Biomonitoring California
Scientific Guidance Panel (SGP) Meeting

Consideration of New Technology Diesel Engine (NTDE) Emissions Characteristics

November 6, 2014

Truck & Engine Manufacturers Association®

SLIDES PRESENTED AT SGP MEETING

Items For Panel's Consideration Regarding Diesel Emissions Biomonitoring

- Characteristics of diesel emissions have fundamentally changed due to new emissions control technology
- CA Diesel PM emissions and ambient concentrations have decreased - over 70% in South Coast in just 6 years
- Ambient concentrations in CA will continue to decrease as NTDE quickly replaces TDE
- 2007 and 2010 engine technology essentially eliminates emission of PAH and Nitro-PAH compounds that may be considered as diesel biomarkers
- Example – 1-nitropyrene not detected in 2010 engine exhaust

Characteristics of NTDE vs. "Traditional" Diesel Exhaust (TDE)

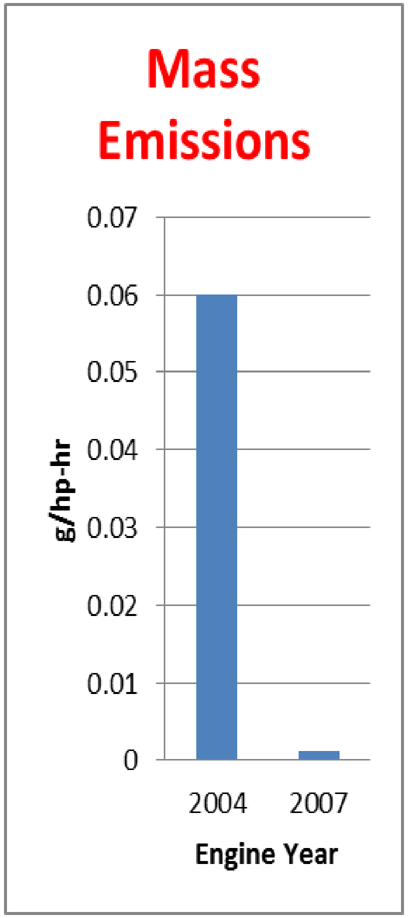
HEI ACES Results Compared to Earlier Testing:

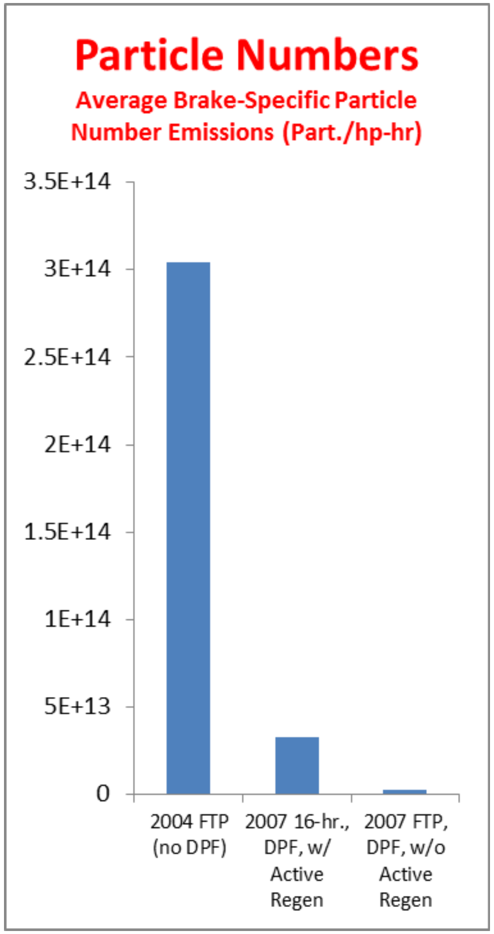
Dramatic PM Reductions

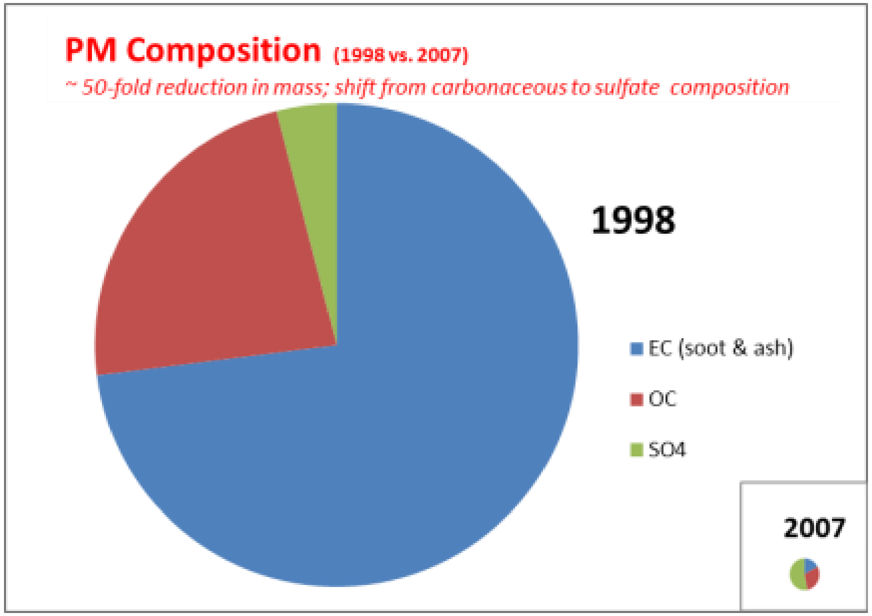
98% reduction in mass

90% - 99% reduction in ultrafine particles

Substantial reduction in carbon particles







Truck & Engine Manufacturers Association®

AQMD MATES-IV Reductions in Ambient Diesel PM

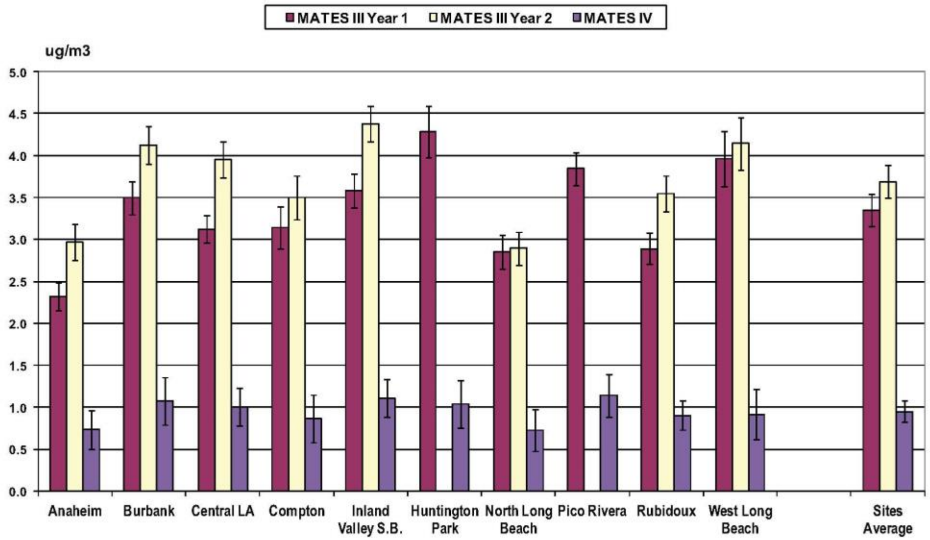


Figure 2-15 Average Concentrations for Diesel PM based on Emissions Ratio Method

2-18

Truck & Engine Manufacturers Association®

MATES-IV Diesel PM Results

- 70% reduction in annual average ambient diesel PM concentrations between 2005 and 2012
- Significant reductions in diesel PM levels at all measured sites
- Site average Diesel PM levels less than 1 ug/m^3
- 66% reduction in Diesel PM Emissions Inventory in South Coast Air Basin between 2005 and 2012
- Highest Modeled Concentration of 2.9 ug/m^3 in 2012 near ports compared to 10.8 ug/m^3 in 2005

Truck & Engine Manufacturers Association®

2010 Engine Emissions
Greater than 99% reduction in PAHs
Many PAHs now below detection limits

- Polycyclic Aromatic Hydrocarbons (PAHs) have been of major concern in diesel exhaust
- Most are so low now they can no longer be measured

ACES Phase 2 TABLE ES-2. SUMMARY OF UNREGULATED EMISSIONS REDUCTION FOR 16-HOUR TEST CYCLE

Compound	2010 % reduction relative to 2007 engines	2010 % reduction relative to 2004 engines
Single Ring Aromatics	50	91
PAH	97	99
NitroPAH	99	100
Alkanes	93	99
Polar	96	99
Hopanes & Steranes	89	100
Carbonyls	80	100
Inorganic Ions	87	92
Metals and Elements	81	100
Organic Carbon	36	97
Elemental Carbon	53	100
Dioxins and Furans	88	100

Truck & Engine Manufacturers Association®

1-Nitropyrene No Longer Emitted From NTDE Engines

Model Year Engine	1-Nitropyrene Emissions ng/hp-hr
Pre 2007	632
2007	20
2010*	<0.1 Below DL

* ACES Phase 2 Data

Truck & Engine Manufacturers Association®

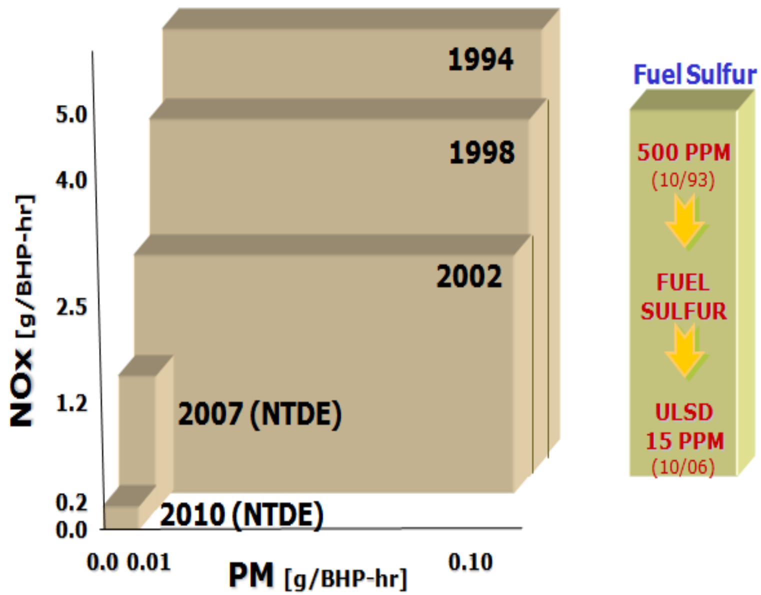
ADDITIONAL BACKGROUND INFORMATION

Truck and Engine Manufacturers Association (EMA)

- Trade Association Representing Manufacturers of Heavy-duty Trucks and Engines
- EMA Members Manufacture Virtually All Diesel Engines Used in California
- Represent Members on Emissions Issues with EPA and ARB
- Sponsor Emissions and Health Effects Research

Truck & Engine Manufacturers Association®

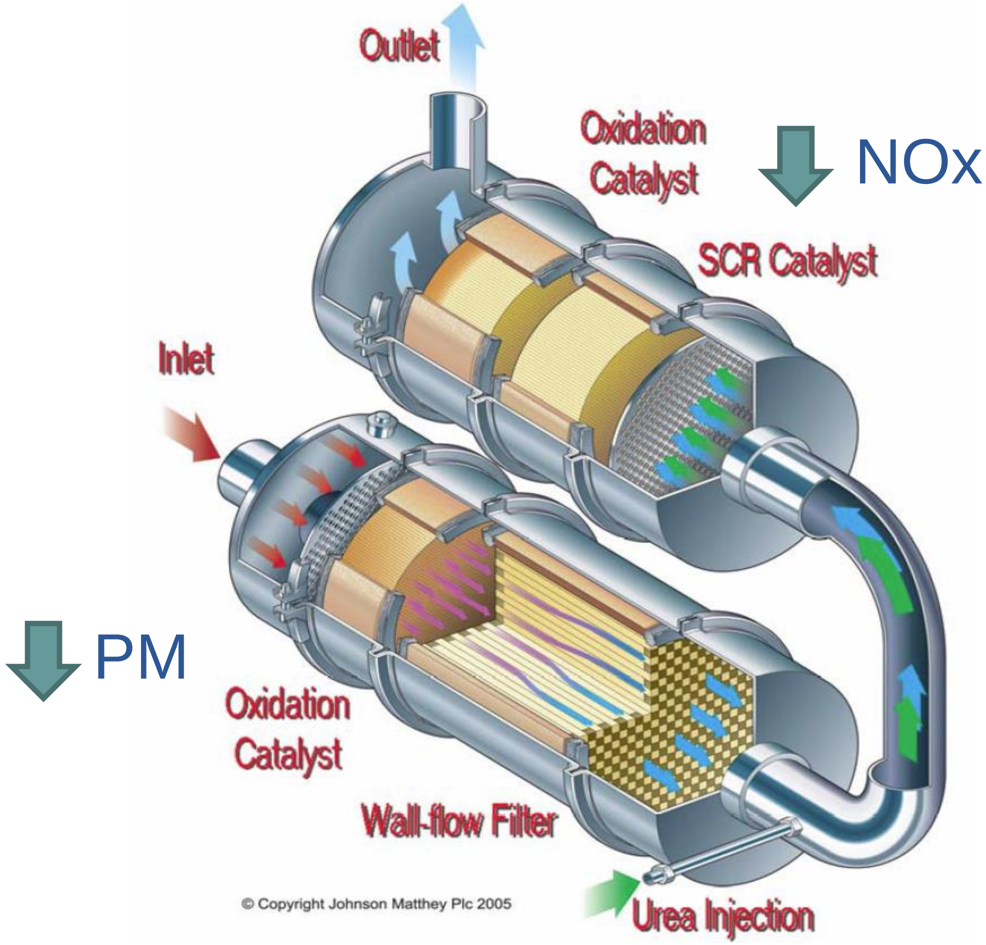
Evolution of US Heavy Duty Diesel On-Road Emission Standards



Truck & Engine Manufacturers Association®

NTDE Exhaust Treatment Systems

—Particle Removal and NOx Elimination Using SCR-Urea—



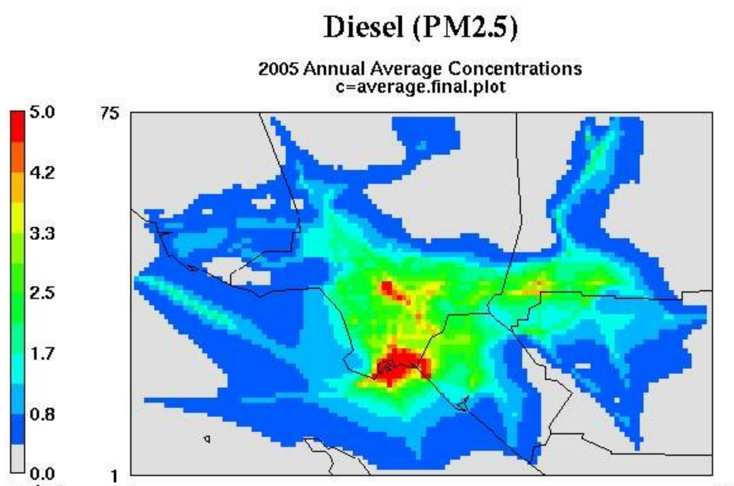
DOC+DPF+SCR

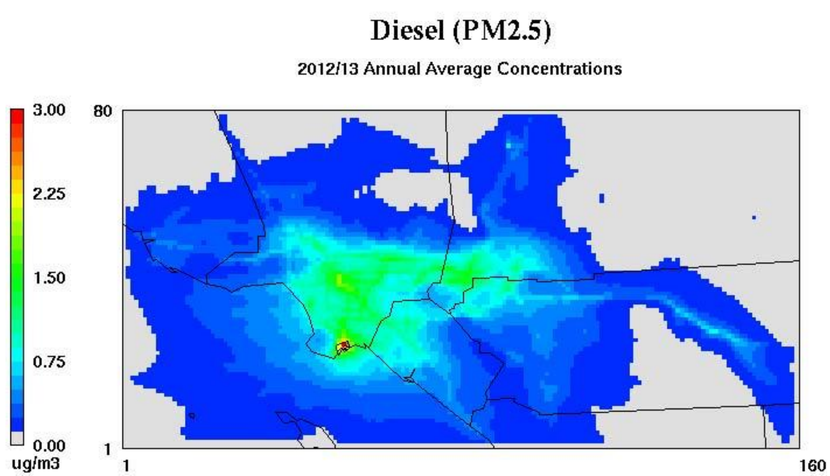
NTDE Reduces Emissions Across a Broad Spectrum of Compounds

Category	Reduction Relative to TDE
Single Ring Aromatics	82%
PAH	79%
Alkanes	85%
Hopanes/Steranes	99%
Alcohols & Organic Acids	81%
Nitro-PAHs	81%
Carbonyls	98%
Inorganic Ions	71%
Metals & Elements	98%
Organic Carbon	96%
Elemental Carbon	99%
Dioxins/Furans	99%

Khalek et al. 2010, Table 6

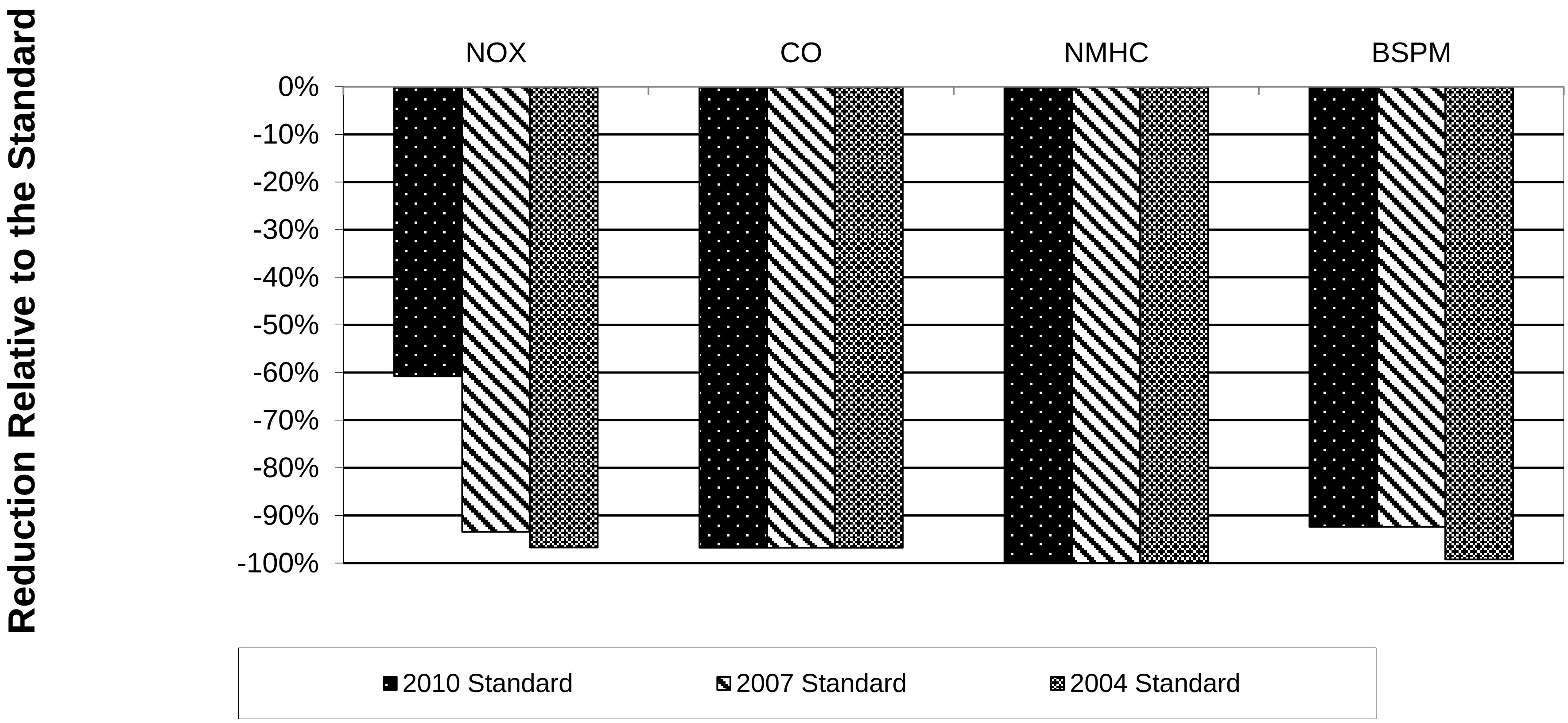
AQMD MATES-IV Modeled Ambient Concentrations of Diesel PM





Truck & Engine Manufacturers Association®

2010 Emissions Are Order of Magnitude Below Regulatory Standards



Truck & Engine Manufacturers Association®

ACES Phase 2 Results for NitroPAHs

- ACES Phase 2 data confirm only trace or no levels of potential diesel biomarkers in NTDE exhaust. Example test results for Nitro-PAHs – measured ug/hp-hr

ni1fluor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni1fluoru	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni1me5n	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000
Ni1me5nu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni1napth	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.008	0.001	0.002	0.003	0.004	0.000	0.000
Ni1napthu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni1pyre	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni1pyreu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni27fl9on	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni27fl9onu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni27fluo	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni27fluou	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni2anthr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni2anthru	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni2biph	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ni2biphu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni2fluo	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001
ni2fluor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni2fluoru	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Complete Database Available on CRC Website

Truck & Engine Manufacturers Association®