2004

High Temperature and Fuel Impacts on HC Emissions

Richard Barrett

Donald H. Stedman

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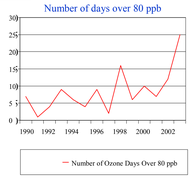
Richard Barrett
Colorado Department of
Public Health and Environment

Donald Stedman
University of Denver

Colorado Summer of 2003

Experienced Highest Temperature and Ozone Levels in Many Years

- 2003 had record high temperatures
- July 2003 was the warmest month on record
- August 2003 was the hottest or second hottest for most of the month

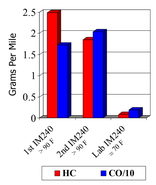


Colorado OBD II Study

10 IM240 failure vehicles were procured for laboratory testing from the I/M lanes on high temperature days

ARE THESE VEHICLES FALSE FAILURES?

- All vehicles were tested in I/M lanes at temp. > 90 degrees
- All vehicles failed two IM240's
- High emissions could not be replicated at the CDPHE lab
- All vehicles < cert. values on the FTP
- No repairable emissions



What are false failures?

- Auto manufacturers are only held accountable to pass the Federal Certification Test
- All I/M short tests (IM240) are an approximation of the certification test
- Short tests will not always give the same result as the full certification tests
- The IM240 was designed to include only a small amount of errors (false pass, false fail)
- However, the emissions from these 10 study vehicles at high temperatures ARE real!

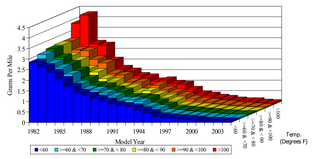
Could These High Emissions be Caused by:

- High Altitude
- Colorado's Fuel Composition
  - Base fuel 8.2 psi RVP
  - 65% Market share of ethanol (10%) blended fuel
  - Weighted average 9.0 psi RVP
- Other Causes

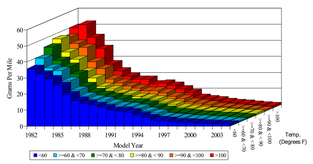
Temperature Effects in Colorado's IM240 Program

- An analysis of Colorado's 2003 IM240 program data was conducted
  - 427,146 Light Duty Vehicles
  - 311,942 Light Duty Trucks
  - October 2002 through September 2003

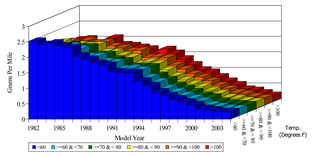
Average HC GPM by Temperature and Model Year



Average CO GPM by Temperature and Model Year

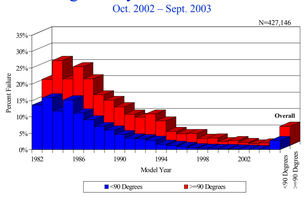


Average NOx GPM by Temperature and Model Year



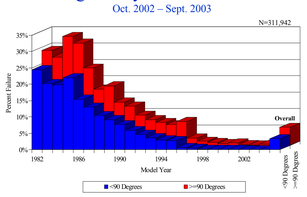
Light Duty Vehicle Fail Rate

Oct. 2002 – Sept. 2003



Light Duty Truck Fail Rate

Oct. 2002 – Sept. 2003



A Comparison Between Colorado and Missouri Summer 2003

- Fuel Characteristics
- I/M program performance
- Altitude
  - Missouri – 200 – 300ft
  - Colorado – 5,000-6,000ft

Colorado's vs. Missouri's 2003 Fuel Characteristics

Colorado vs. Missouri summer 2003 fuel specifications

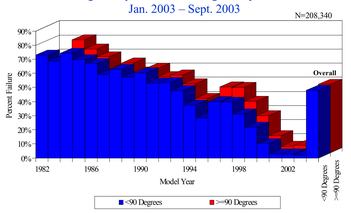
- Colorado
  - Base fuel RVP 8.2 psi
  - 65% Market share of ethanol (10%) blended fuel
  - Weighted average RVP 9.0 psi
- Missouri
  - Phase two reformulated fuel RFG

Missouri's I/M Program

- IM240
- Clean Screen RSD
- Profiling
- Fail rates not directly comparable to Colorado due to Missouri data reflecting only vehicles not clean-screen and/or profiled

Missouri IM240 Fail Rate

Light Duty Vehicles and Light Duty Trucks
Jan. 2003 – Sept. 2003

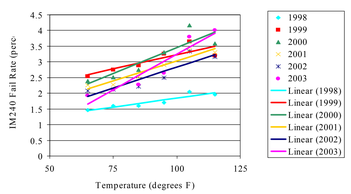


Temperature Sensitivity 1998–2003 Colorado IM240 Data

- All years show a temperature sensitivity with increasing fail rate due to increasing temperature
- A temperature sensitivity index was created for each year (index = increase in fail rate over increase in temperature, i.e., slope)
- Temperature sensitivity is inconsistent from year to year
- Possible causes:
  - Fuel composition
  - Fleet make up
  - Other ???

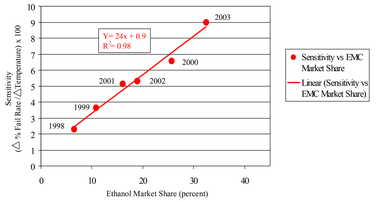
Temperature Sensitivity

(Change in Fail Rate with Change in Temperature)
IM240 Failures



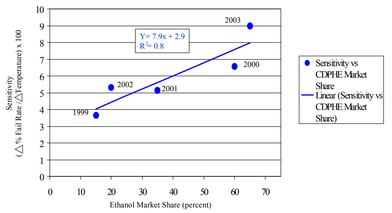
Temperature Sensitivity

(Change in Sensitivity with Change in Ethanol Market Share)
Market Share Reported By Ethanol Management Corporation



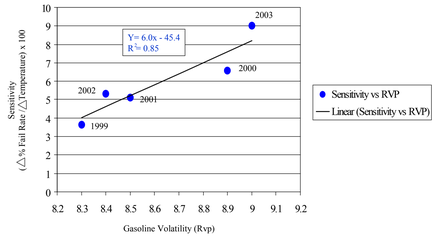
Temperature Sensitivity

(Change in Sensitivity with Change in Ethanol Market Share)
Market Share Reported By CDPHE



Temperature Sensitivity

(Change in Sensitivity with Change in RVP)



IM240 Data Conclusions

- Temperature affect seen in I/M emissions data
- Increase in HC and CO due to higher temperatures
- Higher fail rates across all model years due to these emissions increases
- Not evident in Missouri (low altitude with summertime reformulated fuel)

IM240 Data Conclusions

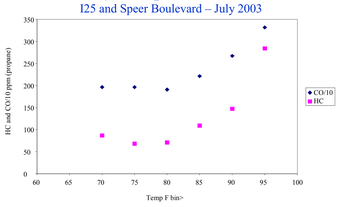
- Failure rates and higher emissions are very strongly correlated to summer ethanol market share and/or weighted average fuel RVP.
- $R^2 = 0.80$ using CDPHE summer ethanol market share and 0.98 using ethanol industry market share
- $R^2 = 0.85$ using Colorado RVP data

2003 Denver "Smart Sign" Remote Sensing Data

- University of Denver "Smart Sign"
- Collected at Interstate 25 and Speer Boulevard Interchange
- July 2003
- 327,984 remote sensing readings

2003 RSD Emission Measurements By Temperature Bin

I25 and Speer Boulevard – July 2003



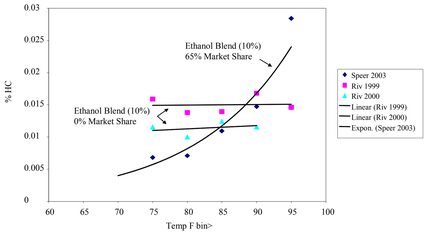
Colorado's On-Road RSD Emissions Trends

- On-Road HC emissions increase with temperature
  - similar trends as IM240 emissions
- On-Road CO emissions also increase with temperature

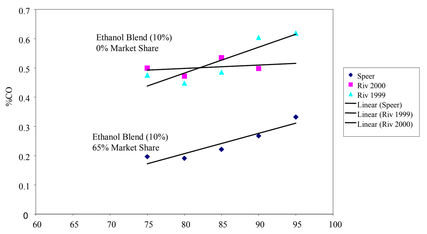
California Summertime Remote Sensing Data

- Riverside 1999
- Riverside 2000
- CRC program data available at www.feat.biochem.du.edu
- More than 20,000 readings in each data set

Comparison of Colorado to California RSD HC Data versus Temperature



Comparison of Colorado to California RSD CO Data versus Temperature



California vs. Colorado RSD Conclusions

- Colo HC data shows strong temperature sensitivity
- California's 1999 and 2000 RSD data shows little (if any) temperature sensitivity
- Is Colorado fuel at fault?
  - Colorado's 2003 summertime average 9.0 lb. RVP and 65% ethanol market share
  - California's 1999 and 2000 summertime fuel was California RFG with 0% ethanol market share