Thinking Off-Cycle About the Future of PEMS

6th International PEMS Conference and Workshop (2016)
University of California, Riverside CE-CERT
March 18, 2016

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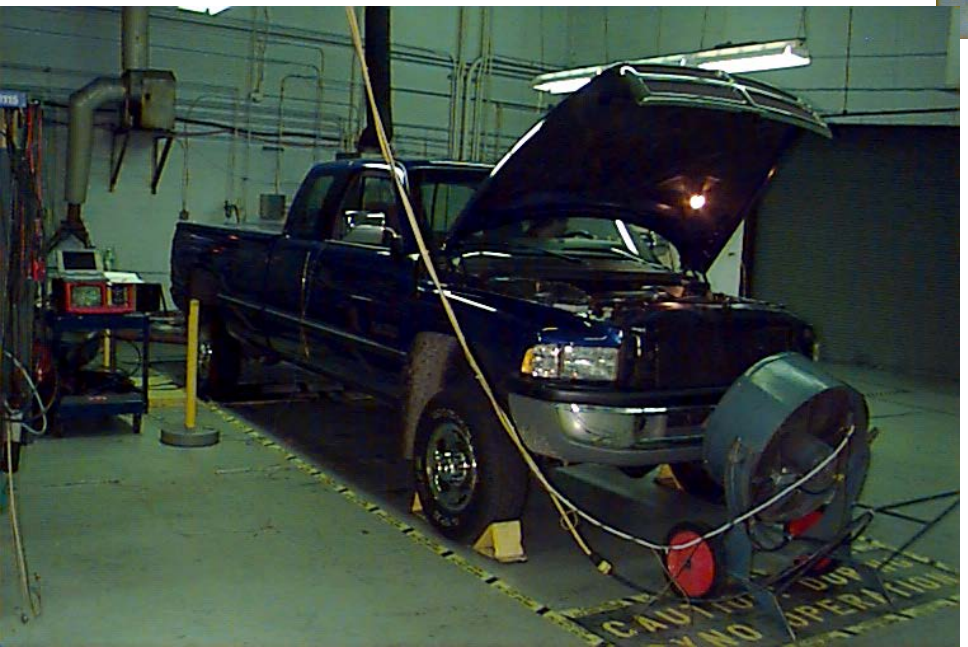
We have come a long way since 1995

1995 - Life Was Easy

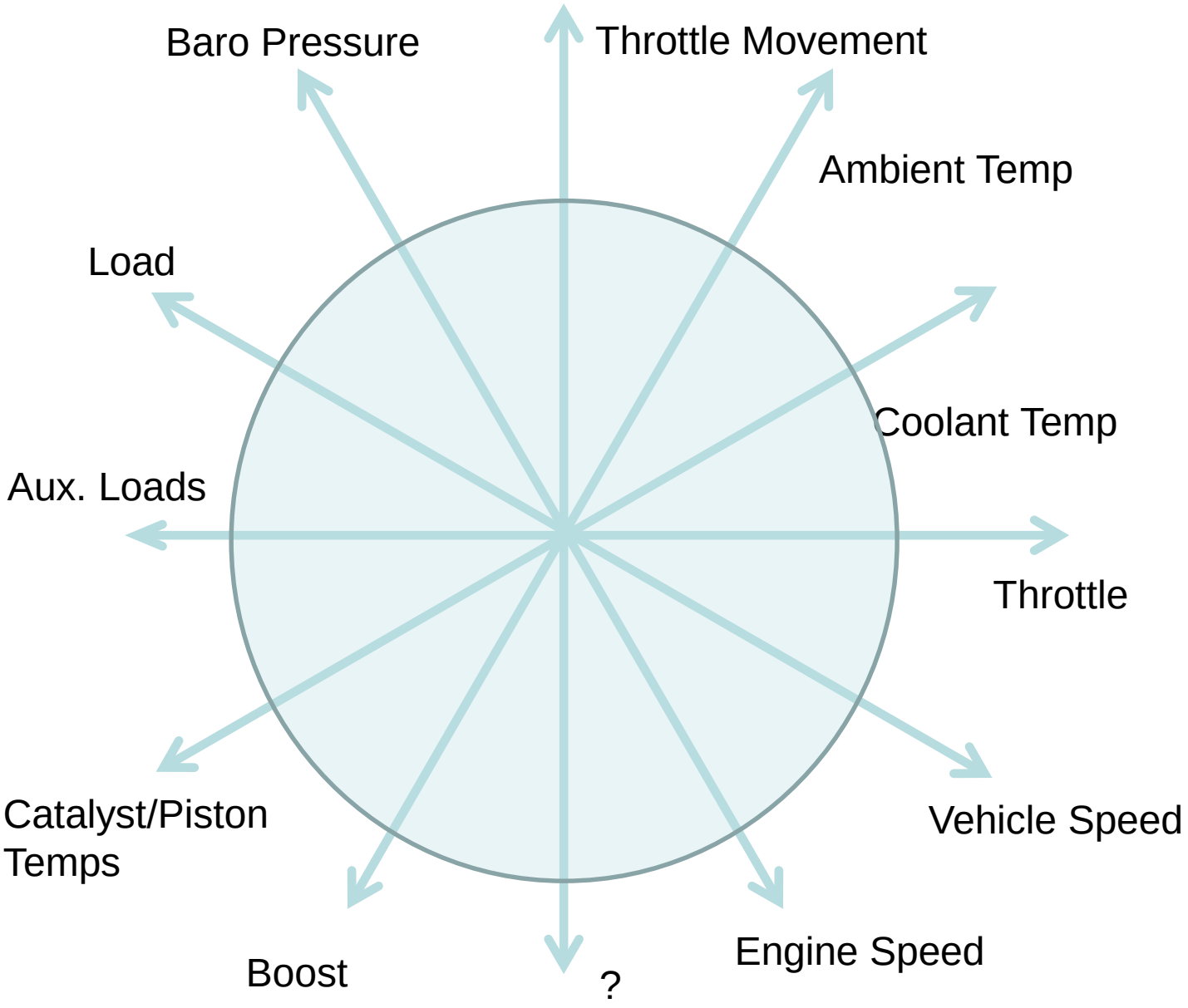
- Road Testing Impossible
- No Equipment Available
- Off-Cycle Denial
- NAAQ Not Responding - Keep Reducing Stds.



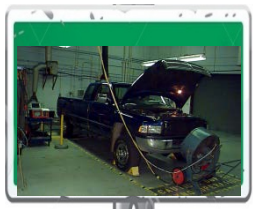
2016 - Life Complicated

- Commercial Equipment
- Defeat Devices Don’t Pay
- Off-Cycle Emissions On Everyone’s Radar
- Calibration Headaches

Calibration Space Dimensions



ROVER PEMS Timeline



FTP

1995

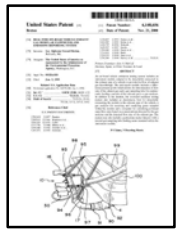
1998

2000

STAY IN LANE

ROAD TESTING AHEAD

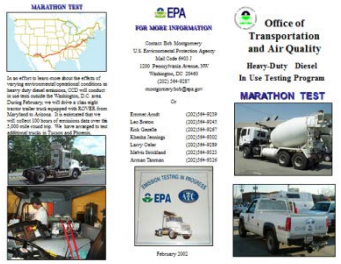
Commercialize



1st Patent Issued

EXIT

WARNING DO NOT BACK UP! SEVERE TIRE DAMAGE



SHARE THE ROAD

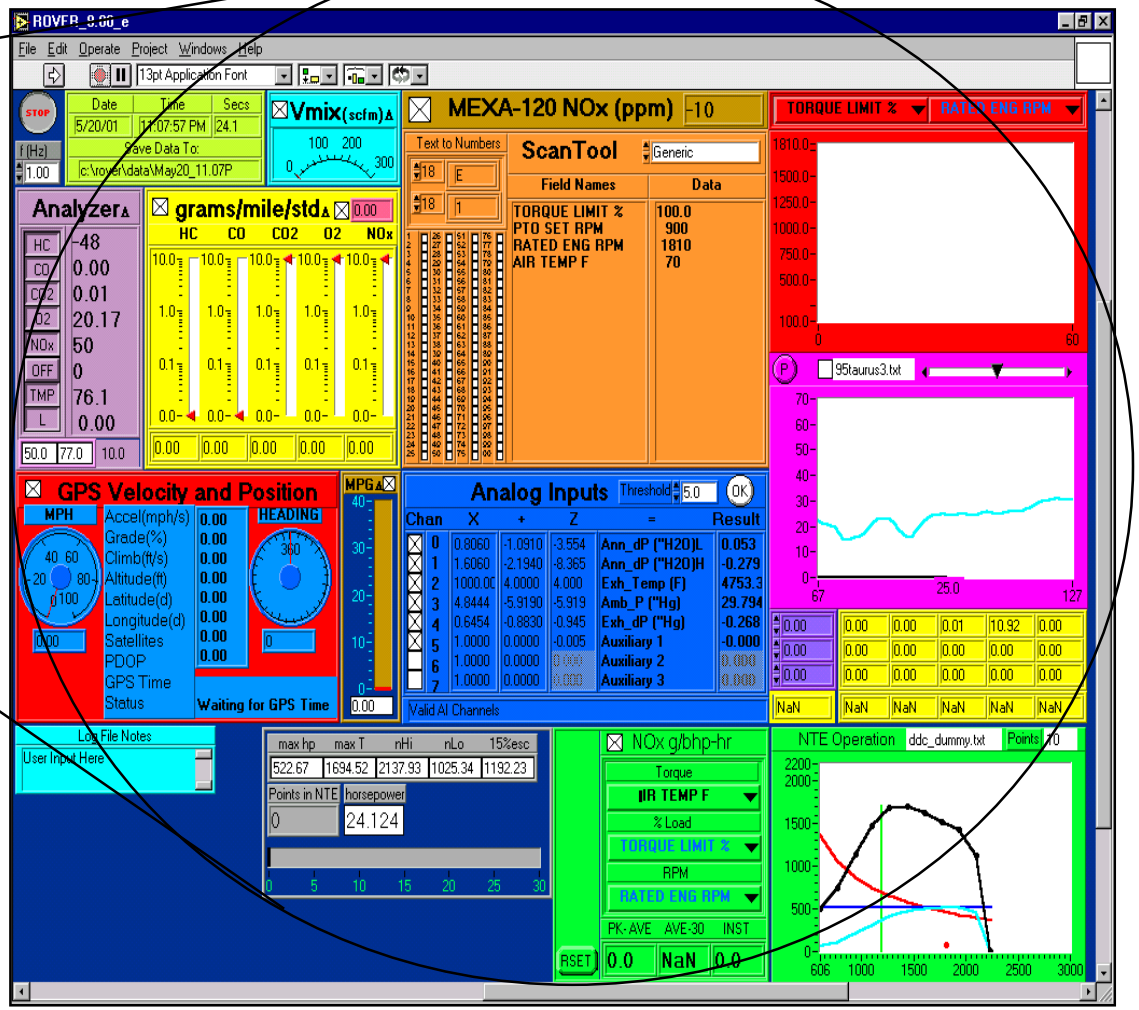
2008

2002

2002

Commercial

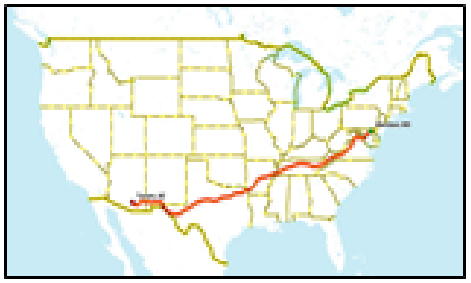
Flexible System Was Created



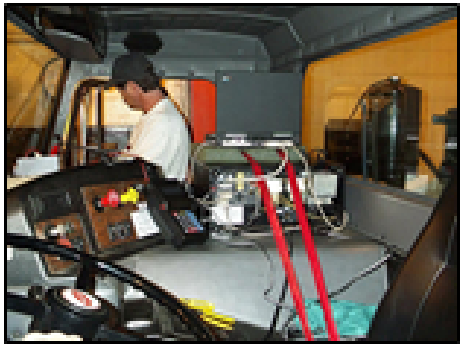
- ✓ Converter Efficiency
- ✓ Smoke
- ✓ Drivers Trace
- ✓ Route Playback On Dyno
- ✓ NTE Realtime
- ✓ Auxiliary Analog Inputs

Marathon Testing

MARATHON TEST



In an effort to learn more about the effects of varying environmental/operational conditions on heavy duty diesel emissions, CCD will conduct in use tests outside the Washington, D.C. area. During February, we will drive a class eight tractor trailer truck equipped with ROVER from Maryland to Arizona. It is estimated that we will collect 100 hours of emissions data over this 5,000 mile round trip. We have arranged to test additional trucks in Tucson and Phoenix.



EPA

FOR MORE INFORMATION

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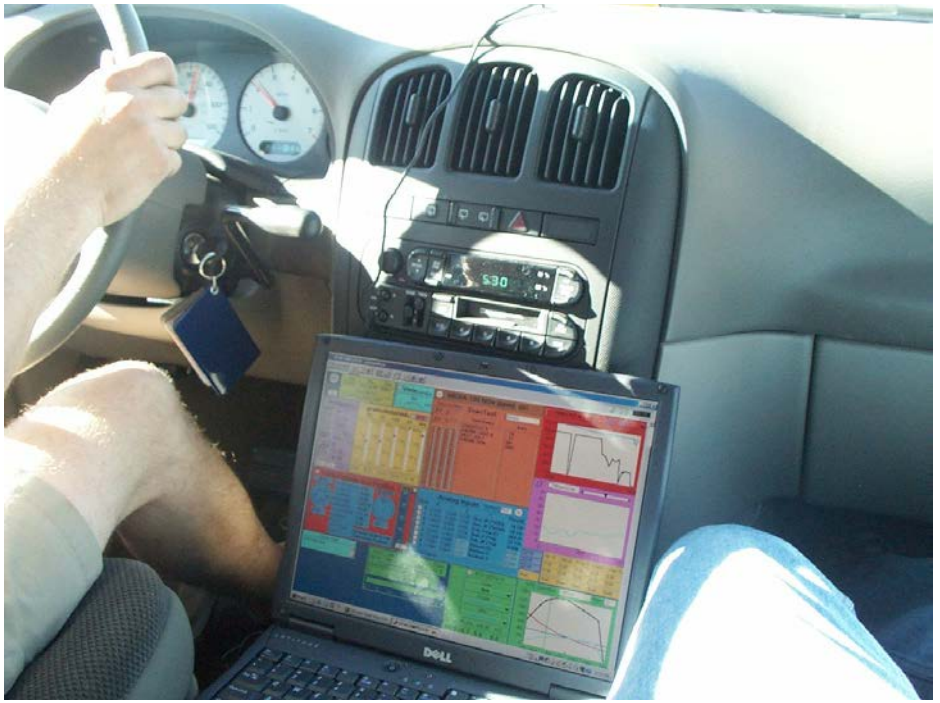
February 2002

Office of Transportation and Air Quality

Heavy-Duty Diesel In Use Testing Program

MARATHON TEST

Monitoring From Chase Vehicle



Still Other Engines Out There…

“Blind Testing” Concept Still Important

- Mass emissions accurately determined by actual measurements of concentrations *and* exhaust flow rate
- Data stream data reserved for diagnostics
- No information is needed from manufacturer
- The methodology is exactly the same for gas/diesel, all manufacturers, turbo/non-turbo, and any size engine from HDD to lawnmower.
- Relying on OBD data or proprietary/manufacturer data is a slippery slope which should be avoided.

Future Cost / Quality Considerations

- Of course lower cost is always good, all else being equal
- PEMS *is* a low cost way of doing near-lab quality data acquisition but standards are needed and drive up cost
- Don’t expect another defeat device in my lifetime – too costly
- Most future uses will be for discerning small differences in fuel economy/emissions – high quality is needed for what WE do
- Consider the OEM legal ramifications – your data *will* be used by others who don’t know limitations for purposes you cannot control
- We fought the battle in the ’90s and prevailed – make sure we don’t regress…

Happy Testing!

Thank You!!