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HEAVY DUTY DIESEL FINE PARTICULATE MATTER EMISSIONS: DEVELOPMENT AND APPLICATION OF ON-ROAD MEASUREMENT CAPABILITIES

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Prepared by

National Risk Management
Research Laboratory
Research Triangle Park, NC 27711

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E. Timothy Oppelt, Director
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Heavy Duty Diesel Fine Particulate Matter Emissions:

Development and Application of On-Road Measurement Capabilities

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Abstract

EPA's On-road Diesel Emissions Characterization Facility, which has been collecting real-world gaseous emissions data for the past 6 years, has recently undergone extensive modifications to enhance the facility's particulate matter (PM) measurement capabilities, with specific emphasis on fine PM or $PM_{2.5}$ (particles less than 2.5 μm in aerodynamic diameter). At present, the facility's capabilities are focused on continuous sampling and analysis, using fast responding instruments such as the Electrical Low-Pressure Impactor (ELPI), the Tapered-Element Oscillating Microbalance (TEOM), and a particle-bound Polycyclic Aromatic Hydrocarbon (PAH) analyzer, all of which require a dilute exhaust sample. This dilute sample has been drawn directly from the vehicle exhaust via a stack dilution system, and sampled from the ambient exhaust plume via probes in the trailer. Dilute samples have also been collected on filters for chemical and gravimetric analysis. Experimental results indicate that stack dilution sampling does not adequately represent real-world conditions as determined from initial plume sampling. Therefore, future efforts will be directed toward improved plume characterization techniques.

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Acronyms and Abbreviations

Accel	Acceleration
Aethal.	Aethalometer made by Magee Scientific Company
APPCD	Air Pollution Prevention and Control Division
ASCII	American standard code for information interchange
CD-RW	Compact disc rewritable
CEM	Continuous emissions monitor
CNC	Condensation nucleus counter
CO	Carbon monoxide
CO_2	Carbon dioxide
CPC	TSI Model 3025a condensation particle counter
D.R.	Dilution ratio
DAS	Data acquisition system
dP	Differential pressure
DQI	Data quality indicator
DQO	Data quality objective
ELPI	Electrical low pressure impactor
EPA	Environmental Protection Agency
ERR	Error
HDDV	Heavy-duty diesel vehicle
hr	Hour
Hz	Hertz
ID	Identifier
JCC	Johnston Community College
kph	Kilometers per hour
KW1	Kenworth truck as-received
KW2	Kenworth truck after engine overhaul

LAN	Local area network
LDDV	Light-duty diesel vehicle
MEC/FTP	Modified energy conservation/federal test procedure
mph	Miles per hour
NA	Not available
NDIR	Non-dispersive infrared
NIEHS	National Institute of Environmental and Health Sciences
NIST	National Institute of Standards and Technology
NO_X	Nitrogen oxides
O_2	Oxygen
ODEC	On-road Diesel Emissions Characterization facility
PAH	Polycyclic aromatic hydrocarbons
part.	Particle
PC	Personal computer
PM	Particulate matter
ppm	Parts per million
QA	Quality assurance
QC	Quality control
R&P	Rupprecht & Patashnich
rpm	Revolutions per minute
RSD	Relative standard deviation
SAE	Society of Automotive Engineers
SCFM	Standard cubic feet per minute
sec	Second
SMPS	Scanning mobility particle sizer
TEOM	Tapered element oscillating microbalance
THC	Total hydrocarbons

u.d.s.	Unit-density spheres
UC-Davis	University of California at Davis
UDDSHDV	Urban dynamometer driving schedule for heavy-duty vehicles
W.G.	Water gauge
WVU	West Virginia University

Conversion Table

English Unit	Metric Equivalent
1 ^{o}R	1.8 K
1 inch	2.54 cm
1 ft	0.3048 m
1 ft^3	0.0283 m^3
1 hp	745.7 W
1 lb	0.4536 kg
1 mi	1.609 km