HONDA
The Power of Dreams

Honda Racing

Honda Racing 60th Anniversary

Honda History of Challenge

WORLD CHAMPIONSHIP RACING SINCE 1959

The Declaration

Thanks to the tremendous efforts of all our employees, in the five years since being founded Honda Motor Co. has achieved remarkable progress.

Ever since I was a child I have dreamed of winning a world championship with a machine of my own design. However, before becoming a world champion, the company must be on a firm footing and must have precision manufacturing equipment and superior designs. Until now, we have focused our efforts on providing high-quality machines for the domestic market, leaving us no time to pursue motorcycle racing.

However, recent reports from the international motorcycle race in São Paulo have provided me with detailed information on Europe and America. And while I thought I was keeping abreast of conditions around the world, I now realize that I have been concentrating too much on Japan while the world around us advances with tremendous speed.

Nevertheless, my confidence in our ability to win remains as strong as ever. The fighting spirit that is part of my nature will not allow me to continue as before.

We now have a production system in which I have absolute confidence. The time is now! I hereby state my intention to enter the Isle of Man TT Races next year.

Never before has a Japanese rider entered this race with a motorcycle made in Japan. The winner of this race will enjoy world fame, and the same can be said for the motorcycle that wins the race. Because this international recognition leads to increased exports, the manufacturers in Germany, England, Italy and France spare no effort in preparing for this race.

I plan to build a 250cc (middleweight class) racer to represent Honda Motor Co. on the world stage. I am confident this machine will reach speeds exceeding 180km/h.

Modern aircraft engines produce about 55 horsepower per liter, but this racer will almost double that output, producing 100 horsepower per liter. When this engine is completed based on our company's original design, it will feature the most advanced technology in the world today.

The motorcycle is a premier product of modern heavy industry, one that requires comprehensive manufacturing skills and high technology to produce not only the engine, but also the tires, chains, carburetors and other components. This can only be achieved through meticulous attention to detail and unremitting effort.

To all employees!

Let all of us at Honda Motor Co. exert our utmost in pursuit of this glorious goal. The future of our company depends on this, and the burden rests on your shoulders. I want all of you to face this difficult challenge with passion, effort and meticulous research. The advances made by Honda Motor Co. are a reflection of your growth as human beings, and your growth ensures the future of our company.

The scrupulous care required when tightening a single screw, the commitment to not waste a single sheet of paper, this will open the road before you and pave the way to success for Honda Motor Co.

Fortunately, our banks, agents and outside contractors are cooperating fully with us in our endeavors, and our customers stand behind us as one.

I have watched as Germany, though defeated in war like Japan, has revived many of its industries. I am convinced that Honda Motor Co. must rise to this challenge and succeed.

This is an opportunity to proudly display the true worth of the Japanese machine industry to the entire world. The mission of Honda Motor Co. is to enlighten Japanese industry.

I hereby pledge that I will devote all my creativity and skills to entering and winning the TT Races.

March 20, 1954 Soichiro Honda President Honda Motor Co., Ltd.

Continuing To Dream

1959 Soichiro Honda at the Arakawa test course

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Cover photos: (Top) Honda Team at the 1959 Isle of Man TT Race
(Bottom) Repsol Honda Team & Honda Associates at the 2018 Japanese GP

*Originally published in 2009 to commemorate 50 years of world championship racing: this pamphlet has been partially updated.

1957 — 250 class lines up for the start of the 2nd Asama Mountain Race

From the First Race to the TT Race Declaration, Then to Asama: A Constant Search for More Power

A Rude Awakening & First Steps to the World Stage

The first Nagoya TT was held in 1953. Open to machines up to 150cc, it was held over a 232km public roads course. Japan's first large-scale race, it was contested by 57 machines from 19 different manufacturers. This was Honda's first race, and the company entered three Dream 3Es. The Hondas finished in 2nd, 4th and 18th with a combined elapsed time of 13hr 44'53". This was the quickest team time in the race, winning the Manufacturers' Team Prize for Honda.

Second place finisher Yasuo Tokunaga's time of 4hr 17'53" was only 18 seconds slower than the winning bike. Although the riders were required to obey the speed limits while on public roads, the average speed was 55km/h and the top speed was 80km/h, proving that Japanese motorcycles had reached a higher level of performance than expected.

In January 1954, Honda entered the São Paulo City 400-Year Anniversary International Motorcycle Race in Brazil. Invited by the local sponsors, Honda's second only race would take place on the international stage. Honda's entry was the R125, powered by a 125cc version of the 146cc Dream E-Type engine. Ridden bravely by Mikio Omura, the machine finished in 13th place. It had taken the team three days to get to Brazil, and while everyone was happy that the bike finished, the sobering results taught all concerned a valuable lesson.

1954 São Paulo City

Compared to the 110km/h top speed of the R125, the winning Mondial from Italy topped out at 160km/h. It was like the difference between a prop plane and a jet.

Prior to the race, then president Soichiro Honda knew that the Isle of Man TT Race was the pinnacle of motorcycle racing, and he knew that if Honda could win that race it would open the world's markets to Honda products. The 'reality check' of the São Paulo race proved to be an in-spiration. In March of that year, Honda declared his intention to race at the Isle of Man: "Whatever happens, we're going to race the TT. If we keep dawdling around, the world will leave us behind."

However, in Japan at that time no one knew anything about GP racing, and almost nobody had even seen a GP. So, that June, Soichiro Honda traveled to the Isle of Man to see for himself. What he saw shocked him to the core. "I thought I should go over there and see the race before we entered, but the huge difference in performance was a major shock for me."

The declaration stated that 100 horsepower per liter would be sufficient to compete at the international level, but at the TT the NSU 125 was putting out more than 15 horsepower and the 250 was at more than 35 horsepower. This equated to 150 horsepower per liter. Soichiro was dumbfound-ed.

The declaration so bravely made now seemed like the words of a child who had just learned to walk predicting a gold medal at the Olympics. From this point Honda began intensive research and development of racing machines, with the intent of competing at the TT in five years. It was to prove a long and difficult journey.

In July of 1955, Honda entered the 3rd All-Japan Mt. Fuji Race for lightweight motorcycles. Domestic racing was now firmly established, and Yamaha would be making its first entry in this race. The Honda team was led by Soichiro Honda himself, and the team took up lodgings at the venue one month before the race. The

Soichiro Honda at the Asama Lodge

hard work paid off; Honda's new 250cc OHC Dreams finished 1st, 2nd and 5th, the first win for Honda. But in the 125cc class, the main class for the domestic market, race regulations forced Honda to change their 4-speed Benly to a 3-speed on site, resulting in a 2nd place finish.

In November of that year the first All-Japan Motorcycle Endurance Road Race (the First Asama Highlands Race) was held. This race was a true test of a machine's performance and was an important development opportunity for Japan's manufacturers, nineteen of which entered machines in the event. Honda won the 350cc and 500cc races, but lost to Yamaha due to engine trouble in the 125cc race and, after various troubles, finished 2nd to Lilac in the 250cc race.

In the smaller displacement classes, the 4-strokes were clearly at a weight and performance disadvantage when compared to the 2-strokes. Everything possible was done to increase the rpm and horsepower of the 4-strokes and to reduce their weight. And although similar performance to the 2-strokes was achieved, the highly tuned nature of these engines and chassis adversely affected their durability.

It was through these efforts to improve performance and reliability that Honda began to develop high-precision high-rpm engines that came to be called 'precision machines.' In an effort to nurture racing riders, HSC (Honda Speed Club) was formed, and work began on building the team for the Isle of Man.

The Second Asama Race, held in October of 1957, saw the first appearance of factory racers, production models specially tuned and modified for racing. The new engine featured gear-driven cams and produced 100 horsepower per liter at 10,000rpm. Machines were entered in each class, but the lightweight 2-strokes still held the upper hand. Honda again won the 350cc class, but finished 3rd in the 125cc class and 4th in the 250cc class.

"All I could think about was the TT," said Soichiro Honda. For him, the Asama Race was merely a testing ground for his machines' performance. As a result, the bikes suffered various ills, and their performance was uneven. On top of that, there was a huge difference between the rough road surface of Asama and the smoothly paved roads at the TT. The machine regulations were also very different.

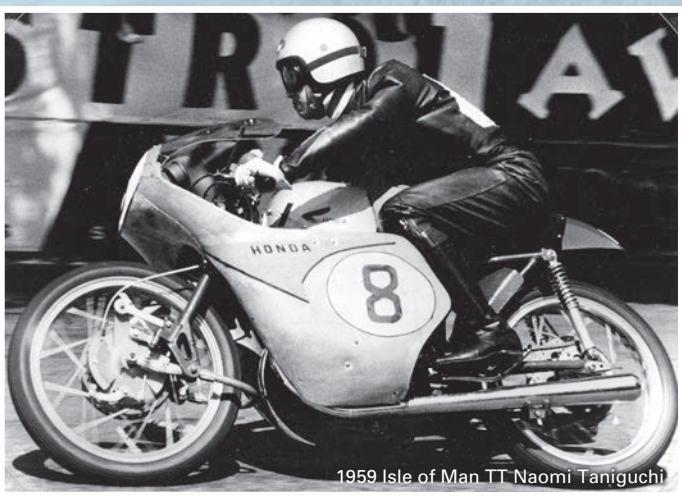
Accordingly, development of Asama machines and TT machines proceeded on a parallel path, each benefiting the other. Still, if the bikes couldn't win in Japan they had no hope on the world stage. Not enough time. Not enough horsepower. Too little information from abroad. Since making the declaration, the team had been plagued by a seemingly unending series of mistakes and problems.

In the midst of all this, the 1958 Asama Race was cancelled due to requests by the manufacturers, who were overwhelmed with developing new bikes every year and operating their race teams. Fortuitously, this allowed work on Honda's TT machines to progress, with performance and reliability improving remarkably. The new engines featured technology seldom before seen in motorcycles, boasting an output of more than 120 horsepower per liter. The time for excuses was over. The decision was made to race the Isle of Man.

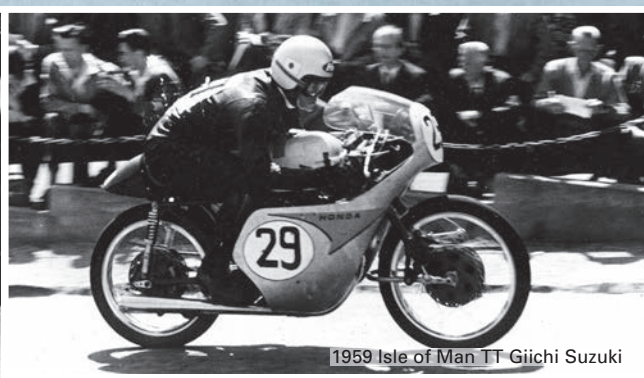
Glory in Year Three! Honda Dominates the Isle of Man TT and Wins a World Championship

The High-RPM, High-Horsepower RC Racers Shock the World

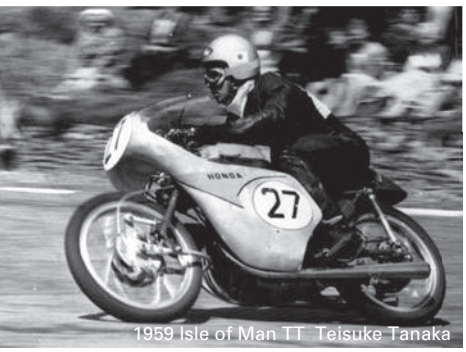
Start of the 250 race at the 1961 West German GP



1959 Isle of Man TT Naomi Taniguchi

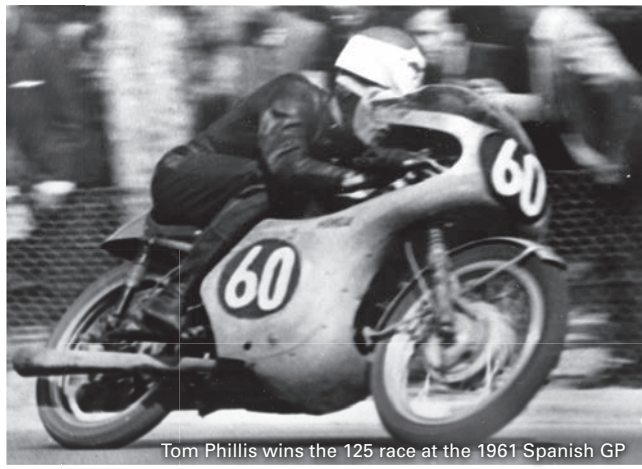


1959 Isle of Man TT Giichi Suzuki

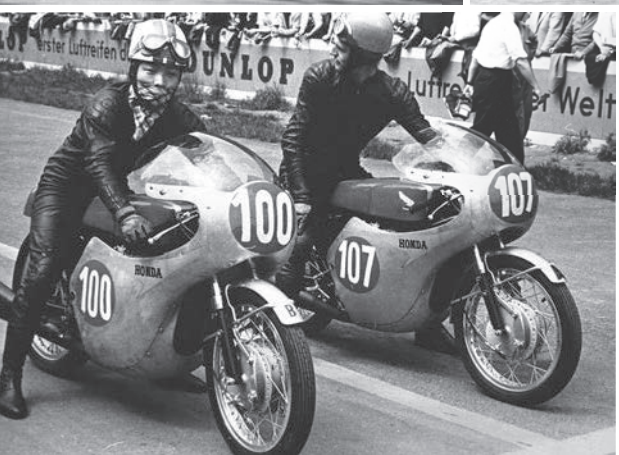


1959 Isle of Man TT Teisuke Tanaka

1959 Isle of Man TT Junzo Suzuki



Tom Phillis wins the 125 race at the 1961 Spanish GP



Kunimitsu Takahashi wins the 250 race for win #100 at the 1961 West German GP

A horsepower here, half a horse there — development on the high-rpm high-output engines continued without letup. For the 125cc TT race a DOHC twin-cylinder design was chosen. This unusual engine featured what at the time was a highly oversquare bore and stroke of 44 × 41mm, with each cylinder displacing 62cc.

Cam drive was via upper and lower bevel gear sets driven by a vertical shaft. Also unusual for the era were horizontally split crankcases (an ideal layout for high-rpm multi-cylinder engines, and later used in F1 engines) and a 6-speed transmission. This machine was developed from the RC140, which was in turn based on the Benly engine. Called the RC141, it was a one-off factory racer.

The RC141 boasted an output of more than 120 horsepower per liter, slightly less than the 150 horsepower of the era's top level machines. Prior to the race the feeling was that if even one machine finished in the top ten, that would be a success. This was Honda's first foray into a totally unknown world and everyone was filled with uncertainty as their TT debut drew near. And in fact, the team's first look at the circuit and the rapid international riders left a lasting impression. As soon as they arrived the team set to work assembling the 4-valve head they had brought with them and installed it on their latest machine, the new RC142 (17.3 HP/13,000rpm).

June 3, 1959 – 125cc Lightweight Class Results

(Clypse Course, 10 laps, 173.6km)

1st	*Tarquinio Provini/MV*	*1hr 27m 25.2s*
6th	*Naomi Taniguchi/Honda*	*1hr 34m 48.0s*
7th	*Giichi Suzuki/Honda*	*1hr 37m 03.4s*
8th	*Teisuke Tanaka/Honda*	*1 lap*
11th	*Junzo Suzuki/Honda*	*1 lap (retired)*

In Honda's first outing at the TT Taniguchi won a silver replica thanks to his 6th place finish. Suzuki and Tanaka were awarded bronze replicas. And because the team had three bikes finish near the top within the allotted time, Honda also won the Manufacturers' prize — an incredible result that no one had expected.

After the race, in an unusual move signifying the importance of the accomplishment, Japan's Ministry of International Trade and Industry announced that Japan's motorcycles had now reached the world level, and that this would help promote the export of Japanese products. And indeed, Japan's automotive industry had taken a huge first step.

In that year's Asama Race, Honda debuted the 250cc RC160, the world's first 250cc, DOHC, 4-valve, 4-cylinder engine. Essentially two 125cc RC142 engines mated together, the RC160 pumped out 35 horsepower at an ear-splitting 14,000rpm. With most of the competition running sin-gles and twins, the RC160 swept the field, taking 1st through 3rd, with a fastest lap run at an average speed of 106.8km/h. This was faster even than the 96.2km/h recorded by the 2-stroke Yamaha which won the 350cc class.

The next year, 1960, Honda entered its new 250cc machines in the TT in addition to the 125s, and also made their first foray into international GP road racing. The 125cc RC143 and the 250cc RC161 featured forward-slanted engines, and the RC161 used spur gears in its gear train. Other notable features included a narrower engine design, more efficient cam drive and more power (38 HP/ 14,000rpm). With the exception of Honda's 50cc engines, this engine architecture was to be-come the standard for the RC engines.

At that year's GP races Hondas finished 6th through 10th and 19th in the 125 race at the Isle of Man (the year's first event), with all machines finishing, and 4th through 6th in the 250 race. And although the results were similar to the previous year, the average speeds were higher. At the second race, the Dutch GP, the best finishes for Honda were a 4th in the 125 race and 7th in the 250 race. In the third race, the Belgian GP, the best 125 finished in 7th and the 250s did not compete.

In spite of Honda's success at the TT, racing the GPs was proving a formidable challenge. The team's early efforts were stymied by the difficulties of traveling between different countries and cultures, machine troubles, the inevitable crashes and injuries, and all the other trials and tribulations afflicting newcomers to the GP scene. Amidst all this, new personnel and new parts arrived in time for the year's fourth event, the West German GP, resulting in a stellar 3rd place finish for Kenjiro Tanaka in the 250 race. It was the first time in history that a Honda rider had stood on the victory podium of an international GP. It wouldn't be the last.

Six years had elapsed since Soichiro Honda's famous declaration. In only the team's second year they had already tasted the sweet fruits of success. Team members were ecstatic.

The next round was the Ulster GP, followed by the Italian GP, the last event of the 1960 season. Hondas finished 2nd in both 250 races. In the Manufacturers' Championships Honda finished 2nd in the 250cc class and 3rd in the 125cc class.

The stage had now been set for one of the most epochal years in motorcycle racing history. For 1961, Honda planned to enter both classes in eleven races and also exert a maximum effort for the Isle of Man. All the machines were thoroughly upgraded for the expected battles. The answer to the question, "What do we have to do to win?" was simple: develop the bikes day and night without letup. The hard work paid big dividends. The 250cc RC162 was now putting out 40 horsepower at 13,500rpm, the equivalent of 160 horsepower per liter.

The new machines made their stunning debut at the first GP of the season, the Spanish GP. Riding the previous year's RC143, Tom Phillis dominated the 125 race, finishing 21 seconds ahead of the 2nd place finisher. After only their seventh race in the 125 class, Honda was already winning. At the next round, the West German GP, history was again made as Kunimitsu Takahashi became the first Japanese rider to win a GP when he won the 250 race on the RC162, Honda's first GP win in the 250 class.

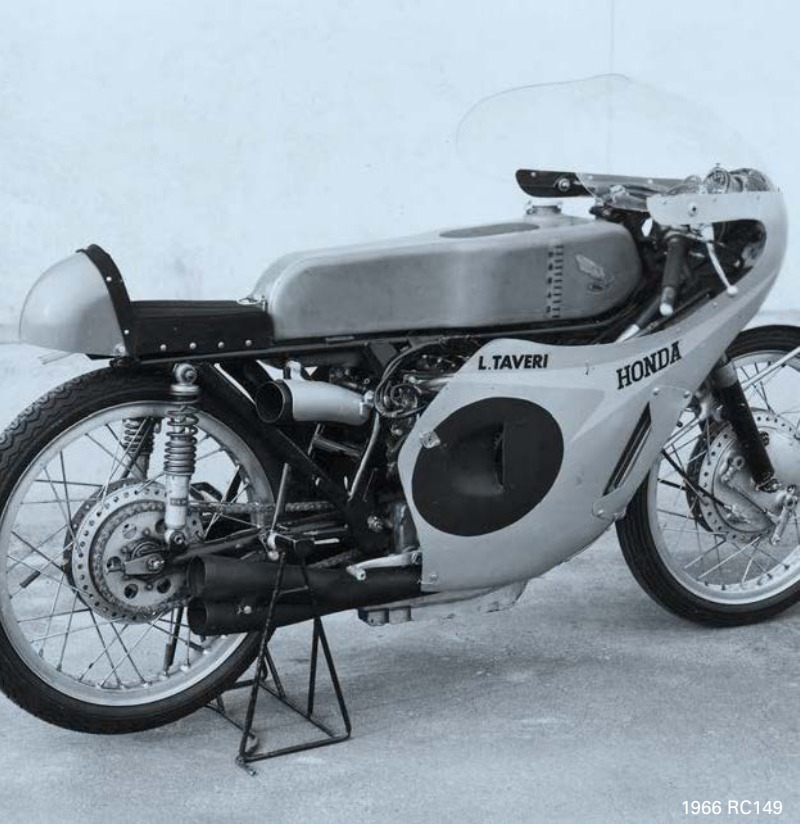
For Round Three the team crossed the border for the French GP. Two of the new RC143s were entered and Hondas finished in 1st, 3rd, 5th and 6th. The 250 race was a Honda rout, with the screaming RC racers filling the podium. The Honda onslaught had begun. During the 1961 season, Hondas won eight of eleven 125 races, and from the third 250 GP onward Hondas filled the victory podium, winning ten of eleven GPs. It was an overwhelming show of superiority.

Hondas dominance of Round 4, the Isle of Man TT, was especially impressive. Course records fell like autumn leaves as Hondas swept the first five places in the 125 and 250 races. In fact, the average lap time of the 250s was faster than the 350 machines.

Regarding this dominating performance, England's respected Daily Mirror wrote: "The internals of the winning machine were so impeccably refined that it was almost frightening. These were no mere copies of European machines. In the coming years Japanese motorcycles may take over the world."

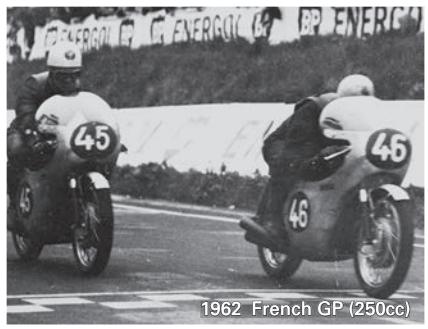
In that year, Honda won both the Riders' and Manufacturers' Championships in the 125cc and 250cc categories. Seven long years after Soichiro Honda's now-famous declaration, Honda ruled the world of racing.

Honda Reproduction of the 1959 RC142



1966 RC149


1967 Mike Hailwood on the RC174 (350cc)



1962 French GP (250cc)

Jim Redman

A World First — Total Domination of All GP Classes! The Shrieking Howl of Multi-Cylinder Honda Racers

The 5-Cylinder 125 and 6-Cylinder 250 Scream Out High Horsepower at Ultra-High RPM

With their victory sweep of the Isle of Man, Honda suddenly went from challenger to the dominant team in GP racing. Honda's dominance was challenged by Suzuki and Yamaha, and they soon became Honda's biggest rivals. For 1962, a 50cc class was added. Honda expanded their effort, developing 50cc and 350cc machines. Now competing in four classes, Honda now fielded the largest team in GP racing.

The new 50 (RC110/111) was a DOHC single featuring gear-driven cams. In spite of its advanced technology, it struggled against the 2-strokes, winning only one race and finishing the season in 3rd place. For the Suzuka All-Japan Road Race, held after the GP season, the twin-cylinder RC112 was introduced and won the race. With a miniscule 33mm bore and 2 valves per cylinder, this high-precision engine put out 10 horsepower at an astronomical 17,500rpm. Its spark plugs were a mere 10mm in diameter.

In the 125 class the RC145 won all ten GPs contested. The previous year's RC162 was used in the 250 GPs and won all nine races contested, sweeping the podium on six occasions. The first RC170 350 was merely an RC162 with a 3mm larger bore, for a displacement of 285cc. This machine was superceded by the 339cc RC171 which, in spite of retiring in its first outing won the next five GPs in a row. Honda won the Riders' and Manufacturers' Championships in three classes.

While the Honda team was busy decimating the competition overseas, back home the company was building Suzuka Circuit, Japan's first road course. This huge project had two goals: provide a place for testing and development, and to serve as a racing venue. At the Tokyo Motor Show, the S500 sports car made its debut featuring GP engine technology developed on the RC racers. Tokyo's first expressway also opened the same year.

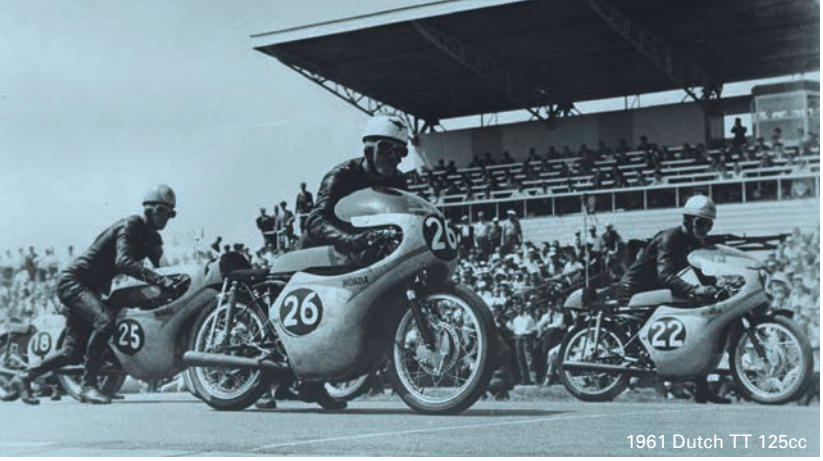
However, the next three years were much harder for Honda in the GPs. In 1963 Honda abandoned the 50cc race in order to further develop the machine. Then, in the 125 class Honda managed to win the first GP, but Suzuki went on to win the next eight GPs in a row. Honda won only three of twelve events. At the final race of the year, the Japan GP, the 4-valve twin-cylinder RC113 and the 4-cylinder RC146 with its center cam drive were debuted in preparation for the 1964 season. To compete with the 2-strokes, Honda was forced to use multi-cylinder designs and ultra-high engine speeds. Other technology included chassis components made of lightweight magnesium and titanium alloys, and fiberglass fairings for the smaller displacement machines.

The competition fought back with ultra-light machines which offset the RC's power advantage. Suddenly, the once invincible RCs had many rivals. The Morini, for example, won four GPs, including the season opener, this in spite of its power deficit. After winning the Isle of Man, Honda introduced the new RC164 and was just able to clinch the Riders' and Manufacturers' Championships in the 250 class at the Japan GP held at Suzuka. Honda had won only four of ten events.

In the 350 class, Gilera made its return to GP racing at the Isle of Man, and the season evolved into a titanic battle between the multi-cylinder machines of Honda, MV and Gilera. But the RC172, with its full 349.5cc displacement, had the advantage, winning six of eight races contested (five of seven races in the series).

For 1964, Honda had little competition in the 125cc and 350cc classes, winning both the Riders' and Manufacturers' Championships. However, in the 50cc and 250cc classes Honda ended the sea-son in second place. In the 50cc class Hondas won three of five races contested (Honda also won the Japanese GP, a non-championship race), while Hondas managed only three wins of ten races contested in the 250cc class. In the face of stiff competition in the prestigious 250 class, Honda unleashed their secret weapon at the second to last race of the season, the Italian GP. The new machine was the incredible 250 Six, designated 3RC164 (RC165). Pumping out 54.3 horsepower at an astronomical 17,500rpm, its unmistakable howl forever transformed the sound of GP racing. The RC165 finished 3rd in the Italian GP and won the season's final GP in Japan, inspiring much hope for the coming year.

For 1965 the 50cc machine (now designated RC115) got an even shorter stroke, with a bore/stroke ratio of 34 × 27.4mm, upping its output to 13.6 horsepower at an astonishing 20,500rpm! Honda's rivals had no answer in this class, and the RC115 screamed its way to victory in five of the season's seven races. Built like a fine watch, the twin-cylinder engine gave Honda its first


1961 Dutch TT 125cc

1961 Luigi Taveri on the RC143 at the Isle of Man


1962 Dutch TT 125cc


1961 Isle of Man TT


Mike Hailwood

twin titles in the 50cc class.

However, in the 125 class Honda was unable to win a race, ten wins going to Suzuki and two to Yamaha. The competition's two-strokes were evolving rapidly, and now featured multi-cylinder engines and water cooling. For the year's final GP in Japan, Honda unleashed the amazing five-cylinder RC148 (31.5 HP/20,000rpm). This engine used five RC116 cylinders in an inline configuration. Although the bike finished in 2nd place in Japan, thirteen seconds behind the winner, its fastest single lap was more than one second faster than any other machine in the race.

In the 250 class, Honda was plagued by mechanical ills and crashes, managing only four wins in eleven races contested. The only bright spot of the year was the 350 class, with Honda clinching the title in the last race of the season at Suzuka. But even this was a struggle against the new 3-cylinder, 12-valve DOHC MVs.

On the same day, October 24, 1965, half a world away, Honda won its first F1 race at the Mexican GP. Honda had made its F1 debut in 1964 using the ultra-high-rpm engine technology developed on the RC racers. In fact, Honda's F1 team was now rivaling the motorcycle GP team in terms of development resources and importance within the company. Too, the motorcycle team had now achieved all the goals it had set out to achieve and more. Earlier the team had added 50cc and 350cc machines to its effort. Now Honda was also competing in the 500 class with an aim to dominating every class with the multi-cylinder, ultra-high-rpm "engines the media were calling 'preci-sion-made' engines. Honda's engine technology was now at its zenith."

- ***50cc: The RC115 evolved into the RC116, with a larger bore and shorter stroke (2-cylinder, 14 HP/21,500rpm).***
- ***125cc: The RC148 had morphed into the shorter stroke RC149 (5-cylinder, 34 HP/20,500rpm).***
- ***250cc: The RC165 was now the RC166 (6-cylinder, 60 HP/18,000rpm).***
- ***350cc: The RC172 was now the RC173 (4-cylinder, 70 HP/14,000rpm).***
- ***500cc: The RC181 (57 x 48mm bore/stroke ratio for 489.94cc, 4-cylinder, more than 80 HP).***

Riding this armada in 1966 were the talented riders Luigi Taveri and Ralph Bryans on the 50 and 125, and Mike Hailwood and Jim Reman on the 250, 350, and 500. Their performances were simply brilliant as Hailwood won the 250 and 350 GPs almost without opposition. Redman won the first two 500 GPs but then crashed heavily and injured himself in the season's third race, forcing Hailwood to become the main rider and add the 500 class to his busy duties in the 250 and 350 classes.

At Round 7, in a stupendous feat of determination and riding skill, Hailwood won all three classes at the rain-sodden Czech GP. Taveri also won the 125 race at this event, making it the season's second four-class sweep for Honda. Even before the season's final race, Honda had locked up the Manufacturers' titles in every category.

The year's GP results were as follows: three wins in five races in the 50cc class; five wins in nine races for the 125; ten wins in ten races in the 250cc class; six wins in seven 350 races contested; and five wins in nine races contested for the 500. It the first time in history that one manufacturer had won all five Manufacturers' titles. As Hailwood said, "A remarkable feat that no one had ever accomplished." Honda won the Riders' Championships in the 125, 250 and 350 classes.

For 1967, Honda downsized their effort, competing in only the 125, 250 and 350 classes. The RC166 in the 250 class, the 297.06cc RC174 in the 350 class, and the larger bore 499.61cc RC181 in the 500 class. The RC174 engine was now more compact and weighed only 26kg. However, a stiffer chassis to handle the RC181's increased power (84.5 HP/12,000rpm) resulted in an increase in weight to just over 150kg.

Honda's main rivals this year were Yamaha in the 250 class and MV in the 350 and 500 classes. However, the Hailwood/Honda combination was almost impossible to beat, with the 250 and 350 Riders' and Manufacturers' titles going to Honda. For the 350 it was the sixth title in succession since 1962.

At the Isle of Man, Hailwood set an incredible lap record of 175.05 km/h that would remain unbroken for ten years. Winning five of ten 500 GPs Hailwood finished the season tied in points with MV, but fell just short of the title due to fewer second place finishes. At the end of the season, Honda dropped a bombshell when they announced their withdrawal from GP racing. Having accomplished everything they set out to do in motorcycle racing, the company would henceforth concentrate their efforts on automobile development.

In nine years of GP racing, Honda had won 138 GPs and 29 class championships, 18 Manufacturers' Championships, and 16 Riders' Championships. Thirteen years had elapsed since Soichiro Honda's famous declaration in 1954, when Honda had just moved its headquarters to Tokyo and knew almost nothing about building racing motorcycles. Thanks to its success in the GPs, the company had now grown into a major motorcycle manufacturer.

Feedback

Machines Featuring Race-Developed Technology

1969 Honda 750 Four

One of the most significant machines in motorcycling history, the CB750 Four featured a 4-cylinder engine reminiscent of the RC racers, a terrific exhaust note from four exhausts and, in a first for a production motorcycle, a top speed of over 200 km/h. The incredible 750cc 4-cylinder engine featured a wealth of technology developed on sixties era GP racers. Features included Honda's first one-piece crankshaft, a dry sump design and a level of reliability never before seen. Like the RC racers, the CB750 was a high-rpm, high-power machine kicking out an un-heard of 67 HP at 8,000rpm. Harnessing this impressive power was an RC-type double-cradle frame and, in another breakthrough, a front disc brake. Other components, like tires and chains, were also of especially high quality. The CB750 brought a new level of performance and sophistication to the world of motorcycles, making it an instant top seller. Truly, this was a machine that changed the history of motorcycling. The CB750 was later followed by 500, 550, 350 and 400 Fours, which firmly established Honda's reputation as a builder of multi-cylinder models.

1962 CR110

1962 CR Series Production Racers

These racing machines were production versions of the RC racers. With the completion of the Suzuka Circuit, road racing flourished in Japan, and the CRs were sold to privateers racing the GPs. The CR lineup included the 50cc CR110, the 125cc CR93, the 250cc CR72 and the 350cc CR77. All were twins except for the CR110, and, like the RC racers, all featured gear-driven cams, DOHC 4-valve heads and redlines exceeding 10,000rpm. The CR110 (8.5 HP/12,700rpm) was aimed at the 50cc class established in 1962, and both it and the CR93 achieved impressive results in domestic and international racing. The CR110 was also marketed in a street-going version with lights as the Cub Racing CR110.

1959 Benly Supersport CB92

The CB92 was derived from the Asama bikes ridden by the HSC (Honda Speed Club) riders. Based on the 125cc C92, it featured many improvements to engine and chassis. The engine produced 15 HP at 10,500rpm. It was the first Honda to reach a production volume of more than 10,000 units and the first with a 120 HP per liter power ratio. Together with its larger cousin, the 150cc CB95 (raced in the 200cc class), these two machines raced extensively at Asama and throughout Japan. This was also the first mass-produced model to be named "CB."

1960 Dream Supersport CB72

This 250cc sports model was loaded with engine technology developed at the Asama Race and at the Isle of Man. Featuring extremely durable engine internals, a sophisticated valve train and ignition system, this twin-cylinder OHC engine pumped out an impressive 24 HP at 9,000rpm (available with both 180° and 360° crankshafts). A racing kit was also available, making the CB72 a popular mount for privateer racers.

1965 Dream CB450

This was Honda's largest displacement model of its era and Honda's first sports model aimed at the overseas market. Race-derived technology in this DOHC twin included torsion-bar valve springs and eccentric tappet adjusters. Output was 43 HP at 8,500rpm. This impressive engine was mounted in a high-rigidity single-downtube frame. Boasting more top speed, power output and acceleration than any domestic model, the CB450 kicked out more performance than the leading 650cc machines from other countries.

1977 Jean-Claude Chemarin & Christian Leon winning the 24-hour endurance race at Le Mans

A New Era of Revolutionary Honda Racers
24 Wins in 26 Endurance Races — The 'Unbeatable' RCB

Honda Reinvents the Inline-Four as Racer and Sportsbike.

After withdrawing from GP racing, Honda developed their first motocrosser powered by a 2-stroke engine. Development had been proceeding with difficulty since 1971, but in June of 1972 the machine won its first race at the All-Japan Championships. This machine was released in 1973 as the CR250M, which became the MT125/250 Elsinore off-road models.

Around this time there were increasing calls for Honda to resume its road racing efforts. This was especially important in Europe, where race wins translated directly into increased sales. At the time, endurance racing in Europe centered around the Bol d'Or 24-Hour race in France. Because endurance racing in Europe was more popular than GP racing, Honda decided to contest the endurance racing world championship beginning in 1976.

A team was organized around sixties era GP personnel, and a one-off engine was built using the crankcase dimensions of a CB750 with a DOHC 4-valve head. This engine was mounted in a chassis featuring the basic layout of the RC racers' chassis. The new machine was called the RCB.

Compared with Honda's GP era, race operations were small scale, but the RCB was a full-on factory endurance racer loaded with the latest technology. Features included unitized components for quick parts changing, engine protectors, quick-change brake pads, and longer lasting sealed chains.

After winning its debut race in 1976, the RCB dominated European endurance racing until 1978. In those three years the RCB won 24 of 26 events, and won all the events in one series in an over-whelming show of superiority. So dominant were the RCBs at the front of every race that they soon earned the nickname 'The Unbeatable Team.'

Developed in parallel with the RCB was a new lineup of street machines, the CB750/900F, featuring DOHC, 4-valve, inline-four engines. These new-generation machines debuted ten years after the CB750 Four and were based on the concept of "Lightest in Weight and Fastest on the Track." Delivering impressive engine response and responsive handling, the bikes set new standards for performance.

This engine would be further developed into the 6-cylinder 1,000cc CBX street bike and into the next-generation endurance racer, the RS1000 in 1980. As a result of these developments, Honda dominated the endurance racing championship for five consecutive years until 1980. The RS1000 production racer was marketed by RSC until 1982, and the race replica CB1100R went on sale in 1981.

1979 CB750F

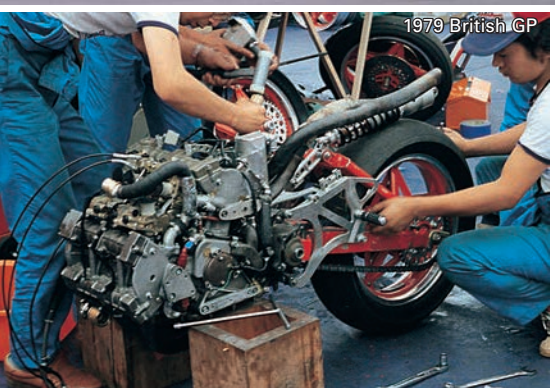
1979 NR500 debuts for the press

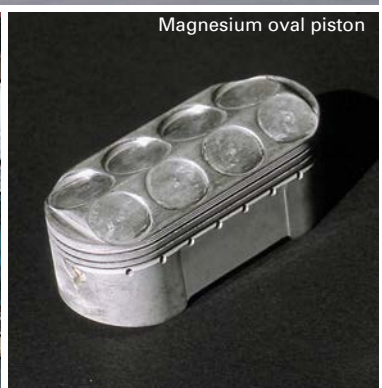
1979 Mick Grant

1980 Takazumi Katayama

1981 Freddie Spencer

1981 Kengo Kiyama


1979 British GP


Magnesium oval piston


Cylinder head

Returning to GP Racing with Unique Technology: Hard Struggles Lead the Way to a Bright Future

The NR500 Writes a Brave New Page in Honda History as the Ultimate 4-Stroke

When Honda made their dramatic return to GP racing in 1979, they did so with astonishing new technology and an innovative new machine, the NR500.

An NR group was formed within the existing race department to develop the bike. To compete with the 2-stroke machines of their rivals, Honda set out to develop a revolutionary new 4-stroke engine.

The new machine would have to produce more horsepower than the competition. The 500cc 2-strokes of that era produced approximately 110 horsepower at 10,000rpm. Compared with the 2-strokes, which had one combustion event for every crankshaft rotation, the 4-stroke engine fired only every other revolution. Theoretically, this meant the 4-stroke would produce only half as much power for the same engine displacement.

However, if the 4-stroke could be made to rev twice as fast, to 20,000rpm, it should be able to beat the 2-strokes. At least, this is what the engineers hoped. Further, the 4-stroke was a more complicated engine with more parts, so 4-stroke engines tended to be larger and heavier. Therefore, the engine would have to be made as compactly as possible. Clearly, the team faced a huge challenge.

When the calculations for intake and exhaust efficiency, friction and other physical limitations were made, the desired engine speed of 20,000rpm could be achieved with a 32-valve V8 engine displacing 62.5cc per cylinder. Given that Honda's sixties' era 50cc twin, the RC115, had run at 20,000rpm, the calculations seemed correct.

However, race regulations limited the number of cylinders to four. In typically innovative fashion, Honda's engineers solved this problem by using four oval cylinders, making the engine effectively a V8. Oval pistons were mounted to two connecting rods per cylinder, and each cylinder was fed via four intake ports and eight valves, with two plugs per cylinder. The result was a V4 engine that behaved like a V8. The NR500 was born.

The goal was 130 horsepower at 20,000rpm. Such an engine had never existed before. Oval pistons had to be designed and tested, the bike would have to be raced on the world stage, yet the team consisted almost entirely of young engineers with little racing background. Truly, this was a huge undertaking.

Developing the engine was a terrible struggle. Subjected to the ultra-high revs, the prototype engines blew up with alarming regularity. One engine after another was built, carried lovingly to the dyno room with high hopes, only to let go in less than twenty minutes. "Every day was hell," said one of the engineers later. After a solid year of trial and error, the engine had still not achieved its goal, putting out only 108 horsepower at 18,000rpm.

This revolutionary engine was mounted in an equally revolutionary aluminum monocoque frame rolling on 16-inch wheels. Other original technology included a countershaft sprocket concentric with the swingarm pivot and Comstar composite wheels. Far behind schedule, the NR500 finally debuted at the British GP in August of 1979.

The debut was a total disaster. The much-heralded NR500 — and Honda's return to GP racing — ended with both NR500s retiring within two laps. Overloaded with revolutionary yet unproven technology, the NR500 was still far from competitive.

For the next three years the NR500 was continually developed, tested and raced. It was a trying time for the engineers, but a period during which much was learned.

Improvements were made with every race, and in time the engine was putting out an impressive 135 horsepower at 19,500rpm. The aluminum monocoque frame was replaced first with a steel diamond-configuration frame, then a more conventional steel double-cradle frame, and finally with a double-cradle aluminum frame. Thanks to ceaseless development, with each season the NR500 became more competitive.

In 1980 the NR500 entered three GPs, finished 15th and 12th in two events, and in 1981 six races were entered, resulting in only one 13th place finish.

In terms of race completions, 1981 was the worst year. However, this year did have one bright spot. The NR500 also raced in the All-Japan Championship, with Kengo Kiyama winning the sixth event of the season, the 200km race at Suzuka. The NR500 also won a heat race at an international event in the United States.That heat race was won by American Honda's ace rider Freddie Spencer over none other than Kenny Roberts, the previous year's GP champion. Spencer had been running as high as 5th place in the British GP when engine trouble forced his retirement. Apparently he had revved the engine to more than 20,000rpm!

By the time 1984 rolled around the NR500 had four years of development behind it, but had still not garnered a single GP point. As a result, in 1982 Honda introduced the 2-stroke NS500 as their new GP weapon, putting an end to the NR500's valiant yet futile struggle. Viewed purely in terms of race results, the NR500 was a failure of historic proportions and a bitter pill for its hard-working engineers to swallow.

However, without the technology and experience gained on the NR500 project, Honda would never have been able to dominate GP racing as it did in the future. Furthermore, technology developed on the NR500 was used in many interesting and very successful Honda production machines. In summation, although the three years spent developing the NR500 were intensely frustrating, these struggles paved the way to a bright new future.

Feedback

Machines Featuring Race-Developed Technology

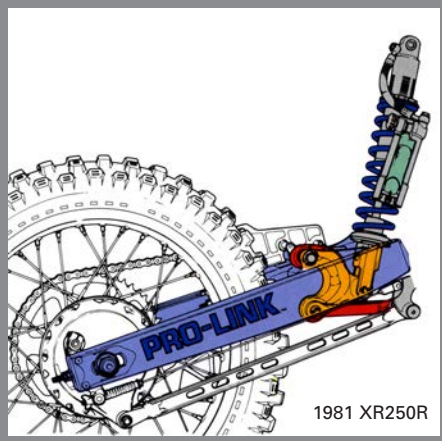
1982 VF750F

1982 VT250F

1982 RS1000RW

1982 VF & VT Series

The RS1000RW factory racer raced by Honda at the 1982 Daytona 200 used round pistons, but much of its V4 engine technology was developed on the NR500. The 1,000cc engine produced 150 HP and gave the bike a faster top speed than the 750cc 2-strokes of the competition, giving Honda the win. The VF750F (later released as the VF1000R) was developed in parallel with the RS1000RW and formed the basis for Honda's powerful and high-revving VF series of liquid-cooled, 90° V-engines. Because the compact engines had the same width as a twin, they contributed significantly to the bikes' legendary handling qualities. The VF Series delivered a combination of hard-hitting high-rpm power and responsive handling that riders loved. Another offshoot of this development stream was the VT250F, a DOHC liquid-cooled V-twin. Producing 35 HP at 11,000rpm and a rev ceiling of over 14,000rpm, the VT250F started a boom in 250c 4-stroke sportsbikes.



1981 XR250R

Pro-Link Rear Suspension

This linkage-equipped monoshock suspension system mounted the damper unit to the rear of the engine, with the linkage mechanism just behind the swingarm pivot. It was originally developed by the NR group for Honda's moto-crossers. Featuring a rising-rate suspension action, the system helps to centralize chassis mass and optimize chassis layout, improving both handling and traction. Also used on the NR/NS machines, it soon became standard technology for rear suspension systems.

1985 RVF

Based on the VF750F engine, the '83 RS850R and '84 RS750R were developed. The 750cc RVF was a factory racer built to contest the Suzuka 8-Hour and other endurance and TT-F1 races. The iconic V4 engine, now symbolic of Honda engines, was mounted in a lightweight twin-spar aluminum frame. In its debut season of 1985 it won the Suzuka 8-Hour race in dramatic fashion. The machine was constantly developed with new engine technology, as well as a single-sided Pro-Arm swingarm, and became legendary for its performance and reliability. After winning countless races around the world the VF Series evolved into the VFR Series, dramatically raising the performance bar for street machines.

1987 VFR750R/RC30

This supersport model was a limited production replica of the RVF and only 2,000 units were produced. Featuring gear-driven cams and an aluminum twin-spar frame with Pro-Arm swingarm, the technology of this production racer was very close to that of the RVF factory racers while staying within race regulations. The VFR750R/RC30 delivered a whole new level of high performance, win-ning countless races and making fans the world over. Later the RVF factory racer would be used as a test bed to further develop the VFR750R, and in 1994 a new RVF replica, the RVF/RC45 was developed to race in World Superbike.

1992 NR

Development of the oval-piston V4 engine continued after the NS500, and by 1987 the NR750 was producing 155 HP at 15,525rpm and contested the 24 Hours of Le Mans and other racing events. The purpose was to develop a street-going version of this remarkable machine. This dream was realized in 1992 with the release of the limited-edition NR (750cc), a crystallization of NR500 technology featuring oval pistons, 8 valves per cylinder, twin fuel injectors and an astronomical rev ceiling of 15,000rpm.

Freddie Spencer winning the 1982 Belgian GP


1983 Ron Haslam

1982 Marco Lucchinelli

1983 Freddie Spencer

After 16 Years Honda Wins a 500GP World Championship with a New Generation of GP Racing Machines

Victories Built on NR500 Struggles and Motocross Glory

In addition to the NR500, the NR group also busy developing Honda's motocrossers. Honda won the 500cc Motocross World Championship in 1979, and many other races and championships thereafter. The NR group performed research on many interesting 2-stroke engines, including a twin-cylinder 125 which raced in the All-Japan Championship.

These successes convinced the group that winning was what was most important. They set out to build a winning GP machine using the 2-stroke technology developed for the motocrossers.

The concept was: Lightweight and Compact. To overcome the top speed and handling of their rivals, Honda focused on superior handling based on instant acceleration, light weight and aerodynamic efficiency. Their scientific analysis of GP racing revealed that winning performance came from a total balance of the above qualities.

They focused on building a very narrow and compact engine with explosive acceleration. By the end of 1980 the new engine was nearing completion. It was essentially three motocross cylinders mounted to a single crankcase. And like a motocrosser, this 112° 2-stroke 3-cylinder V-engine featured crankcase piston reed-valve induction. In its earliest iteration it produced 120 horsepower at 11,000rpm.

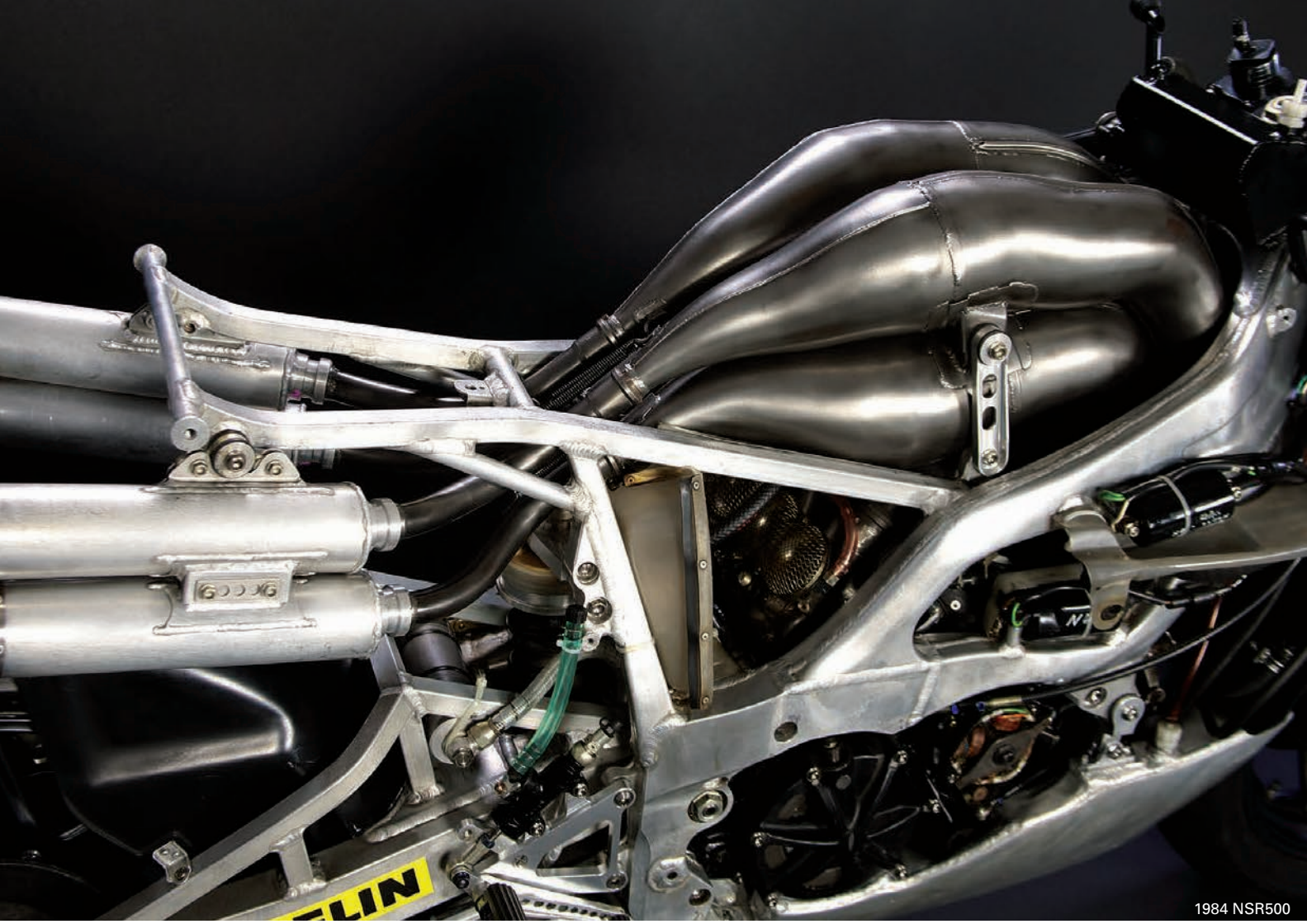
This unique power unit was mounted in an NR-style chassis with front and rear suspension units taken directly from the NR500. As a result, the new machine, on which formal development had be-gun in June of 1981, was completed in a mere six months.

Named the NS500, this new racer was competitive from the start of the 1982 season. In Round 7, the Dutch GP, Freddie Spencer rode the machine to its first victory, Honda's first 500cc GP win in fifteen years. Later that year Takazumi Katayama won the Swedish GP and Spencer took the San Marino GP. Spencer and the NS500 ended the season in third place.

For the 1983 season power output was increased to 130 horsepower at 13,000rpm. To improve low-to-midrange power, variable timing exhaust valves (ATAC) were fitted. Chassis upgrades included the aluminum tube frame introduced during the 1982 season and various carbon-fiber suspension components, all of which made the bike even lighter.

The 1983 season was a battle for the ages as the Wunderkind Spencer on the NS500 fought for the title with 'King' Kenny Roberts on the Yamaha YZR. But the King, who was determined to win the title in his last season before retirement, was no match for the young gun Spencer, who astonished the onlookers with his incredible 2-wheel drifts that seemed to defy the laws of physics.

In the season's twelve rounds, Spencer and the NS500 took six poles and six wins, just edging Roberts for the championship by a mere two points. It was Honda's first 500cc GP Riders' and Manufacturers' titles in sixteen years. The near perfect performance of the NS500 was then faithfully reproduced in the RS500R production racer, which was warmly welcomed by privateer racers around the world.



1984 NSR500

1984 Freddie Spencer

1985 Freddie Spencer wins 250cc & 500cc titles (shown on 500)

1985 Freddie Spencer wins 250cc & 500cc titles (shown on 250)

1987 Wayne Gardner

A Struggle for More Power, Winning Every Race in a Season, Six Titles in a Row — 19 Years of Challenge and Glory with the NSR500

A Trail of Technological Development from GP500 to MotoGP

As the speeds of GP racing increased, and as more high-speed tracks were added to the season, it became apparent that the NS500 was reaching the end of its development cycle. More power was needed. Honda set out to create a machine with dominating performance, powered by a V4 engine with maximum horsepower.

In contrast to the twin-crank, 40° V4 rotary-valve engines of the competition, Honda was determined to produce a high-precision engine with high output at high rpm, all in a compact size. They accomplished this by developing a single-crank, 90° V4 with crankcase reed-valve induction. The new machine with its simplified four-shaft engine was named the NSR500.

In its debut season of 1984, the new NSR featured an unusual design in which the fuel tank was mounted beneath the engine, with the expansion chambers running over the top of the engine. The increased width of the 4-cylinder engine was compensated for by the lower center of gravity, resulting in highly responsive handling. The massive new twin-spar aluminum frame did away with under rails, instead gripping the engine between its branched side beams.

This unique construction had not been seen since the first NR500, and was an example of Honda's continuing efforts to develop innovative technologies. However, once again it was a case of too much too soon. The complex curves of the expansion chambers led to durability problems, and changing fuel loads adversely affected handling. After winning three races on the bike, Spencer switched to the NS500 in mid-season, ending the year in 4th place.

Still, the NSR500's 150 peak horsepower put in the top level of machines for its era, so for 1985 a lightweight, high-rigidity RVF-style 'Ultra Light Frame' was designed. Built of large but light-weight triple-box-section aluminum extrusions, the frame delivered brilliant handling.

In parallel with the NSR500's V4 engine, Honda also developed the NSR250, a 250cc V-twin that was essentially half a V4. Spencer would make GP history when he won both the 500cc and 250cc titles in the same year. From 1985 to 1993 Spencer's two NSR racers would be painted in the Rothmans' colors of the main sponsor. On the new NSRs Spencer was blindingly fast.

During the 1985 season Spencer won seven of twelve GPs, taking his second 500 crown and his first 250 title. Honda also took the Manufacturers' titles in both classes. Truly, an epochal season for both Honda and Spencer.

Injuries prevented Spencer from completing the 1986 season, so Australian Wayne Gardner hopped on the NSR and fought the peaky, vibratory and heavy-handling machine to a hard-won 2nd spot in the championship.

From this point onwards engine development focused less on maximum power output and more on smoother, more linear power delivery. The days when maximum power and high top speeds were enough to win races were over. The 150 horsepower 2-stroke 500s had more than enough power for any rider. The new generation of race bikes would have to be more rider-friendly.

For 1987 the exhaust layout was changed, the cylinder V angle was increased to 112° and a primary balancer shaft was added to quell vibration, making it an entirely new 4-shaft engine. An ATAC exhaust valve was added (electronically controlled RC valves), significantly smoothing the bike's power characteristics. Gardner took the title, winning seven of fifteen GPs and capturing the Manufacturers' title for Honda once again.

Still, the chassis and the tires were now stretched beyond their limits by the powerful engine. So, for 1988 a new frame with an adjustable head pipe and improved suspension components was introduced. These upgrades helped Gardner win three races in a row at mid-season, but still left him in 2nd spot at year's end.

An injury during the 1989 season led to Gardner being replaced by the 1988 world champ, Eddie Lawson, who had switched camps to Honda. In an effort to improve the NSR's handling and traction characteristics, many new frames were tried during the season. Lawson won the title, but not without trying out a lot of new technology in the process.

A big surprise arrived in 1990 was the advent of the 'Big Bang' engine. In this configuration the firing of each cylinder was offset 90°, meaning that instead of each cylinder firing at 90° intervals, each set of two cylinders fired 180° apart. The slight reduction in maximum power that resulted was more than offset by the improved torque characteristics caused by the increased amplitude in combustion torque waves. Traction during acceleration was markedly improved.

This was a major turning point in engine development, and the NSR's engineers experimented with various firing orders and crank angle/ignition timing settings. As the bikes became easier to ride, lap times began to drop. Usable power became more important than maximum power. Chassis upgrades included such trick parts as expansion chambers and other parts made of titanium, helping to reduce machine weight by more than 15kg.

Around this time another gifted rider appeared on the scene. Mick Doohan had been battling with Yamaha's Wayne Rainey and Suzuki's Kevin Schwantz, finishing 3rd in the championship in 1990 and 2nd in 1991. His time had now come.


1997 Mick Doohan


1999 Alex Criville


1997 Tadayuki Okada


2001 Valentino Rossi

By the time 1992 rolled around, a new 68° irregular firing order was being used. Each pair of cylinders fired simultaneously at 68° and 292° intervals. The resulting irregular combustion torque wave shapes delivered markedly superior traction. This new engine had a unique firing order, leading observers to call it a 'big bang' engine. In the opening race, the rain-sodden Japan GP, Mick Doohan rode it to victory. This win was especially impressive because prior to this engine the NSR500 was difficult to ride in the wet.

Everyone expected Doohan to romp to the title in 1992, but his early season win streak of five was cut cruelly short when he suffered a horrendous crash at the Dutch TT resulting in severe inju-ries to his right leg. Still, the NSR500 won seven of thirteen GPs that year, amply proving its superiority. Though still not fully recovered for the 1993 season, Doohan did manage to win one race, ending up fourth in the championship (Daryl Beattie took the other win for the NSR500 in 1993). New technology introduced during the season included electronically controlled fuel injection that boosted output to more than 170 horsepower, allowing the NSR to clock an amazing 320km/h at the German GP.

For 1994, engine performance was further improved by a water injection system for the exhaust which improved combustion chamber filling efficiency at low rpm. Electronically controlled damping for the rear suspension (Active Suspension) was also used. Even after Doohan regained his fitness, the aftereffects of the crash forced him to use a thumb-operated rear brake lever mounted on the left handlebar of his NSR.

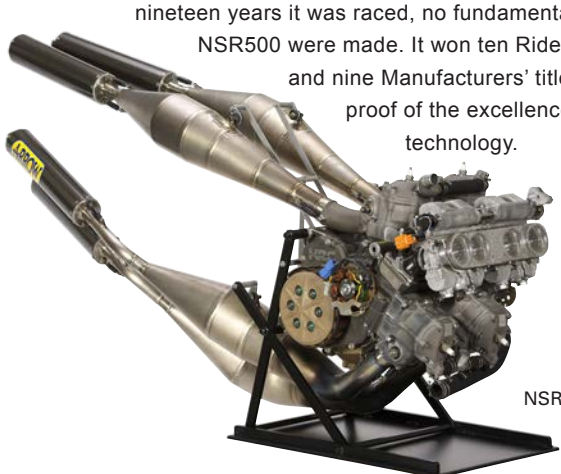
The combination of the new NSR and a rejuvenated Doohan resulted in nine wins of fourteen races, an overwhelming performance that won Doohan the Riders' title and Honda the Manufacturers' title. This was the start of a never-before-seen run of victories for the NSR500. For 1997, Honda chose a path that no one had yet tried: Doohan's machine featured a new 180° 'big bang' engine that was a 'screamer engine' that powered Honda to victory in all fifteen GPs.

1995 *9 wins in 13 races / 7 wins for Mick Doohan*
1996 *13 wins in 15 races / 8 wins for Doohan; NSR500V introduced*
1997 *Wins in all 15 events / 12 wins for Doohan*
1998 *13 wins in 14 races / 8 wins for Doohan; 22 straight wins for Honda*
1999 *9 wins in 16 races / Doohan retires, Alex Criville replaces him and wins the championship. Honda takes Riders' and Manufacturers' titles in six consecutive years.*
2001 *12 wins in 16 races / 11 wins for Valentino Rossi / Honda achieves 500 wins in GP racing and again wins Riders' and Manufacturers' titles.*

During the NSR500's years of dominance, Japanese riders were also busy making GP headlines. In the 125 class, Kazuto Sakata won the titles in 1994 and 1998, and Haruchika Aoki won the titles in 1995 and 1996 (both on the RS125R). In the 250 class, Daijiro Katoh won in 2001 on a works NSR250, contributing to Honda's 500 GP victories. Katoh later went on to ride the NSR500 and RC211V.

In 2002 the 500 GP class changed to MotoGP and 4-stroke engines, making it the last season for the NSR500. Now at the peak of its development, the NSR500 was cranking out an incredible 180 horsepower, allowing it to compete on almost level terms with the 200 horsepower 990cc MotoGP bikes. Still, the NSR500 never beat the RC211V, its best finish being a 2nd place.

However, the technology developed on the NSR500 made a huge contribution to the RC211V's competitiveness. During the nineteen years it was raced, no fundamental changes to the NSR500 were made. It won ten Riders' Championships and nine Manufacturers' titles, indisputable proof of the excellence of its design and technology.


NSR500 engine

Feedback

Machines Featuring Race-Developed Technology

1986 NSR250R

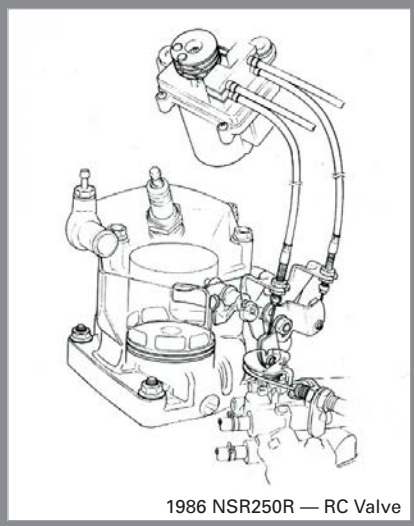
Split an NSR500 lengthwise and the result is an NSR250, one of the most successful lightweight sport bikes of the eighties. Race-developed technology for this V-twin 2-stroke included crankcase reed-valve induction, electronically controlled PGM carburetors and RC exhaust valves. This high-tech power unit was mounted in an NSR-derived triple-box-section aluminum twin-spar frame. This machine was developed concurrently with the RS250 production racer. Never before had a 250cc sportsbike been developed with such a racing pedigree and offered such high performance. The NSR250R was ridden extensively in SP racing and TT-F3 events, and it set new standards for 250-class performance. Following its debut the NSR250R was upgraded in real time in conjunction with upgrades to the NSR250 production racer between 1988 and 1993. An SP model featuring a dry clutch and magnesium wheels was offered, as well as various kit parts. In 1988 this machine was used as a base model for the NSR250RK TT-F3 racer.

1984 NS250R

The NS250R was Honda's first 2-stroke V-twin and its first production model to feature an alumi-num frame. It shared extensive technology with the RS250 production racer released the same year, such as crankcases, long-wearing NS cylinders, ATAC exhaust valve, TRAC anti-dive, composite Comstar wheels and a highly aerodynamic full fairing. This machine was very similar to the NSR500, also released in 1984, which shared much with the NS500. The NS250R was developed simultaneously with the production racer, which featured direct technology transfer from the factory racer. The shared designs between racers and production machines are a characteristic of Honda supersport models. This philosophy has consistently led to dramatic increases in motorcycle performance.

1983 MVX250F

This was Honda's first 250cc 2-stroke sports model. Like the NS500, it was powered by a 90° V3. Power output was 40 HP at 9,000rpm. The engine was mounted in a perimeter-tube double-cradle frame like that on the VT/VF series. A 16-inch front wheel and Pro-Link rear suspension were also fitted. For 1985, a similar engine was fitted into a box-section aluminum perimeter-style frame to create an NS500 replica called the NS400R (59 HP at 8,500rpm).



1986 NSR250R — RC Valve

Exhaust Valve

Exhaust valves are used on high-rpm high-output 2-strokes to change the effective exhaust port timing in order to improve low-to-midrange performance. An expansion-type ATAC using a sub-chamber was used on the 1983 NS500 and soon became indispensable on 2-stroke engines. In 1986, the RC valve was developed, which used an electronically controlled motor-driven flapper valve to vary the area of the exhaust port. This system was used on Honda racers and on the NSR250R, CRM250R and other production models.

1986 NSR250R — Frame & Swingarm

Aluminum Twin-Spar Frame

This frame's main extrusions join the steering head to the swingarm pivot plates in a straight line, and feature multi-box-section construction for high rigidity. The engine is clasped between the spars and engine hangers as an integral stressed member. First seen on the 1985 NSR500, this elegantly simple frame offered light weight and high rigidity, and was later featured on racers and supersport bikes until around 2000. Although its construction and materials improved over the years, its architecture remainedfundamentally unchanged, and this basic design continues to be used in production racers today.

2002 — Valentino Rossi Becomes the First MotoGP Champion

2006 — Nicky Hayden, U.S. GP

2002 — Tohru Ukawa, South African GP

2004 — Tamada Makoto, Rio GP

2006 RC211V, Original

2006 RC211V New Generation

Refined 75.5° V5 Engine — The Embodiment of Honda GP Technology

RC211V — A 4-Stroke MotoGP Machine for the 21st Century

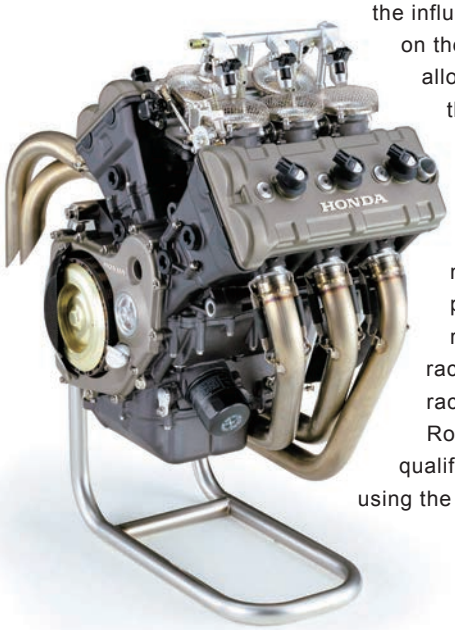
The RC211V was newly developed to race in the 4-stroke MotoGP series which began in 2002. Featuring much of the knowledge gained on the NSR500, the RC211V was designed to offer overwhelming power together with rider-responsive engine and chassis performance.

After examining various engine layouts — from V-Twins and V-Sixes to inline Fours — it was decided that a V5 offered the best balance between power and weight and that it perfectly expressed the originality for which Honda racing machines are famous. In addition, with the V bank at 75.5° and a 3-cylinder + 2-cylinder layout, the center cylinder also functioned as a balancer to cancel primary vibration.

This gives a crank phasing of 104.5° and a firing order (starting at the left side of the front bank) of 1-2-5-3-4 and uneven firing intervals of 284.5°- 75.5°- 104.5°- 180°- 75.5°. Its 5-cylinder, short-stroke design results in a very powerful 990cc engine which early in its development produced 200HP/15,000rpm. (After much trial and error to ensure reliability under racing conditions, a maximum out-put of 210HP was achieved.)

To make the most of the awesome acceleration on tap with these hitherto unknown levels of power, the chassis was designed to deliver superb cornering characteristics at steep bank angles and lightweight, responsive handling qualities. And because the V5 engine had an almost circular shape it gave the bike an almost equal balance of inertial moments about the three axes of roll, pitch and yaw, which significantly con-tributed to the RC211V's handling.

The frame was designed with less lateral stiffness and featured a newly designed Unit Pro-Link rear suspension. Because this system does not mount the shock's upper mount directly to the frame, even when the load shifts to the rear under acceleration, the influence of this load shift on the frame is lessened, allowing the rider to open the throttle earlier when cornering.



These qualities made the RC211V a highly refined machine that was very powerful and very rider-friendly. The first race of 2002 was a wet race at which Valentino Rossi set a track record in qualifying. He won the race using the dry mapping even in the wet, then, after Round 3, went on to win eight consecutive races. He finished the year with eleven wins, becoming the first 4-stroke MotoGP champion. The RC211V dominated the championship, winning fourteen of sixteen races — an incredible record for a new machine in its debut season and a brilliant achievement for Honda.

For 2003 the RC211V got no major changes but did benefit from a higher rev ceiling and more power. In addition, to make the bike easier to ride the throttle control was improved for better engine braking control when slowing. As a result the RC211V won fifteen of sixteen GPs that year and finished on the podium at every race. Rossi won nine races and his second consecutive championship.

For 2004 the RC211V's engine was extensively upgraded. Because power output was now over 220HP an even higher level of control was needed. This was achieved by reducing the engine's stroke, making cylinders 1-2 and 4-5 of the front and back rows fire simultaneously and by changing the exhaust layout to join the pipes from cylinders 5-4 instead of 5-3. The high-precision, electronic throttle control system H.I.T.S.C. was fitted for better control of power delivery in the lower gears.

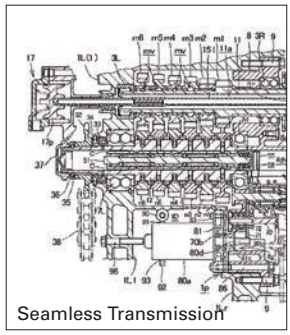
By this time the main theme in racing's premier category was how to best control the high engine output, power that would be difficult to control by conventional means. Two methods were the use of ideal firing orders and electronic controls — areas where Honda had almost 20 years of experience with the NSR500.

Honda was unable to win the rider's championship this year but the six RC211Vs on the grid all finished in the top eight, giving Honda its fourth consecutive manufacturer's championship. The RC211V now had a reputation as an easy-to-ride ma-chine, proof that its fundamental concept was sound. To retake the rider's title, the 2005 RC211V's chassis was thoroughly revised with improved stability under braking and better traction and cornering performance.

Unfortunately, although three different engines and chassis were tried during 2005, engine troubles, crashes and races where the factory team scored no points meant that the season ended with the RC211V having won only four of seventeen races. However, it was during this period of adversity that a new machine was born. Development of the machine — featuring a highly compact engine and chassis — began early during the 2005 season so as to be ready to race under the 800cc regulation coming into effect in 2007. This 2006 model machine was called 'The New Generation' and featured a method for lengthening the swingarm for improved handling. Remarkably, when the swingarm was lengthened the relative forward/backward positions of the engine and frame also changed. Additionally, shortening the overall length of the machine improved its stability.

2011 MotoGP Champion Casey Stoner

Dani Pedrosa, 2009 German GP


Seamless Transmission

2007 RC212V

Two versions of the RC211V were prepared for the 2006 season, a more developed so-called ‘Original’ machine and the ‘New Generation’. Both were developed with special emphasis on braking performance, cornering ability and traction. The feverish pace of development resulted in four engine specifications and five chassis specifications being introduced during the season.

The 2006 season started with bang — at the opening round the seven RC211Vs entered by five teams all finished in the top ten. And at Round 3 the RC211V riders took all three podium spots. At Round 4 they finished 1st and 2nd. As the ‘New Generation’ machine rallied against its rivals it continued to pile up impressive results. Nicky Hayden won two races in the latter half of the season and went on to clinch the championship at the final round.

That year Honda won every title: the rider’s, manufacturer’s and team championships and also rookie of the year, leaving behind an indelible mark on the final season of 990cc MotoGP racing. In five years the RC211V won forty-eight of eighty-one races for a 59.2% winning average. This was the most impressive record in Hon-da’s fifty years of GP racing history.

After MotoGP made the switch from 500cc 2-strokes to 990cc 4-strokes the top speeds of the bikes increased inexorably as technical developments progressed. For safety reasons the organizers decided to limit the maximum engine displacement to 800cc beginning in 2007. They also set minimum machine weights depending on the number of cylinders: 135kg for Twins, 142.4kg for Threes, 150 kg for Fours, 157.5kg for Fives, and 165kg for Sixes. Fuel tank capacity was limited to 21 liters.

Under the new regulations although RC211V’s V5 engine was allowed a higher rev ceiling than competing 4-cylinder machines this was more than offset by its higher minimum weight, so it was decided to develop a new V4 engine. Honda had accumulated extensive experience with V4 engines throughout the eighties. This knowledge was used to design a compact new engine offering excellent mass centralization and weight distribution in the chassis as well as high power and low vibration. The 2007 RC212V mounted its newly designed 800cc V4 engine in a compact chassis based on the 2006 ‘New Generation’ RC211V.

From the outset the RC212V was designed with emphasis on cornering perfor-mance and off-corner acceleration. Even with 800cc the engine produced massive torque and more than 200HP. This necessitated a wider use of electronic control technologies to improve the machine’s controllability. As with the other manufacturers, this made the bikes about 5kg heavier than the 990cc machines. Nevertheless, lap times were quicker and overall performance improved. (In 2009 Dani Pedrosa recorded a top speed of 349.3km/h.)

However, the rival Ducatis had quicker acceleration and higher top speeds and they took the title in 2007, the first year of 800cc MotoGP. With only two GP wins, it was a humiliating year for Honda. Improvements were made to engine and chassis for 2008, but Yamaha’s combination of rider and bike was too strong and Honda again ended the season with only two wins. (Yamaha went on to take their third consecutive title.) Riders continued to complain that the RC212V lacked power, resulting in major engine improvements for 2009.

The major changes to the RC212V were pneumatic valve actuation for 2008 and a seamless transmission for 2011, both of which significantly improved the machine’s performance. The comeback year was 2011 as 2007 World Champion Casey Stoner joined the the Repsol team and Honda won thirteen of seventeen races (ten by Stoner and three by Pedrosa), bringing Honda its first rider’s title and first ‘triple crown’ (rider, manufacturer and team) in five years.

Feedback
Machines Featuring Race-Developed Technology

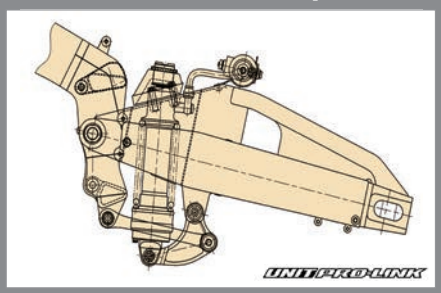
2004 CBR1000RR

Released in 2004, this new-generation supersports machine was loaded with technology developed on the RC211V. Its compact, high-precision inline-four engine was mounted in an advanced chassis tuned for an optimized balance of rigidity. Its frame design and rear suspension were specially developed for mass centralization, while its aerodynamic fairing design was evocative of the RC211V. Other advanced technology included an electronically controlled steering damper (HESD), PGM-DSFI and other RC211V derived high technology. In spite of the CBR1000RR's stunning perfor-mance on the track, the bike was extremely rider-friendly and enjoyable to ride.

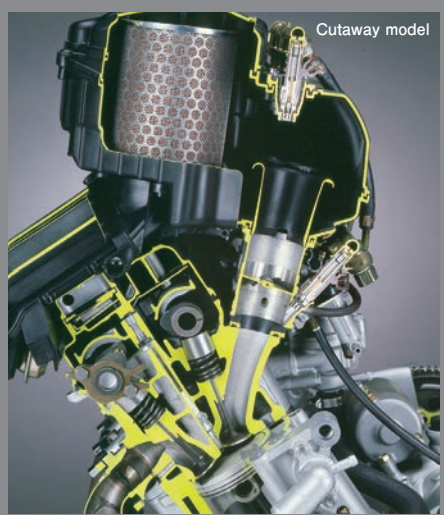
CBR600

In 2003, the CBR600RR's development concept 'Innovative Wonder,' meant that it was to be unlike any other production model. Racetrack testing was a key part of its development, and the data derived there was incorporated into the bike's design. For high performance on the track, a special frame was made using a special weldable die casting method that featured hollow precision castings. Like the frame, the rear suspension system, riding position and styling featured direct technology transfer from the RC211V, which was also being developed at the same time. The engine used light-weight slipper pistons, carburized nutless connecting rods, PGM-DSFI and other top-shelf innovations to deliver fistfuls of screaming high-rpm power. Like the CBR1000RR, a racing version of the CBR600RR is also available and continues to win races on circuits around the world.

Unit Pro-Link Rear Suspension

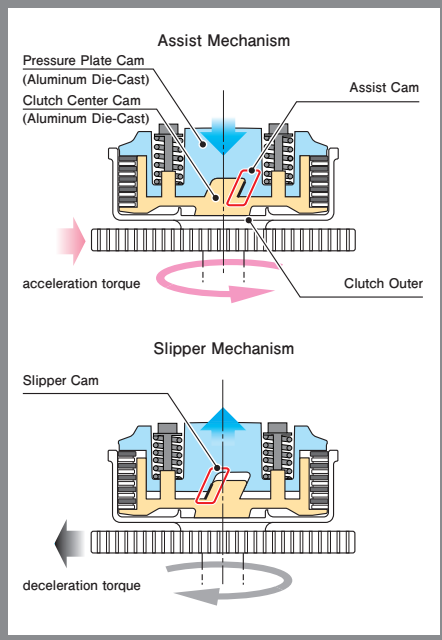


Developed on the RC211V, the Unit Pro-Link rear suspension was featured on the CBR1000RR/600RR. Because the upper shock mount is not attached to the frame, the damper unit operates independently of the motion of the swingarm. As a result, the chassis is unaffected by the action of the suspension, improving traction and handling characteristics during off-corner accelera-tion. This rear suspension is also largely independent of chassis' bank angle, resulting in improved cornering performance. Further, because no support structure is needed for the upper suspension mount, the frame's overall balance of rigidity can be tuned to offer ideal cornering characteristics and more freedom in frame design.



PGM-DSFI

The electronically controlled Programmed Dual Sequential Fuel Injection system developed on the RC211V uses two independent injectors for each cylinder. In addition to the main injector located in the throttle body, a second injector located above the air funnel operates above a set rpm and above a throttle opening of approximately 25% or more. The result is high combustion efficiency from low rpm to high and smooth, linear power characteristics. PGM-DSFI is featured on the CBR1000RR/600RR.



Assist Slipper Clutch

When heavy loads are imposed on a clutch during acceleration, this system increases the clutch's capacity. Then, during deceleration, when back torque and engine braking forces are fed through the clutch, it is allowed to slip. This technology played an important role in helping the RC211V to win the 2006 MotoGP Championship. It is now featured on the 2008 CBR1000RR. It offers smooth clutch action, smooth deceleration and increased performance, all while reducing rider fatigue.

Electronically Controlled Combined ABS

Electronic control of both the front/rear combined brake system and ABS (Anti-lock Brake System) gives more precise control compared to conventional systems. Based on technology developed in the harsh environment of MotoGP racing and on Honda's many years of acquired knowledge, Honda's electronic control technologies have made rapid progress, helping to ensure chassis stability and precise control during heavy braking under various conditions.

2012 RC213V

Dani Pedrosa, 2012 Catalonia GP

2015 — 700 wins in WGP

The 1000cc Era: Higher Technology Super-Talent Marquez Prevails

5 Titles in 7 Years — Proof of Honda's People Power

In 2012 MotoGP returned to large-displacement 1,000c 4-cylinder engines with maximum bore of 81 mm and a minimum weight of 157kg compared to the 150kg of the 800cc machines. Contesting the series were factory teams and satellite teams running prototype machines supplied by the manufacturers. As before, engines were limited to six per year and fuel tank capacity to 21 liters.

Even during the 800cc era various regulations were implemented to control costs, level the playing field and make the racing more entertaining. For example, between 2009 and 2011 a single tire supplier was used (Bridgestone/3-year contract). Prohibited technologies included ceramic compound brake parts, variable exhaust systems, electronically controlled suspension, MMC (metal matrix composites), FRM (fiber-reinforced metals), tire temperature sensors, and non-TV-use GPS equipment.

Additionally, starting in 2012, to make MotoGP participation a little easier a CRT regulation was established that permitted the use of modified production engines in custom-made frames. Then, beginning in 2014, an open class was established that allowed those using the organizer's designated ECU software to use more engines and more fuel tank capacity. This led Honda to develop the RC213V, a new 1,000cc V4 based on the RC212V. This was followed by the RC213-based RCV1000R open class machine that went on sale in 2014. In 2015 the RC213V-RS with pneumatic valves went on sale.

The open class was abolished in 2016 and all entrants were required to use the organizer's ECU and software. Seven engines were allowed per year (since 2013, new entrants were allowed nine engines under certain conditions), minimum machine weight was 157kg and fuel tank capacity was 22 liters for everyone. Tires were supplied by Michelin and the tire size was increased from 16.5" to 17". In this roundabout and hectic way the present 1,000cc era came to be.

By regulating electronic controls, special materials and the number of engines, the technology tended to remain simpler and the bikes were less exotic than before. As a result, small difference could exert a big influence during a race. This led to a concentration of team manpower among engineers, riders and all team members all striving to achieve a perfect, error-free race — this has become a major theme in MotoGP. Looking closely at the race seasons since 2012 this trend is clear to see.

In 2012, the RC213V's debut year, Dani Pedrosa won 7 of 18 races, the most wins in the season, and was on the podium fifteen times but lost the championship by a mere 18 points (his total was 332 points, a new record for 2nd place. Honda did win the team and manufacturer's titles.) However, his Yamaha rival Jorge Lorenzo took the title from Honda by riding steady, winning six races and finishing 2nd ten times.

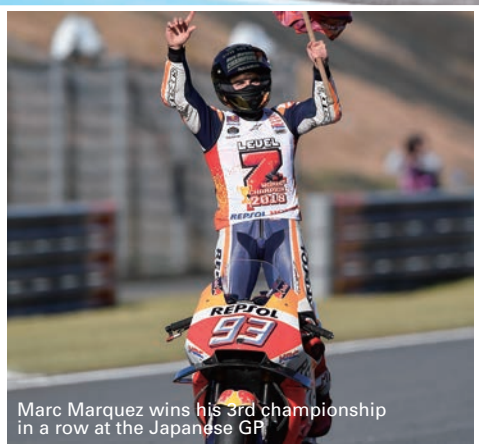
In 2013 an exciting new rider burst onto the MotoGP scene riding the RC213V — and in so doing revealed the importance of rider ability — Marc Marquez, 2012 Moto2 champion. The 'super-rookie' won six of eighteen races, stood on the podium in sixteen races and rode like a seasoned veteran. Although his main rival Lorenzo won eight races Marquez took the title by a mere 4 points.

Marquez was only the second rider in history to win the world championship in the premier class in his debut year. At 20 years and 266 days of age, he was also the youngest. And he was the first to win six races in his debut year since the start of the world championship.

The Marquez offensive continued in 2014. He won from pole in Round 1 and went on to win ten consecutive races (nine from

Marc Marquez, 2018 Argentina GP

2015 CR213V-RS (Nicky Hayden)



Marc Marquez wins his 3rd championship in a row at the Japanese GP

Honda takes the triple crown at the 2016 Valencia GP

pole). In spite of some ups and downs during the latter half of the season he overwhelmed the competition, winning thir-teen of eighteen GPs. In so doing he broke Mick Doohan's record of twelve wins in a season set in 1997 on the NSR500.

The expected arrival of a golden era of Marquez and the RC213V hit a speed bump in 2015, a season filled with drama. Although Marquez won five of the eighteen GPs, he retired in six. In addition to Lorenzo he faced an additional rival, the veteran Yamaha superstar Valentino Rossi with whom he fought many ferocious battles. During this three-way battle for supremacy he fell often and the title went to Lo-renzo, with Rossi 2nd, Marquez 3rd.

But in racing, even when bike and rider are in top form, unknown factors can determine the results — that's the nature of racing. Honda believes that one major goal of its engineering is to eliminate as many of these uncertainties as possible through technology.

Vindication came in 2016. The season began with a three-way battle, but Marquez pulled away from the Yamaha duo by winning five of eighteen races and standing on the podium twelve times. Rossi retired in four races and Lorenzo in three, while Marquez rode steady and failed to finish only once. This was the key to victory.

"After a victory, tighten your helmet strap," is a well-known Japanese proverb. For 2017 Honda wasn't about to rest on their laurels. This year Ducati burst from the shadows, their bikes exhibiting blinding top speed and ferocious acceleration. Marquez and Ducati's Dovizioso fought a series of titanic battles, each winning six of the eighteen GPs. But Dovizioso retired three times while Marquez failed to finish only twice, and that made all the difference. Marquez took the title with 298 points to Dovizioso's 261.

However, complacency or a mistake could easily have changed the result, a fact that Honda knows all too well. So, for 2018 the machine benefitted from many im-provements, including increased engine output for more top speed with improved durability. Honda was determined that no other bike would beat the RC213V in a straight line!

For 2018 Honda was expecting a season-long bare-knuckled fight for the title but the would-be rivals were weaker than predicted (though the Ducatis were still very fast). Once again Marquez and the RC213V were an almost unbeatable combination and he sped to nine wins in eighteen races, finishing 2nd twice and standing on the podium fourteen times. When the dust settled he'd taken the title by 76 points, giving Honda the rider's, manufacturer's and team titles.

Marquez and the RC213V won the world championship five times in six years, establishing a new era in MotoGP. But the engineers have not let this success go to their heads. "There's still more we can do," they say with enthusiasm. "We can make it faster." Success always brings new challenges. And even after 60 years, Honda's spirit of challenge remains unchanged.

Feedback

Machines Featuring Race-Developed Technology

2015 RC213V-S

The RC213-S was developed as a MotoGP machine that could be ridden on public roads. This street legal machine was developed to allow riders to experience the incredible performance of the RC213V in a road going package. Constructed of light-weight, precision machined components and featuring electronic control technologies used on the RC213V, the RC213V-S offered a level of performance and quality unattainable in a mass production machine. It exemplified the Honda philosophy that the fastest machine in the world is the one that's easiest to ride, and gave riders the opportunity to experience for themselves the riding feel of the RC213V.

2019 VFR800F

The VFR800F is the latest and most advanced model in the famous VFR series. It can trace its roots to the 1985 RVF750, and its silky smooth V4 engine has been steadily refined over 30+ years. From the very first, the VFR benefitted from Honda's race-bred technologies such as the aluminum twin-beam frame and Pro Arm (single-sided swingarm). One 2019 model features a color scheme reminiscent of the VFR750F Interceptor that won so many races in the U.S.A. during the eighties.from other countries.

2014 RCV1000R

This production racer was designed to compete in the newly established open category for machines using the organizer supplied ECU kit. Designed to reflect the full potential of the RC213V, the RCV1000R's chassis construction and geometry were almost the same. Designed as a lower cost racer for private teams, the 999.5cc 90° V4 engine pumped out more the 175kW at 16,000rpm, used the spec. ECU software, and the transmission and valve actuation were conventional

2019 CBR1000RR SP

2017 CBR1000RR SP2

2019 CBR1000RR SP

Designed for maximum fun on winding roads, this top-spec supersport bike features an IMU (Inertial Measurement Unit) and a full suite of electronic control technolo-gies developed from feedback from the 2017 RC213V-S — all of which delivers for enhanced chassis stability and unmatched supersport performance. The higher-spec CBR1000RR SP features electronically controlled suspension, and the CBR1000RR SP2 features a race-tunable engine and lightweight racing wheels. Wheelie Control was added to the 2019 model's electronic controls.

Chassis Stabilization System

For precise chassis control an IMU (Inertial Measurement Unit) is fitted which senses the chassis' angular velocity and acceleration. Honda's unique algorithm measures 5-axis inertial measurements 100 times every second to help maintain chassis stability. That information is sent to the ABS, torque control system and suspension to enhance chassis control in response to riding conditions. This MotoGP derived sensing technology makes these machines incredibly fun to ride.

Honda's GP Racing Activities Span Sixty Years — Sixty Years of Emotion, Challenge and Excitement

An Unchanging Desire to Create Joy & Shared Emotions

Twin Ring Motegi — 2018 Japanese GP

The excitement of motor racing, the thrill of victory and the satisfaction of achieving one's goals — these emotions are shared by everyone involved with racing. Then there is the excitement experienced by customers who ride the machines built with the race-developed technology that results. To Honda, motorsports are a way of sharing this excitement and joy with people around the world.

When Honda constructed Japan's first road course at Suzuka in 1962, they did so not only as a place to develop their machines, but as a venue for promoting World Grand Prix racing, to enhance motor safety and to contribute to the motorization of Japan. During the sixties Honda sought to increase the understanding of motor vehicles and their technology through Honda 'Technical Construction' facilities established in Tama, Suzuka, Ikoma and Asaka.

As a continuation of this history, in 1997 Honda constructed Twin Ring Motegi, a 1.5-mile oval course and a 4.8km road course. Every year since 2004 it has hosted the popular MotoGP Japan Round. Other events include the well-attended Japan GP of the Trials World Championship, making Motegi a wonderful venue for meeting people from around the world.

In addition to serving as a venue for MotoGP and IRL car racing, the facility offers play areas for children, various training activities, riding programs and a wide range of other motorsports-related activities. Various racing schools are also held at Suzuka Circuit.

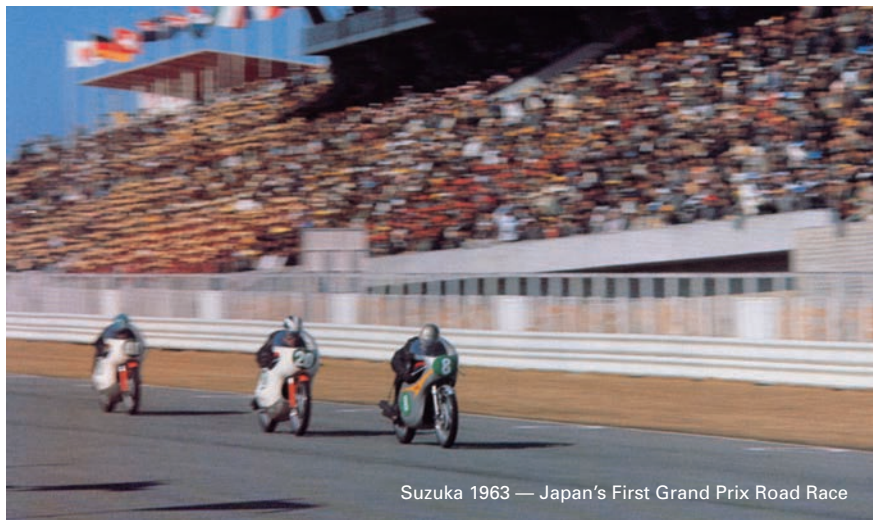
Honda's remarkable history can be seen up close and personal at the on-site Honda Collection Hall. Displayed here are modern and vintage racing machines, production bikes and many other exhibitions from Honda's half-century of motorsports activities.

On these expansive grounds and in this interactive environment, people can experience for themselves the intimate relationships between technology, machines and human beings. In 1965 Honda established RSC (Racing Service Center) to supply race tuning information and sell racing parts to customers.

HRC (Honda Racing Corporation), formed in 1982, grew out of RSC and in addition to its racing activities is now in charge of supplying customers around the world with production racers, race parts and information from Honda's factory racers.

The accumulated technology and know-how from sixty years of racing are reflected in Honda motorcycles in both tangible and intangible ways. This unchanging spirit of challenge is recognized and respected by its many fans. It is a philosophy which has remained unchanged for more than half a century.

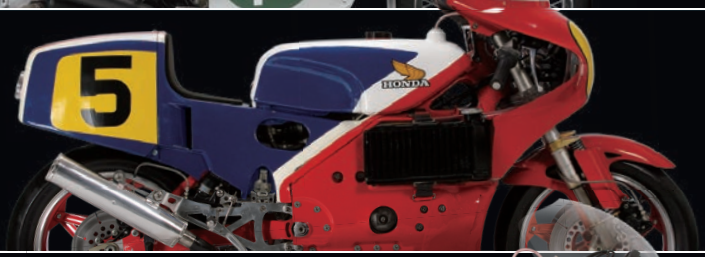
Twin Ring Motegi — Honda Collection Hall



Suzuka 1963 — Japan's First Grand Prix Road Race

RC142 1959

RC166 1967



NR500 1979

NS500 1982

NSR500 1987

NSR500 1997

RC211V 2002

RC213V 2019

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March 2019