

VI Acronyms and Abbreviations

°C	Degrees Celsius		
°F	Degrees Fahrenheit		
0-D	Zero-dimensional		
1-D	One-dimensional		
3-D	Three-dimensional		
4Q	Fourth quarter		
a.u.	Arbitrary units		
A/cm ²	Amps per square centimeter		
A/T	Aftertreatment	bhp-hr	Brake horsepower hour
A75	Near peak torque speed & 75% engine load point of ESC Test Procedure	Bi ₂ Te ₃	Bismuth Telluride
		BMEP	Brake mean effective pressure
AC	Alternating current	bmep	Brake mean effective pressure
AEC	Advanced Emission Controls Working Group	BOI	Beginning of injection
		BP	British Petroleum
AETEG	Automobile exhaust thermoelectric generator	BPF	Bandpass Filter
		Bsfc	Brake specific fuel consumption
Ag	Silver	BSFC	Brake specific fuel consumption
AHRR	Apparent heat release rate	btdc	Before top dead center
Al	Aluminum	BTE	Brake thermal efficiency
Al ₂ O ₃	Aluminum oxide	C:N	Ratio of carbon to nitrogen
ANL	Argonne National Laboratory	C ₁	Carbon content in the exhaust or reformer in terms of carbon atoms
ANSI	American National Standards Institute	C ₂ H ₆	Ethane
		C ₃ H ₆	Propylene
ASI	Time after the start of injection	CA	Crank angle
ASME	American Society of Mechanical Engineers	CA50	Crank angle at which 50% of the combustion heat release has occurred
		CAD	Computer-aided design
AT	Aftertreatment	CAD	Crank angle degrees
ATDC	After top dead center	CAI	Controlled autoignition
atm	Atmosphere	CAP	Critical adjustable parameter
Au	Gold	cc	Cubic centimeter
B	Boron	CDI	Compression direct injection
B100	Mid-speed & 100% engine load point of ESC Test Procedure	CDPF	Catalytic diesel particulate filter
		CeO ₂	Cerium oxide
B25	Mid-speed & 25% engine load point of ESC Test Procedure	CFD	Computational fluid dynamics
		CFR	Coordinating Fuel Research
B75	Mid-speed & 75% engine load point of ESC Test Procedure	CFR	Critical functional response
		CHEMKIN	Name of chemical-kinetic code
Ba	Barium	CI	Compression ignition
BaO	Barium oxide	CIDI	Compression ignition direct injection
BDC	Bottom dead center	CIMAC	International Council on Combustion Engines
BET	Named after Brunauer, Emmett and Teller, this method for determining the surface area of a solid involves monitoring the adsorption of nitrogen gas onto the solid at low temperature and, from the isotherm generated,	CLEAN	Trademark for Detroit Diesel low-temperature combustion strategy
		CLEERS	Cross-Cut Lean Exhaust Emissions Reduction Simulations
			deriving the volume of gas required to form one monolayer adsorbed on the surface. This volume, which corresponds to a known number of moles of gas, is converted into a surface area though knowledge of area occupied by each molecule of adsorbate.

cm	Centimeter	ELS	Elastic light scattering
cm ³	Cubic centimeters	ELSLII	Elastic laser scattering with laser-induced incandescence
CO	Carbon monoxide		
CO ₂	Carbon dioxide	EMD	Electro-Motive Division of General Motors Corporation
COV	Coefficient of variation		
CO _x	Oxides of carbon	EPA	U.S. Environmental Protection Agency
CP	Chevron Phillips		
cpu	Cells per inch	ESC	Steady-State Emission Test Procedure
Cr	Chromium		
CRADA	Cooperative Research and Development Agreement	ETC	Electric turbocompound
		φ	Fuel/Air Equivalence Ratio
CR-DPF	Continuously regenerating diesel particle filter	Fe	Iron
CRF	Combustion Research Facility	fFO	Fuel oxygen equivalence ratio
CRS	Common Rail System	FLC	Federal Laboratory Consortium
Cu	Copper	FLRS	Full load rated speed engine condition
CWLR	Constant weight loss rate	FMEA	Failure mode and effects analysis
DC	Direct current	fmeP	Friction mean effective pressure
DCSF	Diesel combustion simulation facility	FSN	Filter smoke Number (AVL)
DDC	Detroit Diesel Corporation	FTIR	Fourier transform infrared
DECSE	Diesel Emission Control Sulfur Effects	ft-lb	Foot-pound
		FTP	Federal Test Procedure
DEER	Diesel Engine Emissions Reduction	FTP	Federal Transient Protocol
deg	Degrees	FTP-75	Federal Test Procedure for LD vehicles
DELTA	Diesel Engine for Light Truck Application	FWHM	The full width at half the maximum activity as a function of temperature
DEM	Delayed and extended main		
DeNO _x	Oxides of nitrogen reduction	FY	Fiscal year
DI	Direct injection	g	Gram
dm	Decimeter	g/hp-hr	Grams per horsepower-hour
DME	Dimethyl ether	g/kWh	Grams/kilowatt-hour
DNS	Direct Numerical Simulation	g/mi	Grams per mile
DOC	Diesel oxidation catalyst	GC-MS	Gas chromatography – mass spectrometry
DoE	Design of experiment		
DOE	U.S. Department of Energy	GDI	Gasoline direct injection
DOHC	Double overhead camshaft	GE	General Electric
DPF	Diesel particulate filter	Ge	Germanium
DPNR	Diesel Particulate NO _x Reduction	GHSV	Gas Hourly Space Velocity; a measure of gas flow rate through a reactor in units of liters of gas per liter of catalyst per hour, or L L ⁻¹ h ⁻¹ , or h ⁻¹ .
DPV	Differential pulse voltammetry		
DRIFT	Diffuse reflectance infrared Fourier transform		
DRIFTS	Diffuse reflectance infrared Fourier-transform spectroscopy	GRC	GE Global Research Center
DTTEG	Diesel truck thermoelectric generator	GT-Power	Gamma Technologies engine modeling software
e ⁻	Electron		
ECM	Electronic control module	H ₂	Diatomic (molecular) hydrogen
EDS	Energy dispersive spectroscopy	H ₂ O	Water
EGR	Exhaust gas recirculation	H ₂ O ₂	Hydrogen peroxide
EINO _x	Emissions index of NO _x		
ELPI	Electrical low pressure impactor		

H ₂ -SpaciMS	Hydrogen-calibrated spatially resolved capillary inlet mass spectrometry	kJ/L kJ/m ³	Kilojoules per liter Kilojoules per cubic meter
HC	Hydrocarbons	KL	Soot optical thickness
HCCI	Homogeneous charge compression ignition	kPa kW L	Kilopascal Kilowatt Liter
HCN	Hydro-cyanic acid	L/D	Length-to-diameter ratio
HD	Heavy-duty	La	Lanthanum
He	Helium	LANL	Los Alamos National Laboratory
HECC	High-efficiency clean combustion	lb ft	Pound foot
HELD	High-energy laser diagnostics	lb/mi	Pounds per minute
HEV	Hybrid electric vehicle	lbs	Pounds
HMO	Hydrous metal oxide	lbs/sec	Pounds per second
hp	Horsepower	LD	Light-duty
HPCR	High-pressure common rail	LDT	Light-duty truck
HR	Heat release	LEP	Low Emissions Technologies Research and Development Partnership (often abbreviated to Low Emissions Partnership); a consortium between Ford, General Motors and DaimlerChrysler
hr	Hour		
HRR	Heat release rate		
HTCD	Heavy truck clean diesel		
HTML	High Temperature Materials Laboratory		
Hz	Hertz	LES	Large eddy simulation
IC	Internal combustion	LHV	Lower heating value
ICCD	Intensified Charge Coupled Device (camera)	LIBS	Laser-induced breakdown spectroscopy
ICE	Internal combustion engine	LIDELS	Laser-induced desorption with elastic light scattering
ID	Injection duration		
ID	Internal diameter	LIF	Laser-induced fluorescence
IEA	International Energy Agency	LII	Laser-induced incandescence of soot
IEEE	Institute of Electrical and Electronics Engineering	LLNL	Lawrence Livermore National Laboratory
IMEP	Indicated mean effective pressure	LNT	Lean NO _x trap
imep	Indicated mean effective pressure	LO	Light-off temperature – the minimum temperature at which half the maximum catalyst activity is identified
IR	Infrared		
IVC	Intake valve camshaft		
J	Joule		
K	Kelvin	LQHCCI	Lean quasi-homogeneous charge compression ignition
K	Potassium		
K ₂ CO ₃	Potassium Carbonate	LSC	Lanthanum strontium chromite
K ₂ O	Potassium oxide	LTC	Low-temperature combustion
KeV	Kilo electron volts, a unit of energy	M/G	Motor/generator
kg	Kilogram	m ²	Square meters
kHz	Kilohertz	m ² /gm	Square meters per gram
KIVA	a transient, three-dimensional, multiphase, multicomponent code for the analysis of chemically reacting flows with sprays developed at the Los Alamos National Laboratory	m ³ mA mbar MBE MCRS	Square meters Milliamperes Millibar Molecular beam epitaxy Modular Common Rail System
kJ	Kilojoule		

MECA	Manufacturers of Emission Controls Association	OH	Hydroxyl
MeOH	Methanol	OH PLIF	Planar laser-induced fluorescence of OH
mg/cm ²	Milligrams per square centimeter	OMS	Octahedral molecular sieve
mg/mi	Milligram per mile	ORC	Organic Rankine Cycle
mg/mm ²	Micrograms per square millimeter	ORNL	Oak Ridge National Laboratory
mg/scf	Milligrams per standard cubic foot	P	Pressure
min	Minute	P2P	Ratio of the peak activity of a new material to the peak activity of a reference material
MIT	Massachusetts Institute of Technology		
MLQWF	Multi-layer quantum well films	PAC	Plasma-assisted catalyst
MLR	Multivariable local regression	PC	Personal computer
μm	Micrometer	PCCI	Premixed charge compression ignition
mm	Millimeter		
mmols	Micro-moles	PD	Photodiode
Mn	Manganese	PDF	Probability density function
Mo	Molybdenum	PEMS	Portable emissions measurement system
mol	Mole		
mol/s	Moles per second	PFI	Port fuel injection
MOU	Memorandum of Understanding	PFI-DI	Port fuel injection/direct injection
MPa	Megapascals	PhosphorT	Phosphor thermography instrument
mph	Miles per hour	PLII	Planar laser-induced incandescence
ms	Millisecond	PM	Particulate matter
MTU	Michigan Technological University	PM	Permanent magnet
MY	Model year	PMT	Photomultiplier tube
N ₂	Diatomic nitrogen	PNGV	Partnership for a New Generation of Vehicles
N ₂ O	Nitrous oxide		
N ₂ O ₃	Nitrogen trioxide	PNNL	Pacific Northwest National Laboratory
Na	Sodium		
NEA	Nitrogen-enriched air	Post80	Late cycle injection after the main fuel pulse at 80° after top dead center
NH ₃	Ammonia		
NLCAT	National Laboratory Catalysis Conference	PO _x	Partial oxidation
		ppb	Parts per billion
nm	Nanometer	ppi	Pores per square inch
Nm	Newton meter	ppm	Parts per million
NMHC	Non-methane hydrocarbon	PRF	Primary Reference Fuels (iso-octane and n-heptane),
NMOG	Non-methane organic gases		
NMR	Nuclear magnetic resonance	PRF80	PRF mixture with an octane number of 80 (i.e., 80% iso-octane and 20% n-heptane)
NO	Nitric oxide		
NO ₂	Nitrogen dioxide	psi	Pounds per square inch
NO _x	Oxides of nitrogen (NO and NO ₂)	psig	Pounds per square inch gauge
ns	Nanosecond	Pt	Platinum
NSR	Normalized stoichiometric ratio	QSB5.9	Quantum System B Series 5.9 Liter (Midrange Industrial Product)
NTE	Not-to-exceed		
NTP	Non-thermal plasma		
NTRC	National Transportation Research Center	QSC8.3/QSL9	Quantum System C Series 8.3 Liter, Quantum System L Series 9 Liter
O ₂	Diatomic (molecular) oxygen	QSK19	Quantum System K Series 19 Liter
OEM	Original Equipment Manufacturer	QSX15	Quantum System X Series 15 Liter
OFCVT	Office of FreedomCAR and Vehicle Technologies	QW	Quantum well
		R&D	Research and development

RANS	Reynolds averaged navier stokes	TACOM	Tank Automotive Armaments Command
RASP	Rotating arc spark plug	TCI	Turbulence/chemistry interactions
RCF	Rapid Compression Facility	TDC	Top dead center
RDG-PFA	Rayleigh-Debye-Gans polydisperse fractal aggregate	TDI	Turbocharged direct injection
Rh	Rhodium	TE	Thermoelectric
RIF	Representative interactive flamelet	TEG	Thermoelectric generator
ROI	Rate of injection	TEM	Transmission electron spectroscopy
rpm	Revolutions per minute	TEOM	Tapered element oscillating microbalance
RSM	Response surface method	TGA	Thermal gravimetric analysis
s	Conductivity (Wcm) ⁻¹	THC	Total hydrocarbons
S	Seebeck coefficient	Ti:Si	Ratio of titanium to silicon
S	Sulfur	TPD	Temperature-programmed desorption
S/N	Signal-to-noise ratio	TPGME	Tri-propylene glycol monomethyl ether
SAE	Society of Automotive Engineers	TPM	Total particulate matter
SBCE	Set-based concurrent engineering	TPR	Temperature-programmed reduction
sccm	Standard cubic centimeters	TPRX	Temperature-programmed reaction
SCE	Single-cylinder engine	TRLG	Top-ring-land crevice
SCF/min	Standard cubic feet per minute	TWC	
SCR	Selective catalytic reduction	UCB	University of California Berkeley
SCTE	Single-cylinder test engine	UEGO	Universal exhaust gas oxygen
sec	Second	UHC	Unburned hydrocarbons
SEM	Scanning electron microscopy	UIS	Unit injector system
SGS	Subgrid-scale	ULSD	Ultra-low sulfur diesel
Si	Silicon	UM	University of Michigan
SI	Spark ignition	UPS	Unit pump system
SiC	Silicon carbide	USCAR	U.S. Cooperative Automotive Research
SICM	System Integration Configuration Matrix	V	Volt
SIDI	Spark ignition direct injection	VCO	Valve-covering orifice
SINL	Spatially Integrated Natural Luminosity	VCR	Variable compression ratio
SLPM	Standard liters per minute	VDC	Voltage – direct current
SMPS	Scanning mobility particle scanner	VGC	Variable geometry compressor
SMR	Steam reformation	VGS	Variable geometry spray
SNL	Sandia National Laboratories	VNT	Variable nozzle turbine
SO ₂	Sulfur dioxide	VVA	Variable valve actuation
SOI	Start of injection	W	Watt
SO _x	Oxides of sulfur	W/cmK	Watts per centimeter-Kelvin
SpaciMS	Spatially resolved capillary inlet mass spectrometer	wt%	Weight percent
Sr	Strontium	XPS	X-ray photoelectron spectroscopy
SR	Switched reluctance	XRD	X-ray diffraction
sS ² T	Power factor (mV/°C)	Y	Yttrium
SU	Stanford University	yr	Year
SUV	Sports utility vehicle	Zn	Zinc
SV	Space velocity	ZT	Dimensionless thermoelectric figure of merit; equal to: (electrical conductivity)(Seebeck coefficient) ² (temperature)/(thermal conductivity)
T	Temperature		
T70	A fuel blend containing the oxygenate tetraethoxy-propane		

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