B

B20

B20 is a diesel fuel blend consisting of 20% biodiesel and 80% petroleum diesel. It can generally be used in unmodified diesel engines; however, users should consult the engine original equipment manufacturer (OEM) for fuel usage information. For more information on this, see **J1297_201710** *Alternative Automotive Fuels* [1].

Babbitt

An automotive engine bearing material made from a combination of lead, tin, and antimony. Lead and tin are alloyed with small quantities of copper and antimony to provide the needed strength. Babbitt is used in internal combustion engines (ICEs) where a soft material is required for soft shafts running under moderate loads and speeds.

Back Spacing

The distance between the rear wheel rim edge and therefore the center section mounting pad of a wheel. For more information on this, see **J2047_201911** [6].

Back Taper

An angle cut opposite to a chamfer of a gear in order that the spine or tooth narrows just behind the chamfered end.

Backfire

Combustion or an explosion produced by a running ICE that happens in the exhaust, instead of inside the combustion chamber. The fuel burn occurs while the intake valve is open, causing combustion to maneuver backward through the system and out through the intake rather than the exhaust. When the flame moves backward, it is going to even be called a pop-back. A backfire can be caused by either ignition that takes place while the poppet valve is open or

unburnt fuel making its way within the hot exhaust. It is possible for a visual flame to momentarily shoot out the throttle valve.

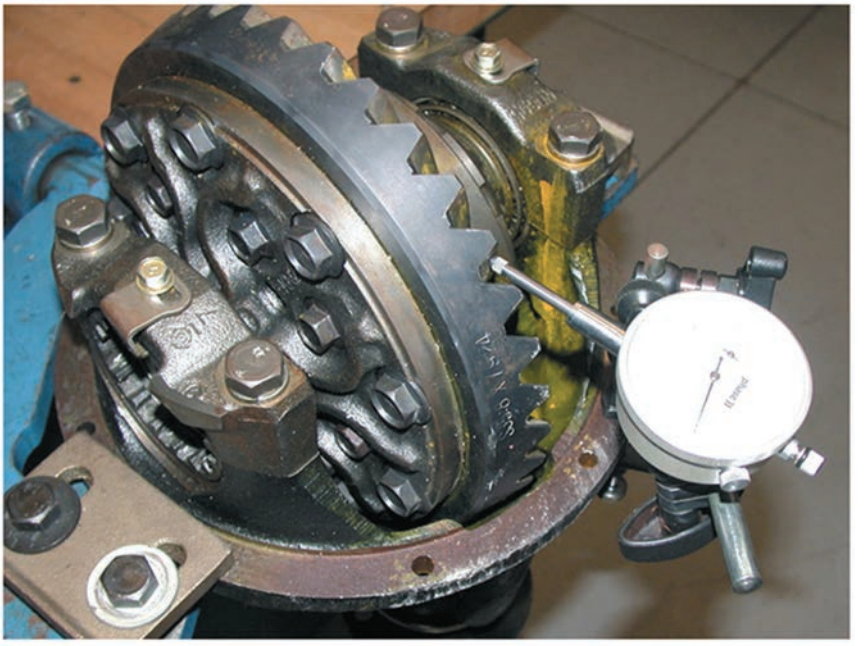
Backing Plate

This device is the mounting for the braking components of a drum brake system. The backing plate holds the hydraulic brakes shoes, springs, wheel cylinder, and other hardware inside the cylinder. The backing plate bolts to the axle housing or spindle, and helps keep dirt and water off the brakes.

Backlash

Clearance between the ring gear and pinion on the final drive. Backlash is determined by mounting a dial indicator to the differential housing and placing the button of the dial indicator gauge against a tooth of the ring gear. Move the ring gear back and forth to indicate movement on the dial indicator.

FIGURE B.1 Final drive ring and pinion backlash.



Courtesy of John F. Kershaw Ed.D.

Backlight

Another name for the rear window glass in a car.

Backpressure

The exhaust system resistance to flow, which can be measured using a gauge installed in the exhaust or a vacuum gauge in the intake manifold on a spark-ignited ICE and measured in pounds per square inch (psi). It is the exhaust gas pressure buildup in the exhaust system, and it can occur before or after the exhaust turbine of the turbocharger.

Backside Spacing (Rear Spacing)

The distance between the back wheel rim edge and the wheel center section mounting pad. This is not the same as offset.

Backup Camera

This camera gives the motive force a view of the realm behind the vehicle when the transmission is placed in reverse. It is utilized in conjunction with a frontway camera that shows the trail forward. The rear vision camera may be a video camera that is produced specifically for the aim of being attached to the rear of a vehicle to assist in backing up and to alleviate the rear blind spot. The backup camera is employed to avoid a collision when stepping into reverse. The rear vision camera provides the driving force with a view of the scene directly behind the vehicle on the infotainment system display (or inside the rearview mirror) to assist in parking and avoid crashing into nearby objects when in reverse. If the vehicle is supplied with a high-definition (HD) rear vision camera, this feature provides the driving force with a high-resolution "digital" view. Analog rear vision cameras are identified by multiple wires at the camera electrical connector. Digital rear vision cameras are identified by a line connection at the camera [2].

Bakelite

Brand name of the Union Carbide Company for phenolformaldehyde resin plastic.

Balance Shaft

A shaft in the engine that is designed so that, as it rotates, it reduces or cancels out any vibration by providing an opposite force to counter the vibrating force.

Ball Bearing

A rotating bearing that can be located between two rotating components like an automotive wheel and a fixed axle, where the rotating part and the stationary part are separated by a ring of small solid metal balls lubricated by grease used to reduce friction.

Ball Joint

Flexible joint having a ball-and-socket kind of construction. Ball joints are typically constructed of a ball and socket. This term is reserved for the primary joints that the steering knuckle pivots on, and tie-rod ends are the term used for the ball-and-socket joints on the steering linkage. They allow the control arms to move up and down with suspension deflection and let the wheel and knuckle assembly rotate for steering. The ball joint in most modern vehicles is a sealed, self-contained unit that is replaced as a unit when it is worn out. It is contained in a pressed-steel housing, fitted with sintered (bonded using pressure and heat) iron seats

FIGURE B.2 Ball joints are swivel connections mounted on the outer ends of the control arms or steering linkage.

Warut Wetsanarut/Shutterstock.com.

Banjo Axle

This axle design uses a hollow central member having a pair of hollow tubes extending outwardly therefrom. Forward and rearward openings are in the central member, each having triangular shaped side portions located adjacent to the tubes.

FIGURE B.3 Heavy truck banjo axle.

Ake Apichai Chumsri/Shutterstock.com.

Bar

Bar is a measure of pressure: 1 bar = 14.5038 psi.

BARO Sensor

A sensor used to measure barometric pressure (BARO) or changes in barometric absolute pressure (atmospheric air pressure). It is vented directly into the atmosphere.

Barometric Manifold Absolute Pressure (BMAP) Sensor

Combination of a BARO and MAP sensor in the same housing.

Barometric Pressure

The measure of atmospheric pressure, in inches of mercury (Hg), which reflects altitude and weather conditions.

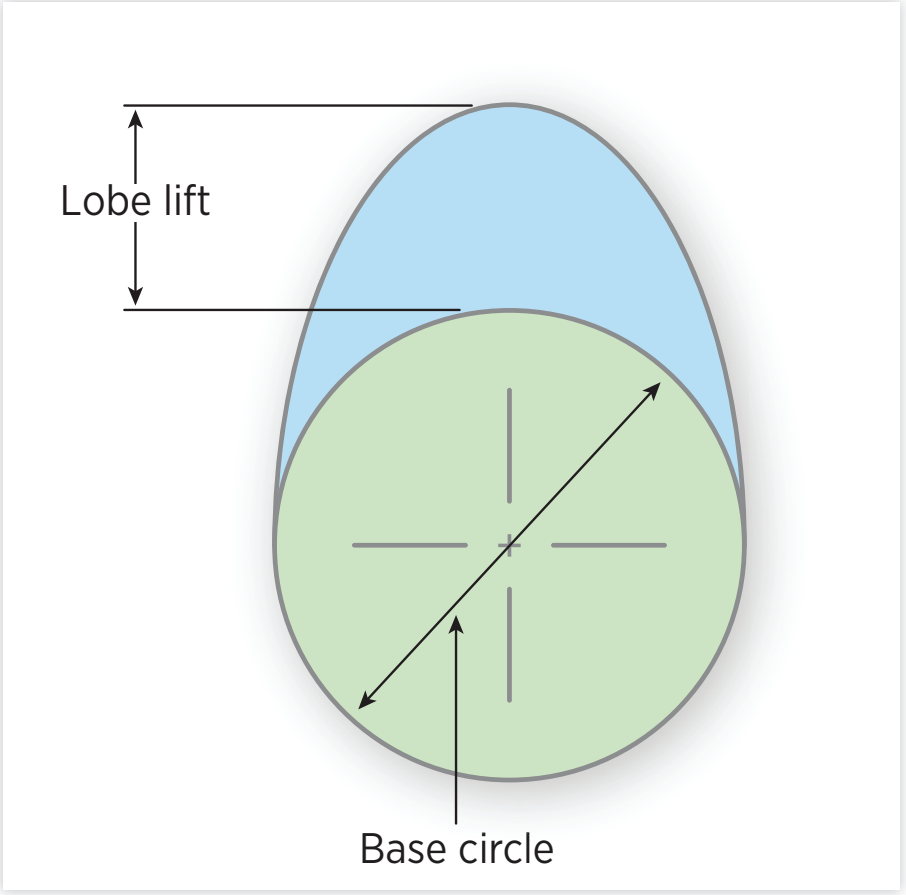
Base

The name for the portion of a solid-state silicone transistor that controls the current flow through the transistor.

Base Circle

Lowest spot on an ICE camshaft, which is the area of the camshaft directly opposite the lobe or nose.

FIGURE B.4 The base circle.



Courtesy of John F. Kershaw Ed.D.

Base Timing

Timing of an ICE ignition spark before the ignition timing is advanced electronically or mechanically.

Basic Mathematics (Addition, Subtraction, Multiplication, and Division)

Mathematics is the manipulation of numbers. Taught at the first or secondary levels. The mastery of mathematics is critical for several professions, including engineering, electronics, carpentry, plumbing, and automobile repair. The order of mathematical actions is Parentheses, Exponents, Multiplication, Division, Addition, and Subtraction. The acronym PEMDAS "Please Excuse My Dear Aunt Sally" is useful in remembering the order of mathematical operations

Battery

A device that uses chemical energy to store and produce electric current and voltage. It changes the electric current generated by the charging system into chemical energy and uses this energy for vehicle systems when the ICE is not running. Chemicals inside the battery store the electrical energy until needed to perform work. It is then changed back into electrical energy and sent through a circuit to the system where it is needed. Electrochemical reaction occurs so that electrons move from one pole to other metals and electrolytes used to control the voltage of the battery. It has one or more cells where chemical energy is converted into electricity and used as a source of power. Automotive batteries use a lead-acid chemical process to store electrical current. The inside of a lead-acid battery is made up of grids, positive plates, negative plates, and separators. The grids form the basic framework of the battery plates. The grids of the positive plates are filled with lead dioxide paste. Negative plates of the battery are coated with sponge lead paste. For more information on this, see **J1715/2_202108** [3].

Battery Case

Positive and negative plates sit in a case or shell of the battery. This case is a strong but lightweight one-piece molded plastic or rubber housing. Inside the battery case is a number of individual cell compartments. For more information on this, see **J1715/2_202108** [3].

Battery Charging

The method in which charging occurs inside of a battery is the reverse of the discharging process. Electricity from the alternator is forced into the battery. This causes the water in the battery to change back to sulfuric acid. This change from water to sulfuric acid causes some of the water to turn into hydrogen and oxygen gas. On vented batteries this gas can vent into the outside air. This causes the electrolyte level inside the battery to drop. For more information on this, see **J1715/2_202108** [3].

Battery Conductance Test Procedure

Using a battery conductance tester:

- Consult the online service information for procedures and guidelines for the battery being tested and tester being used.
- Isolate batteries if they are connected to a bank so that they can be individually tested.
- Identify the type of battery, size, and voltage for input into the tester.
- Turn off all electrical loads.
- Make sure the test leads make good contact with the battery terminals.
- Enter the CCA rating of the battery in the display window if required.
- Press the START button.
- Test results will be displayed in a few seconds.
- Refer to the tester instruction manual for additional information.

Battery Conductance Testing

The number and mobility of free-charge carriers determine the capacity of a private material to conduct electricity. Batteries are designed to store power from chemical action. Conductivity is the ability to transmit heat or electricity. Electrical conductivity is expressed in terms of the present per unit of applied voltage, so conductivity is the reciprocal of resistivity. Resistivity could be a measure of the resistance of a cloth to an electrical phenomenon either through its volume or on a surface. Using the conductance tester you can determine the condition of the battery by using conductance. Conductance may be a measurement of the ability of the battery to provide current. The conductance tester creates a signal impressed through the battery and thus measures a portion of the AC response. Conductance may be a measure of the battery plate surface to work out the quantity of power that a battery can supply. Constant cycling of batteries in heavy-duty service like medium- and heavy-duty trucks will eventually cause subplate growth on the plates and/or shedding of active material. The conductance tester can detect cell defects and short and open circuits that may reduce the ability of batteries to deliver current. The battery to be tested are often less than a 75% state of charge, so you are do not need to wait from 8 to 24 h while the battery is being recharged. For more information on this, see **J1715/2_202108** [3].

FIGURE B.5 Battery conductance tester.

Courtesy of John F. Kershaw Ed.D.

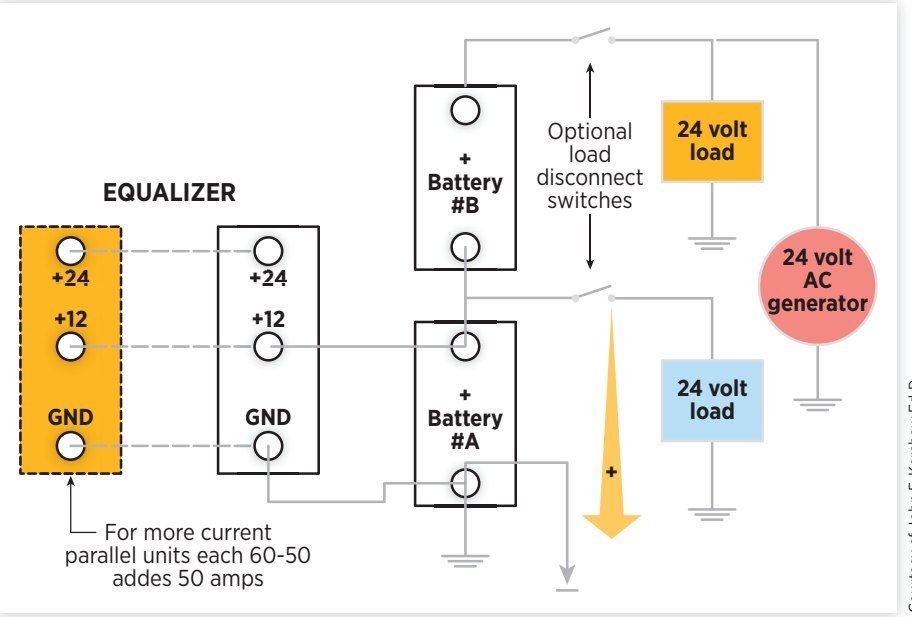
Battery Discharging

The storage of electricity inside a battery depends on the chemical reaction between the active materials on the positive and negative plates. As the battery discharges, the hydrogen and acid in the electrolyte change to water. As the hydrogen and acid converts to water, the specific gravity of the electrolyte will get lower. Measuring the specific gravity of the electrolyte with a hydrometer can be a way to tell the battery charge. For more information on this, see **J1715/2_202108** [3].

Battery Equalizer

A battery equalizer is used to obtain 12-V power in a truck with a dual battery 24-V system. The power harness leads are directly connected to the primary battery. The wiring should never be arranged so that the equalizer becomes a converter, meaning you can never pull 12 V directly from the 12-V post on the equalizer. Battery equalizers are generally original equipment manufacturer (OEM) supplied. For more information on this, see **J1715/2_202108** [3].

FIGURE B.6 Battery equalizer.



Courtesy of John F. Kershaw Ed.D.

Battery Isolator Systems

Facilitate the charging of an auxiliary battery by the vehicle charging system and electrical separation of the auxiliary battery from the starting circuit when the engine shuts down. Separation of most starting and auxiliary batteries can happen automatically during charging and discharging. Battery isolation systems range from simple, isolating solenoids, or relays, to complex battery management systems that monitor charge rates and voltages for both the starting and auxiliary battery. For more information on this, see **J1715_202105** [4].

Battery Pack SOC (State of Charge)

Share of total charge in a hybrid electric vehicle (HEV) battery pack. For more information on this, see **J1715_202105** [4].

Battery Pack Visual Signal

Lightweight within the dashboard that illuminates if the HV battery pack state of charge is below normal limits. For more information on this, see **J1715_202105** [4].

Battery SOC (State of Charge)

Level of electrical charge in a battery relative to its capacity. The units of SOC are percentage points (0% = empty; 100% = full). It can even be measured in voltage for a sealed lead-acid (SLA) battery at 2.1 V per cell. The SOC for a totally charged battery is 12.6 V. For more information on this, see **J1715/2_202108** [3].

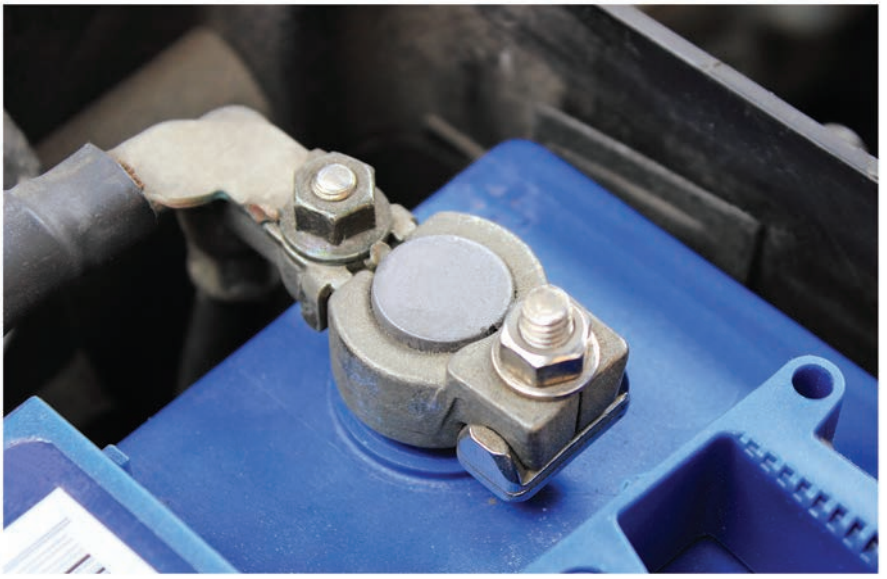
Battery State-of-Charge Indicator

A built-in hydrometer that is installed within the top of an SLA-defined battery. This indicator shows if the electrolyte level has fallen below a minimum level. The indicator could be a plastic rod located at the highest of the battery and into the electrolyte. The Delphi design uses a green plastic ball suspended in a cage from the rod bottom. The precise gravity of the electrolyte determines if the ball floats or sinks within the cage, changing its look from green to dark. If the attention is dark, the battery must be charged. Some designs use a red and a blue ball side by side within the cage. If the precise gravity is high, you may only see the blue ball. Due to the reduced relative density, the blue ball will sink, allowing the red ball to take its place. If the battery is recharged, with increase in relative density, the blue ball will move upward, forcing the red ball back to the side of the cage. For more information on this, see **J1715/2_202108** [3].

Battery Terminals

Automotive batteries use two terminals on the outside of the case: a positive (+) and a negative (–). These terminals can be either two tapered posts or threaded studs on top of the case, or two internally threaded connectors on the front side. These terminals connect to either end of either the positive or negative series of cells inside the battery. Both terminals are marked as positive (+) or negative (–). For more information on this, see **J1715/2_202108** [3].

FIGURE B.7 Tapered type automotive battery terminal.



ratmaner/Shutterstock.com.

Baud Rate

The speed at which bits of computer information are transmitted on a serial data stream; measured in bits per second (bps).

B-CAN (Body Control Area Network)

A group of computers that work together to control relay modules, entry lights, exterior lights, the horn, interlocking system, key-in reminder, keyless entry, power door locks, safety belt reminder, security alarm, turn and hazard signals, wiper-washer system, and other functions. B-CAN communicates at a knowledge rate of about 33 kbps.

BCM (Body Control Module)

The BCM, also called a body computer, is a generic term for an electronic control unit or computer used for monitoring and controlling various electronic accessories in an automotive vehicle. The BCM controls the power windows, power mirrors, air conditioning, immobilizer system, central locking, etc. The BCM communicates with other on-board computers via the car controller area network (CAN) bus, and its main application is controlling load drivers—actuating relays that successively perform actions within the vehicle, like locking the doors, flashing the turn signals (in older cars), or dimming the inside lighting.

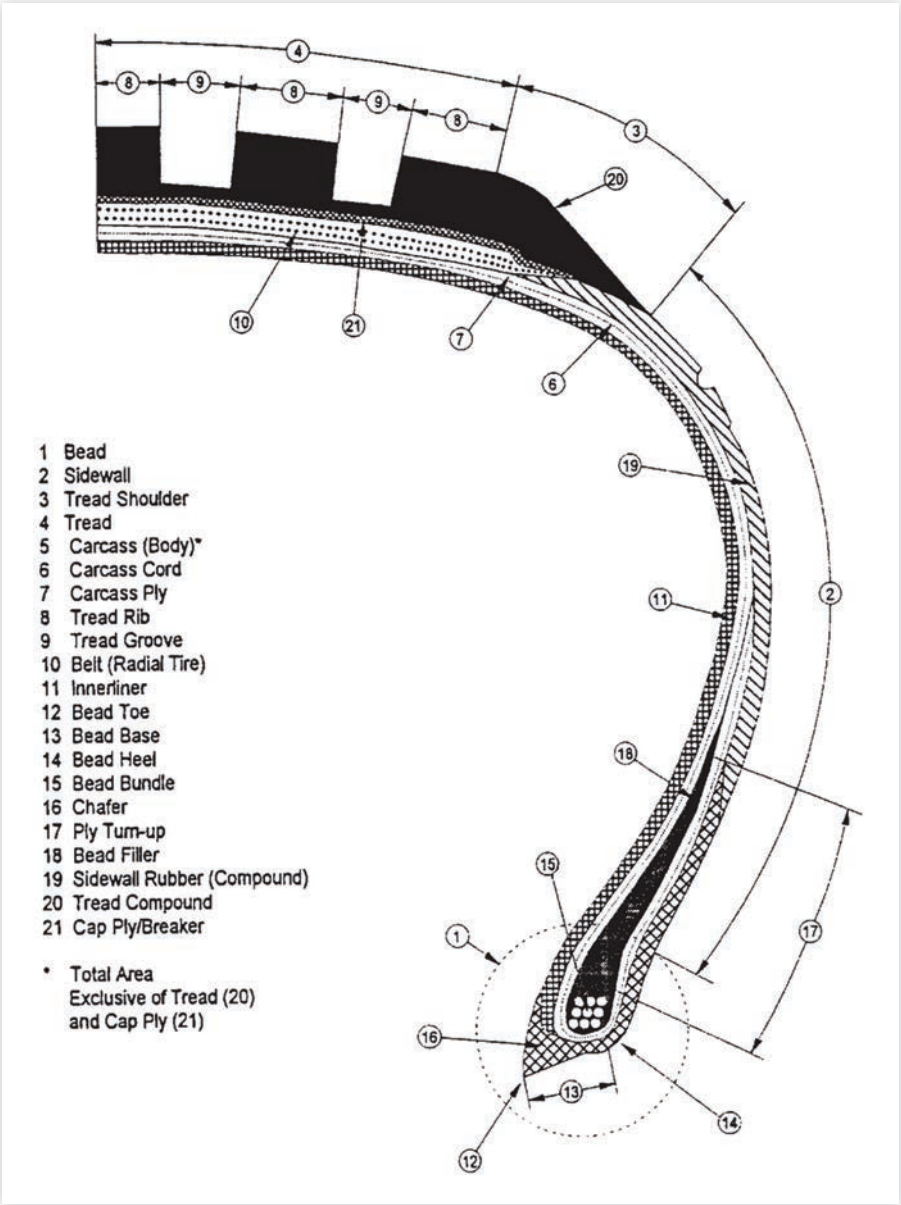
BDC (Bottom Dead Center)

The exact bottom of a piston stroke of an ICE.

Bead

"The part of a tire that comes into contact with the rim and is shaped to secure the tire to the rim." For more information on this, see **J2047_201911** [6].

FIGURE B.8 Tire construction (example from SAE J2047_201911).



Bead Base
"Inner portion of the bead that is seated on the bead seat." For more information on this, see **J2047_201911** [6].

Bead Bundle (Bead Coils, Bead Cord)
"A circumferentially steel hoop made of steel wires embedded in the bead which resists the inflation pressure generated forces." For more information on this, see **J2047_201911** [6].

Bead Face
"The portion of the bead above the bead heel that interfaces with the rim flange." For more information on this, see **J2047_201911** [6].

Bead Filler (Apex)
"A rubber compound fillet between the bead bundle and adjacent ply cords." For more information on this, see **J2047_201911** [6].

Bead Heel
"Outer portion of the bead base." For more information on this, see **J2047_201911** [6].

Bead Seat
"The part of the wheel rim which provides radial support to the tire and air pressure seal for tubeless tires." For more information on this, see **J2047_201911** [6].

Bead Toe
"Inner portion of the bead base." For more information on this, see **J2047_201911** [6].

Bearing
A support device where the contacting surface of a revolving part rests in order to minimize wear and friction between two surfaces. A friction-reducing device found between two moving parts. Bearings made from Babbitt are used between the connecting rod and cap and the crankshaft and main bearing cap. They are lubricated and cushioned with oil, and the front-wheel bearings must be repacked with grease at regular intervals. Bearings can be ball or roller type.

Bearing (Inside Diameter)

The diameter across the hole for the journal, with the bearing inserts in place.

Bearing Cap

A device that is bolted in place to secure an ICE bearing in place.

The bottom portion of a connecting rod or main ICE bearing that holds the bearing to the shaft.

FIGURE B.9 Bearing caps.

Courtesy of John F. Kershaw Ed.D.

Bearing Cone

The inner race of a tapered roller bearing.

Bearing Crush

When the bearing is installed, each end of the bearing shell is slightly above the parting surface. When the bearing cap is tightened, the ends of the shells are forced together. This force is named bearing crush. Th crush holds the bearing in situ and keeps the bearing from turning when the engine runs. The rush must exert a force of a minimum of 12,000 psi (82,740 kPa) at 250°F (121°C) to carry the bearing securely.

Bearing Lubrication

Lubrication is critical to bearing durability and reliability. The lubricant should be of the NLGI GC-LB type. Wheel bearings should never have differing kinds of grease intermixed as possible incompatibility between lubricants could occur, causing thinning and lack of lubrication. If no lubrication is provided, even for a brief period of time, the controller can become so hot that the rollers or balls are welded to the race. Often, the heat is enough to cause small particles to come back off and weld to a different location. This can be named as "smearing" or "scoring." In tapered roller bearings, the primary signs of inadequate or lack of lubrication appear as scoring on the massive ends of the rollers. This soon progresses into heat discoloration on the massive end of the rollers and races. The big end of the roller is the area of sliding contact within a tapered bearing and is the most difficult area to forestall scoring, especially when lubrication is not readily available. If operation under these conditions continues, the damaged bearings eventually soften the fabric, with the top result being bearing seizure or other component damage. Bearings may also develop "peeling," which supplies the races or rollers a frosty appearance. Peeling may indicate the presence of high operating temperatures or low lubricant viscosity. Bearings must be full of the specified lubricant.

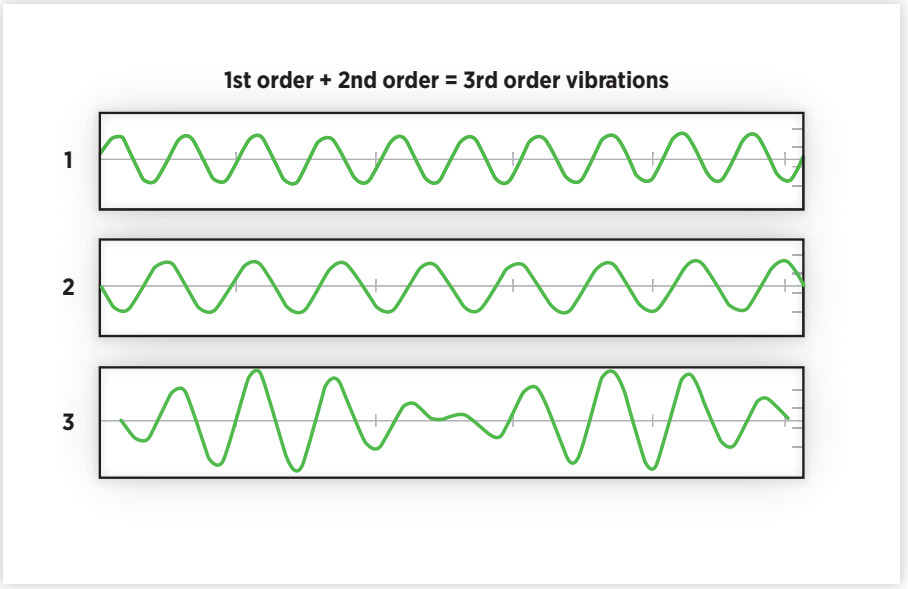
Bearingized

A surface that is exceptionally smooth and durable.

Beating Vibration

Action that takes place when two vibrating forces are adding to each other's amplitude. Yet two vibrating forces may subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is termed beating. In many cases, eliminating either one of the disturbances can correct the condition. For more information on this, see **J3152_202005** [5].

FIGURE B.10 Two separate disturbances.



Courtesy of John F. Kershaw Ed.D.

Before Top Dead Center (BTDC)

Position of a piston before it reaches the highest of its stroke and shown in the crankshaft as degrees of rotation.

Bell Housing

A term for the portion of a manual or automatic transmission that covers the flywheel and the clutch or torque converter of the transmission on ICE-powered vehicles.

Belleville Spring

Flat, round piece of spring steel with a hole in the center. Slots are cut from the central hole toward the skin of the spring to create a variety of flexible fingers.

Belt

Fabric or woven steel material over the body plies of a tire, and slightly below the tread area, to assist keep the tire tread from squirming. For more information on this, see **J2047_201911** [6].

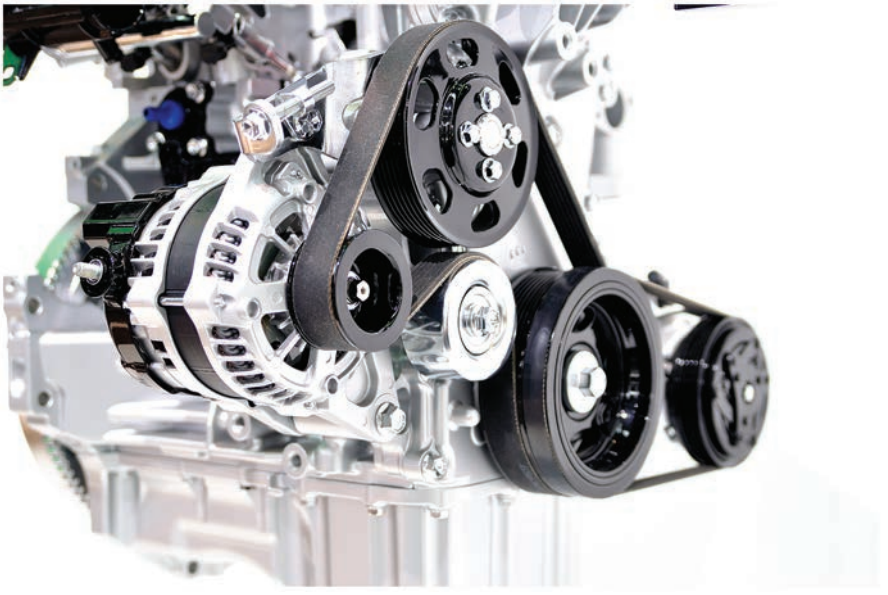
Belt Alternator Starter (BAS): Low-Cost Hybrids

BAS is an HEV option. The BAS concept is to interchange the belt-driven alternator with an electrical motor that is a generator and a motor. When the engine is running the motor, and acting as a generator, the system will charge a separate 36-V battery. When the engine must be started, the motor then applies its torque via the accessory belt, and cranks the engine rather than using the starter motor. The motor/generator is made larger than a standard starter motor so more torque can be generated when in the motoring mode. This allows for quicker starts of the engine and makes the start/stop operation possible. Stopping the engine while the vehicle is at idle is a means to conserve fuel. The belt system gets a 2–5% increase in fuel economy. For more information on this, see **J1715_202105** [4].

Belt System

The drive belt system may use one belt or two drive belts. The drive belt is thin so it can bend backward and has several ribs to match the grooves within the pulleys. There also is also a V-belt style belt used in the past to drive certain accessory drive components. The drive belts are a product of differing types of rubbers—Chloroprene or EPDM (Ethylene Propylene Diene Terpolymer), an artificial rubber. They have different layers containing either fiber cloth or cords for reinforcement. Either side of the drive belt can drive the various accessory drive components. When the rear side of the drive belt is employed to drive a pulley, the pulley is smooth.

FIGURE B.11 Typical automotive serpentine drive belt system.



loraks/Shutterstock.com.

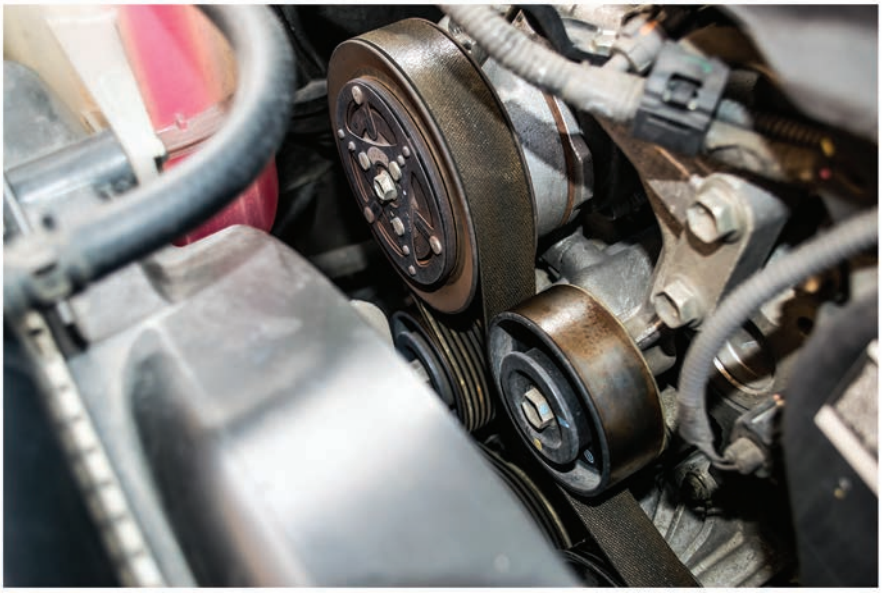
Belt Tension

Tightness of the accessory drive belt.

Belt Tensioner

A device that places tension against a serpentine belt. The crankshaft balancer pulley pulls the drive belt across the accessory drive component pulleys. The spring-loaded drive belt tensioner keeps constant tension on the drive belt to forestall the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and also the crankshaft.

FIGURE B.12 Serpentine belt tensioner.



ETAP/Shutterstock.com.

Bendix Drive

A term used for the electric cranking motor clutch that connects the cranking motor drive to the ICE flywheel. It is properly named a Starter Drive. It was named after its inventor, Vincent Hugo Bendix.

FIGURE B.13 ICE cranking motor starter drive clutch.

notsuperstar/Shutterstock.com.

Bevel Gears

Used to alter the direction of a shaft. They are mounted on shafts that are 90° apart and may also work at other angles. The teeth will be straight, spiral bevel, or hypoid. Straight pinion and crown wheel teeth even have the identical noise problem as straight gear wheel teeth. As each tooth engages it impacts the corresponding tooth all without delay. The answer to the current problem is to curve the gear teeth. These spiral teeth engage a bit like helical teeth. The contact starts at one end of the gear and spreads across the entire tooth. On spiral bevel gears, the shafts must be perpendicular to each other and even be within the same plane. If you extended the two shafts past the gears, they'd intersect. The hypoid gearset can engage with the axes in a very different plane.

FIGURE B.14 A bevel gearset using a ring gear and drive pinion.

Sergey Ryzhov/Shutterstock.com.

BHP (Brake Horsepower)

BHP (shaft horsepower) is the power delivered at the engine crankshaft of the engine. The term brake horsepower comes from the method of early engine testing. This consisted of putting a mechanical brake on the engine and measuring the force required to keep the brake from turning. The energy produced was dissipated as heat. Water or air was used to cool the friction surfaces of the brake. Brakes of this type, called Prony brakes, were an early type of absorption dynamometer. The horse terms come from the following: One horsepower would be produced when a horse walked 165 ft in 1 minute pulling a 200-lb weight, or 165 ft × 200 lb = 33,000 ft-lb. BHP may be measured with either a transmission or an absorption dynamometer and is determined by the following formula (see Equation B.1), which is the same as the one listed under horsepower, but stated for BHP:

$$\text{bhp} = \frac{2\pi FRN}{33{,}000} \quad \textbf{(B.1)}$$

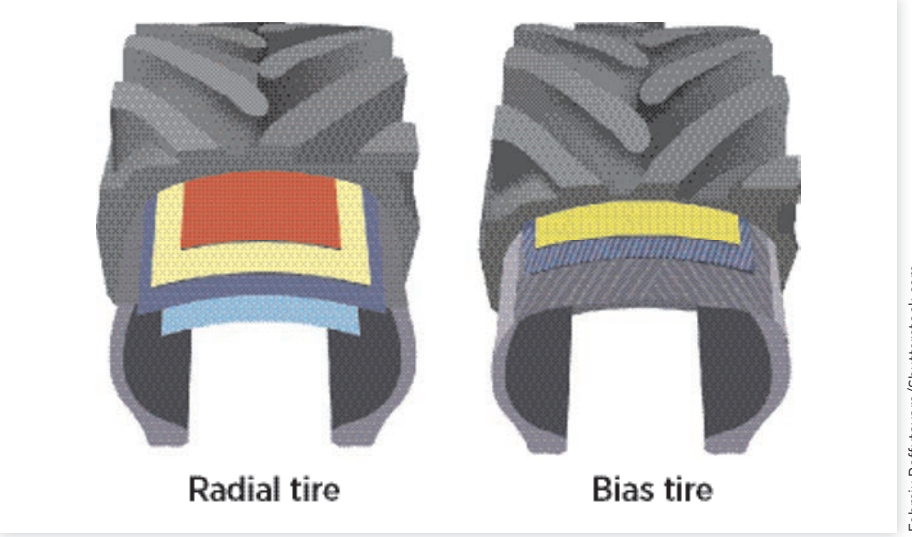
where

bhp is brake horsepower
F is the dynamometer load, in lb
R is the radius arm of the dynamometer, in ft
33,000 is the conversion factor, ft-lb/min, to produce 1 hp
N is the engine speed, in RPM
π = 3.1416, a constant

Bias Belted Tire

A type of tire that has the same ply configuration as a bias-ply tire except that the tire has belts added after the plies in the tread area made from fiberglass or steel that is used to prevent punctures in the tread and on top of the cords which form the tire main tire carcass and set diagonally to the center line of the tread. For more information on this, see **J2047_201911** [6].

FIGURE B.15 Comparison between a radial tire and a bias-belted tire.



Fehmiu Roffytavare/Shutterstock.com.

Bias Ply Tire

The bias-ply tire construction uses body ply cords that extend and overlap diagonally, on a bias, from bead to bead at 30 to 40° angles with successive plies laid at opposite angles, which result in a crisscross pattern onto which tread is set. This design furnishes a strong, stable casing, but with relatively stiff sidewalls. During cornering, stiff sidewalls can distort the tread and partially lift it off the road surface, which reduces the surface area between the road and the tire. For more information on this, see **J2047_201911** [6].

Bias Voltage

In electrical terms, bias is the voltage applied to a device or component to establish the reference point for operation.

Biasing

Applying current to a junction of semiconductor materials.

Bidirectional Communication

Automotive computer communication that uses serial data as both an input and an output.

Big End

Another term used for the ICE connection rod end that connects to the crankpin of a crankshaft.

Bimetal Gauge

A gauge that uses two kinds of metal bonded to create one strip. The expansion characteristics of every piece of metal are different. Electrical current flows through the bimetal strip causing heat to bend the bimetal strip. This bending movement swings an indicator needle across a gauge face.

Bimetallic

Made or consisting of two metals.

Binary

A mathematical system, consisting of only two digits (0 and 1), that enables an information processing system to read and process input voltage signals.

Biodiesel

Domestically produced, renewable fuel that may be manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is safe, biodegradable, and reduces serious air pollutants like particulates, carbon monoxide gas, hydrocarbons, and air toxins. Biodiesel is defined as mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats that conform to ASTM D6751 specifications to be used in diesel engines. Biodiesel refers to the pure fuel before blending with diesel oil.

Bipolar

Having two opposite and opposing forces.

Bit

The individual voltage signal of a serial data stream; also the smallest unit of measurement recognized by a computer.

Black Smoke

Owing to the extremely short time available for mixing, as the fuel-air rate increases beyond a certain value, an appreciable fraction of the fuel fails to find the necessary oxygen for combustion and passes through the cylinder unburned or partially burned black smoke. Fuel burned without air is black smoke. The tendency to produce black smoke is any variable that increases the amount of fuel injected or reduces the amount of air taken into the cylinder. These include the following: any nozzle (injector) malfunctions, turbocharger failures, restricted air flow,

Blink or Flash Codes (OEMs Use Both Terms)

These codes are an on-board means of troubleshooting computer-controlled engine management systems using a dash or computer-mounted electronic malfunction light or CEL (check engine light). Normally, only active codes, i.e., one indicating a malfunction at the time of reading, can be read on the vehicle management computer, usually an engine control module (ECM). Since the adoption of automotive OBD II (On-Board Diagnostics Generation II) and heavy truck HD-OBD (Heavy-Duty On-Board Diagnostics), they have gone away but some OEMs still used them on a limited basis. The following example uses the cruise control function switches of the vehicle to activate the blink code sequence:

1. Turn the ignition key on and wait until the malfunction indicator light (MIL)'s 2-second power-up test is completed. If the lamp remains on after the 2-second power-up test, this indicates an active fault in the memory that can be accessed.

2. Set the cruise control speed control on/off switch to the "off" position and press and hold the Set/Decel switch until the MIL lamp goes out. The lamp will remain off for approximately 1 sec.
3. Immediately after the wait time, the ECM will begin to flash a two-digit blink code on the MIL. The two digits will be separated by an idle time of approximately 1 sec. The on and off time between each flash for each number should be a quarter of a second.
4. Count the number of flashes for the first digit and write the number down.
5. After the 1-sec pause, count the number of flashes for the second digit and record. You now have the two-digit fault code.
6. Cross-reference the blink code with the chart in the service manual to identify the problem area.

Block Diagram

A diagram that uses boxes and symbols, parenthetical components and contours, to represent wires and hoses. Simplifies a system gate so it will be easy to understand how a locality of the system operates and how major components interact.

Block Learn Function

Generically referred to as long-term fuel trim. Fuel delivery adjustments to the injector pulse width supported control system feedback. Short-term fuel trim is predicated on rapidly switching oxygen sensor values, while long-term fuel trim could be a learned value accustomed to make amends for continual deviation of the short-term fuel trim from its central value. For more information on this, see **J1930DA_202105** [7].

Blockchain Framework

Blockchain framework is used in automotive technology to detect unauthorized modifications to vehicle management computers like the engine control module (ECM) or engine control unit (ECU). "A proof of concept blockchain prototype framework is implemented on a set of microprocessors (comparable to those used by simple ECUs) as a means to assess the efficacy of using our blockchain approach to detect unauthorized updates. Traditional cybersecurity protection approaches managed by a centralized authority are not directly applicable to handle automotive cybersecurity given the disparate and distributed nature of the automotive attack vectors. Currently, multiple international, cross-organizational groups are developing guidelines and standards for automotive cybersecurity, but to date, there is no formally adopted or even de facto standard for securing OTA updates or ECU integrity." Refer to SAE Article 11-04-01-0002 for more information [10].

Blocker Rings (Synchronizer)

A speed-operated clutch located within the synchronizer clutch in a manual transmission that synchronizes the speed of the fixed gear shaft with one of the freewheeling speed gears.

FIGURE B.16 Blocker ring.

StockTeamBaku/Shutterstock.com.

Blowby Gases

Combustion gases that leak past the piston rings into the crankcase during the compression and combustion strokes of an internal combustion engine.

Blower Motor

An electric motor and squirrel-cage type of fan that moves air inside the vehicle for heating, cooling, and defrosting.

Blow-Off Valve (BOV)

This is also called a dump valve or vent valve and features an adjustable spring design that keeps the valve closed until a sudden release of the throttle. Allows the manifold pressure to vent to the atmosphere.

Blue Smoke

A blue smoke color comes from engine lubrication oil mixing with the diesel fuel and can be caused by:

- Oil level too high
- Worn valve guides and seals
- Worn piston rings or cylinder walls
- Bad piston oil control rings
- Bad turbocharger seals
- Excessive crankcase pressure

Bluetooth

A radio frequency standard for short-range communications that connects vehicle devices. The range of a typical Bluetooth device is 33 ft (10 m) and operates within the ISM (industrial, scientific, and medical) band between 2.4000 and 2.4835 MHz. It is a wireless standard that works on two levels. It provides physical communication using low power, requiring only about 1 mW (1/1,000 of a watt) of electric power, making it suitable to be used with small handheld or portable devices, like an ear-mounted speaker/microphone. It provides a typical protocol for the way bits of information are sent and received. The Bluetooth standard is wireless. The automotive use of Bluetooth technology is within the operation of a cell phone being connected into the vehicle. The vehicle enables the use of hands-free phone. A vehicle equipped with a Bluetooth phone has the following components:

- Bluetooth receiver may be built into the navigation or existing audio system.
- Microphone allows the driving force to use voice commands moreover as phone conversations from the vehicle to the cell via Bluetooth wireless connections.

All cell phones are equipped with Bluetooth, which allow the caller to use an ear-mounted microphone and speaker. If the vehicle and the cellular phone are equipped with Bluetooth, the speaker and microphone will be used as a hands-free phone when the phone is within the vehicle. The cellular phone will be activated within the vehicle by using voice commands. It was named after Harald Bluetooth, the king of Denmark in the late 900s. The king united Denmark and a part of Norway into one kingdom.

Bluetooth Detection

Bluetooth devices are detected by sensing devices along the road or hand-held cell phones. When these Bluetooth sensors are interconnected they are ready

to calculate the time period and supply data for origin and destination matrices. Bluetooth measurement has some differences compared to other traffic measurement technologies. Bluetooth is additionally non-intrusive, which might result in lower-cost installations for both permanent and temporary sites. Bluetooth features are as follows:

- Limited to number of devices broadcasting from a vehicle.
- Systems are generally quick to line up with no calibration needed.
- Since Bluetooth devices become more prevalent on board vehicles and with more portable electronics broadcasting, the number of information collected over time becomes more accurate and valuable for period and estimation purposes

BMEP (Brake Mean Effective Pressure)

A term used for design purposes. BMEP is an academic constant pressure acting on the piston during each power stroke. BMEP produces a power equal to the engine brake horsepower. This term indicates how well an engine uses its displacement to produce torque, and it is a better parameter for comparing engines than horsepower. The BMEP force on the top of the piston is the average pressure exerted on each square inch of the top of the piston, during the power stroke multiplied by the area on top of the piston (Force (f) = area × BMEP). BMEP is determined by the formula:

$$p_b = \frac{BHP \times 33{,}000}{LANK} \quad \textbf{(B.2)}$$

where

L is the length of stroke, in ft
A is the area of the piston, in $in.^2$
N is the number of power strokes per minute
K is the number of cylinders

BNC Connector

Coaxial-type connector usually used on oscilloscopes. Named after its inventor Bayonet Neil-Concelman (BNC).

Bobtail Proportioning Valve

Senses when the tractor equipped with air brakes is bobtailing and operates when the tractor parking brake is released and the trailer supply valve remains closed. The objective is to reduce the air pressure applied to the tractor drive

axle(s) and minimize drive wheel lock-up on slippery pavement. Bobtail proportioning is integral with the relay valve managing the service braking. This valve will function as a relay valve under normal operation. In bobtail mode, the valve ratio is determined by bleeding a percentage of the application air to exhaust.

Body Ground Wire

A wire used on the negative battery cable to confirm that the vehicle body is grounded.

Bogie Axle

A bogie axle may be a modular chassis with a wheel axle attached to it that is attached, or are often detached, as in semi-trailers, and will have its own suspension and brakes.

Boiling Point

Temperature at which a solid or liquid substance turns to vapor. For water at normal water level conditions, the boiling point is 212°F (100°C).

Bolt

Screws, bolts, and studs are the three types of threaded fasteners employed in automotive applications.

Bolt Circle

The diameter of a circle (inches/millimeters) drawn through the middle of the bolt holes in a wheel. For more information on this, see **J2047_201911** [6].

Bolt Pattern

Refers to the amount and spacing of the lug nuts or wheel studs on the wheel hub on the wheel rim. It is also called a bolt circle because the line drawn through the centers of the wheel lugs forms an imaginary circle. Studs are frequently evenly spaced, and the amount of studs determines the pattern. Some smaller vehicles have three studs, some may have four studs, but most passenger cars have five. Pickup trucks and huge SUVs can have as many as six, eight, or ten studs. Vehicles that carry heavier loads generally have more studs. The precise number and pattern of studs vary looking on the vehicle type and OEM design. Some manufacturers also offer a dual bolt pattern, or two possible bolt patterns, on one wheel. For more information on this, see **J2047_201911** [6].

Boom Vibration

A vibration felt in the cabin of a vehicle that travels through the roof caused by a third-order vibration from the driveline and wheels. For more information on this, see **J3152_202005** [5].

Boost

An increase in ICE air pressure above atmospheric at 14.7 psi (pounds per square inch) used when supercharging or turbocharging. Superchargers and turbochargers are designed to provide a pressure greater than atmospheric pressure (14.7 psi) in the intake manifold. This increased pressure forces more air into the combustion chamber over what would normally be forced in by atmospheric pressure to provide a heavier charge with greater mass. This increased charge increases engine power. The higher the boost (pressure), the greater will be the horsepower. Other factors must also be considered when increasing boost pressure: As boost pressure increases, the temperature of the air also increases. As the air temperature increases, so does the combustion temperatures that increases the possibility of detonation.

Boost Control

Both supercharged and turbocharged systems are designed to provide a pressure greater than atmospheric pressure in the intake manifold. This increased pressure forces additional amounts of air into the combustion chamber over what would normally be forced in by atmospheric pressure. The amount of "boost" (or pressure in the intake manifold) is measured in pounds per square inch (psi), in inches of mercury (Hg), bars, or in atmospheres and controlled by several different devices, such as wastegates, boost control valves, and variable position turbine nozzles on turbochargers.

Bore

The diameter or width of an ICE piston or the cylinder diameter. When the bore is larger than the stroke the engine is over squared and most of its power is dependent on the revolutions per minute (RPM) value and generated at higher RPM values. When the stroke is larger than the bore, the engine is undersquare with most of its power dependent on torque development.

Borescope

Optical instrument designed to help visual inspection of narrow, difficult-to-reach cavities, consisting of a rigid or flexible tube with an eyepiece or display on one end, an objective lens or camera on the opposite, linked together by an optical or electrical system in between. The optical system, in some instances,

is in the lighting process to boost brightness and contrast. An indoor image of the illuminated object is made by the target lens and magnified by the eyepiece which presents it to the viewer's eye.

Bosch Peak-and-Hold Injector Waveform

The waveform of a peak-and-hold fuel injector is similar to the peak-and-hold waveform except that, instead of lowering the current to hold open the injector, the current is rapidly pulsed on and off.

Bottom End

Industry term for the rotating bottom end of an ICE that includes those made by the crankshaft and the piston and connecting rod assemblies.

Bound Electrons

When there are five or more electrons in the valence ring of an atom, they are held tightly together. This is characteristic of an insulator.

Bowden Cable

A flexible cable that transmits force through the movement of an inner cable relative to a hollow outer cable housing. This cable is used for parking brakes on many vehicles.

Bowed (Buckled) Frame

When one or both frame rails are bent upward in relation to the ends of the rails.

Boxer ICE

A horizontally opposed ICE is a boxer design. It is called a boxer because each set of pistons moves in and out at the same time, like a boxer's gloves. The centrally located crankshaft has the cylinders on each side. The boxer engine design allows a lower center of gravity that lowers the vehicle center of gravity and is more responsive when cornering.

Boyle's Law

The pressure of a perfect gas varies inversely to its volume at a constant temperature, or that the product of the pressure and volume is a constant. The pressure of a perfect gas varies inversely to its volume at a constant temperature, or that the product of the pressure and volume is a constant. Pressure is inversely proportional to the volume occupied by the gas. High pressure equals low volume. At a constant temperature, the pressure of a gas depends on the volume

of the vessel holding it. Boyle's Law applies to compression in an ICE. When the piston rises on compression, cylinder volume is reduced and the pressure increases. This exerts pressure on the cylinder walls when the same number of molecules now have less space to move. The general formula is:

$$P \propto \frac{1}{V} PV = \text{Constant} \quad \textbf{(B.3)}$$

Brake Bleeding (Hydraulic Brakes)

An automotive service procedure used to remove trapped air from a hydraulic brake system. Hydraulic brakes need to be bled whenever a hydraulic component of the brake system is replaced, or whenever a diagnosis indicates that air is trapped in the hydraulic system. Methods of bleeding brakes will vary with the type of system. The reason that the brakes are being bled will also influence the method. If a vehicle has a spongy pedal, then bleed the entire brake system. The bleeding procedure for a front/rear split brake system will be different from bleeding a diagonally split brake system. Whenever bleeding an entire brake system, the usual method is to begin by bleeding the master cylinder, then bleed the wheel cylinder farthest from the master cylinder, and continue by bleeding each wheel cylinder from the farthest to the closest in sequence.

There are four methods used: manual, gravity, pressure, and vacuum. Manual or pedal bleeding requires two people to perform the task. One person pumps the brake pedal slowly and firmly to force fluid through the system. After four or five applications of the brake pedal, the pedal is held down. At that time, the second person opens the bleeder valve at that wheel allowing the fluid and air in the line to escape. The pedal sinks to the floor as the fluid and air escapes. The pedal must not be released until the bleeder valve is closed or air will be drawn into the system. The procedure is repeated at each wheel until air bubbles are no longer evident. Gravity bleeding consists of letting the weight of the brake fluid force itself through the system. This is accomplished by simply opening the wheel cylinder bleeder valves one at a time until a solid flow of fluid flows out of the valve.

Pressure bleeding method requires the use of a pressure bleeder, which consists of a tank which is divided into two chambers by a flexible diaphragm. One chamber contains the brake fluid, the other contains air. The air chamber can be pressurized with compressed air from the shop air system. When the air chamber is pressurized, it exerts pressure through the flexible diaphragm against the brake fluid in the fluid chamber. A valve in the fluid side of the tank allows fluid to escape through a hose to an adapter. This adapter fits tightly over the master cylinder reservoir, thus allowing the fluid to enter the brake system under pressure. In this way, the pressure bleeder not only pressurizes

the brake system, but it also maintains the fluid level in the master cylinder. Vacuum bleeding is using a Mityvac suction pump attached to the bleeder screw. The pump creates a low-pressure area at the bleeder screw that allows atmospheric pressure to push brake fluid through the system when the bleeder screw is opened, thus removing the air.

Brake Booster (Brake Assist)

Automotive power brakes are used to reduce the force required from the driver when applying the brake pedal. This is done through the use of a brake booster of which there are three types of power assist systems used on most vehicles:

- Vacuum power assist
- Hydraulic boosters
- Anti-lock brake system (ABS) booster

Pneumatic (vacuum) power assist may use vacuum (low pressure) with pressure differential between air pressure and engine vacuum or low to help in pushing the brake cylinder piston. Hydraulic boosters use fluid pressure generated by the power steering pump. Most current vacuum boosters are vacuum-suspended units. The term vacuum-suspended describes the condition of the unit when the car engine is running and therefore the brakes are released. When in this condition, an equal vacuum is present on either side of a diaphragm, thus suspending the diaphragm in a specific vacuum. Although all booster components are combined during a single assembly, a vacuum booster consists of two subassemblies.

Brake Caliper

See **Caliper**.

Brake Chamber

Compressed air from within the brake system is directed through the lines to two or more brake chambers to apply the foundation brakes. Pressurized air from the compressor via the air reservoirs is sent to the application valve. When the driver steps on the treadle, the application valves sends air signals to the quick release valve and relay valve/anti-lock brake system (ABS) modulators. These devices then connect the air supply to the flexible diaphragms of the service brake chambers, which forces a pushrod assembly forward against the force of a coil return spring to move the S-cam to apply the drum brakes. When the air is released from the chamber, the coil return spring pulls the pushrod back to the released position. The number and size of the brake chambers determines the air compressor supply and reservoir requirements. The brake chamber is mounted on a bracket welded to the axle housing assembly as shown

in Figure B.17. The chamber pushrod is connected by a yoke and a clevis pin to a slack adjuster. The slack adjuster acts as a lever to multiply the force from the diaphragm and pushrod, which, in turn, rotates the S-cam brake shaft. The S-cam is rotated to permit two cam rollers to be raised. This action, in turn, causes the brake shoes to be forced outward against the spinning brake drum bolted to the wheel. On air disc brakes, as the actuating beam moves the inner brake pad into contact with the rotor, the caliper slides away from the rotor, pulling the outer brake pad into the rotor. For more information on this, see **J1410_202012** and **J2627_202207** [8, 9].

FIGURE B.17 Air brake chambers.

Kevin Norris/Shutterstock.com.

Brake Fade

Brake drums and rotors are forced to soak up a major amount of warmth during braking. Brake fade describes a condition where heat is generated at a faster rate within the brakes than is capable of dissipating the warmth into the surrounding air. During a hard stop the temperature of drums or rotors may rise as high as 100°F in just a few seconds. It should take 30 sec to cool down the temperature of these components before braking. During repeated hard stops, overheating can cause brake inefficiency or a complete failure. Brake fade is the rationale for towing weight limits and trailer brake requirements for

vehicles. The added energy resulting from the increased vehicle mass requires added heat conversion capacity when the brakes are applied. There are two types of brake fading caused by heat: mechanical fade and lining fade. Mechanical fade occurs when the drum overheats and expands off from the liner, resulting in increased treadle travel. Rapidly pumping the pedal will help to keep the linings in tune with the drum. Lining fade affects both drum and disc brakes and occurs when the friction material becomes overheated to the point where the coefficient of friction drops. When the coefficient of friction drops, it both reduces friction and also the ability of the brake to convert added heat.

Brake Fluid

Brake fluid is the hydraulic fluid utilized by the automotive hydraulic brakes system to maneuver the pistons within the calipers and wheel cylinder. The US Department of Transportation (DOT) issues specifications for brake fluid. The three main kinds of brake fluid now available are DOT 3, DOT 4, and DOT 5. DOT 3 and DOT 4 are glycol-based fluids, and DOT 5 is silicone-based. The difference is that DOT 3 and DOT 4 is hydroscopic and absorbs water, while DOT 5 does not.

The most important characteristics of brake fluid is its boiling point. Hydraulic systems depend on an incompressible fluid to transmit force. Liquids are generally incompressible while gases are compressible. If the brake fluid boils (becomes a gas), it will lose most of its ability to transmit force. This might partially or completely disable the brakes. The time that drivers are likely to boil the brake fluid is during a period of prolonged braking, such as a driving down a mountain. As a DOT 3 or DOT 4 brake fluid absorbs water, its boiling point decreases. It can absorb water from the air, which is why technicians and drivers should avoid opening the brake fluid reservoir of vehicles. For the same reason, always keep containers of brake fluid tightly sealed.

DOT 5 fluid does not absorb water and is purple in color. This implies the boiling point will remain relatively stable, but it also means any water that does get into the brake will tend to create pure water pockets, which could cause brake corrosion. DOT 5 also does not mix with either DOT 3 or DOT 4. Most OEMs use two kinds of brake fluid: DOT 3 and DOT 5. DOT 3 is that the standard brake fluid used in all cars and lightweight trucks manufactured for the North American market. It is colorless and readily absorbs moisture. For more information on this, see **J1703_201909** [11].

SAE Standard for BHP Rating

- Net horsepower available from the engine with specified induction specifications and engine speed
- Rating guaranteed within 57%

- Corrected to SAE standard ambient conditions
- Air temperature 85°F (29.4°C)
- Elevation 500 ft (159.4 m)
- Dry air density 0.0705 lb/cu ft (11.29 g/m^3)
- May be without the accessories required for the application (compressor, fan, generator, and so on)

Brake Lines

Brake fluid is carried through steel pipes called brake lines. Brake lines are usually constructed of double-walled steel tubing that has double-lap flare or an ISO (International Organization for Standardization) flare on the ends.

Brake Pad

A friction material pad of which there are two pads that grabs the brake rotor like a C-clamp to stop it from turning and that effects braking. A hydraulic caliper piston pushes against the pads to stop the rotor.

FIGURE B.18 Brake pad shown with a caliper and rotor assembly.

LightField Studios/Shutterstock.com.

Brake Rotor

A component used in the disc brake system that is mounted on a front or rear hub at the axle and has a hydraulic caliper mounted above that pushed the two pads to stop the rotor and effect vehicle braking.

FIGURE B.19 Brake rotor.

Setta Somnoi/Shutterstock.com.

Brake Specific Fuel Consumption (BSFC)

BSFC is the rate of fuel consumption per unit of brake horsepower output. This parameter demonstrates how efficiently the engine converts fuel energy into work. Most OEMs prefer the BSFC to thermal efficiency because it is determined by using the practical units of weight, horsepower, and time. The following formula determines BSFC:

$$\text{BSFC} = \frac{\text{W}}{\text{BHP}} \qquad \textbf{(B.4)}$$

where

W is the weight of fuel component, in lb/hr
BHP is the brake, in hp

Engine manufacturers' sales data literature list BSFC, which is shown in either lb/bhp/hr or g/kW-h (grams/kilowatt-hour). One lb/hp-hr is equal to

608.277 g/kW-h. The BSFC for a Caterpillar 3406E engine rated at 475 hp (354 kW) at 1,800 RPM and peak torque of 1,750 lb/ft (2,373 Nm) at 1,200 RPM is approximately 0.316 lb/hp-hr (192 g/kWh) for a fuel rate of 21.3 US gallons (80.8 L/h) when running at 1,800 RPM. At the peak torque rating of 1,200 RPM, the fuel rate is 0.304 lb/hp/hr (185 g/kW-h) for a fuel consumption rate of 16.9 US gallons (64 L/h).

Braking Performance

The automotive braking performance general equation is based upon Newton's Second Law of Motion: Force = Mass times acceleration. The general equation is:

$$Ma_x = \frac{W}{g} D_x = F_{xf} - F_{xr} - D_A - W\sin\theta \qquad \textbf{(B.5)}$$

where

W is the vehicle weight
g is acceleration due to gravity: g-force
$D_x = a_x$ is the linear deceleration
F_{xf} is the front axle braking force
F_{xr} is the rear axle braking force
D_A is aerodynamic drag
θ is the upgrade hill angle

Braking Ratio

Braking ratio is the comparison of the front wheel and rear wheel braking effort. When a vehicle brakes, its weight tends to transfer to the front wheels. This causes the front wheels to be pressed against the road with greater force. At the same time, the rear wheels sometimes lose traction on the road. As a result, the front brakes do more of the braking than the rear.

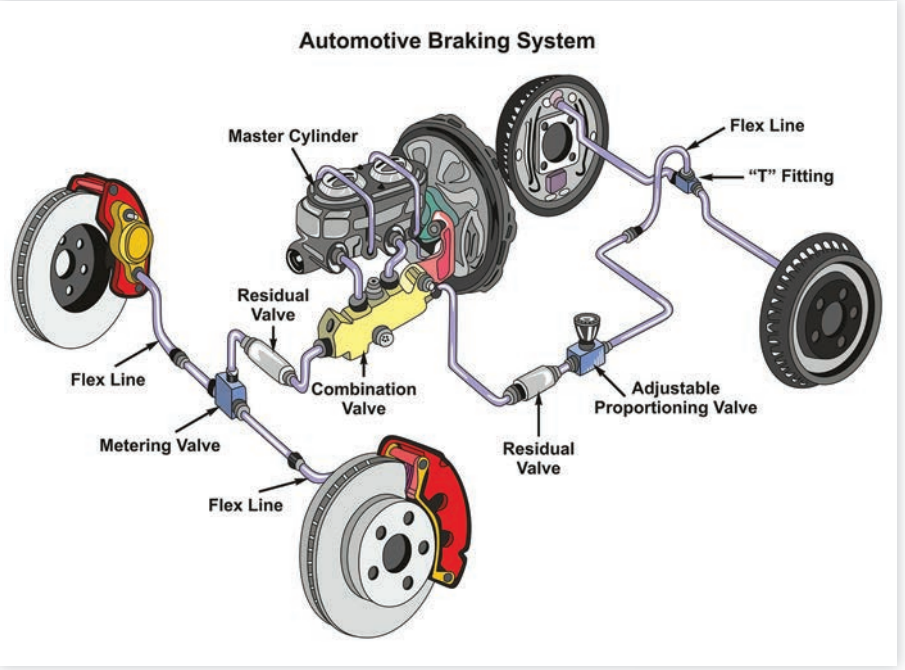
Braking Stability

Effective braking is also dependent on the pressurization and control of hydraulic fluid. By applying the brake pedal, the hydraulic fluid is pressurized and applies the braking force necessary to stop the vehicle. When braking, the wheels must not lock or the driver will lose steering control (see **ABS**). To prevent wheel lock, the rear wheels must decelerate at a slightly lower rate than the front in order to maintain directional stability. For rear-wheel-drive vehicles, up to 60% of the braking force is applied to the front wheels and 40% is applied to the rear wheels. For front-wheel-drive vehicles, up to 80% of the braking force is applied to the front wheels and 20% is applied to the rear wheels.

Braking System (Automotive)

The automotive brake must be able to rapidly change the state of energy, so the brakes must have more power than the kinetic energy of the vehicle. Brakes in terms of horsepower are 5× that of a standard ICE. A vehicle accelerating from 0 to 60 mph in 10 sec is common. Nominal brakes should stop a vehicle traveling 60 mph within 3–4 sec. The foot lever assembly acts like nothing over a mechanical lever arm to apply force to the brake cylinder piston. When the motive force presses the treadle, the cylinder piston presses against the brake fluid. Brake fluid is not compressible. The force is transmitted as hydraulic pressure. This pressure is sent to the individual wheel cylinders so that the cylinders utilize the friction components of the brake system. All vehicles have a stoplight switch attached to the pedal arm. Depressing the pedal causes the stoplight switch to activate the red stoplights on the rear of the vehicle. The cylinder is actually a foot-operated hydraulic ram that gives the pressure utilized in the braking system. A basic hydraulic brake cylinder consists of a reservoir, reservoir cover with gasket, housing, piston, rubber piston cup, and return spring. The components may vary slightly with different styles or styles of vehicles.

FIGURE B.20 Automotive brake system.



udaix/Shutterstock.com.

Breaker Points
The metal contact points that act as an electrical switch in an ICE ignition distributor to open and close the ignition primary circuit.

Breakout Box
A device that is connected into an electrical circuit or component to check values at specific points in the circuit.

Brinelling
A mechanical failure characteristic of a dent in metal such as what occurs when a shock load is applied to a bearing.

British Thermal Unit (BTU)
The amount of heat required to raise 1 pound of water 1°F at sea level.

Brushes
A copper or carbon conductor used to transfer electrical current from or to a revolving electrical part such as the commutator used in an electrical motor or generator.

BSFC
See **Brake Specific Fuel Consumption**.

Buffer
Circuit or component used to reduce the interaction between two electronic circuits.

Bump Steer
A driving condition that occurs when the front wheels of a front-wheel-drive vehicle steer themselves without input from the steering wheel. This condition is caused by bumps in the track interacting with improper length or angle of your drive axles, suspension, and steering linkages.

Bulkhead
The front partition that separates compartments in a vehicle. It is a metal wall that extends from one side of a vehicle to the other side.

Bus
An electrical conductor, or conductors, serving as a common connection for three or more circuits.

Bus Configuration
A computer network topology in which several of the computers of the vehicle are wired to a single conductor, or bus.

Bushing
A cylindrical metal sleeve that inserts into a machined bore to reduce the effect of friction on moving parts or decrease the diameter of the hole. It is used in joints between moving components and is designed to eliminate the friction that causes premature wear. However, the bushings themselves are subject to wear and may cause play within the connecting points of the component. Bushings are manufactured with bronze or rubber compounds, depending on design requirements. Bushings should be tight and typically do not require lubrication.

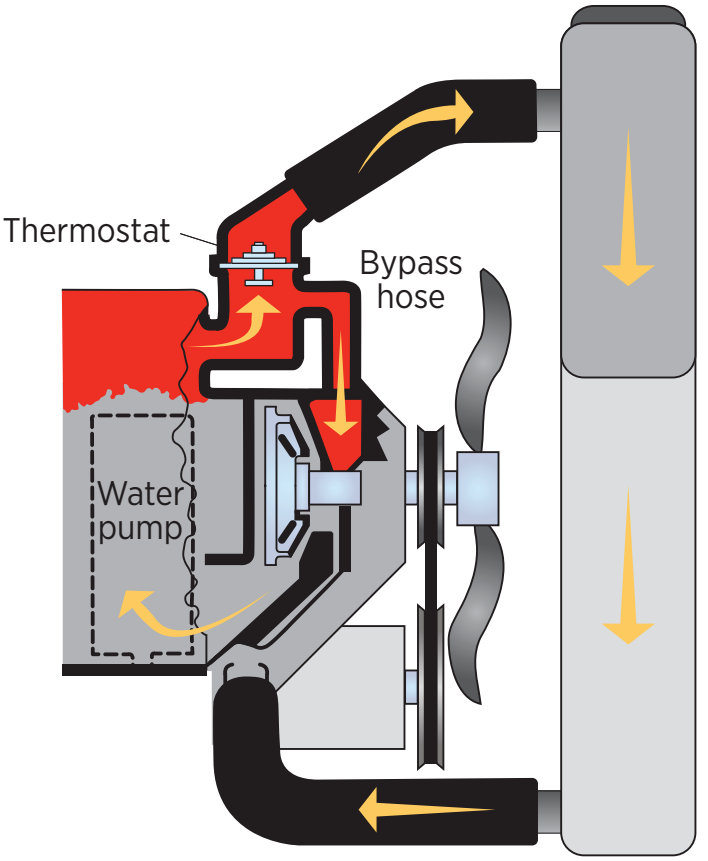
Buss Bar
Buss bar is a solid metal strip, or bar, used as a conductor in a multiple fuse panel.

Butt Splice
Wires to be connected together are placed end to end, without overlap.

Butterfly Valve
This is a slang term for the throttle valve. See **Throttle**.

Bypass Hose
A hose that permits coolant to flow through the water pump and back into the engine when the thermostat is closed. The bypass itself may be an external hose or a passage within the thermostat housing or water pump body. It allows for a faster warmup of the ICE.

FIGURE B.21 Bypass hose.



Courtesy of John F. Kershaw Ed.D.

Bypass Valve

See **Blow-Off Valve**.

Byte

A byte is eight bits of computer information processed as a unit and transmitted as a sequence on the serial data stream. Also known as a word.

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