



Instrumented In-Use-Vehicles, a Versatile Tool to Measure Emissions

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Agra, India Dec 2004

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THE TASK

The need and desire of cities to have a correct picture of its main transportation polluters

Three major factors influence quality:

1. Emission

Technology mix of
Age distribution of
Maintenance
Quality of fuel

Factors

vehicles
vehicles

• Driving- Activity and Behavior

• Traffic

Population of

Congestion

Vehicles

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THE SOLUTION

1. By sampling the emission of well selected vehicles during their daily cruise
2. By calculating the daily/ annual total emission of each vehicle class, using statistical methods

Creating the Emission Inventory

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THE PURPOSE

- To predict emission reductions by changing fuel quality, fuel type, applying retrofit devices or upgrading vehicle- and engine technology
- To verify predicted improvements by repeated and selected sampling after longer time intervals

Key to Policy


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THE ALTERNATIVES 

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- Using emission factors and inventories obtained by other cities or existing data bases
- Build, maintain and operate Vehicle Emission Test Laboratories
Such Labs are beyond the reach of many who need data on local emission and activity. Buses and trucks rarely covered!
- Fix Portable Emission Measuring Systems to the vehicle and obtain emission data while driving- "mobile emission laboratory"

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Calculating Emissions Inventory 

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$$\text{Emissions [g]} = \text{Driven Vehicle} - \text{km} * \text{Emissions factor [g/km]}$$


Vehicle Fleet Average

Vehicle Categories

LD * Gasoline pre EURO * Gasoline EURO 1 * * Diesel EURO 4	HD solo HD pre EURO solo HD EURO 1 Semitrailer Truck EURO 4
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For all relevant Driving Conditions (urban to highway, cold- and warmstarts, different gradients, different loadings,...)

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Steps to More Accurate Inventories 

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Accuracy

+

-


Existing Improved, maybe OK? Sufficient for Action

Methods gaining emission maps based on vehicle-speed and -acceleration

Simulation Models giving emissions factors as function of cycle mean speed

Methods gaining engine maps directly from standard measurement programmes. Including:
- gear shift model
- transient correction
- cold start tool
- road gradients
- vehicle loading

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Calculated Emission Factors (g/km), at 40 km/h 

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Bus (Diesel)

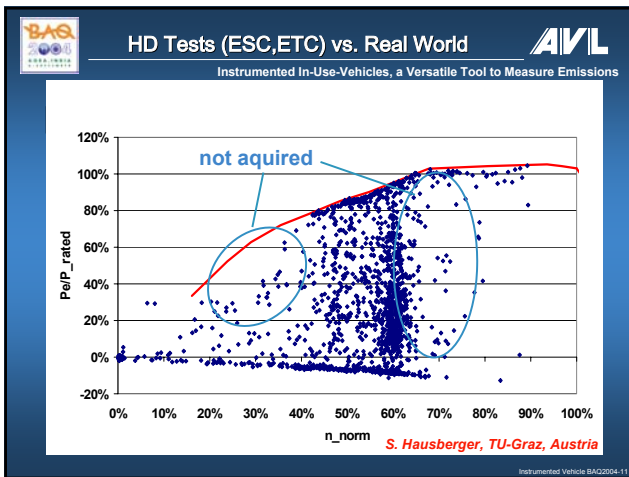
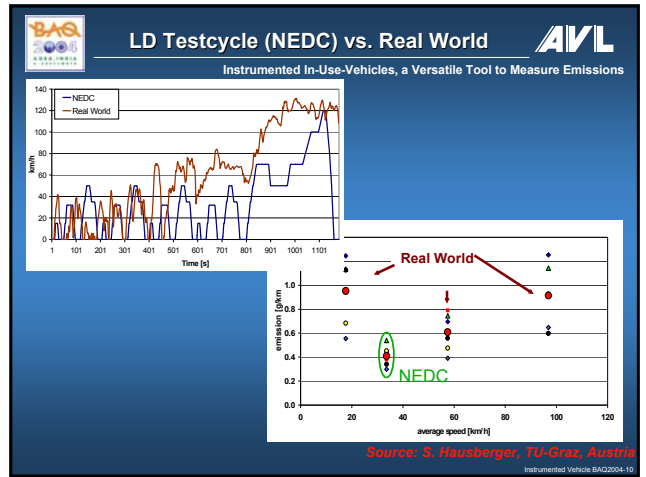
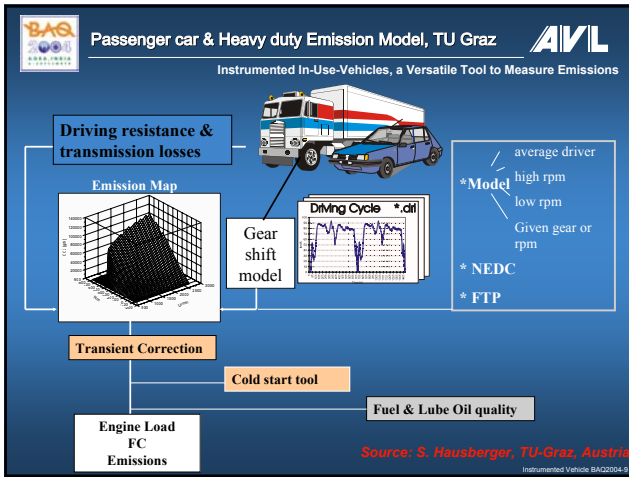
	"Handbook" Copert	MTC
CO	11.7	2.9
HC	3.5	1.6
NO _x	10.7	5.0
Part.	2.3	0.7

Taxi (Diesel)

	"Handbook" Copert	MTC
CO	0.4	1.1
HC	0.08	0.3
NO _x	0.5	1.1
Part.	0.1	0.3

Source: L. Eriandsson, MTC Sweden

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Requirements for Mobile Emissions Testing **AVL**
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US EPA Statement (G. Tierny):

- High quality lab grade instruments
 - FID for THC (NDIR insufficient)
 - NDIR for CO
 - NDUV for NOx (as good as chemi)
 - Microbalance for PM (coming soon)
- Full activity/environmental data collection
 - GPS, cellular modem, grade sensors, temperature, pressure, humidity, etc.
- Designed for both electronics-equipped and pre-electronics technology

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New Approach to test Real World Emissions
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- Compact solution for emission analyses of all kinds of vehicles during real world driving conditions
- Simultaneously acquisition of NO, NO₂, CO, CO₂, THC and of the exhaust gas flow
- Online data acquisition of engine relevant parameters and of GPS data for calculating emissions of road trials (e.g. in g/km)

Cooperation Sensors, Inc. & AVL

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LD Vehicle, On Board Emission Testing
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Challenge Bibendum 2004, Shanghai

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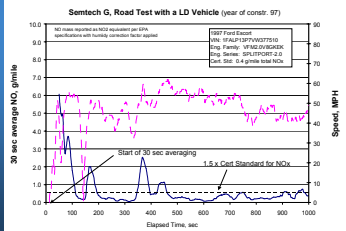
BAQ **AVL**
Bus Application, Real World Emissions
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Sentech G. Road Test with a LD Vehicle (year of constr: 97)

No data reported in this measurement cell (0%)
 Specifications with factory calibration factor applied

1997 Ford Escort
HW: 19427 (VIN: 9FVYD77510)
Eng. Series: 19427 (04/03/03)
Eng. Series: 04110 (04/03/03)
Eng. Ser.: 04110 (04/03/03)



1.5 x Test Standard for NOx

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BAQ 2004, Dec, 2004, Agra- India

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In-Use Vehicle Emissions Testing, Conclusions **AVL**

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1. True picture of real world vehicle pollution
2. Filling the gap lost by certification testing
3. Efficient way of validating emissions inventories
4. Possibility to measure emissions of vehicles, it does not fit into a chassis dyno