Towards Clean Air in Asian Cities
The Importance of I/M

Jakarta, Indonesia
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The Global Health Impact of Urban Air Pollution

*Annual Premature Deaths*

Total: 799,000

Source: WHO

The World Health Report 2002

Elements of a Comprehensive Vehicle Pollution Control Strategy

- Clean Vehicle Technology
- Appropriate Maintenance
- Transportation & Land Use Planning
- Clean Fuels

Vehicle Inspection and Maintenance (I/M) Program

- Purposes:
  - To assure that vehicle is properly maintained and used
  - Identify Dirtiest Vehicles & get them repaired
  - Identify Unsafe Vehicles & get them repaired

- General attributes:
  - Relatively short
  - Relatively simple

- Test types:
  - Idle
  - 2-Stage idle
  - Steady speed loaded
  - Transient loaded

- Variety of safety tests (not included in this presentation)
Pollutants to Consider

- "Local" pollutants
  - Particulates (diesel, gasoline)
  - Carbon monoxide (gasoline, CNG)
  - Hydrocarbons (diesel, gasoline)
  - Smoke (diesel)
  - Oxides of nitrogen (diesel, CNG)
- "Global" pollutants
  - Carbon dioxide (all)

Emission Reductions

- Technical Status of Vehicle
  - New vehicle standards
  - Maintenance
- Fuel Quality (adulteration)
- Administrative Set Up For I/M
- Type of Test Method
  - Accuracy, Quality
- Cut Points (pass/fail criteria)

Potential Emissions Reductions

<table>
<thead>
<tr>
<th>Idle Test</th>
<th>Conventional Gasoline</th>
<th>CO = 15 %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TWC Gasoline</td>
<td>All emissions ≈ 5-15 %</td>
</tr>
<tr>
<td>Potential reduction if loaded mode tests are used in I/M</td>
<td>CO ≈ 35 %</td>
<td></td>
</tr>
<tr>
<td>(Diesel)</td>
<td>HC ≈ 25 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOx ≈ 5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Part. ≈ 25 %</td>
<td></td>
</tr>
</tbody>
</table>

Islamic Republic of Iran

Heavy Duty Diesel Fueled Vehicle (Minibuses, buses and trucks)

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>35 – 50 %</th>
<th>HC</th>
<th>30 – 60 %</th>
<th>NOx</th>
<th>≈ 20 %</th>
<th>Part.</th>
<th>45 – 55 %</th>
<th>Fc.</th>
<th>15 – 20 %</th>
</tr>
</thead>
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European Commission

MTC, 1997
No – Load Tests (Idle)
- Fastest, cheapest and easiest to perform
- Effectively identify faulty vehicles w/o converter
- Not possible to measure NOx
- Not possible to measure transient emissions
- Detect only 15% of high emitting vehicles with converter

Steady-State Loaded Tests
- Possible to measure NOx
- ASM driving cycles simulates a car during acceleration
- Appropriate to inspect vehicles with converters
- "Type specific" cut points
- Test time app. 10 minutes

Transient Loaded Tests
- Can identify all high polluters (50% above set standards)
- Offer potential emission reductions of 15 – 20% (CO, HC, NOx)
- "Most expensive" test method
- Test time app. 10 minutes

Test Type: Transient Loaded Test (VMAS)
A Typical Inspection Scheme

**EQUIPMENT REQUIRED**
- Side slip Tester
- Noise Tester
- Brake Tester
- Speedometer Tester
- Headlamp Tester
- Tread depth gauge for Tires
- Roller Dyno
- 4 gas analyzer
- PC with software

**SAFETY**
- Emergency warning system
- Ear protectors
- Safety glasses
- Anti-skid shoes
- Mufflers

**POLLUTION**
- Smoke and opacity meter
- Exhaust gas analyzer

Auditing of Test Centers

- Individual auditors to be selected based on their technical expertise.
- Auditors must undergo a training and evaluation program on regular basis.
- Certified auditors should be used for conducting unannounced audits to check –
  - equipment status
  - records of measurement and calibration
  - presence of qualified and trained operators
  - proper test procedure being followed
- Audit plan must be worked out to regularly audit all test centers
Data Collection & Analysis

- Collected automatically and sent to Data Management Center using the internet
  - Emission performance of in use vehicles organized by vehicle type, model, age etc.
  - Identifying the performance of the center (center showing ‘all passes’, center giving excessively large number of certificates, etc.)
  - Keeping track of vehicles which have undergone the test & identifying the vehicles due for the test
  - Useful for defining future norms & procedures

Remote Sensing

- Definition
  - Measure emissions while vehicle drives on road

- Features
  - Measures HC, CO, NOx, “Particles”
  - May measure speed or acceleration, etc.
  - Uses lasers or NDIR
  - Tests many cars per hour
  - Set up on roadways
  - Takes picture of license plate

- Advantages
  - Very cheap tests
  - Complements I/M
  - Prevent readjustment
  - Screen un inspected vehicles

- Challenges
  - Comprehensiveness
  - Selecting appropriate locations
  - Single lanes
  - Slight acceleration

Applications

- Auditing
  - Over 1 million vehicles tested worldwide
  - Very good for seeing trends
- Clean Screening
  - Useful complement to high quality comprehensive I/M program
  - Colorado’s RapidScreen
- Dirty Screening
  - Useful in areas with limited or weak I/M programs
  - California/Swedish studies show very good results
  - Requires good registration data
  - Good also for central fleets

Lay out of test site for Remote Sensing
Elements of A Successful I/M Program

- Centralized Testing
- Strong Enforcement
- Privatized
- Government Oversight & Auditing
- Inspector Training
- Public Awareness
- Appropriate Test Procedures
- Appropriate Standards & Norms

Good Quality I/M