

## Audi A6 C5 Service Manual

Electrical issues in European cars can be intimidating. The Hack Mechanic Guide to European Automotive Electrical Systems shows you how to think about electricity in your car and then take on real-world electrical problems. The principles discussed can be applied to most conventional internal-combustion-engined vehicles, with a focus on European cars spanning the past six decades. Drawing on The Hack Mechanic's wisdom and experience, the 38 chapters cover key electrical topics such as battery, starter, alternator, ignition, circuits, and relays. Through a practical and informal approach featuring hundreds of full-color illustrations, author Rob Siegel takes the fear-factor out of projects like making wire repairs, measuring voltage drops, or figuring out if you have a bad fuel pump relay. Essential tools such as multimeters (DVOM), oscilloscopes, and scan tools are discussed, with special attention given to the automotive multimeter needed to troubleshoot many modern sensors. You'll get step-by-step troubleshooting procedures ranging from safely jump starting a battery to diagnosing parasitic current drain and vehicle energy diagnosis. And you'll find detailed testing procedures for most problematic electrical components on your European car such as oxygen sensors, crankshaft and camshaft sensors, wheel speed sensors, fuel pumps, solenoids, and actuators. Reading wiring diagrams and decoding the German DIN standard are also covered. Whether you are a DIY mechanic or a professional technician, The Hack Mechanic Guide to European Automotive Electrical Systems will increase your confidence in tackling automotive electrical problem-solving. This book applies to gasoline and diesel powered internal combustion engine vehicles. Not intended for hybrid or electric vehicles.

The ultimate service manuals! Bentley manuals are the only comprehensive, single source of service information and specifications available for BMW cars. These manuals provide the highest level of clarity and completeness for all service and repair procedures. Enthusiasts, do-it-yourselfers, and professional technicians will appreciate the quality of photographs and illustrations, theory of operation, and accurate step-by-step instructions. If you are looking for better understanding of your BMW, look no further than Bentley. Even if you do not repair your own vehicle, knowledge of its internal workings will help you when discussing repairs and maintenance with your professional automotive technician. This Bentley Manual is the only comprehensive, single source of service information and specifications available specifically for BMW 5 Series from 1997 to 2002. The aim throughout this manual has been simplicity, clarity and completeness, with practical explanations, step-by-step procedures and accurate specifications. Whether you are a professional or a do-it-yourself BMW owner, this manual will help you understand, care for and repair your E39 5 Series. Though the do-it-yourself BMW owner will find this manual indispensable as a source of detailed maintenance and repair information, the BMW owner who has no intention of working on his or her car will find that reading and owning this manual will make it possible to discuss repairs more intelligently with a professional technician.

Saloon & Estate inc. special/limited editions. Does NOT cover Quattro, S4 or S6 Petrol: 1.8 litre (1781cc), 2.0 litre (1984cc) & 2.3 litre (2309cc). Does NOT cover V6 petrol engine. Turbo-Diesel: 1.9 litre (1896cc) & 2.5 litre (2460cc).

The MINI Cooper Service Manual: 2002-2006 is a comprehensive source of service information and specifications for MINI Cooper models from 2002 to 2006. This manual supersedes our previous 2002-2004 manual with two more model years of coverage as well as new repair information for the Convertible model. The manual also includes coverage of the Cooper S models. The aim throughout this manual has been simplicity, clarity and completeness, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself MINI owner, this manual will help you understand, care for and repair your car. Though the do-it-yourself MINI owner will find this manual indispensable as a source of detailed maintenance and repair information, the owner who has no intention of working on his or her car will find that reading and owning this manual will make it possible to discuss repairs more intelligently with a professional technician.

First shown as the TT coupe concept at the 1995 Frankfurt Motor Show and then soon afterward as the TT convertible at the Tokyo Motor Show, the cars heralded a new design language from Audi - the Bauhaus style from the 1930s that looked a little brutal at first, but has proven to have a long and successful production life. It finally arrived on the European market for the 1999 model year, with America following a little later. Senior Audi models, the A4, A6, and A8, have their engine and transmission sited longitudinally in the car, but the TT was based on the smaller A3 platform, which meant that the mechanical components were sited transversely. After a slow start, sales picked up and have remained strong ever since. The media loved the Audi TT and continued to write glowing reports about it even though it was six years old in the marketplace, outlasting the Mercedes-Benz SLK, BMW Z3, and Porsche Boxster by quite some time.

A History of Progress chronicles the fascinating history of Audi AG, from its beginnings in Germany in 1909 to its unique place in the market today. This detailed walk through Audi's accomplishments covers all of the company's changes through the years. The entire Audi "family tree" is examined in detail-Wanderer, DKW, Horch, AudiA697, Auto Union, NSU-their participation in motor sports, & bios of the people who made the company what it is today. A History of Progress contains hundreds of rare factory photos & illustrations, presenting Audi's past & present in a hardcover, high quality book. Whether you are an Audi owner, enthusiast or automotive historian, A History of Progress belongs on your bookshelf. A beautiful hardcover edition.

"Service and repair information for Porsche 911 vehicles, Type 993, applicable to model years 1995, 1996, 1997, and 1998"--

Provides a general overview of Lessac-Madsen Resonant Voice Therapy and demonstration of this voice therapy with a patient.

This international bestseller is the most comprehensive and authoritative DIY manual ever produced. This new edition has been updated with information on all the latest changes in products, techniques and regulations developed since the last edition (published in 2004). Catering to novices, DIY enthusiasts or professionals, this essential book continues to be the most in-depth, up-to-date and user-friendly DIY book on the market, covering everything from decorating and repairs to electricity, plumbing and much more.

Energy Efficiency: Concepts and Calculations is the first book of its kind to provide an applied, systems oriented description of energy intensity and efficiency in modern economies across the entire energy chain. With an emphasis on analysis, specifically energy flow analysis, lifecycle energy accounting, economic analysis, technology evaluation, and policies/strategies for adopting high energy efficiency standards, the book provides a comprehensive understanding of the concepts, tools and methodologies for studying and modeling macro-level energy flows through, and within, key economic sectors (electric power, industrial, commercial, residential and transportation). Providing a technical discussion of the application of common methodologies (e.g. cost-benefit analysis and lifecycle assessment), each chapter contains figures, charts and examples from each sector, including the policies that have been put in place to promote and incentivize the adoption of energy efficient technologies. Contains models and tools to analyze each stage at the macro-level by tracking energy consumption and how the resulting data might change energy use Includes accessible references and a glossary of common terms at the end of each chapter Provides diagnostic figures, tables and schematics within the context of local, regional and national energy consumption and utilization

Hatchback, including special/limited editions. Does NOT cover features specific to Dune models, or facelifted Polo range introduced June 2005. Petrol: 1.2 litre (1198cc) 3-cyl & 1.4 litre (1390cc, non-FSI) 4-cyl. Does NOT cover 1.4 litre FSI engines. Diesel: 1.4 litre (1422cc) 3-cyl & 1.9 litre (1896cc) 4-cyl, inc. PD TDI / turbo.

Modern cars are more computerized than ever. Infotainment and navigation systems, Wi-Fi, automatic software updates, and other innovations aim to make driving more convenient. But vehicle technologies haven't kept pace with today's more hostile security environment, leaving millions vulnerable to attack. The Car Hacker's Handbook will give you a deeper understanding of the computer systems and embedded software in modern vehicles. It begins by examining vulnerabilities and providing detailed explanations of communications over the CAN bus and between devices and systems. Then, once you have an understanding of a vehicle's communication network, you'll learn how to intercept data and perform specific hacks to track vehicles, unlock doors, glitch engines, flood communication, and more. With a focus on low-cost, open source hacking tools such as Metasploit, Wireshark, Kayak, can-utils, and ChipWhisperer, The Car Hacker's Handbook will show you how to: –Build an accurate threat model for your vehicle –Reverse engineer the CAN bus to fake engine signals –Exploit vulnerabilities in diagnostic and data-logging systems –Hack the ECU and other firmware and embedded systems –Feed exploits through infotainment and vehicle-to-vehicle communication systems –Override factory settings with performance-tuning techniques –Build physical and virtual test benches to try out exploits safely If you're curious about automotive security and have the urge to hack a two-ton computer, make The Car Hacker's Handbook your first stop.

The Audi A4 Service Manual: 2002-2008 contains in-depth maintenance, service and repair information for Audi A4 models from 2002 to 2008 built on the B6 or B7 platforms. Service to Audi owners is of top priority to Audi and has always included the continuing development and introduction of new and expanded services. Whether you're a professional or a do-it-yourself Audi owner, this manual will help you understand, care for and repair your Audi. Engines covered: 1.8L turbo gasoline (engine code: AMB) 2.0L turbo FSI gasoline (engine codes: BGP, BWT) 3.0L gasoline (engine codes: AVK, BGN) 3.2L gasoline (engine codes: BKH) Transmissions covered: 5-speed Manual (transmission codes: 012, 01W, 01A) 6-speed Manual (transmission codes: 01E, 01X, 02X) 5-speed Automatic (transmission code: 01V) 6-speed Automatic (transmission code: 09L) CVT (transmission code: 01J)

How Cars Work is a completely illustrated primer describing the 250 most important car parts and how they work. This mini test book includes wonderfully simple line drawings and clear language to describe all the automotive systems as well as a glossary, index, and a test after each chapter. How Cars Work provides the basic vocabulary and mechanical knowledge to help a reader talk intelligently with mechanics understand shop manuals, and diagnosis car problems. Tom Newton guides the reader with a one topic per page format that delivers information in bite size chunks, just right for teenage boys.

How Cars Work was the most stolen book at Kennedy High School in Richmond California! Teachers like our title and so do librarians. The History channel, Modern Marvels-2000, Actuality Productions, Inc is using How Cars Work to train staff for a documentary on automobiles.

Iolanthe and Titus's mission comes to its thrilling end in the third book in the Elemental Trilogy—perfect for fans of Cinda Williams Chima and Kristin Cashore—which Publishers Weekly called "a wonderfully satisfying magical saga" in a starred review and Kirkus Reviews said "bids fair to be the next big epic fantasy success." In a pursuit that spans continents, Iolanthe, Titus, and their friends have always managed to remain one step ahead of the forces of Atlantis. But now the Bane, the monstrous tyrant who bestrides the entire mage world, has issued his ultimatum: Titus must hand over Iolanthe, or watch as his entire realm is destroyed in a deadly rampage. Running out of time and options, Iolanthe and Titus decide to act now and deliver a final blow to the Bane that will end his reign of terror for good. But getting to the Bane means accomplishing the impossible: finding a way to infiltrate his crypt in the deepest recesses of the most ferociously guarded fortress in Atlantis. And everything is only made more difficult when new prophecies come to light, foretelling a doomed effort. . . . Iolanthe and Titus will put their love and their lives on the line. But will it be enough?

The BMW X3 (E83) Service Manual: 2004-2010 contains in-depth maintenance, service and repair information for the BMW X3 from 2004 to 2010. The aim throughout has been simplicity and clarity, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself BMW owner, this manual helps you understand, care for and repair your BMW. Engines covered: M54 engine: 2.5i, 3.0i (2004-2006) N52 engine: 3.0si, xDrive 30i (2007-2010) Transmissions covered: Manual: ZF GS6-37BZ (6-speed) Automatic: GM A5S390R (5-speed) Automatic: GM GA6L45R (6-speed)

Engines covered - 1.9L TDI diesel (engine code: BRM) - 2.0L FSI turbo gasoline (engine code: BPY) - 2.5L gasoline (engine code: BGP, BGQ) Transmissions covered (remove, install, external service): - 04A 5-speed manual - 02Q 6-speed manual - 09G 6-speed automatic - 02E 6-speed DSG

The Audi A6 (C5 platform) Repair Manual: 1998-2004 is a comprehensive source of service information and technical specifications available for Audi A6 and S6 models build on the C5 platform, including the allroad quattro and the RS6. The aim throughout has been simplicity and clarity, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself Audi owner, this manual helps you understand, care for and repair your Audi. Engines covered: \* 1998 - 2001 2.8 liter V6 (AHA, ATQ) \* 1999 - 2004 4.2 liter V8 (ART, AWN, BBD) \* 2000 - 2004 2.7 liter V6 biturbo (APB, BEL) \* 2002 - 2004 3.0 liter V6 (AVK) \* 2003 - 2004 4.2 liter V8 (BAS) \* 2003 - 2004 4.2 liter V8 biturbo (BCY) Transmissions covered: \* 5-speed manual AWD (01A) \* 6-speed manual AWD (01E) \* 5-speed automatic AWD (1L) \* 5-speed automatic FWD or AWD (1V) \* Continuously variable transmission (CVT) FWD (01J)

Audi A6 (C5) Service Manual 1998, 1999, 2000, 2001, 2002, 2003 2004A6, Allroad Quattro, S6, RS6

Bentley Publishers is the exclusive factory-authorized publisher of Audi Repair Manuals in the United States and Canada. The format has been designed for professional technicians so that finding applicable specifications is quick and easy, and so that repair procedures can be grasped after a minimum of reading. All manuals are heavily illustrated with high-quality photographs and drawings, and cover aspects of



maintenance and service work. Every manual is with factory specifications and tolerances. The "Audi A6 Electrical Wiring Manual: 1998-2000 covers Audi A6 models built on the "C5" platform through model year 2000. This manual has been prepared using factory wiring diagrams, electrical component location information and scan tool diagnostics. Whether you're a professional service technician or a do-it-yourself Audi owner, this manual will be indispensable as a source of the same detailed electrical system information available at an authorized Audi dealer. Unfortunately, Audi factory wiring diagrams are no longer available on paper. Even an Audi owner who has no intention of working on his or her car will find that reviewing and owning this manual will make it possible to discuss repairs more intelligently with a professional service technician.

Hydrogen Fuel Cells for Road Vehicles addresses the main issues related to the application of hydrogen fuel cell technology in the road transportation sector. A preliminary treatment is given on fuel resources and atmospheric pollution concerns which are closely related to the current technology (internal combustion engine) used for moving people and goods. The authors deal, in particular, with the problems that can hinder a widespread hydrogen market (production, storage and distribution), as well as giving an analysis of fuel cell technologies available for utilization of this energy carrier in the automotive field. Hydrogen Fuel Cells for Road Vehicles also examines the concerns faced during the design and realization of a PEM fuel cell system with optimal size and efficiency, evidencing the impact of the individual auxiliary components on energy losses and dynamic stack performance. The book ends with the analysis of two practical case studies on fuel cell propulsion systems. Hydrogen Fuel Cells for Road Vehicles is a useful text for researchers, professionals and advanced students in the fields of automotive and environmental engineering.

This book presents some of the world's greatest modern buildings, from 1950 to the present, dissected and analyzed through specially commissioned freehand drawings.

The Audi A4 (B5): 1996-2001 Service Manual contains in-depth maintenance, service and repair information for Audi A4 models built on the B5 platform from 1996 to 2001. Service to Audi owners is of top priority to Audi and has always included the continuing development and introduction of new and expanded services. The aim throughout this manual has been simplicity and clarity, with practical explanations, step-by-step procedures, and factory specifications. Whether you're a professional or a do-it-yourself Audi owner, this manual will help you understand, care for, and repair your Audi. Engines covered: \* 1.8L turbo gasoline (engine codes: AEB, ATW, AWM) \* 2.8L gasoline (engine codes: AFC, AHA, ATQ) Transmissions covered: \* 5-speed Manual (transmission codes: 012, 01W, 01A) \* 5-speed Automatic (transmission code 01V)

Throughout history, many people have escaped to nature either permanently or temporarily to rest and recharge. Richard L. Proenneke, a modern-day Henry David Thoreau, is no exception. Proenneke built a cabin in Twin Lakes, Alaska in 1968 and began thirty years of personal growth, which he spent growing more connected to the wilderness in which he lived. This guide through Proenneke's memories follows the journey that began with One Man's Wilderness, which contains some of Proenneke's journals. It continues the story and reflections of this mountain man and his time in Alaska. The editor, John Branson, was a longtime friend of Proenneke's and a park historian. He takes care that Proenneke's journals from 1974-1980 are kept exactly as the author wrote them. Branson's footnotes give a background and a new understanding to the reader without detracting from Proenneke's style. Anyone with an interest in conservation and genuine wilderness narratives will surely enjoy and treasure this book.

This Bentley Manual contains in-depth maintenance, service and repair information for the BMW 3 Series from 2006 to 2010. The aim throughout has been simplicity and clarity, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself BMW owner, this manual helps you understand, care for and repair your BMW.

This Bosch Bible fully explains the theory, troubleshooting, and service of all Bosch systems from D-Jetronic through the latest Motronics. Includes high-performance tuning secrets and information on the newest KE- and LH-Motronic systems not available from any other source.

The BMW 3 Series (F30, F31, F34) Service Manual: 2012-2015 contains in-depth maintenance, service and repair information for the BMW 3 Series from 2012 to 2015. The aim throughout has been simplicity and clarity, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself BMW owner, this manual helps you understand, care for and repair your 3 Series. Engines (Gasoline): N20 engine: 320i, 328i, including xDrive N26 (SULEV) engine: 328i including xDrive N55 engine: 335i, including xDrive

The BMW 4 Series Service Manual: 2014-2016 contains in-depth maintenance, service and repair information for the BMW 4 Series from 2014 to 2016. The aim throughout has been simplicity and clarity, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself BMW owner, this manual helps you understand, care for and repair your 4 Series. The do-it-yourself BMW owner will find this manual indispensable as a source of detailed maintenance and repair information. Even if you have no intention of working on your vehicle, you will find that reading and owning this manual makes it possible to discuss repairs more intelligently with a professional technician. Features: \*Maintenance procedures from changing the cabin microfilter to replacing and registering a new battery. This manual tells you what to do and how and when to do it. \*Front-to-rear fluid and lubricant service, including xDrive transfer case fluid and ATF. \*Cylinder head cover gasket and crankshaft seal replacement. \*Cooling system, thermostat and radiator service. \*Gasoline fuel and ignition system diagrams and explanations for turbo-valvetronic-direct injection (TVDI) engines. \*Service and repair information on BMW EfficientDynamics technology, such as Valvetronic, xDrive, TwinPower turbo, and DSC (dynamic stability control). \*Twin scroll (gasoline) turbocharger replacement for 4- and 6-cylinder engines. \*Step-by-step variable camshaft timing (VANOS) service. \*Suspension repairs, including wheel bearing replacement. \*Brakes, steering and ABS troubleshooting and repair. \*Heating and air-conditioning repair, including A/C component replacement. \*Body and lid repairs and adjustments, including Gran Coupe tailgate and rear doors. \*Retractable hardtop service, including electrical, mechanical and hydraulic component operation, locations and replacement. \*Electrical system service, with an easy-to-use illustrated component locator section. \*Comprehensive wiring schematics, including fuses and grounds. \*BMW OBD II

diagnostic trouble codes, SAE-defined OBD II P-codes, as well as basic scan tool operation.\*BMW factory tolerances, wear limits, adjustments and tightening torques.Engines:\*N20 engine: 428i, including xDrive\*N26 (SULEV) engine: 428i including xDrive\*N55 engine: 435i, including xDriveManual transmissions:\*GS6-17BG (4-cylinder models)\*GS6-45BZ (6-cylinder models, RWD)\*GS6X-45BZ (6-cylinder models, with xDrive)Automatic transmissions:\*ZF GA8HP45Z

If you own one of these fabulous cars then you know how fun it is to drive. And, you probably know that your MINI is packed with some of BMW's latest automotive technology. But if you want to maintain and repair your car yourself (or just want to understand what's going on under the bonnet), you'll be wanting the MINI Cooper, Cooper S 2002-2004 Service Manual by Bentley Publishers. This is the only comprehensive, single source of service information and specifications available for MINI models from 2002-2004. The aim throughout this manual has been simplicity, clarity and completeness, achieved through practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional technician or a do-it-yourself MINI owner, this manual will help you understand, care for and repair your car. Bentley Publishers' new MINI service and repair manual is based on factory information, but is heavily supplemented by hands-on experience and illustrations. The service manual editorial team has disassembled and photographed several MINI models for this project in the Bentley Service Information Research Center.

Few would deny that we are entering a period of great change. Our environment is collapsing. Social disruption abounds. All around, it seems, we are experiencing breakdown. But out of this chaos comes the opportunity for breakthrough-the opportunity to reimagine our future. In *Dreaming the Future*, Kenny Ausubel leads us into that possible new world and introduces us to the thinkers and doers who are-sometimes quietly, sometimes not-leading what he calls "a revolution from the heart of nature and the human heart." In a collection of short, witty, poignant, even humorous essays, Ausubel tracks the big ideas, emerging trends, and game-changing developments of our time. He guides us through our watershed moment, showing how it's possible to emerge from a world where corporations are citizens, the gap between rich and poor is cavernous, and biodiversity and the climate are under assault and create a world where we take our cues from nature and focus on justice, equity, diversity, democracy, and peace. Even those steeped in the realities of a world gone wrong and efforts to right it will find refreshing, even surprising, perspectives in *Dreaming the Future*. It will come as no surprise to readers that Ausubel is cofounder of Bioneers-which foreword author David W. Orr describes as "one part global salon...one part catalytic organization."

For over 25 years Rob Siegel has written a monthly column called "The Hack Mechanic" for the BMW Car Club of America's magazine *Roundel*. In *Memoirs of a Hack Mechanic*, Rob Siegel shares his secrets to buying, fixing, and driving cool cars without risking the kids' tuition money or destroying his marriage. And that's something to brag about considering the dozens of cars, including twenty-five BMW 2002s, that have passed through his garage over the past three decades. With a steady dose of irreverent humor, *Memoirs of a Hack Mechanic* blends car stories, DIY advice, and cautionary tales in a way that will resonate with the car-obsessed (and the people who love them).

The FileMaker Pro 10 desktop database lets you do almost anything with the information you give it -- especially with this book as your guide. Clear, thorough, and accessible, FileMaker Pro 10: *The Missing Manual* helps you get in, build your database, and get the results you need, whether you're running a business, pursuing a hobby, or planning your retirement. It's the ideal guide for non-technical and experienced folks alike. Each chapter in this fully updated edition covers the latest timesaving features of FileMaker Pro 10, including saved finds and a redesigned toolbar that reveals information and features more clearly than ever. You'll learn how to import information from the new Bento consumer database (Mac only), write scripts to make your database even easier to use, and send email without leaving FileMaker. With this book, you will: Get your first database running in minutes and perform basic tasks right away Catalog people, processes, and things with streamlined data entry and sorting tools Use your data to generate reports, correspondence, and other documents with ease Create, connect, and manage multiple tables and set up complex relationships that display just the data you need Crunch numbers, search text, or pin down dates and times with dozens of built-in formulas Outfit your database for the Web, and import and export data to other formats You'll also get objective advice on which features are really useful, and which aren't. To make the most of this database, you need FileMaker Pro 10: *The Missing Manual* -- the book that should have been in the box.

The MINI Cooper, Cooper S, Clubman (R55, R56, R57) 2007-2013 Service Manual is a comprehensive source of service information and specifications for MINI Cooper models from 2007 to 2013 (Mk II). The aim throughout this manual has been simplicity, clarity and completeness, with practical explanations, step-by-step procedures and accurate specifications. Whether you're a professional or a do-it-yourself MINI owner, this manual will help you understand, care for and repair your car. Engines covered: Cooper: 1.6 liter normally aspirated engine (engine codes N12, N16) Cooper S: 1.6 liter supercharged engine (engine codes N14, N18) Transmissions covered: Manual: 6-speed Getrag (GS6-55BG for Cooper, GS6-53BG for Cooper S) Automatic: 6-speed with Agitronic, Aisin (GA6F21WA)

Head gasket repairs, valve adjustments, camshaft timing, carb and SPICA fuel injection tuning, and driveshaft donut replacement are all explained. Experienced, hands-on guidance that'll keep you in the drivers seat.

More muscle under your hood! Covers computer chips to crate motors! • Early or late model GM, Ford or Chrysler • Step-by-step engine build-ups • Quick and easy horsepower tips Included in the Engine Performance Haynes Techbook are these topics: • Power planning • Choosing a speed shop • Computers and chips • Ignition systems • Fuel and induction systems • Cylinder heads, camshafts. and valvetrain • Nitrous oxide, turbos and superchargers • Engine build-ups • Crate motors and engine swaps

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