



*On The Road To
Clear Skies™*

On-Road, In-Use Emissions Test Systems

Mobile Source Technical
Review Subcommittee

February 13, 2002



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Why On-Vehicle Testing?

- Despite FTP compliance, air quality goals are not being achieved
- On-road, real-world emissions can be much higher than under FTP test conditions
- Basis for Consent Decree (a major \$1.1B penalty for HDE manufacturers)
- On-vehicle testing is US EPA's stated direction for SET and compliance



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Benefits of On-Vehicle Testing

Validation that:

1. OEMs' OBD II strategies are working to detect excess emissions
2. New vehicle fleets are in compliance
3. Aging vehicle fleets remain in compliance
4. Vehicles will meet NTE limits
5. Defeat devices/strategies are not used



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Benefits of On-Vehicle Testing

6. Calibration of Remote Emission Analyzers
7. Vehicles operating with alternative fuels are in compliance
8. Determine the effectiveness of exhaust after-treatment devices



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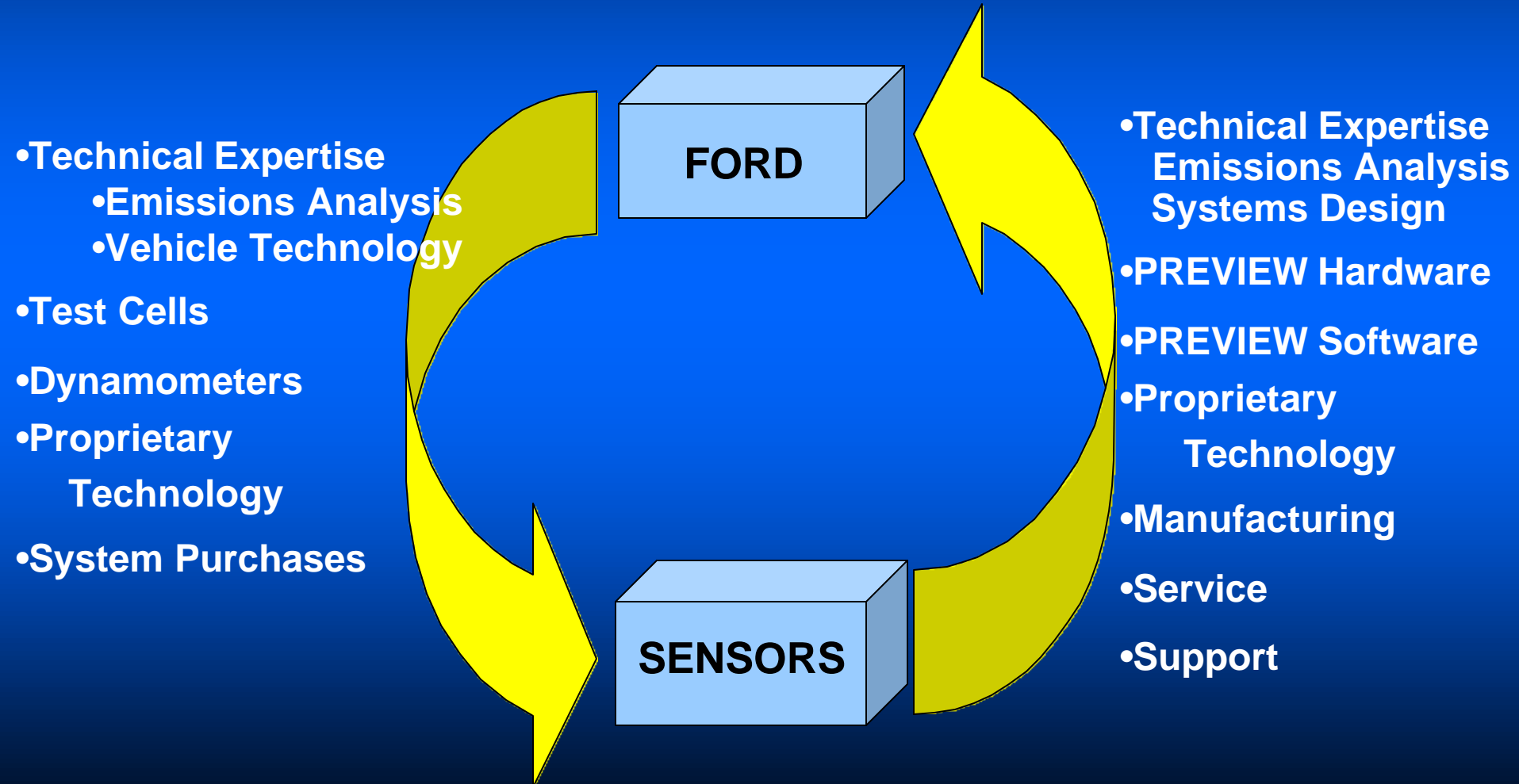
Benefits of On-Vehicle Testing

Assisting with:

9. Testing vehicles beyond dynamometer capabilities
10. Detecting and solving driveability problems
11. Developing ECM function, control strategies and calibration
12. Developing realistic mobile source emission models

FORD – SENSORS

Three Year Partnership





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FORD PREVIEW

- NDIR measurement of HC, CO, CO₂
- UV measurement of NO
- “Wet” exhaust sampling system
- Exhaust flow rates calculated from vehicle interface data



FORD PREVIEW

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SEMTECH-G:

- FID measurement of THC
- NDIR measurements of CO, CO₂
- NDUV measurement of NO
- Exhaust flow rates calculated from vehicle interface data or from an ancillary flowmeter



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SEMTECH-G



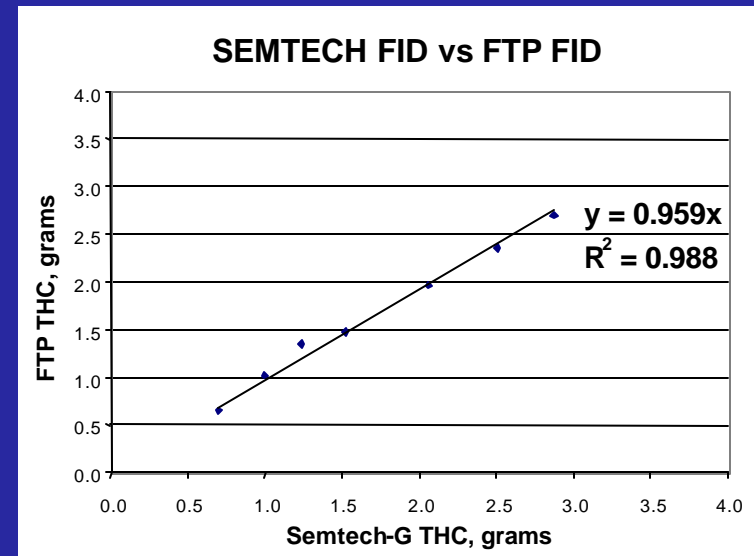
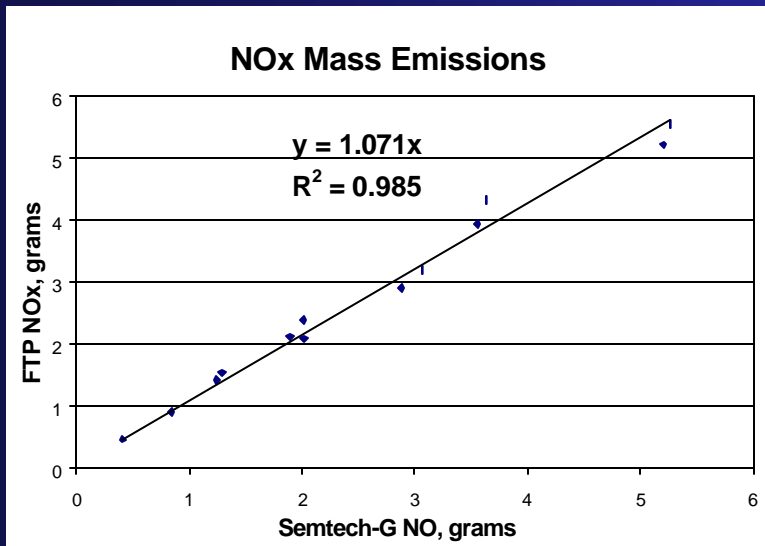
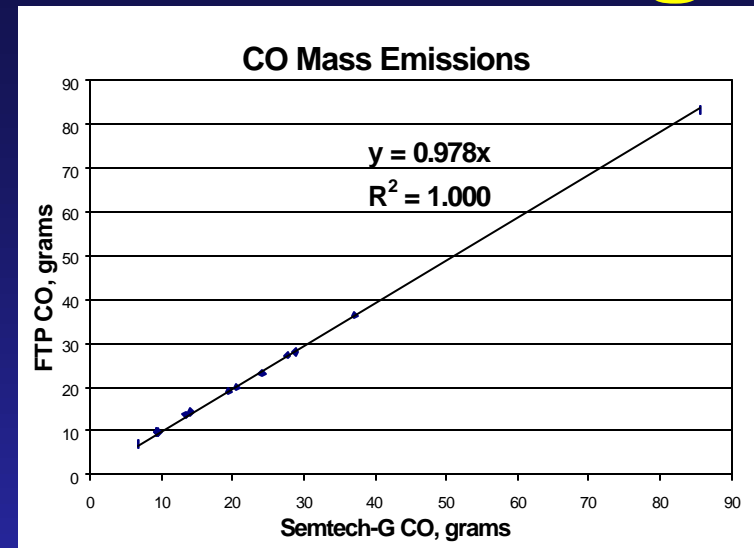
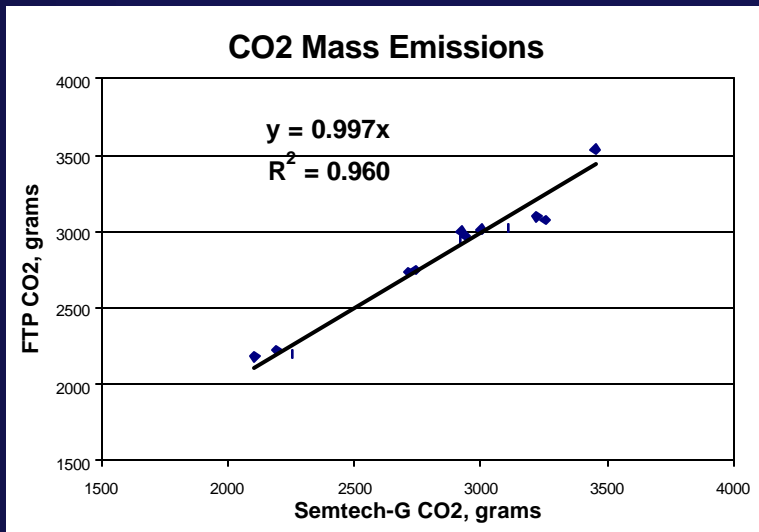


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2001 EPA Study

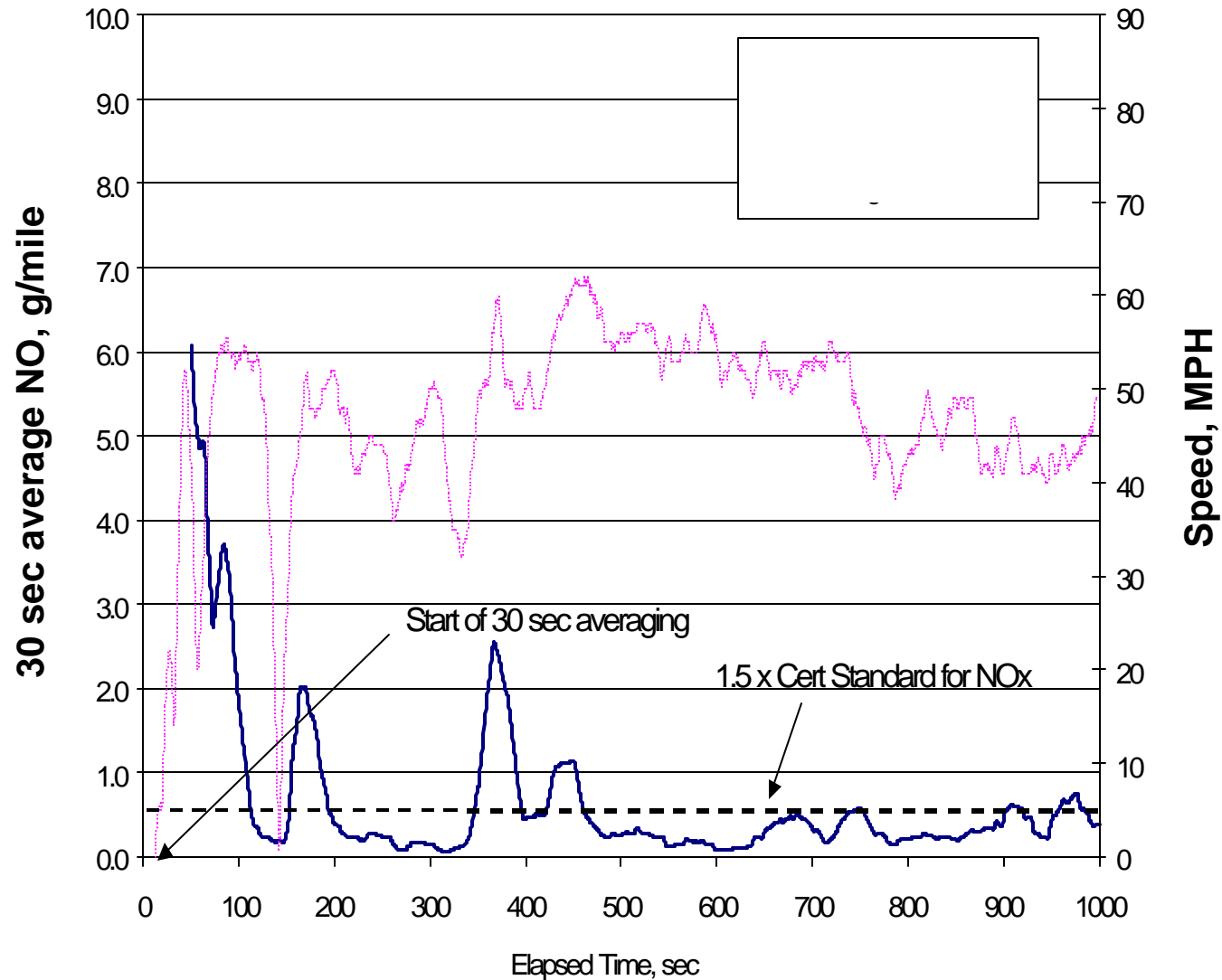
- SEMTECH-G used to measure mass emissions on 18 Ford, GM, Chrysler vehicles.
- Real world, in-use testing by owners.
- Automated data collection at key-on.
- Full FTP correlation testing at EPA labs for each vehicle.

Results of EPA FTP Testing



EPA IN-USE STUDY OF AUTOS USING SEMTECH-G

- '97 Tier 1 Passenger car passed FTP testing at EPA
- Repeatedly exceeded 1.5x NO_x standard during 30-second window during on-road testing.

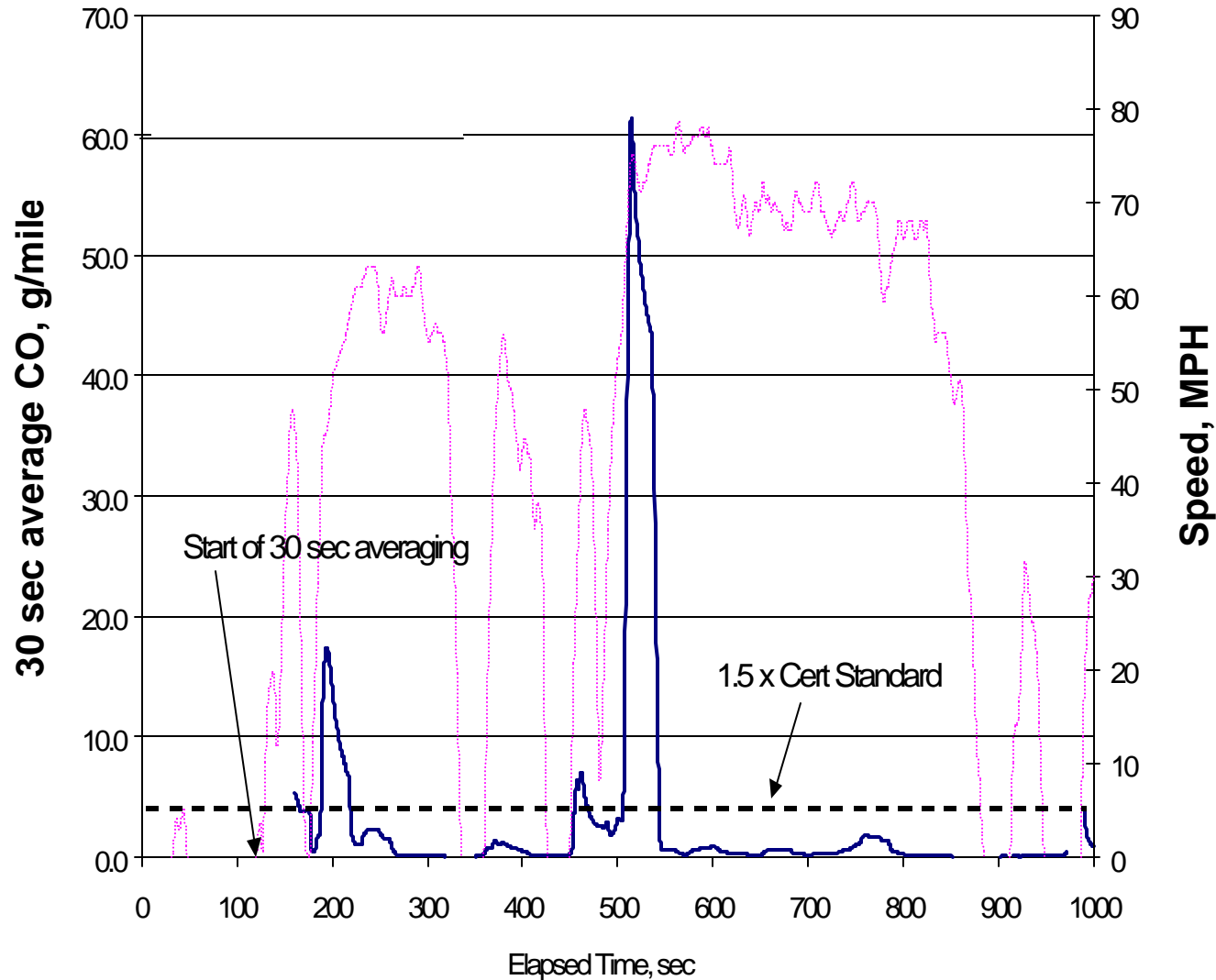


EPA IN-USE STUDY OF AUTOS USING SEMTECH-G

- 2000 Domestic LEV Passenger Car tested at EPA:

- FTP CO: 0.7 g/mi
- Cert Std: 3.4 g/mi

- 30 second avg CO g/mi exceeded 1.5 x cert std on several occasions.





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ON-ROAD, IN-USE DIESEL VEHICLE EMISSIONS ANALYZER



SEMTECH-D



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SEMTECH-D (DIESEL VEHICLE ANALYZER)

Technologies employed:

- HC: Heated FID (200°C)
- CO: NDIR (35°C)
- CO₂: NDIR (35°C)
- NO: NDUV (60°C)
- NO₂: NDUV (60°C)
- CPU: AMD 586
- Vehicle ECM Interface(s)
- Wireless Communications
- GPS

**Vehicle
Computer**

**Heated
Sample
Line**

**VEHICLE ECM
INTERFACE**

ELECTRONICS

**NDUV:
NO, NO₂,**

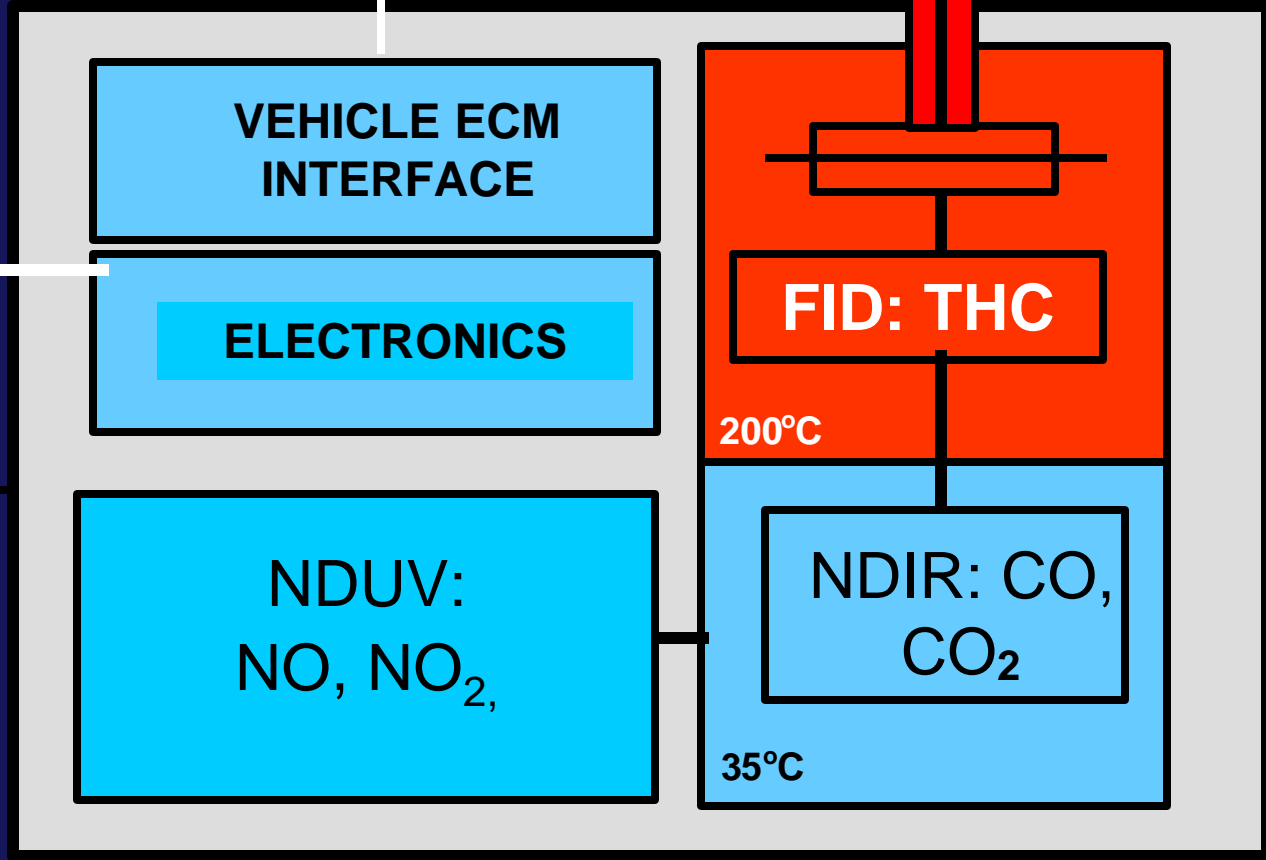
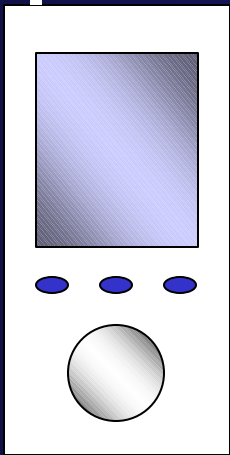
FID: THC

200°C

**NDIR: CO,
CO₂**

35°C

SEMTECH-D




Instantaneous Results:

Data name	Value	Units
ENVIRONMENT:		
Ambient Temp.	22	deg C
Ambient Pres.	972	mbar
Relative Humidity	24	%
Humidity	29	grains/(lb air)
Grade	4.5	%
VEHICLE DATA:		
Engine Speed	1107	RPM
Vehicle Speed	29.7	MPH
Engine Load	72.8	%
Throttle Position	6	%
Fuel Rate	0.001608	gal/s
Fuel Mass Flowrate	4.939	g/sec
Fuel Economy	5.13	mpg
Oil Temp.	152	deg F
Oil Pres.	300.2	kPa
Coolent Temp.	148	deg F
Barometric Pres.	99.1	kPa
RESULTS:		
Exhaust Flow	134.42	SCFM
Torque	588	lb-ft
Brake Horsepower	123.96	bhp
Avg Fuel Economy	7.17	mpg
NOx Correction Factor	0.806	
CO2	7.9643	%
CO	0.024	%
THC	21	PPM
NO	1466	PPM
NO2	30.8	PPM
O2	11.1765	%
Mass CO2	15.641	gps
Mass CO	0.02999	gps
Mass NOx	0.30865	gps
Corrected Mass NOx	0.24877	gps
Mass HC	0.0013	gps

NTE Zone Results:

Data name	g/sec	avg. g/BHp-hr
NTE HC	0.0013	0.052
NTE NOx Cor...	0.249	5.88
NTE NOx	0.309	7.33
NTE CO	0.030	1.48
NTE CO2	15.6	403.9



sensors, inc.

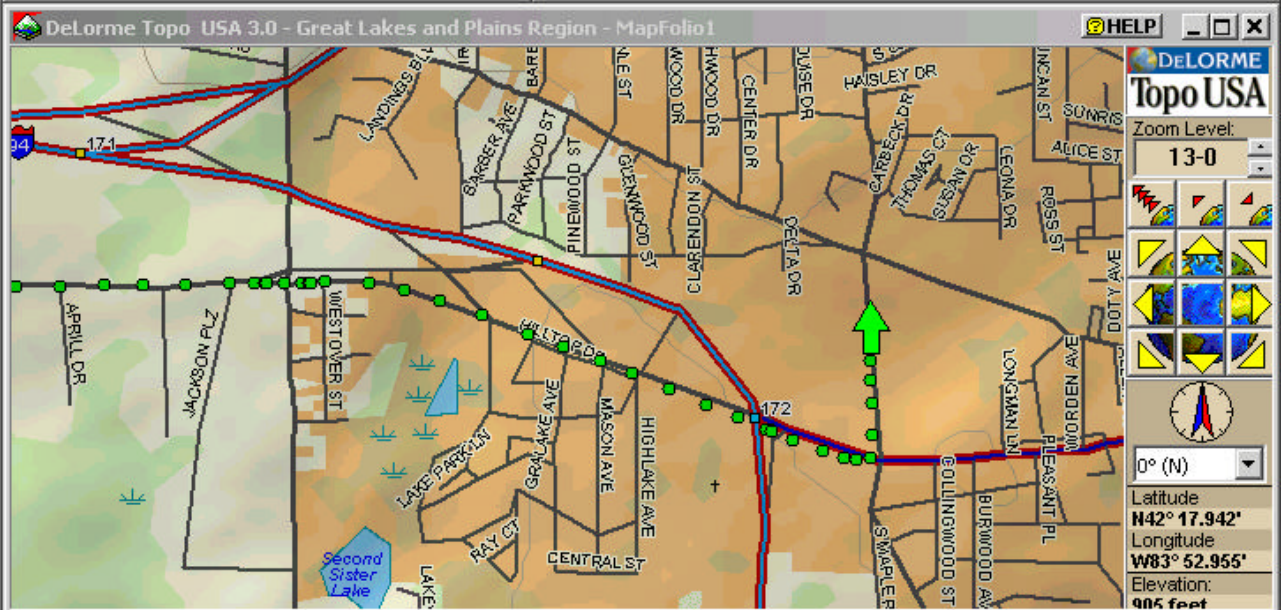
SEMTECH-D

Data Display

NTE Zone Status: **IN** ← **OUT**

NTE Zone Duration: 16 seconds

Longest NTE Zone Duration: 57 seconds



Find Print MapFolio Draw GPS Navigate Profile 3-D Prefs NetLink

Settings Status GPS Log

Speed: 29.7 MPH

Heading: 358 T

Latitude: N42° 17.0488'

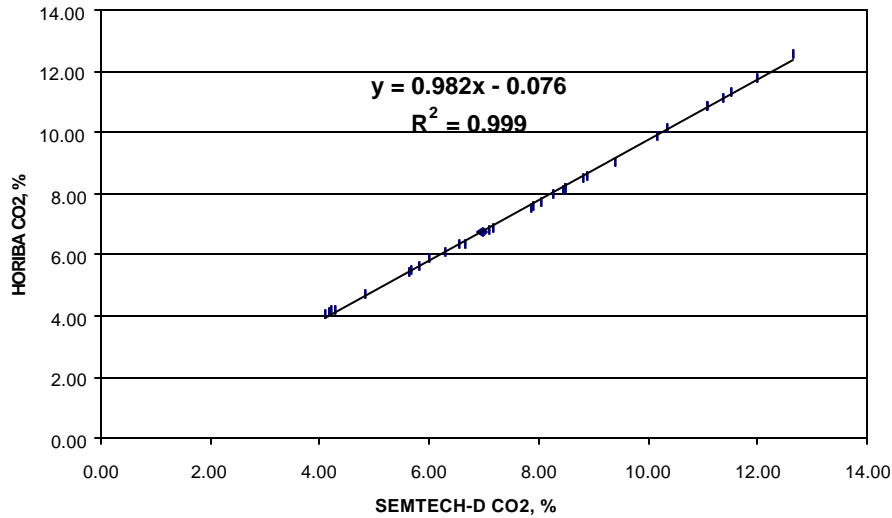
Longitude: W83° 46.8238'

Elevation: 948.16 feet

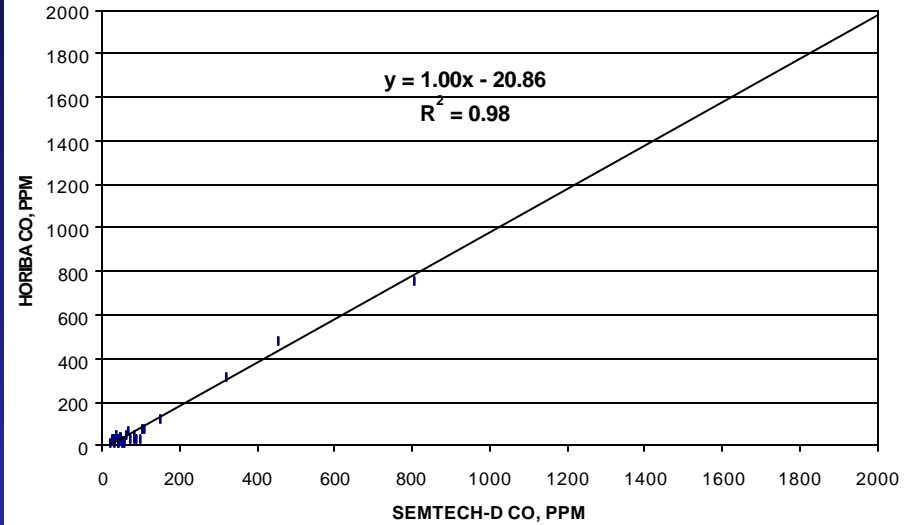
3-D Satellite Info

Steady State Correlation

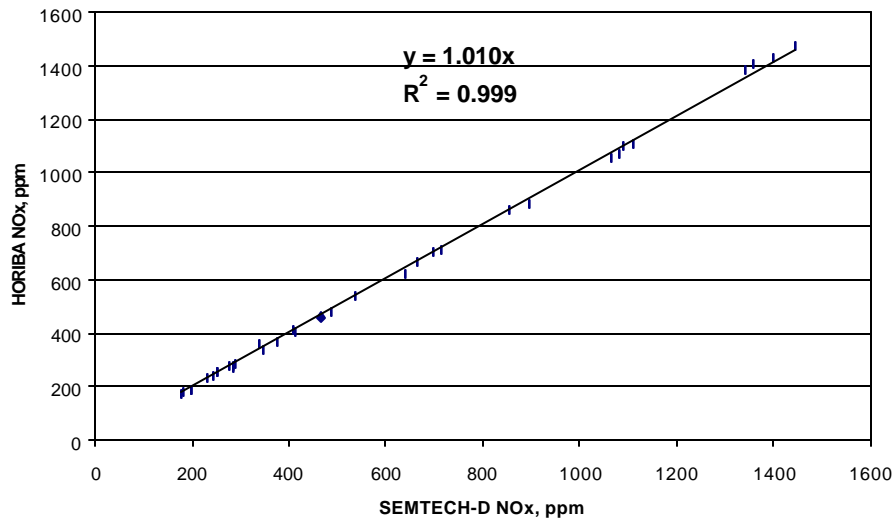
CO₂



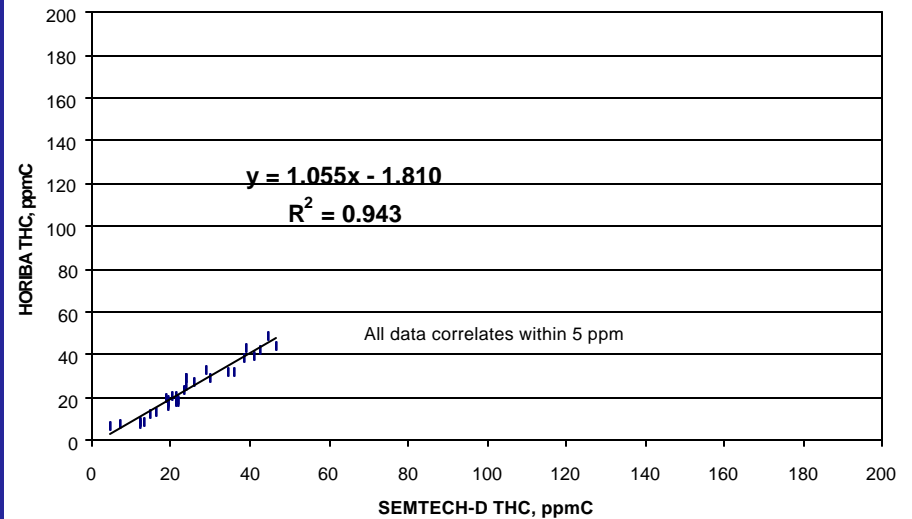
CO



NO_x

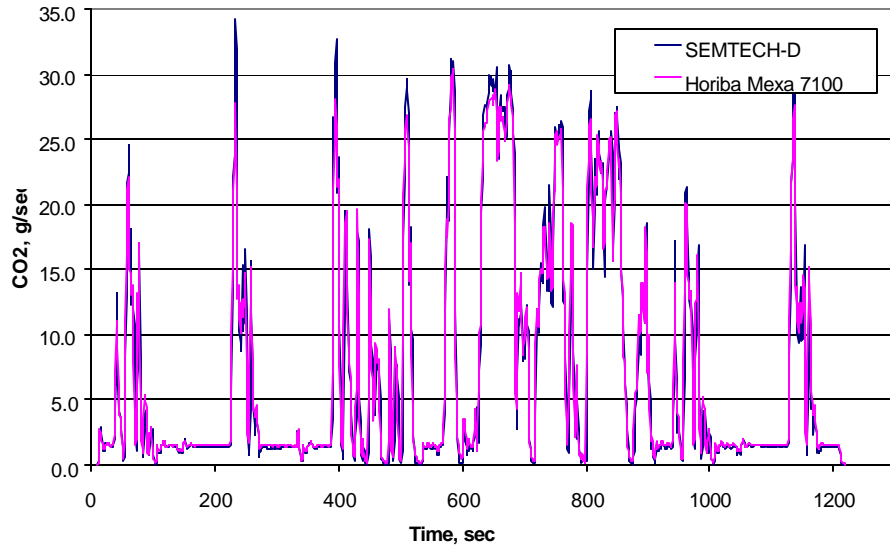


Total HC

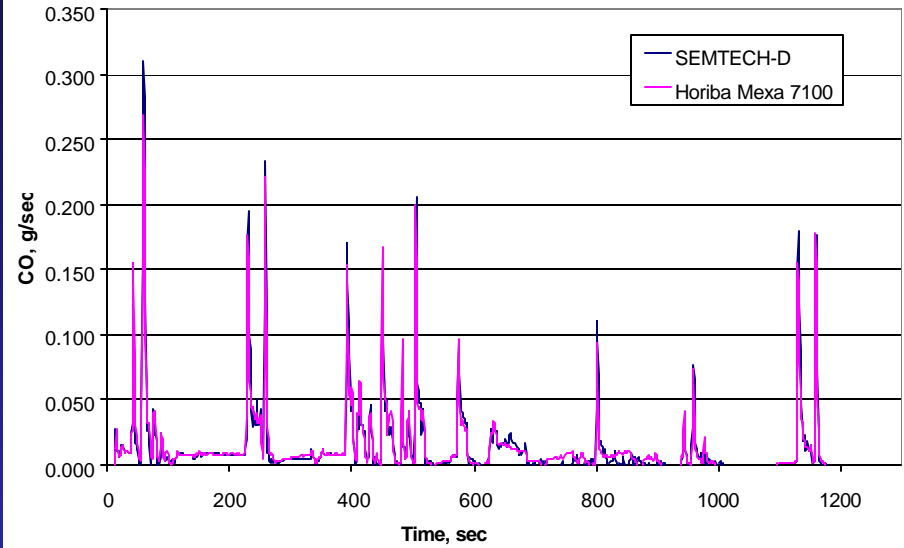


Transient Mass Correlation

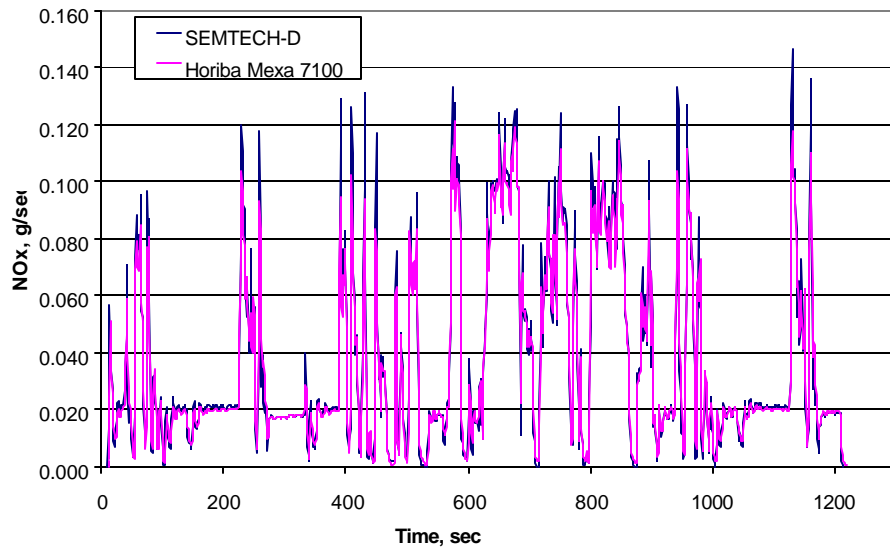
CO₂



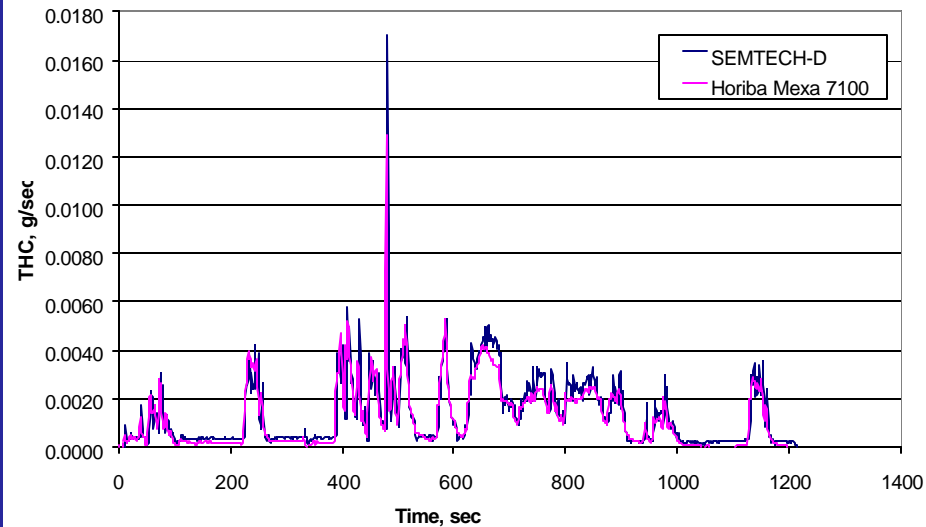
CO



NO_x



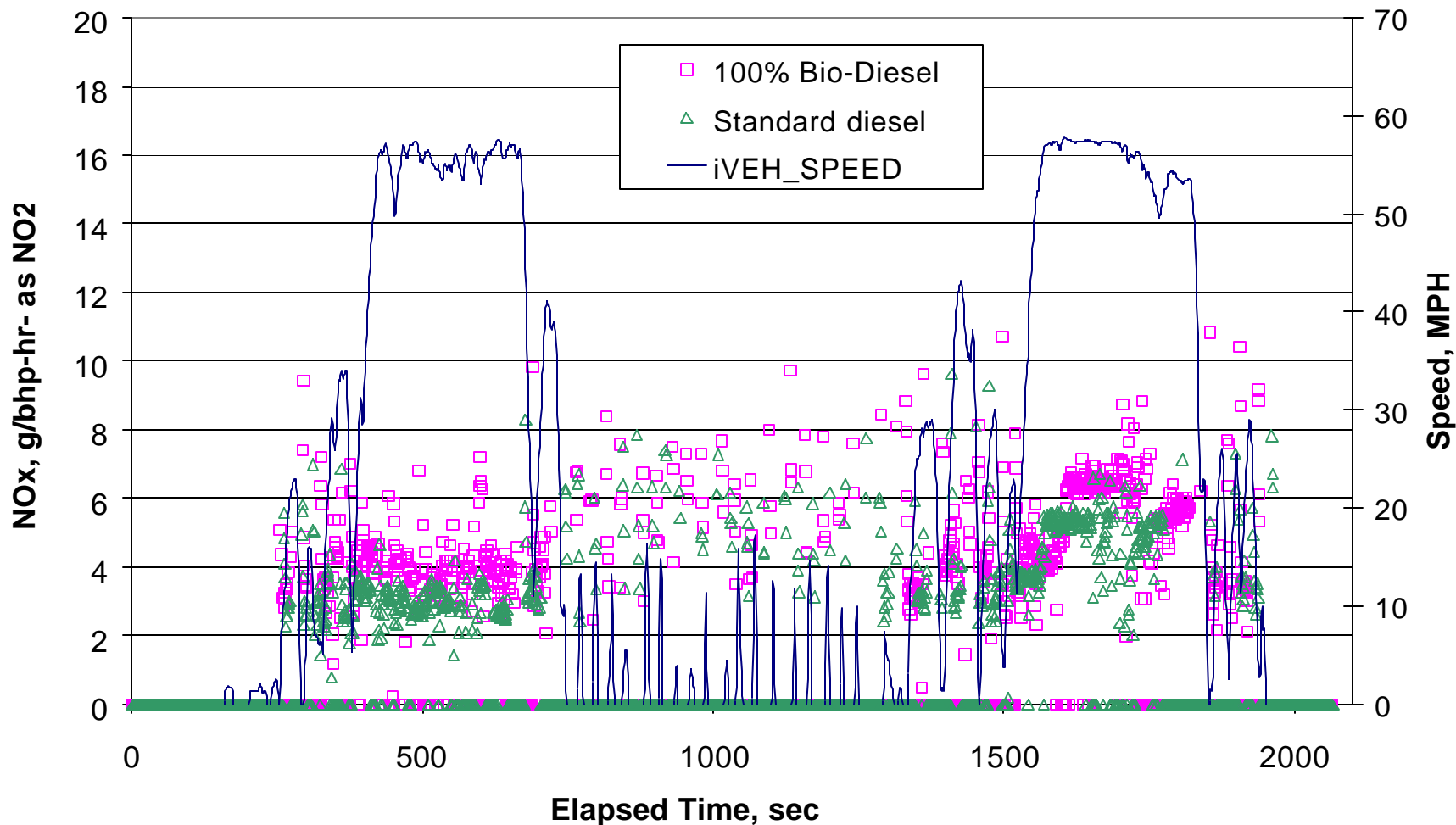
Total HC



CARB On-Road Evaluation of Alternate Fuels

Vehicle deploying SEMTECH D

NTE Zone NOx Emissions: Bio-diesel vs Standard Diesel





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ON-VEHICLE

SEMTECH-D

STATIONARY





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Other Applications for On-Vehicle Testing Systems

- Low cost alternative to certification grade analytical systems for:
 - End of production line test
 - Comparative studies of aftertreatment devices
 - Engine “screening” in test cells



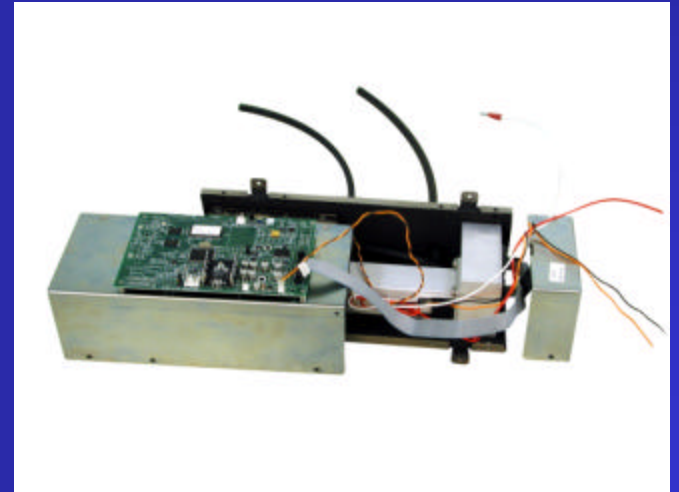
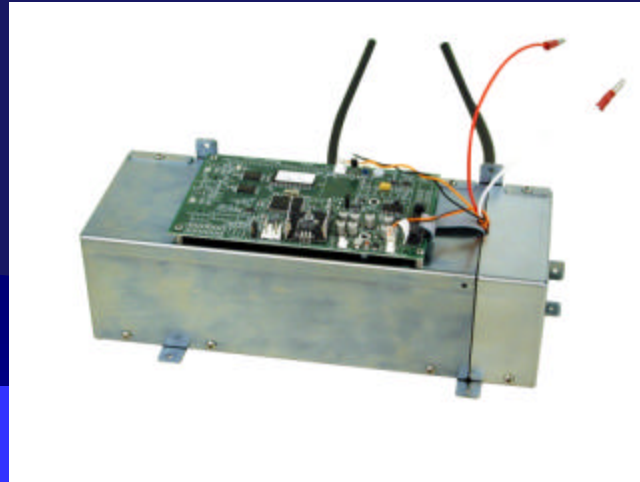
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New Technologies

NDUV NO/NO2 Analyzer



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NDUV NO/NO2 Analyzer

- EDL technology (20,000 hrs)
- Simultaneous NO & NO2 measurement
- Continuous output
- 0 – 5000 ppm
- Accuracy 10 ppm; 3% of reading
- Resolution 1 ppm
- $T_{90} \sim 2 - 3$ seconds
- Continuous refinements beyond BAR specifications



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PM-100 Particulate Analyzer





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Particulate Analyzer

- Laser light scattering technology
- 100 nm minimum particle size
- Individual particle counts
- Proprietary dilution system
- 1 second scan rate
- Particles bins providing counts and size in 100nm increments
- Raw & dilute exhaust measurement



SEMTECH

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