

SAE International's
Dictionary for
Automotive Engineers

SAE International's Dictionary for Automotive Engineers

BY
JOHN F. KERSHAW EdD



Warrendale, Pennsylvania, USA



400 Commonwealth Drive
Warrendale, PA 15096-0001 USA
E-mail: CustomerService@sae.org
Phone: 877-606-7323 (inside USA and
Canada)
724-776-4970 (outside USA)
FAX: 724-776-0790

Copyright © 2023 SAE International. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE International. For permission and licensing requests, contact SAE Permissions, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA; e-mail: copyright@sae.org; phone: 724-772-4028.

Library of Congress Catalog Number 2022951323
<http://dx.doi.org/10.4271/9781468604078>

Information contained in this work has been obtained by SAE International from sources believed to be reliable. However, neither SAE International nor its authors guarantee the accuracy or completeness of any information published herein and neither SAE International nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that SAE International and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

ISBN-Print 978-1-4686-0406-1
ISBN-PDF 978-1-4686-0407-8
ISBN-epub 978-1-4686-0408-5

To purchase bulk quantities, please contact: SAE Customer Service

E-mail: CustomerService@sae.org
Phone: 877-606-7323 (inside USA and Canada)
724-776-4970 (outside USA)
Fax: 724-776-0790

Visit the SAE International Bookstore at books.sae.org

Publisher

Sherry Dickinson Nigam

Development Editor

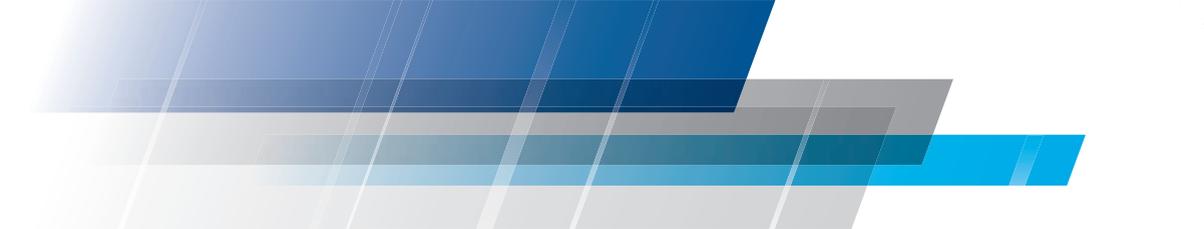
Publishers Solutions, LLC
Albany, NY

**Director of Content
Management**

Kelli Zilko

**Production and
Manufacturing Associate**

Brandon Joy



Contents

Preface	vii
Acknowledgments	viii
List of Acronyms	ix
A	1
B	65
C	109
D	163
E	203
F	233
G	265
H	279
I	303
J	321
K	327
L	335
M	353
N	373
O	379
P	393
Q	431
R	435
S	473

T	529
U	577
V	585
W	607
Y	623
Z	627

Index	629
About the Author	649



Preface

Without vision you may not succeed, so the vision for *SAE International's Dictionary of Automotive Engineering* is to become the most comprehensive automotive engineering reference for professionals and students alike.

This authoritative reference provides clearly written, easy-to-understand definitions for over 1,800 terms used in automotive engineering worldwide. Unlike a standard dictionary that provides only definitions, the *SAE International's Dictionary for Automotive Engineers* provides a unique level of details including:

- In-depth definitions including formulas and equations where appropriate.
- Over 300 full-color illustrations to provide clarity for a definition, component, or system identification.
- References to relevant SAE Standards to direct the read to additional information beyond a practical definition.
- Coverage of newer technologies such as electric vehicles, automated vehicles, hydrogen fuel.

Organized in alphabetical order, readers will find most acronyms are listed first followed by the term then the definition to mimic conventional usage of acronyms within the industry.

Whether you use the print or eBook addition, *SAE International's Dictionary of Automotive Engineering* exceeds similar resources providing readers with comprehensive view of all SAE offers by providing SAE Standard Identification whenever appropriate.



Acknowledgments

I want to thank my wife Joan for her continued support in all of my projects. Also, I need to acknowledge my good friend and colleague, noted author James Halderman, who has generously supported this project and many others projects along with Tom Richardson, Vice President of Government Affairs with the National Institute for Automotive Service Excellence (ASE).

List of Acronyms

2WD - Two-Wheel Drive	CCC (C3) - Computer Command Control
4WD - Four-Wheel Drive	CCI - Calculated Cetane Index
ABS - Anti-lock Brake System	CCM - Comprehensive Component Monitor
AC - Alternating Current	CDI - Capacitor Discharge Ignition
ADS - Automated Driving Systems	CDR - Crankcase Depression Regulator
AGM - Absorbed Glass Mat (Battery)	CDR - Crash Data Retrieval
ALCL - Assembly Line Communication Link	CEMF - Counterelectromotive Force
ALDL - Assembly Line Diagnostic Link	CFR - Cooperative Fuel Research
ASD - Automatic Shutdown	CHT - Cylinder Head Temperature
ASE - Automotive Service Excellence	CKP - Crankshaft Position
ASME - American Society of Mechanical Engineers	CM - Continuous Monitor
ASTM - American Society for Testing and Materials	CMP - Camshaft Position
AT - Automatic Transmission	CN - Cetane Number
ATA - American Trucking Associations (Connector)	CNG - Compressed Natural Gas
ATC - Automatic Traction Control (Heavy Truck)	CO₂ - Carbon Dioxide
ATC - Automatic Transfer Case	CO - Carbon Monoxide
ATCM - Automatic Transfer Case Control Module	COE - Cab-Over-Engine
ATDC - After Top Dead Center	CPI - Continuous Port Fuel Injection
ATF - Automatic Transmission Fluid	CPU - Central Processing Unit
AUTO-4WD - Automatic Four-Wheel Drive	CRT - Cathode Ray Tube
AV - Autonomous Vehicle	CV - Constant Velocity
AWD - All-Wheel Drive	CVT - Continuously Variable Transmission
BA - Brake Assist	DC - Direct Current
BAS - Belt Alternator Starter (Low-Cost Hybrids)	DEF - Diesel Exhaust Fluid
BCM - Body Control Module	DI - Direct Ignition
B-CAN - Body Control Area Network	DI - Distributor Ignition
BDC - Bottom Dead Center	DIC - Driver Information Center
BEV - Battery Electric Vehicle	DIS - Distributorless Ignition System
BHP - Brake Horsepower	DLC - Data Link Connector
BMEP - Brake Mean Effective Pressure	DMM - Digital Multimeter
BOV - Blow-Off Valve	DMS - Driver Monitoring System
BSFC - Brake Specific Fuel Consumption	DOC - Dual Overhead Camshaft
BTDC - Before Top Dead Center	DOC - Diesel Oxidation Catalyst
BTU - British Thermal Unit	DOT - Department of Transportation
CA - Cranking Amps	DPF - Diesel Particulate Filter
CAC - Charge Air Cooler	DSRC - Dedicated Short-Range Communication
CAFE - Corporate Average Fuel Economy	DTC - Diagnostic Trouble Code
CAN - Controller Area Network	EAS - Electrically Assisted Steering
CCA - Cold Cranking Amps	EBA - Emergency Brake Assist or Brake Assist (BA/BAS)
	EBCM - Electronic Brake Control Module

ECM - Engine or Electronic Control Module	IC - Integrated Circuit
ECU - Engine or Electronic Control Unit	ICM - Ignition Control Module
EEPROM - Electronically Erasable Programmable Read-Only Memory (E ² PROM)	IDI - Indirect Diesel Injection
EFI - Electronic Fuel Injection	IHP - Indicated Horsepower
EFT - Engine Fuel Temperature	IMEP - Indicated Mean Effective Pressure
EGR - Exhaust Gas Recirculation	IRS - Independent Rear Suspension
EMD - Engine Manufacturer's Diagnostic	ISO - International Standards Organization
EMI - Electromagnetic Interference	ITS - Intelligent Transportation System
EMF - Electromagnetic Field	IVHS - Intelligent Vehicle Highway System
EMF - Electromotive Force	IVT - Intelligent Vehicle Technologies
EP - Extreme Pressure (Additive)	KAM - Keep Alive Memory
EPA - Environmental Protection Agency	KES - Keyless Entry System
EPHS - Electrically Powered Hydraulic Steering	LCC - Lane Centering Control
EPROM - Erasable Programmable Read-Only Memory	LCD - Liquid Crystal Display
EPS - Electric Power Steering	LDW - Lane Departure Warning
ERFS - Electronic Returnless Fuel System	LNG - Liquefied Natural Gas
ESC - Electronic Spark Control	LPG - Liquid Petroleum Gas
ESC - Electronic Stability Control	LSD - Limited Slip Differential
ESD - Electrostatic Discharge	LTFT - Long-Term Fuel Trim
ESI - Electronic Service Information	LVD - Low-Voltage Disconnect
EST - Electronic Spark Timing	MAF - Mass Air Flow
EST - Electronic Service Tools	MANET - Mobile Ad Hoc Network
ETBE - Ethyl Tertiary Butyl Ether	MAP - Manifold Absolute Pressure
EUI - Electronic Unit Injector	MEP - Mean Effective Pressure
EV - Electric Vehicle	MIC - Multiplex Integrated Control
EVA - Electronic Vibration Analyzer	MID - Message Identifier
EVAP - Evaporative Emissions	MMT - Methyl-cyclopentadienyl Manganese Tricarboxylic
F-CAN - Fast Control Area Network	MON - Motor Octane Number
FAD - Front Axle Disconnect	MRFS - Mechanical Returnless Fuel System
FCD - Floating Car Data	MTBE - Methyl Tertiary Butyl Ether
FIFV - Flexible Fuel Vehicles	Nimh/Ni-MH - Nickel Metal Hydride Battery
FIPG - Formed-In-Place Gasket	NOP - Nominal Opening Pressure
FM - Frequency Modulation	NOx - Oxides of Nitrogen
FMI - Failure Mode Identifier	NTC - Negative Temperature Coefficient
FMVSS - Federal Motor Vehicle Safety Standard	OAT - Organic Acid Technology
FTP - Federal Test Procedure	OBD - On-Board Diagnostics
FWD - Front-Wheel Drive	OBD II - On-Board Diagnostics Generation II
GAWR - Gross Axle Weight Rating	OEM - Original Equipment Manufacturers
GCWR - Gross Combined Weight Rating	OHV - Overhead Valves
GDI - Gas Direct Injection	OL DMM - Digital Multimeter Symbol Over Limits or Overload
GVWR - Gross Vehicle Weight Rating	PCD - Pitch Circle Diameter
HD-OBD - Heavy-Duty On-Board Diagnostics	PCM - Powertrain Control Module
HEUI - Hydraulically Actuated Electronic Unit Injection	PDOF - Principle Direction of Force
HEV - Hybrid Electric Vehicle	PHOAT - Phosphate Hybrid Organic Acid Technology
HOAT - Hybrid Organic Acid Technology	PID - Parameter Identifier
HPCR - High-Pressure Common Rail	PM - Particulate Matter
HSD - High-Side Drivers	PMAC - Permanent Magnet AC
HUD - Heads-Up Display	PROM - Programmable Read-Only Memory
IAC - Idle Air Control	PTC - Positive Temperature Coefficient
IAT - Intake Air Temperature	PTO - Power Takeoff
IAT - Inorganic Additive Technology	PWM - Pulse Width Modulation
IC - Ignition Control	RAM - Random Access Memory

RBM - Resistance to Bending Moment	TCS - Traction Control System
RFG - Reformulated Gasoline	TDC - Top Dead Center
RFI - Radio Frequency Interference	TOOT - Toe-Out On Turns (Turning Radius)
ROM - Read-Only Memory	TPS - Throttle Position Sensor/Switch
RON - Research Octane Number	TSB - Technical Service Bulletins
RPM - Revolutions Per Minute	UTQGS - Uniform Tire Quality Grading System
RVP - Reid Vapor Pressure	V2I - Vehicle-to-Infrastructure
SAE - Society of Automotive Engineers	V2V - Vehicle-To-Vehicle Communication
SAI - Steering Axis Inclination	VANET - Vehicular Ad Hoc Network
SCR - Select Catalyst Reduction	VCO - Valve Covering Orifice
SDS - Safety Data Sheets	V/div - Volts Per Division
SFI - Sequential Fuel Injection	VI - Viscosity Index
SID - Subsystem Identifier	VIN - Vehicle Identification Number
SLA - Short-Arm/Long-Arm (Suspension)	V-ref - Reference Voltage
SLA - Sealed Lead-Acid	VRLA - Valve Regulated Lead Acid (Battery)
SOC - State of Charge	VSM - Value Stream Map
STFT - Short-Term Fuel Trim	VSS - Vehicle Speed Sensor
TAC - Thermostatic Air Cleaner	WSS - Wheel Speed Sensor
TBI - Throttle Body Injection	WVSCT - Wireless Vehicle Safety Communications
TCC - Torque Converter Clutch	Telematics
TCM - Transmission Control Module	

