

Yamaha Motor Monthly Newsletter

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A cutaway of the new YZF-R1's 998cc liquid-cooled in-line 4-cylinder engine with a crossplane crankshaft

The Core of Yamaha Motor

Core Competency

Part 1: Small-engine Technology

Driving our main product line while contributing to multi-axial business growth

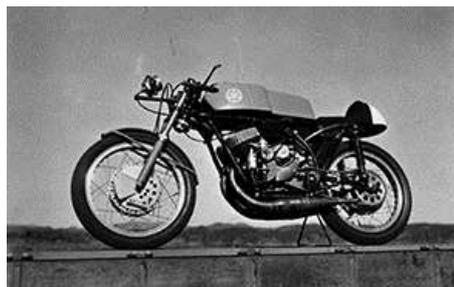
Yamaha Motor's history began with the 2-stroke, air-cooled, piston valve-induced single-cylinder 125cc engine that powered its first motorcycle, the YA-1. Since then, Yamaha has developed a wide variety of motorcycles and scooters with different engine formats and displacements, and has also applied its engine technology in a wide range of fields to create new lines of business. In this way, the company's development has indeed been a direct manifestation of the "Motor" in our name.

In this issue, we introduce the "small-engine technology" that stands as one of Yamaha Motor's core competencies along with our "FRP processing technology" and "electronic control technology."

Two-stroke Technology Honed by Racing

The history of Yamaha Motor's motorcycle engines started with the 125cc single-cylinder engine of the YA-1 model released in 1955. Within the company's first three years, two more variations were added: a 175cc single-cylinder engine (YC-1) and a 250cc 2-cylinder engine (YD-1). Then throughout the 1960s, Yamaha continued to refine its technology for simple 2-stroke engines with single-cylinder or in-line 2-cylinder formats and displacements up to 350cc.

The driving force behind this development turned out to be racing: the way to quickly earn recognition for the new Yamaha-brand motorcycles was to win races. Winning demanded machines that efficiently turned fuel into power, had the durability to withstand continuous use at full throttle and were designed with lightness and compactness that contributed to handling performance. To build such machines also required the latest engineering technologies and high-precision manufacturing. Yamaha engineers answered these demands by developing new technologies ranging from rotary disc valve induction and the exclusive "Autolube" separate oil supply system, to piston reed valve induction and the 7-port Torque Induction system. After they were tested and refined on road racers and competition motocrossers, these innovations were put to practical use on a wide variety of production bikes, from road sport models to family-use models. It was during this era that Yamaha began full-fledged participation in World GP racing and expanded export of its products abroad. Before long, the reputation of "Yamaha 2-strokes" had spread throughout the world.



The RD56 factory machine was raced in the 250cc World GP. It won consecutive Rider and Constructor titles (1964–1965) and established the strong reputation for "Yamaha 2-strokes" at a time when 4-strokes dominated the championship.

Pursuing Distinctiveness and Diversity

From the latter half of the 1960s, however, there was a shift in the motorcycle markets in the advanced motorized countries of Europe and North America, as well as Japan, which was in the midst of its period of rapid economic growth. The popularity of high-power, large-displacement 4-stroke motorcycles built for comfortable high-speed cruising was on the rise, and this trend only became more widespread as time went on. This change prompted Yamaha to introduce the XS-1 in 1970, its first 4-stroke model. As with its 2-strokes, Yamaha would again set about launching a varied range of models one after another, all based on its own unique identity as a manufacturer.

For example, the XS-1 was aimed at achieving the light, agile handling desired in a sport model and was built around a lightweight and compact 650cc in-line 2-cylinder engine. The GX750 that followed was a more powerful sport model mounting an in-line 3-cylinder engine in order to make a slimmer chassis design possible. For the XV750 full-fledged cruiser model, Yamaha chose the V-twin format that was the standard for American cruisers. Then there was the XS1100, born of an ambitious attempt to build the fastest, most powerful bike on the road by giving it a 1,100cc in-line 4-cylinder engine—the largest motorcycle power unit motorcycle at the time. Together with the XT500 big-displacement off-road bike mounting a torquey 500cc single-cylinder engine, these and other Yamaha products had unique, innovative engines designed and built in line with each model's product concept to deliver "fun to ride" performance.



Drawing on its expertise garnered in the joint development of the Toyota 2000GT sports car, Yamaha developed and marketed in 1970 its first 4-stroke model in the XS-1, a large-displacement sport model with a lightweight, slim and compact design.

Since the 1980s, the development and evolution of Yamaha's 4-stroke engines has continued unabated. Our engines now range from 50cc to 1,900cc and from single-cylinder to 4-cylinder formats, powering products that cover the many motorcycle categories that exist today, from family-use models to sport bikes.

Some representative models mounting engines that epitomize one ideal of today's Yamaha engine technology are the Mio 125 and the Soul GT. Their high-performance 125cc "BLUE CORE" engines are designed to achieve the best balance of both performance and environmental friendliness. On the other end are the YZF-R1 and the MT-09 mounting Crossplane Concept engines with technology derived from Yamaha's MotoGP machines with the aim of achieving linear and easy-to-use torque characteristics.

Roots in Motorcycle Technology: Outboards and Recreational Vehicles Evolve in Their Own Ways

In 1957, after production and sales of the YD-1 motorcycle were in full swing, Yamaha Motor president (at the time) Genichi Kawakami ordered development to begin on an outboard motor using the YD-1's engine. With Japan being a country surrounded by the sea and blessed with numerous lakes and rivers, he believed that the day would come when the Japanese would enjoy marine leisure in the same way he had seen in North America and Europe. The outboard motor would be the first step toward building that leisure market.

Although the first prototype ended in failure, the second one—it used the lightweight YA-1 engine—adopted a number of new measures; the cylinder used a new aluminum alloy containing high silicon content, making it both lightweight and highly resistant to abrasion and seawater-induced corrosion. Efforts like this resulted in the successful development and subsequent release in 1960 of Yamaha's first outboard motor, the P-7. Yamaha then developed the 60cc 3-horsepower P-3 outboard model using the engine from a new moped model and the new rotary disc valve induction system first adopted on the YA-5 motorcycle (the fourth model in Yamaha's YA series). This engine made the P-3 lightweight, compact and versatile, and it quickly became a big hit in Japan's coastal fishing industry and elsewhere.

Entering the 1970s, Yamaha developed its "Enduro" series of commercial-use outboard motors with outstanding serviceability and durability to meet the needs of markets in regions such as Central and South America, Asia and Africa. At the same time, in a tie-up with a North American manufacturer, Yamaha introduced large-displacement, high-horsepower outboard models for the pleasure-use market. In the process of creating numerous outboard models tailored for specific purposes, Yamaha made advances in its own original outboard-specific engine technology.

Then, in the 1980s, Yamaha responded to the growing awareness around the world of the impact of engines on the environment by introducing 4-stroke outboard motors. The company continued to steadily strengthen its product lineup, adopting exclusively developed anti-rust and anti-corrosion technology, fuel injection and innovations like the "Command Link" digital electronic monitoring and control system. All of these efforts contributed to Yamaha passing the 10 million unit mark in cumulative outboard production in 2014 and in attaining the world's largest share in the outboard market. Other Yamaha products that began by using motorcycle engines include the company's first snowmobile, the SL350 (1968), and its first ATV model, the YT125 (1979). As was the case with our outboard motors, these products would also evolve in response to the



The popularity of Yamaha Motor's outboards owed much to the high level of performance of commercial-use "Enduro" models like the E40G (1982) that could withstand tough usage conditions, and the unique service and support network Yamaha developed to back them up.

unique uses and environments of their respective categories, and they would develop new markets worldwide, contributing to the multi-axial growth of the Yamaha Motor group.

Automobile and Multipurpose Engines Create New Businesses

It should be noted that not all Yamaha engines originated from motorcycles; a good example are our engines for cars. Yamaha Motor began research in the field of small Japanese *kei* ("light") cars around the end of the 1950s. That line of research and development eventually shifted to sports cars, and in 1965, Yamaha Motor announced its partnership with Toyota Motor Corporation to jointly develop the Toyota 2000GT sports car. This project was the starting point of Yamaha's 4-stroke engine technology.



The "0X11A" lightweight, compact, high-revving, high-output 3,000cc V10 engine from the time Yamaha ended its F1 participation in 1997

Also around that time, the Toyota 2000GT and the Toyota 7 race car began to compete in automobile races with Yamaha support. In the 1980s, Yamaha

engaged in the development of Yamaha-brand Formula-class racing engines, providing units that would power cars competing in the All Japan F2 Championship as well as an All Japan F3000 title-winner. Then in the 1990s, Yamaha also entered the Formula 1 World Championship as an engine supplier.

At the same time, Yamaha Motor put its now-extensive engine technology expertise to work with the start of its automobile engine business, manufacturing production model engines for not only Toyota Motor Corporation but also Ford and Volvo. Today, Yamaha continues its close working relationship with Toyota and develops and manufactures engines for Lexus-brand models and others.

Another branch of Yamaha's engine development began in 1969 with the release of the MT100. It was a standalone single-cylinder multipurpose engine designed for affordability and excellent versatility in a variety of uses, ranging from powering water pumps or agrichemical sprayers in farming to winches and net haulers in fishery. The MT100 motorized a variety of jobs that were formerly performed manually. After the introduction of the MT100, a number of new models were added to Yamaha's multipurpose engine lineup and continuous updates improved their performance. They have also been used as power units for a variety of new Yamaha products, including portable generators, racing karts, snow throwers, industrial-use unmanned helicopters and water pumps, thus contributing greatly to Yamaha's "multi-axial" diversification of business fields.

From the earliest years of the company until the present, engine technology has always been at the core of Yamaha Motor. It not only supports the diverse range of Yamaha products, but continues to be the "motor" powering the satisfaction and reliability of those products and the trust as a brand that we offer to customers around the world.

Message from the Editor

Yamaha Motor's story has unfolded as the engines that constitute the vital working heart of our diverse range of distinctive products have evolved, for use on the road, the unpaved terrain of open country, the waters of the world, snowfields, deserts or even in the sky. The roots of Yamaha's 4-stroke engines lie in the power unit for the Toyota 2000GT sports car that finished 1st and 2nd in the Suzuka 1000 km endurance race in June 1966.

Suzuka Circuit also hosts the Suzuka 8 Hours Endurance Road Race, a round of the Endurance World Championship. This year, the race is scheduled for July 26th and Yamaha will enter it as a factory for the first time since 2002 with the "Yamaha Factory Racing Team." Top Japanese rider Katsuyuki Nakasuga will team with Yamaha MotoGP riders Pol Espargaró and Bradley Smith to compete on a machine based on the YZF-R1 and specially developed for the grueling 8-hour race. I hope you will all be cheering for them!



[Yamaha Suzuka 8 Hours Website](#)
(Opening soon)

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