicles are subject to testing using the Society of Automotive Engineers (SAE) procedure J 1667.

IM 147: test conducted on a dynamometer, for light duty vehicles, at various speeds up to 92 km/hr and a varying loads depending on the vehicle inertia weight. The test is 147 seconds in duration with average peak opacity measured in half second increments over a 10 second period.



SAE J1667: test conducted for heavy duty vehicles using snap-acceleration to check vehicle's exhaust for opacity. The abbreviated test procedure is listed below:

- Governor/mechanical condition check
- At least three, but no more than 6, snap-acceleration clean outs prior to the actual tests
- Three snap-acceleration snaps for opacity. Measurement is the average of the three snaps after applying half second averaging, correction for horsepower and ambient weather conditions

A “snap” refers to the rapid application of maximum rack (flooring the accelerator pedal), allowing the engine to free-rev to the governed rpm, holding for about 3 seconds and then allowing the engine to return to idle.

Engines that have been tampered or that have defects in the fuel or air intake systems will emit an initial puff of dark smoke when snapped. The peak opacity reading a snap event, averaged over 0.5 second, is taken as the official reading.

9. Effectiveness of I/M

One of the major challenges facing jurisdictions in North America with IM programs is to quantify benefits attributable to IM programs. Jurisdictions such as BC which utilize the ASM test procedures would be hard pressed to quantify emissions reductions without the use of a Mass Emissions Transient Test (METT) facility to quantify the benefits.

The AirCare Program uses the CVS facility within the Research Centre to perform before and after repair testing on vehicles that fail the AirCare inspection as a means of quantifying the emissions reductions attributed to the AirCare Program. The before and after testing program is available to vehicle owners whose vehicles have failed the AirCare inspection. Contractor staff solicits test vehicles and vehicle owners who participate in the program are offered an incentive equivalent to \$34.00, a voucher for \$10.00 worth of gasoline and an inspection coupon.