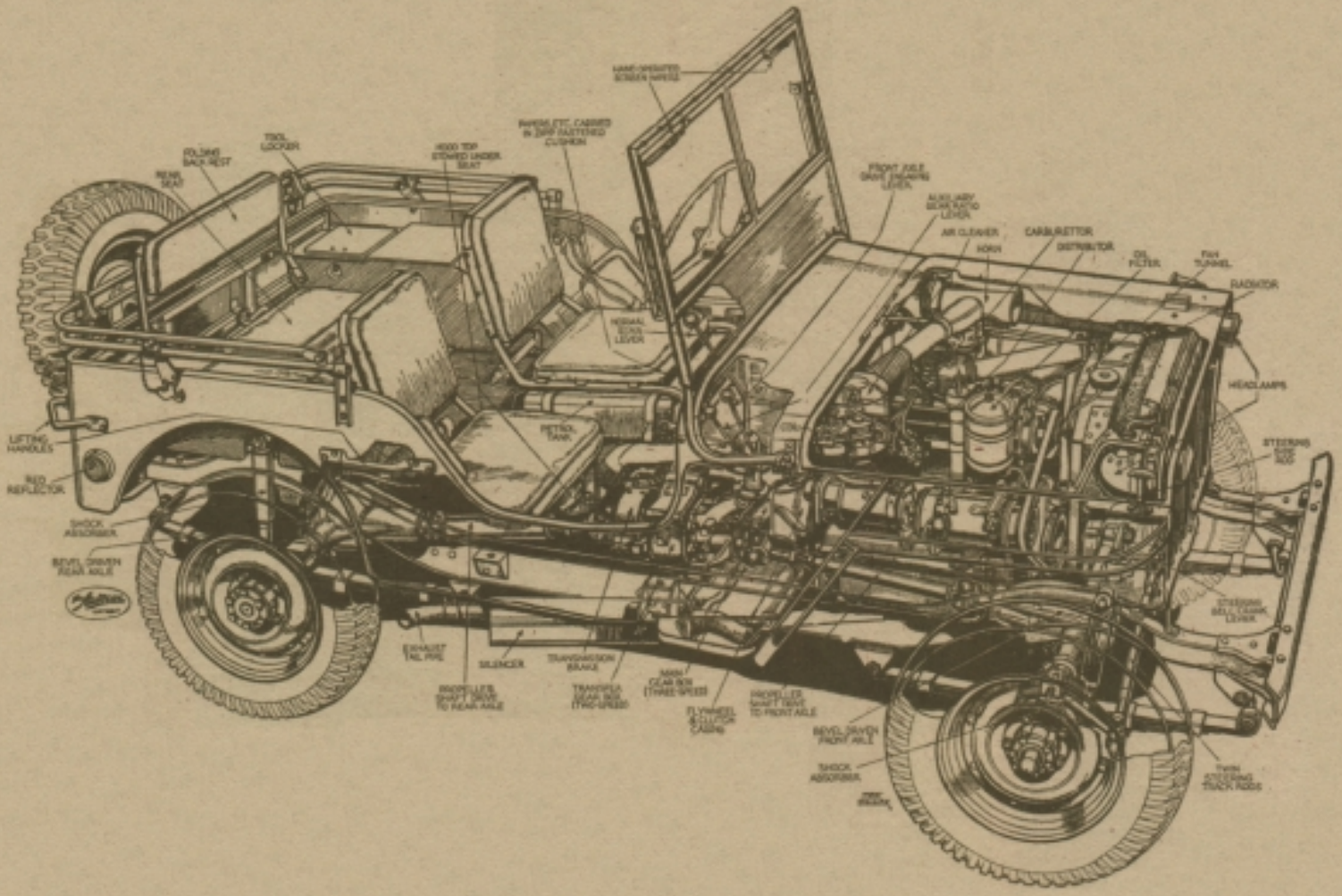
The American Society of
Mechanical Engineers

THE JEEP® MB

An International Historic Mechanical Engineering Landmark

July 23, 1991

Jeep House, Toledo, Ohio



The JeepMB. Born of Necessity.

The original Jeep vehicle was the answer to the U.S. Army's call for a light, four-wheel drive, general-purpose vehicle and scout car. For years, the motorcycle and sidecar had been deemed unsatisfactory. It was a call that, as of March 1940, had attracted only a two-person vehicle known as the "Bellyflopper," a small four-wheel drive vehicle that required the driver to lie on his stomach.

Within months, the Army's search for the "perfect vehicle" would lead to the Jeep MB.

Specifications for the vehicle were demanding. It had to have four-wheel drive with a front driving axle and a two-speed transfer unit. Its engine had to be capable of 85 foot-pounds of torque. It also required a rectangular body, a fold-down windshield, three seats, and blackout lighting. Original weight restrictions were a low 1,300 pounds. The vehicle needed to operate from 3 to 50 miles per hour, and the wheelbase was to be 75 inches (eventually lengthened to 80). It also had to carry a 660-pound payload including a .30-caliber machine gun.

These were the specifications sent to 135 U.S. automotive firms on July 11, 1940. Bids were to be received by July 22, just eleven days later. Due to the war then underway in Europe, the rush was on.

Two companies responded initially: Toledo-based Willys-Overland Company and the American Bantam Company of Butler, Pennsylvania. (Ford Motor Company's bid was accepted later.)

Jeep MB model in front of Jeep House, Toledo, Ohio.

Bantam developed a prototype first, the "Blitz Buggy," which was delivered in two short months. It was the work of Bantam's designer, Karl Probst. After 20 days, the Blitz Buggy was accepted, and Bantam earned a contract for 70 more. The first Bantam vehicles were field-tested by Colonel (later General) Dwight D. Eisenhower.

Spurred by Bantam's success, Willys-Overland, under chief engineer Delmar Roos, continued to work on its prototype, the "Quad," so named for its four-wheel drive system. By November, the Quad was ready.

It was symbolically pictured first on Armistice Day, November 11, 1940, and arrived for testing ten days ahead of the Ford model.

Unfortunately, the Quad was 250 pounds too heavy. First thoughts were to replace the powerful Willys engine, an engine Roos had been designing for years.

"The problem that confronted me," said Roos, "was whether or not we should redesign our pilot model to meet this weight specification and stick to the Willys-Overland engine, or simply go out and buy a Continental engine as Bantam was doing and redesign our vehicle." In what proved to be the correct decision, the engine stayed.

The vehicle was taken apart piece by piece. Each part was evaluated with respect to weight and whether a lighter material could be substituted. Bolts that were longer than necessary were trimmed, and other modifications were made. For example, just one coat of paint was applied. The refined vehicle made the weight restriction by seven ounces.

In the end, all three prototypes were similar in design, with the Willys-Overland entry being the most powerful. In fact, the Willys 105 foot-pounds of torque not only exceeded the requirement, but also dwarfed Bantam's 83 and Ford's 85 foot-pounds of torque.

Contracts for 1,500 units each were given to the three companies, with delivery to begin in June 1941. The order accompanied the Army's recognition that the original weight requirement was neither sound nor realistic. The new weight requirement was 2,160 pounds.

After studying these production models, the Army decided to have Willys-Overland produce the vehicle, although the final design incorporated some of the features of the Ford and Bantam models. The general design and bodywork were largely from Bantam; the front end, Ford; the power unit, Willys.

Going back further, the driveline layout was used by the Dutch Spijker in 1902; the type of driven front axle was pioneered by Otto Zachow in 1907; and, mechanically, the Quad was a scaled-down Marmon-Herrington half-ton 4x4 designed in 1936.

The key factor in the selection of the Willys-Overland vehicle was its powerplant. The Willys Quad had a 60 hp "Go Devil" 4-cylinder L-head engine (both intake and exhaust valves were in the cylinder block). The Willys "Go Devil" engine was rugged, strong, and reliable. It had greater displacement and horsepower than that of either Bantam or Ford. Furthermore, it had come from the Willys Americar and had been tested and tried in years of service.

The horsepower of the basic Willys engine had been greatly increased by Roos. Roos had joined Willys-Overland in 1938 after a career of solving engineering problems for Pierce-Arrow, Locomobile, and Studebaker.

When Roos arrived at Willys-Overland, the engine that would later power the Jeep MB already was in production. It had the same bore and stroke but developed only 45 horsepower at 3400 revolutions per minute (rpm) as compared to the 60 horsepower at 4000 rpm it had after Roos' mechanical ministrations.

His first step was to take the engine out of production and run it at full throttle, or 3400 rpm, for 22 minutes.At this point, the cylinders began to score and the rod bearings burned out. To solve these problems , he redesigned the cooling system and replaced the cast-iron pistons with tin-plated aluminum ones. These changes, together with other minor ones, made it possible to run the engine for 50 hours at 3600 rpm. However, this caused the valves to burn out. More redesigning followed and this weakness was eliminated. Step by step, Roos got the engine up to the point where it would run at 4000 rpm for 100 hours without engine failure.

It was this engine that tipped the scales in favor of the Willys-Overland entry.

Close-up views of Jeep MB instrument panel, driver's front seat over fuel tank, and rear end showing blackout lamps, pintle hook, and bumperettes.

Ford was asked to co-produce the Willys to boost production and guard against delays because of accidents or sabotage at Willys-Overland. From 1941 to 1945, Ford produced 277,896 Jeep vehicles, because Bantam's Butler, Pennsylvania, plant did not have the capacity to produce the numbers needed.

Willys-Overland produced 1,800 Jeep MA models from 1940 to 1941, and 368,714 Jeep MBs from 1941 to 1945. The Army requested changes before the MB went into production. As a result, it díffered from the MA in a number of ways. Most noticeable was the design of the front end, which followed the Ford design.

Other changes were made as well. Unlike the MA, the MB did not have vacuum ignition-advance control. The Army also requested an improved carburetor air cleaner and a larger generator with 4-ampere capacity, which was standard on most government trucks. The battery was standardized, using the government 2-H6-volt type in place of the passenger-car type.

The hand brake was moved to the center of the vehicle so it could be reached by either driver or passenger. The single-bow top was changed to a double-bow for more headroom.

In addition, the open shift lever and driving lights were standardized to conform with other government vehicles. Improvements were made to protect the steering tie-rods and spring shackles. Seals were provided to keep water and dirt out and hold the lubricant in, thereby tripling the life of the shackles and reducing the frequency of lubrication.

From 1941 to 1945, a number of field modifications were made. Improvements included installation of a surge tank in the cooling system for desert service; conversion of the electrical system from 6 to 12 volts for radio equipment; installation of a capstan winch; oversize tires and engine-driven air pump; and vacuum instead of manually operated windshield wiper. Also available were field kits for winter conditions, cold starting, heating, and deep-water fording.

During the war, variations of the Jeep vehicle were built. The amphibious Jeep or "Seep" (for seagoing Jeep) was produced by Ford starting in September 1942. Production was halted in 1943 as the vehicle was not particularly successful, especially on land.

Jeep vehicles were also modified for ambulance duty. Dubbed the "Jane," a Jeep vehicle thus converted could carry three stretcher cases. Lightweight variations for airborne assaults were also produced. Jeep vehicles were lengthened and made into personnel carriers. They also appeared as half-tracks. In some cases, skis replaced the front wheels. In other cases, trailers were attached to carry supplies and ammunition. Jeep vehicles were equipped with many different kinds of ordnance, from mortars to cannons to machine guns.

The origin of the Jeep name remains clouded in mystery. One of the most popular theories is that the name came from "General Purpose," or "G.P." Another widespread theory is that it was named in honor of a character in the Popeye comic strip, Eugene the Jeep. Eugene's ability to bound about and go just about anywhere was similar to the characteristics of the vehicle carrying his name. Willys copyrighted the name "Jeep" in 1946. Since then, it has been a trademark of Willys-Overland, Kaiser, American Motors Corporation, and, now, Chrysler Corporation. Although the mystery of the name may remain unsolved, the Jeep performance during World War II is a matter of record.

The late General George C. Marshall called the Jeep vehicle "America's greatest contribution to modern warfare." The Jeep MB model served in every WW II theater as a litter bearer, machine-gun firing mount, reconnaissance vehicle, pickup truck, front-line limousine, ammo bearer, wire layer, and taxi.

In the Ardennes during the 1944-45 Battle of the Bulge, Jeep vehicles, loaded with stretchers and draped with wounded, raced to safety ahead of spearheading Nazi armor. In the sands of the Sahara, the morass of New Guinea, and the snow fields of Iceland, Jeep vehicles hauled the .37mm anti-tank cannons to firing sites. In Egypt, the British used a combat patrol of Jeep vehicles to knock out a fleet of fuel tankers en route to Rommel's armor forces on the eve of the battle of El Alamein. At Guadalcanal, Jeep vehicles went in with the U.S. Marines. In the end, the Jeep vehicle was called "the most valuable weapon during the war" by two U.S. Presidents.

The first post-war Jeep vehicle was the prototype CJ-1A (CJ stands for Civilian Jeep). The first production CJ, the CJ-2A, was introduced in August 1945 at a price of $1,090. The CJ-2A was heavily based on the wartime MB model. Vehicles with the C J designation were built until 1986.

Although the Jeep MB was not the first four-wheel drive vehicle, it did bring together a series of engineering concepts that influenced every four-wheel drive vehicle being built today. Four-wheel drive technology has been greatly refined and horsepower tremendously increased, but much of the success of these components is due to the Jeep MB.

The Jeep MB can be seen on display at the Henry Ford Museum in Dearborn, Michigan, the Smithsonian Institution in Washington, D.C., and at the Jeep House in Toledo, Ohio. The Jeep model at the Jeep House is a typical example of the first high-volume production vehicle. Further more, the MB displayed in Toledo is at the site of the original Willys-Overland factory where it was conceived and built.

Historical Jeep MB models are on display at the Jeep House, Toledo, Ohio; Smithsonian Institution, Washington, D.C.; and Henry Ford Museum, Dearborn, Michigan.

Jeep® MB Technical Data

ENGINE

Willys model 441or 442 "Go Devil" 4-cylinder in-line water cooled side-valve (L-head) gasoline engine, developing 60 bhp (54 net) at 4000 rpm and a max. torque of 105 lb-ft (95 net) at 2000 rpm Cubic capacity 134.2 in. (2199 cc). Bore and stroke 3.125 x 4.375 in (79.375 x 111.125 mm). Compression ratio 6.48:1. SAE and RAC rated hp: 15.63. Firing order: 1-3-4-2. Valve tappet clearance (cold) inlet and exhaust: 0.014 in. Spark plugs: Champion QM2 or Auto-Lite AN7,14 mm, gap 0.030 in. Auto-lite ignition distributor (dust-proof on certain vehicles); contact breaker gap: 0.020 in AC model AF mechanical fuel pump. Carter model W0-539S downdraft carburetor. Note: Ford-built engines were virtually identical but used studs instead of bolts for connecting rod bearing caps; rods were interchangeable.

TRANSMISSION

Borg and Beck model 11123 single-dry-plate clutch; driven-plate diameter 7 7/8 in. Warner Gear model T-84-J gearbox with three forward speeds and one reverse; synchromesh on second and top gear. Spicer model 18 transfer case/auxiliary gearbox bolted onto main gearbox, with high (direct) and low (1.97) range. Separate lever to engage or disengage front-wheel drive. Locking arrangement to prevent use of low transfer ratio with rear-wheel drive only. Provision for PTO (power take off)at rear end of gearbox mainshaft. Spicer U-jointed propeller shafts to front and rear axles. Spicer fully floating driving axles with hypoid-bevel final drive, ratio 4.88:1. Front axle with Bendix-Weiss, Rzeppa, Spicer, or Tracta constant-velocity joints.

GEAR RATIOS

	Gearbox	Overall High Range	Overall Low Range
First	2.665	13.005	25.573
Second	1.564	7.632	15.036
Top	1.000	4.880	9.614
Reverse	3.554	17.344	34.167

CHASSIS

Midland Steel ladder-type chassis frame (with differences in front cross-member and shock-absorber mountings between Ford and Willys). Semi-elliptical leaf springs, front and rear with U-shackles and screwed bushes. Rear spring assemblies identical left and right. Left front spring had different spring rate from right-hand spring to cope with extra load (engine offset to left)and was identified by the letter "L" painted in yellow on the underside. Willys units, from serial number 146774, and all Fords were fitted with a torque reaction stabilizer spring below the left front spring (could also be installed on earlier Willys vehicles). Hydraulic telescopic shock absorbers. Bendix hydraulic service brakes on all wheels. Mechanical parking brake on transfer case output shaft (externally contracting on most, internally expanding on some late prnduction models). Ross cam and twin-lever steering gear. Split-rim combat-type road wheels (conventional drop-center type on early models) with 6.00-16/6-ply. tires, usually with non-directional cross-country tread. Tire pressure, front and rear: 30-35 lb./sq. in.

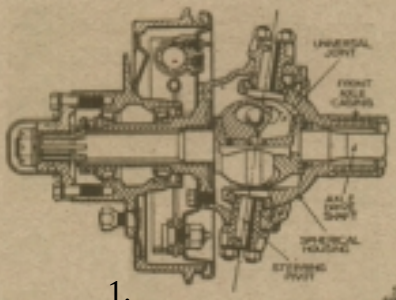
DIMENSIONS AND WEIGHTS

Wheelbase: 80 in. Track (tread), front and rear: 48¼ in. (49 with combat wheels). Overall length: 131 in. (early models 132¼ to 132 ¾in.). Overall width: 62 in. Overall height (with normal load), at cowl: 40 in., at top of steering wheel: 51¼ -52 in., with top up: 72 in. (early models 69¾ in.). Ground clearance: 8¾ in. Shipping weight (less fuel and water): 2337 lb. Curb weight of complete vehicle: 2453 lb (early models 2315 lb). Gross vehicle weight, off highway: 3253 lb, on highway: 3653 lb. Maximum payload: 800 lb. Maximum trailer load 1000 lb.

ELECTRICAL

6-volt negative-ground system. Sealed-beam headlights, mounted on hinged brackets. Lighting system controlled by blackout (main) light switch on dashboard (later production models had rotary-type light switch, replacing push-pull type). Auto-Lite generator, regulator, and starter motor. The spring-loaded generator brace could be pulled up to slacken the fan belt, thus preventing the fan from throwing water over the engine when fording.

A radio outlet box was fitted against the bodyside panel at the right front seat on later vehicles. Certain vehicles were fitted with a l2-volt 55-amp auxiliary generator, V-belt-driven from transmission PTO.



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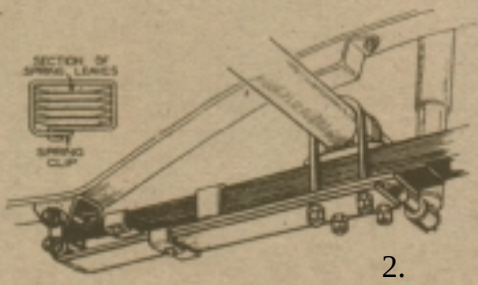

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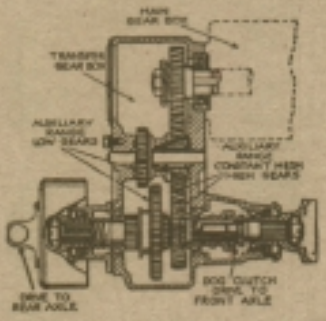

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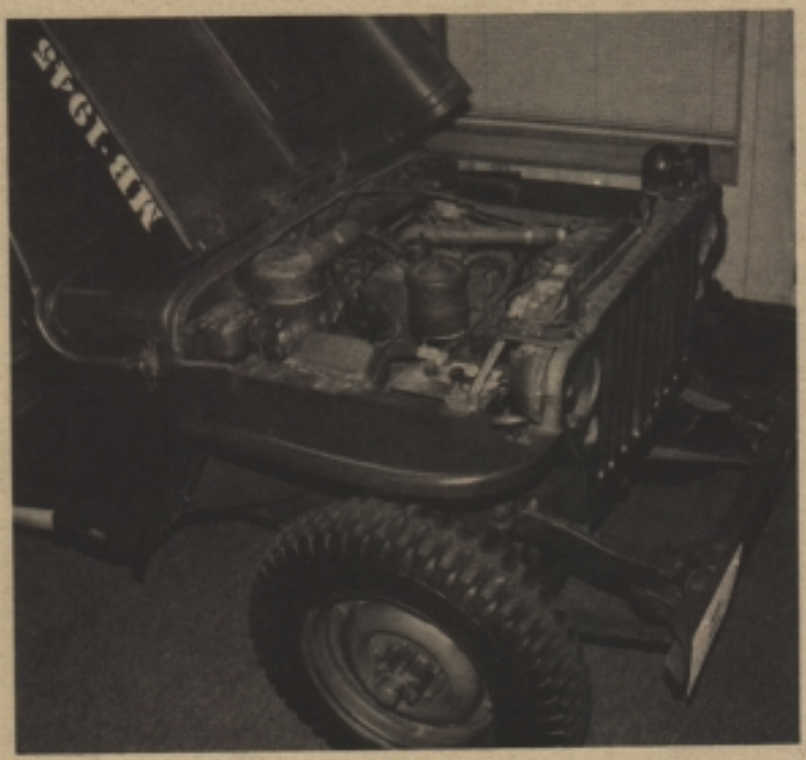

Jeep MB engine designed by Delmar Roos.

1. Front-wheel drive and steering details with Bendix-Weiss type CV joint.
2. Left front spring with additional torque-reaction spring to stabilize front axle in rough service.
3. Cross-section of 2-speed transfer case.

The History and Heritage Program of the ASME

The ASME History and Heritage Recognition Program began in September 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee, initially composed of mechanical engineers, historians of technology, and curator (emeritus) of mechanical engineering at the Smithsonian Institution. The Committee provides a public service by examining, noting, recording, and acknowledging mechanical engineering achievements of particular significance. The History and Heritage Committee is part of the ASME Council on Public Affairs and Board on Public Information. For further information, please contact Public Information, American Society of Mechanical Engineers, 345 East 47 Street, New York, NY 10017-2392;(212) 705-7740.

Designation

The Willys-Overland Jeep MB model is the thirty-third International Historic Mechanical Engineering Landmark to be designated. Since the ASME Historic Mechanical Engineering Recognition Program began in 1971, 145 Historic Mechnical Engineering Landmarks, five Mechanical Engineering Heritage Sites, and two Mechanical Engineering Heritage Collections have been recognized. Each reflects its influence on society, either in its immediate locale, nationwide, or throughout the world.

An ASME landmark represents a progressive step in the evolution of mechanical engineering. Site designations note an event or development of clear historical importance to mechanical engineers. Collections mark the contributions of a number of objects with special significance to the historical development of mechanical engineering.

The ASME Historic Mechanical Engineering Recognition Program illuminates our technological heritage and serves to encourage the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians, and travelers. It helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery.

Personal Acknowledgement

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Recommended Reading and Acknowledgements

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From Left to Right: Jeep MA (1941), Jeep MB (1941-45), Jeep M38 (1950-52), Jeep M38A1 (1955-63).