

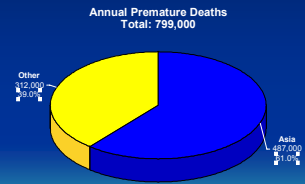
## Towards Clean Air in Asian Cities The Importance of I/M

**Jakarta, Indonesia**  
July 22, 2004



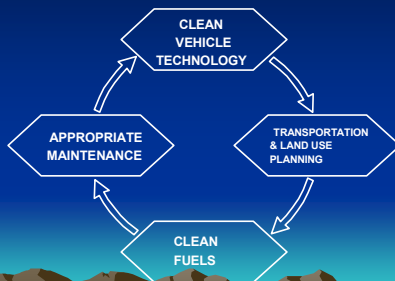
Michael P. Walsh

## The Global Health Impact of Urban Air Pollution



Source: WHO  
The World Health Report 2002

### ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY



## 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

### Idle Test

Conventional Gasoline CO  $\approx$  15 %  
TWC Gasoline All emissions  $\approx$  5-15 %

Potential reduction CO  $\approx$  35 %  
if loaded mode tests HC  $\approx$  25 %  
are used in I/M NO<sub>x</sub>  $\approx$  5 %  
(Diesel) Part.  $\approx$  25 %

European Commission

## Potential Emissions Reductions

### Islamic Republic of Iran

### Heavy Duty Diesel Fueled Vehicle

(Minibuses, buses and trucks)

CO 35 – 50 %  
HC 30 – 60 %  
NO<sub>x</sub>  $\approx$  20 %  
Part. 45 – 55 %  
Fc. 15 – 20 %

MTC, 1997

## No – Load Tests (Idle)

- Fastest, cheapest and easiest to perform
- Effectively identify faulty vehicles w/o converter
- Not possible to measure  $\text{NO}_x$
- Not possible to measure transient emissions
- Detect only 15 % of high emitting vehicles with converter

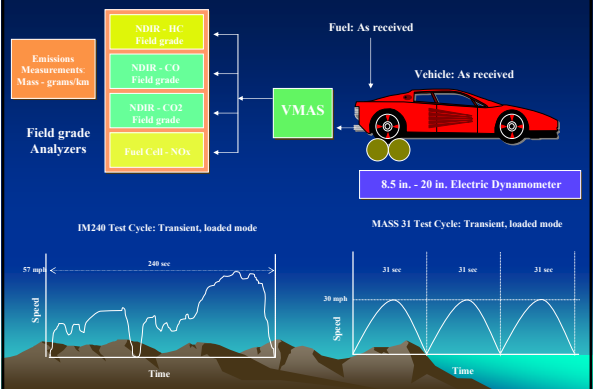
## Steady-State Loaded Tests

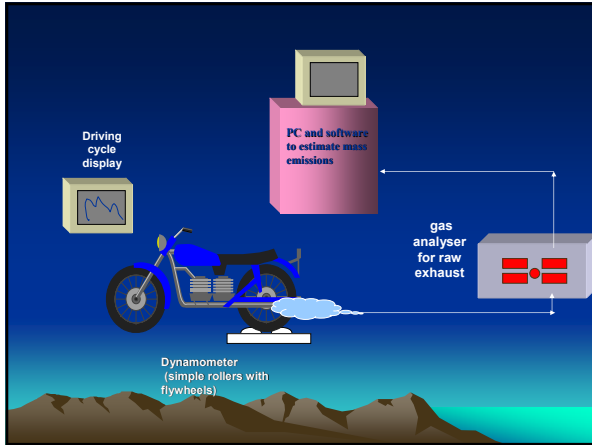
- Possible to measure  $\text{NO}_x$
- ASM driving cycles simulates a car during acceleration
- Appropriate to inspect vehicles with converters
- “Type specific” cut points
- Test time app. 10 minutes

## Transient Loaded Tests

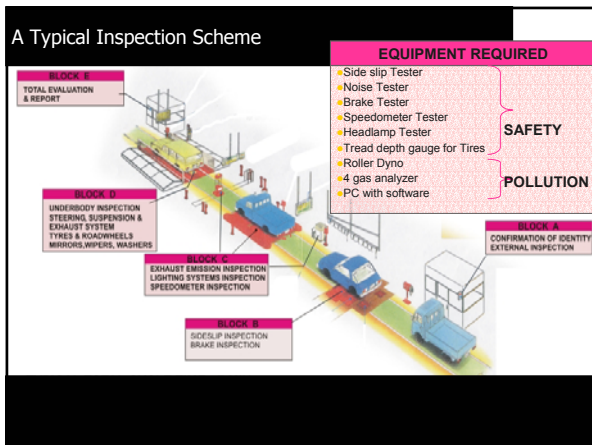
- Can identify all high polluters (50 % above set standards)
- Offer potential emission reductions of 15 – 20 % ( $\text{CO}$ ,  $\text{HC}$ ,  $\text{NO}_x$ )
- “Most expensive” test method
- Test time app. 10 minutes

## Test Type: Transient Loaded Test (VMAS)





## Lessons From Hong Kong; Diesel Tests Under Load



## 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

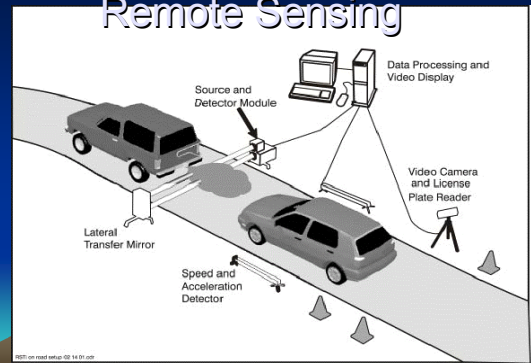
## Remote Sensing

- 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 uninspected 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

