BMW 801

BMW 801 side view. Note the fan on the front (left) and large accessories section at the rear, which includes the supercharger.

BMW 801 front view. Note the cooling fan (black). The three cylinders at the front are the propeller pitch drive, not part of the engine itself.

The **BMW 801** was a powerful German air-cooled radial aircraft engine built by BMW and used in a number of German military aircraft of World War II. The engine's cylinders were in two rows of seven cylinders each, the bore and stroke were both 156 mm, giving a total capacity of 41.8 litres (2,560 in^3). The engine generated between 1,600 and 2,000 metric horsepower (1,176 and 1,471 kW). The unit (including mounts) weighed around 1,250 kg and was about 1.27 m across, depending on the model.

Development history

In the 1930s, BMW took out a license to build the Pratt & Whitney Hornet engines. By the mid-30s they had introduced an improved version, the BMW 132. The 132 was widely used, most notably on the Junkers Ju 52, which it powered for much of that design's lifetime.

In 1935 the RLM funded prototypes of two much larger radial designs, one from Bramo, the Bramo 329, and another from BMW, the BMW 139. BMW bought Bramo soon after the projects started; unsurprisingly BMW folded the Bramo engineers into the BMW project, cancelling the Bramo design. The resulting proposal was essentially a two-row version of the 132, the 1,400 hp (1,029 kW) BMW 139.

The 139 was originally intended to be used in similar roles as the other German radials, namely bombers and transport aircraft, but mid-way through the program Kurt Tank suggested it for use in the Focke-Wulf Fw 190 fighter project. Radial engines were rare in land-based fighters at the time due to their larger frontal size, but Tank felt that attention to detail could result in a streamlined radial that would not suffer undue drag.

The main concern was providing cooling air at the tops of the cylinders, which generally required a very larger opening at the front of the aircraft. His solution for the 139 was to use an engine-driven fan

behind an oversized prop-spinner, blowing air through the engine, with some of it being "sucked" through S-shaped ducts over a radiator for oil cooling. However this system proved almost impossible to make work with the 139; early prototypes of the 190 demonstrated terrible cooling problems. Although the problems appeared to be fixable, since the engine was already fairly dated in terms of design, in 1938 BMW proposed an entirely new engine that could be brought to production quickly. Work started in October.

Differences between the 139 and the new design were fairly minor and limited primarily to details except for the use of 14 larger cylinders instead of 18 smaller ones. The new design was given the name 801 after BMW was given a new block of engine numbers by the RLM to use after their merger with Bramo. The 801 retained the 139's older-style single-valve intake and exhaust for instance, while most engines of the era had moved to four valves per cylinder, or in British use, sleeve valves. Several advances were worked into the design, however, including the use of sodium-cooled valves and a fuel injection system. The supercharger was rather basic in the early models, using a single-stage two-speed design directly geared to the engine (unlike the DB 601's hydraulically-clutched version) which led to rather limited altitude performance in keeping with its intended medium-altitude usage. One key advancement was the *kommandogeraet* (command-device), a mechanical-hydraulic unit that automatically adjusted engine fuel flow, propeller pitch, supercharger setting, mixture and ignition timing in response to a single throttle lever, dramatically simplifying engine control, and could be considered a pioneering step towards the use of a type of "computer" to control an internal combustion engine's operation, as in modern automobile and truck engines.

The first 801A's ran in April 1939, only six-months after starting work on the design. The 801B series were identical to the A models, but ran the airscrew in the opposite direction to the left using a different gearbox. They were intended to be used in pairs with the A series on twin-engine designs, thereby cancelling out net torque and making the plane easier to handle. The 801L was an A model modified for "tropical" use. However all of these proved to have terrible cooling problems as well, and a number of efforts were improvised in an attempt to cure them.

Eventually all of the A, B and L's were replaced with the C series, which included a new hydraulic prop control and various changes intended to improve cooling, including cooling "gills" on the cowling behind the engine. The 801C-1 engines used in the first 190A-1 fighter aircraft delivered about 1,560 hp (1,147 kW) for takeoff, improved to 1,600 hp (1,176 kW) in the 801C-2 used in the 190A-2.

These were soon replaced with the 801D series engines, which ran on C2/C3 100 octane fuel instead of the A/B/C's B4 87 octane, boosting takeoff power to 1,700 hp (1,250 kW) in the D-1, and 1,730 hp (1,270 kW) in the strengthened D-2. The D models also included a system for injecting a 50-50 water-methanol mixture known as MW50 into the supercharger output to cool the charge, and thereby reduce backpressure. Although practically every production model 190 included the 801D engine, it was not until very late in the war that the MW50 kits were actually supplied and available. With boosting on, low and medium-altitude performance improved considerably, with takeoff power increasing to 2,000 hp (1,470 kW). The 801G and H models were D engines modified for use in bomber roles with lower gear ratios for driving larger propellers, right and left turning, respectively.

With the engine now being used in higher-altitude fighter roles, a number of attempts were made to address the limited performance of the original supercharger. The 801E was a modification of the D-2 using supercharger gear ratios tuned to higher altitudes. Although takeoff power was unaffected, cruise power increased over 100 hp (75 kW) and "high power" modes for climb and combat were likewise improved by up to 150 hp (110 kW). The E model was also used as the basis for the 801R, which included a much more complex and powerful two-stage four-speed supercharger. Continued improvements to the basic E model led to the 801F, which dramatically improved performance across

the board, with takeoff power increasing to 2,400 hp (1,790 kW). It was planned to use the F on all late-model Fw 190's, but the war ended before production started.

A number of attempts were made to use turbochargers on the 801 series as well. The first used a modified 801D to create the 801J, delivering 1,810 hp (1,331 kW) at takeoff and 1,500 hp (1,103 kW) at 40,000 ft (12,200 m), an altitude where the D was struggling to produce 630 hp (463 kW). The 801E was likewise modified to create the 801Q, delivering a superb 1,715 hp (1,261 kW) at 40,000 ft (12,200 m), power ratings no existing allied engine could touch. However none of these engines ever entered production due to high costs, and the various high-altitude designs based on them were forced to turn to other engines entirely, typically the Junkers Jumo 213.

Engines were typically delivered from BMW complete in their cowling, ready to be bolted to the front of the plane, since 1942 as *Motoranlage (M)* and 1944/1945 as *Triebwerksanlage (T)*. The Motorenanlage was the interchangeable *Kraftei*, or "power-egg", powerplant installation format used in many German wartime aircraft, with some need for external add-ons and the Triebwerksanlage was the Motoranlage + some external mountings like exhaust pipes as completely interchangeable unit.

The M and T versions confuses the naming considerably, as they referred to these complete kits and their "bare" engine counterparts almost interchangeably. The A, B and L models were known (logically) as the MA, MB and ML in this form, but the common D-2 was instead known as the MG. The E model was delivered as the TG or TH, seemingly suggesting a relation to the G and H engines, but in fact those were delivered as the TL and TP. It is rather common to see the turbocharged versions referred to only with the T, notably the TJ and TQ models, further confusing the issue.

Variants

- 801A,B,C: 1,600 hp (1,176 kW)
- 801D,G,H: 1,730 hp (1,272 kW)
- 801E,S: 2,000 hp (1,471 kW)
- 801F: 2,400 hp (1,765 kW), development halted by the end of the war

Specifications (BMW 801C-2)

General characteristics

- **Type:** 14-cylinder supercharged two-row air-cooled radial engine
- **Bore:** 156 mm (6.14 in)
- **Stroke:** 156 mm (6.14 in)
- **Displacement:** 41.8 litres (2,550 in^3)
- **Length:** 2,006 mm (79 in)
- **Diameter:** 1,290 mm (51 in)
- **Dry weight:** 1,055 kg (2,325 lb)

Components

- **Valvetrain:** One intake and one sodium-cooled exhaust valve per cylinder
- **Supercharger:** Gear-driven single-stage two-speed
- **Fuel system:** Fuel injection
- **Cooling system:** Air-cooled

Performance

- **Power output:** 1,176 kW (1,600 hp) at 2,700 rpm for takeoff
- **Specific power:** 28.1 kW/L (0.62 hp/in³)
- **Compression ratio:** 6.5:1
- **Specific fuel consumption:** 0.308 kg/(kW·h) (0.506 lb/(hp·h))
- **Power-to-weight ratio:** 1.11 kW/kg (0.69 hp/lb)

Applications

Germany

- Dornier Do 217
- Focke-Wulf Fw 190
- Junkers Ju 88
- Junkers Ju 188
- Junkers Ju 290
- Junkers Ju 388
- Junkers Ju 390
- Messerschmitt Me 264

Comparable engines

- Wright R-2600

See also

- List of aircraft engines