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Kansas City Gasoline PM Project

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Sponsors

- U.S. EPA
- Emission Inventory Improvement Program
- Coordinating Research Council
- Department of Energy/NREL
- Department of Transportation

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Prime Contractor

- ERG Eastern Research Group

Subcontractors

- Nustats
- BKI Bevilacqua Knight, Inc.
- DRI Desert Research, Inc.
- ESP Environmental Systems Products
- Sensors, Inc.

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Major Objectives

- **Identify the distribution of PM emitters**
  - First random sample for gasoline PM
- **Determine fraction of PM high emitters**
  - Establish definition of high emitter
- **Expand data on PM emission rates**
  - Improve our basis for modeling PM
- **Others**
  - Update PM and toxic speciation profiles
  - Evaluate performance of PEMS
  - Real world data on emissions, activity and fuel economy

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Why Kansas City?

- Centrally located
- Non-I/M area
- Large metropolitan area
- Previous work using RSD
- Good jazz

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Four Phase Test Plan

- **Pilot phase** — **May 2004**
  - Install equipment
  - Work out bugs
  - Cross lab correlation
- **Phase One** — **Jul – Oct 2004**
  - Summer testing
- **Phase Two** — **Nov 2004**
  - PEMS only testing
- **Phase Three** — **Jan – Mar 2005**
  - Winter testing

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Sampling Plan

- **Stratified random sample**
  - Random digit dialing
- **Phase 1 and 3**
  - 240 vehicles each
  - 8 strata
  - Based on analysis of existing data
- **Phase 2**
  - 100 vehicles
  - 2001+ vehicles

	Class	MYR	Sample
1	Truck	Pre 81	30
2	Truck	1981-1990	50
3	Truck	1991-1995	50
4	Truck	1996+	75
5	Car	Pre 81	30
6	Car	1981-1990	100
7	Car	1991-1995	65
8	Car	1996+	80
		Total	480

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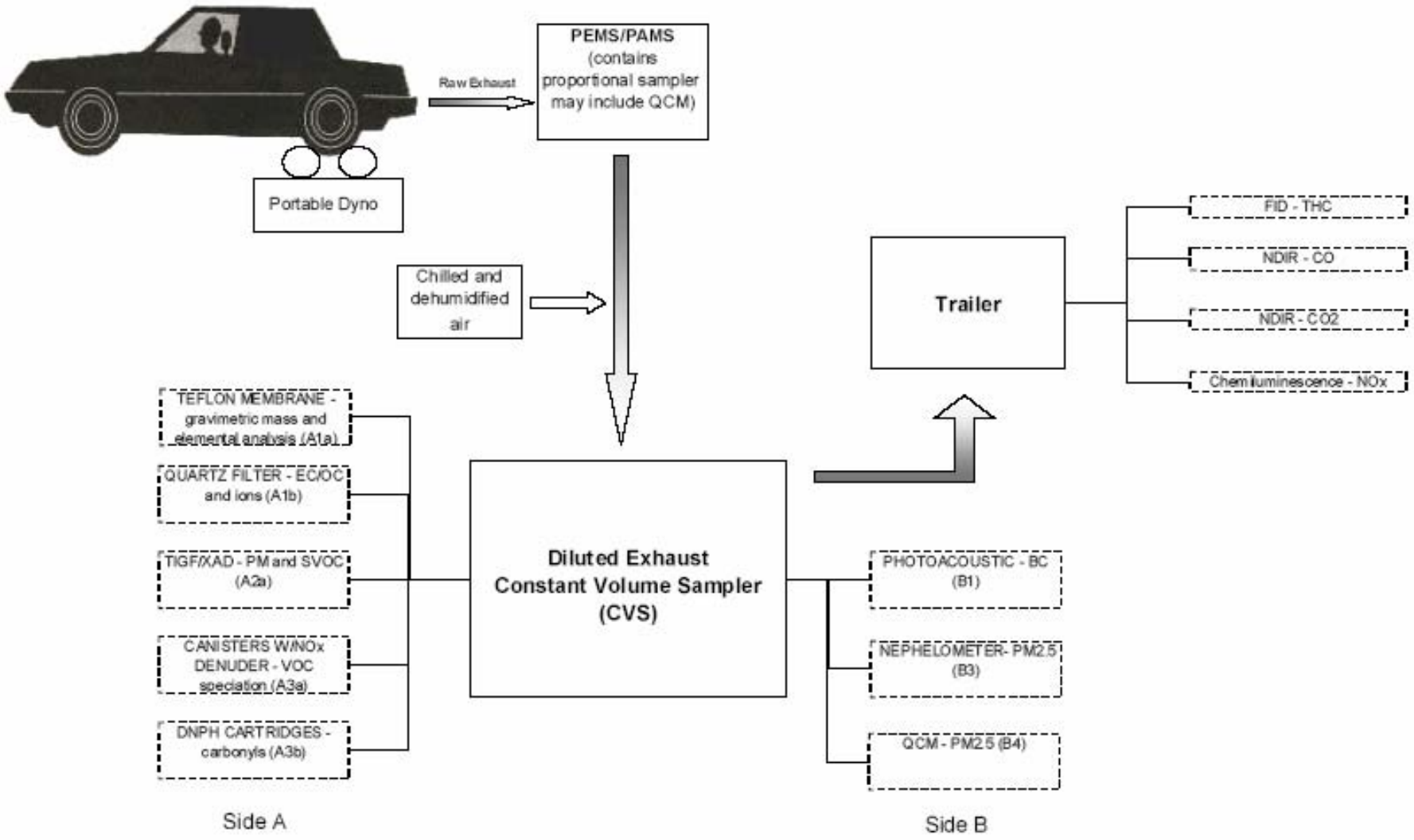
Equipment

- **EPA Portable CVS Laboratory**
  - Clayton Twin Roll Chassis Dynamometer
- **PM Measurement**
  - Teflon membrane filters (PM) @ 47 C
  - QCM (Quartz Crystal Microbalance)
  - Nephelometer, Photoacoustic Instrument
- **Other filters/cartridges**
  - Teflon membrane (elemental analysis)
  - DNPH cartridges (carbonyls, aldehydes)
  - Quartz filters (EC/OC and ions)
  - TIGF/XAD (PM and SVOC)
  - Canisters with NO_2 denuder (VOC speciation)
- **PEMS - Semtech G**

Figure 2-6. Kansas City Exhaust Measurement Flowchart



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Test Procedures

- **LA92 – the Unified Driving Cycle**
  - More aggressive than the FTP
  - Most rigorous cycle for that dyno
- **Preconditioning on the road with PEMS**
  - “Clean” out the exhaust system
  - Capture cars that couldn’t be dyno tested
  - Get PEMS data to compare with dyno
- **Real world driving by owners with PEMS**
  - Limited subset
- **Remote sensing**

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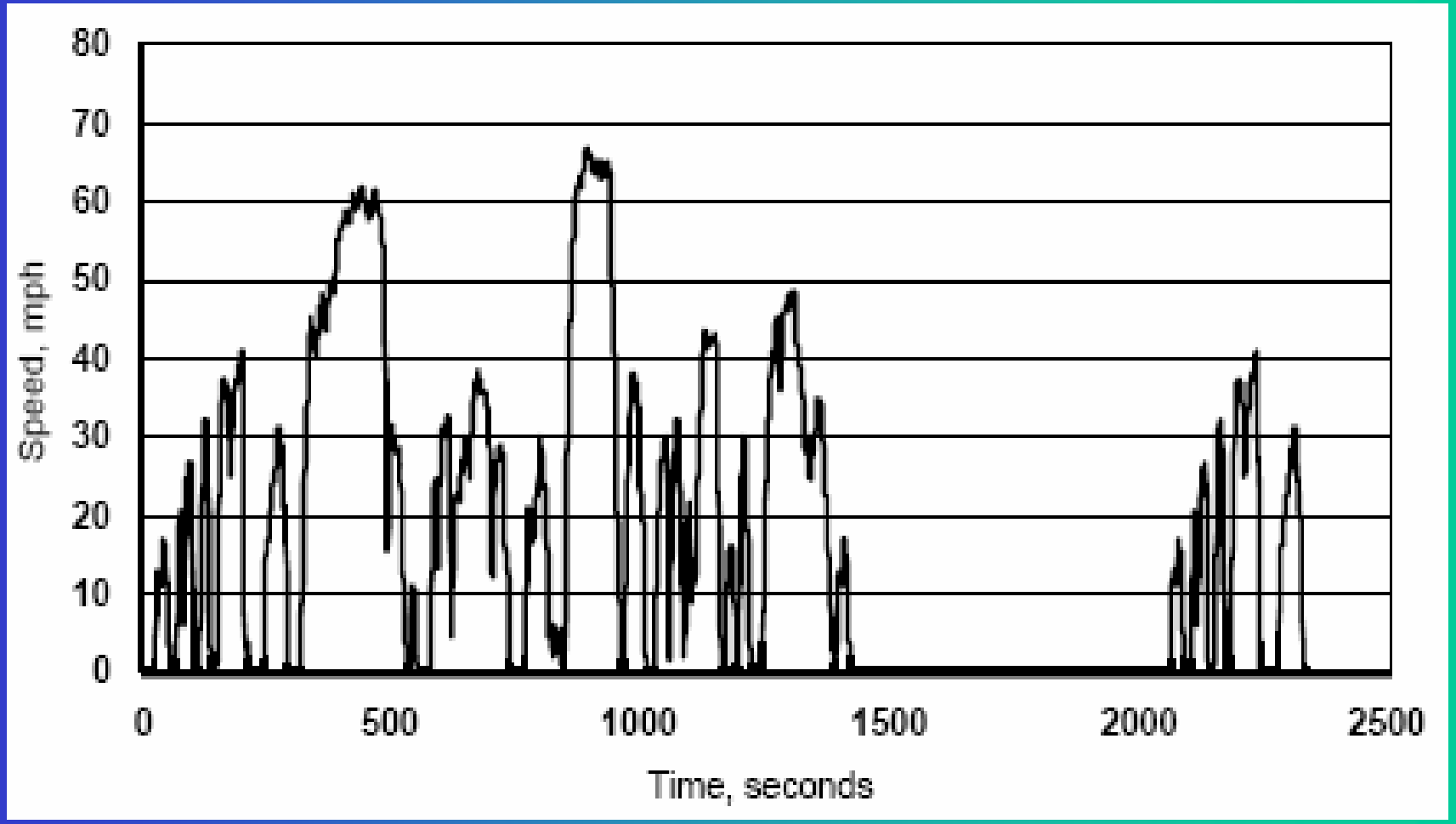
LA-92 Unified Driving Cycle



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Measurements

- **Composite PM gravimetric mass**
  - Separate measurements of 3 phases
- **Continuous PM**
- **Continuous and bag HC, NOx, CO, CO2**
- **Elements, EC/OC, black carbon, ions, particulate and semi-volatile organic compounds, volatile organic air toxics**
  - Chemistry on 50 vehicles
- **Vehicle Fluids Sampling**
  - Fuel and oil samples from all vehicles
  - Analysis on 200 vehicles scheduled
- **Speciation of composite PM samples**
  - Unregulated and toxic compounds

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Quality Control

- **Pilot Phase**
  - System verification
    - Shipped 3 vehicles from Ann Arbor to test
- **Weekly correlation tests**
- **Replicate emission testing on 25 vehicles**
- **Replicate testing of 25 vehicles between summer and winter phases**
- **PEMS comparison**
- **Remote sensing**
  - 6 weeks
  - 8 locations
  - 20,000 measurements per week

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Schedule

Pilot Phase	**May 2004**
Phase 1 Testing	
Complete Work Plan	May 2004
QAPP	Jun 2004
Vehicle recruitment	Jun 2004
Vehicle Testing	Jul - Oct 2004
Phase 2	**Nov - Dec 2004**
Phase 3	**Jan - Mar 2005**
Draft Final Report	**Jun 2005**
Final Report	**Aug 2005**

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Phase 1 Status as of 9/26

Class	Year	Type	Tested	Goal
1	Pre 81	Truck	2	16
2	81-90	Truck	18	26
3	91-95	Truck	18	26
4	96+	Truck	38	39
5	Pre 81	Car	5	16
6	81-90	Car	47	51
7	91-95	Car	32	34
8	96+	Car	75	42
			235	250

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Kansas City Test Facility

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On the portable dyno

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Instruments

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Quartz Crystal Microbalance

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QCM Close-up

Proportional Sampler

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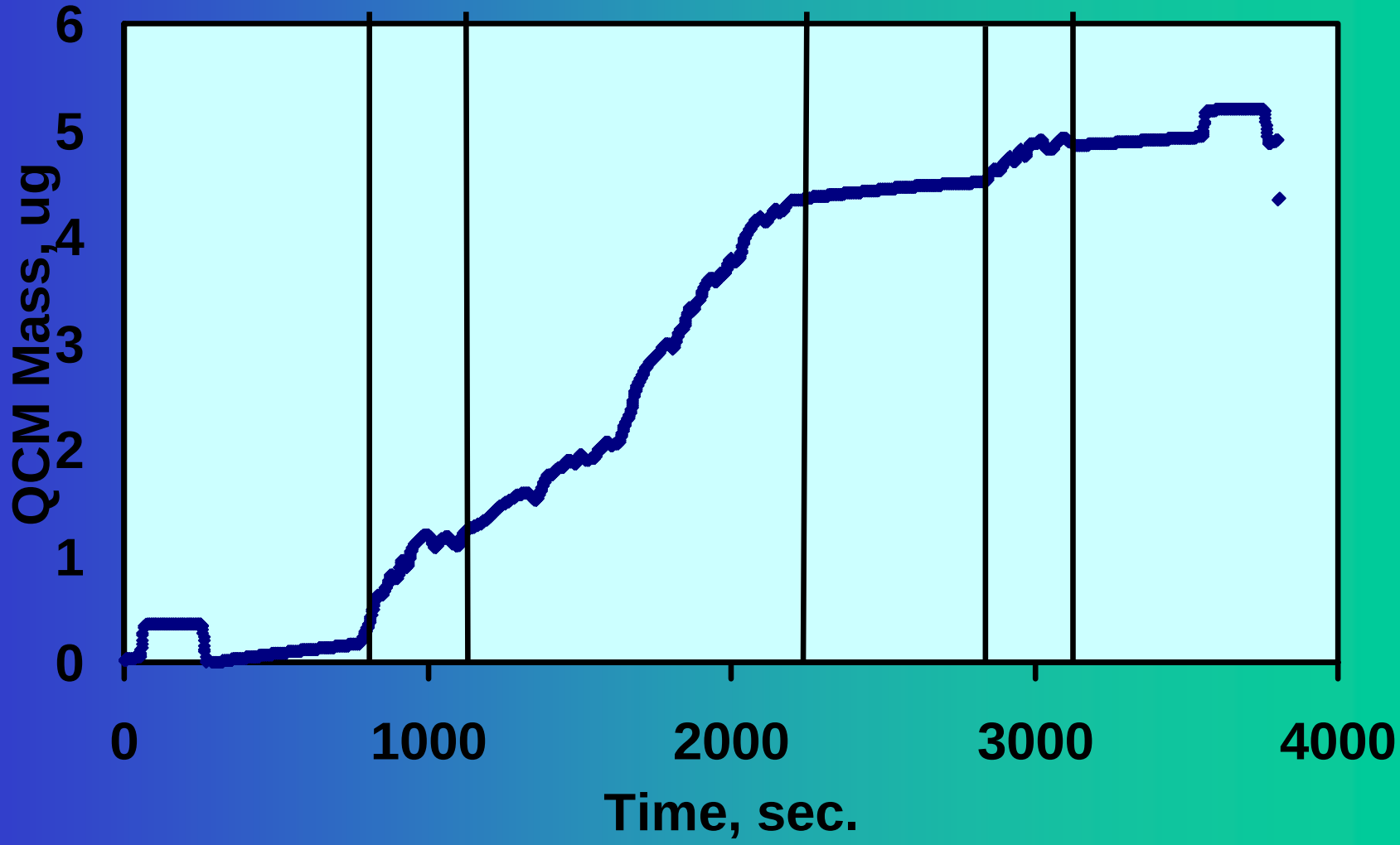
QCM Test 84355



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PEMS Testing

- Pre-Conditioning Vehicles
- Correlation w/ Portable Dynamometer
- Real-World Driving by Vehicle Owner

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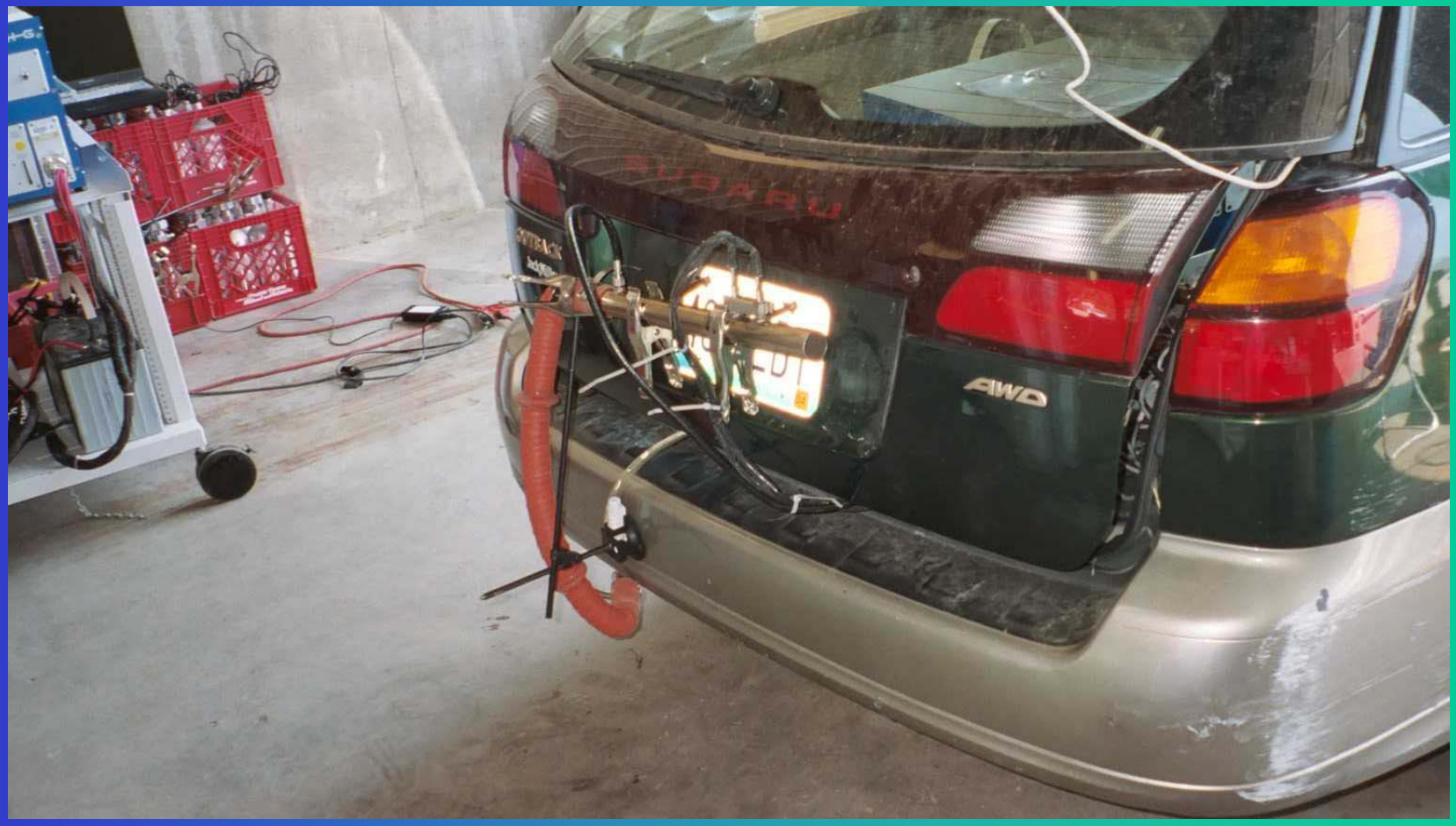
PEMS in a hatchback



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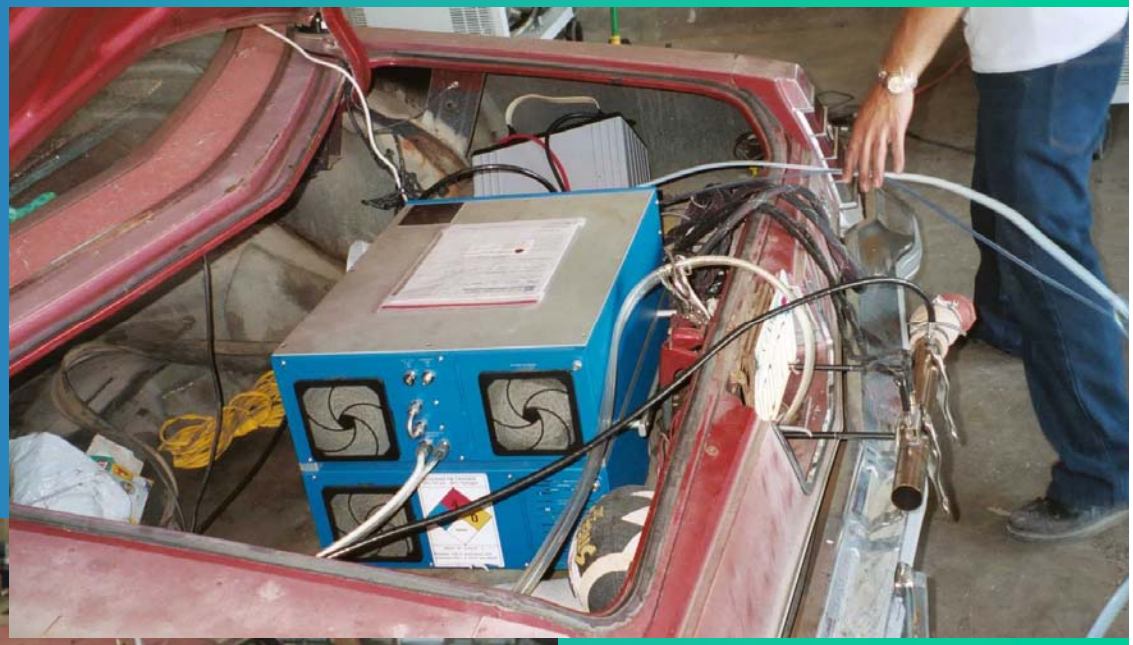
PEMS in the trunk



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PEMS in a Truck