



**UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH**

**Escola Superior d'Enginyeries Industrial,
Aeroespacial i Audiovisual de Terrassa**

Study on the technical, design and strategic reasons why Ford beat Ferrari in Le Mans 66 with the design of the Ford GT40 model

Annex I: Press of the 24 Hours of Le Mans 1966

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Degree: GRETI - ESEIAAT

Delivery date: 13/01/2021



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1- Ford immediate release about the 24 Hours of Le Mans 1966



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FOR IMMEDIATE RELEASE

A light rain was falling and gray clouds hung low over the rolling French countryside, producing premature twilight as three sleek prototype automobiles rolled across the finish line to end the 24 Hours of LeMans for 1966.

This event had been run 33 times prior to 1966, but this year's race had special significance for American race fans. The first three cars that crossed the finish line at 4 p.m. Sunday, June 19, were Fords. Never before had an American-built car won this premier endurance event.

How Ford GT Mark II automobiles came to finish 1-2-3 at LeMans is a story that began more than three years ago. It chronicles the dedicated efforts of many men who contributed to a project that drew on most of the resources of the Ford Motor Company and a number of small specialized firms.

In 1962, Ford announced it was disregarding the Automobile Manufacturers Association's ban on participation in motor sports events. A new era of competition dawned at Ford, one which would involve supremacy in all areas of racing.

The goal in sports car racing was the 24 Hours of LeMans, a grueling affair southeast of Paris run on an 8.3-mile course which includes a straightaway of more than three miles and turns that reduce speeds to below 60 miles an hour. In the past, American-built cars had tried and failed to win LeMans where even to finish is an accomplishment.

The foremost name in sports car racing in 1963 was Ferrari of Modena, Italy. A Ferrari had won LeMans in 1949, 1954, and every year from 1960 on. A decision was made to contact Enzo Ferrari in an attempt to purchase the Ferrari company and have it continue its racing operation under the Ford name.

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"No one at Ford Division had any real knowledge of sports car racing in those days, with the possible exception of Roy Lunn (Ford Division Advanced Concepts Manager) who was working in another area," Donald N. Frey, Company vice-president and Ford Division general manager, explained.

"I was one of these who went to Italy to try to arrange the Ferrari deal. It didn't work out and we know now that it was just as well it didn't. When we couldn't obtain the services of Ferrari, Mr. Ford (Henry Ford II) then told us to go out and beat him."

An early problem was where to build a GT car. Englishman Eric Broadley had built three cars to run at LeMans in 1962. Equipped with Ford 289-cubic-inch V-8 engines, they had displayed considerable promise. Ford purchased these cars and immediately started work on it's own GT vehicle.

It was decided to build the cars at Broadley's facilities in England. Lunn and several assistants were sent over from Ford Research along with Phil Remington of Shelby American, Inc., to help in the construction of the original Ford GT which, while related to Broadley's cars, was basically a Ford-designed car.

Like any new vehicle, the Ford GT had its troubles. Two cars crashed in the April trials for the 1964 LeMans race and a lone starter in the 1,000-kilometer event at Nurbringring failed to last. Three cars were readied for LeMans, all with the Indianapolis version of the Fairlane engine.

Ford's first try at LeMans was short and sweet. None of the three cars finished, although one driven by Ritchie Ginther and Masten Gregory led for 35 laps and proved itself to be the fastest machine that had competed at LeMans, hitting speeds of 200 miles an hour on the Mulsanne straightaway.

The Ford GT had made a startling impression on LeMans. Only 40 inches high and employing a semi-monocoque steel construction that used the roof skin section as a stressed member, the car proved to have stability on the straightaway and outstanding cornering ability.

There still were weak links. Three cars were started a month later in the 1964 endurance race at Rheims, France, and all three were eliminated by gear box problems. However, the ground work had been laid for greater things.

There were several other significant developments in 1964. One was the forming of Ford Advanced Vehicles (FAV) at Slough, England, under the direction of John Wyer, who had served as general manager of Aston-Martin. A subsidiary of Ford of Britain, FAV received direction from Ford Division and is the source of all Ford GT40's.

In Dearborn meanwhile, Roy Lunn was establishing Kar Kraft, a Ford Division-maintained organization that could work independent of the parent corporation in the development of new prototype machinery. The creation of the Mark II was the first major Kar Kraft project.

Shelby American, Inc., closely associated with Ford through its build and sale of Cobras and Mustang-based Shelby GT350s, moved into the picture early in 1965 when it was given responsibility for preparing and racing the Ford GT as well as its own Cobra Daytona Coupes.

That the Ford GT was much improved in 1965 was immediately evident when a car driven by Ken Miles and Lloyd Ruby won the 1,000-kilometer Daytona Continental at record speed. At the 12 Hours of Sebring, Miles and Bruce McLaren drove a Ford GT to second place overall and first in class.

While the Ford GT was looking better and better, Kar Kraft was plunging ahead on a Mark II version which would be slightly bigger, heavier and more powerful with a 427-cubic-inch engine replacing the 289 used in the Ford GT40.

While the Mark II originally had been scheduled for completion after LeMans, disquieting rumors from the Ferrari camp resulted in a campaign to ready two cars for the 1965 race. Lights burned late at Kar Kraft as the cars were rushed to completion.

It was May, little more than a month before LeMans, when the Mark II made its first shakedown run at Ford's Dearborn Proving Ground. Further testing was undertaken at the Michigan Proving Grounds at Romeo where Ken Miles clocked 201.5-mph-laps around the banked five-mile oval.

There was time for only brief tests at Riverside, Calif., before the cars had to be shipped to LeMans for the race. A stability problem arose at LeMans and stabilizers had to be attached to the cars, which detracted aesthetically but got the job done.

On the last day of practice before the 1965 race, Phil Hill in a Mark II turned in a record lap of 3 minutes, 33.0 seconds. Four 289 Ford GTs were in the race as well. Two of these cars were to have used a stroked 325-cubic-inch engine, but late results on the dynamometer indicated that the 289's would be more dependable.

The results of the 1965 LeMans race were discouraging to say the least. One of the Mark II's, that driven by Miles and McLaren had a transmission failure in less than three hours. The Hill-Chris Amon car lasted six hours before a clutch gave out.

The 289's did not fare much better. Three of the cars had their engines overheat with the trouble eventually traced to faulty head gaskets. Ford's second year at LeMans was no better than its first.

Sunday night, just four hours after the 1965 race had ended, Leo C. Beebe, public relations and promotions manager for Ford Division, called a meeting at LeMans' Hotel de Paris of all those connected with the Ford effort. In opening the meeting he said:

"I want you to know that this is a victory celebration. We're celebrating our victory in the 1966 race."

Thus, preparation for the 1966 event began just hours after the finish of the 1965 race. Among the conclusions drawn that night were: the seven-lieter Ford GT Mark II was capable of winning the event once it had been thoroughly developed; and one individual was needed to devote his full time to coordinating the effort.

The Mark II was not raced again in 1965. Shelby American, under the supervision of Ford Division's Special Vehicle Activity, began a thorough development and test program on the car. Beebe and Special Vehicle Manager Jacque Passino selected John Cowley as manager of the 1966 LeMans effort. Cowley runs Ford's successful stock car program.

To provide maximum cooperation between the various Ford departments involved in the LeMans project, a LeMans Committee was formed with William D. Innes, vice president - Engine, Transmission and Parts Group, and Mr. Frey as co-chairmen.

This committee met faithfully during the next 11 months to study in detail progress in the LeMans project and to discuss solutions of any problems that occurred. Some of the finest brains at Ford Motor Company sat in on these discussions, contributing important advice.

One important decision prior to the start of the 1966 racing season was to retain more than one racing team to campaign the Mark II, since a bigger entry list was planned for LeMans. In addition to Shelby American, Holman and Moody, Inc., and Alan Mann Racing Ltd., joined the team.

It was a highly refined Mark II that emerged from Shelby American's spacious operation adjacent to the Los Angeles airport. The long nose that distinguished the early Mark II was gone, and innumerable design changes had gone into the chassis and suspension.

The Mark II represented a new approach to prototype endurance racing. It was an attempt to win over Europe's best racing machines with a vehicle driven by what was basically a production engine and driveline. The 427 CID pushrod engine in the Mark II has lightweight alloy heads, but is basically the same powerplant that any buyer can order for his Galaxie.

In early trials the Mark II showed signs of great promise. The first test came in the Daytona Continental which was lengthened to 24 hours for 1966. Five Mark II's were entered, four with Ford's four-speed manual transmission and one with a new two-speed automatic.

The Mark II's 1-2-3-5 finish showed that it now had durability to match its speed. Winning drivers Miles and Ruby covered 678 laps at a record 108.02 mph. Dan Gurney and Jerry Grant covered 670 laps to finish second, and Walt Hansgen and Mark Donohue 669 laps to place third.

It was much the same at Sebring where the number of sharp turns and the emphasis placed upon acceleration was supposed to handicap the heavy Mark II (2,400 pounds). Miles and Ruby again finished first in a roadster version of the Mark II after Gurney's engine failed with less than a lap to go. Hansgen and Donohue placed second.

The Sebring race proved that Ford had found a way around the Mark II's biggest problem -- brakes. The weight of the car placed a great deal of stress on the brake discs. While constant innovating had improved braking, the ultimate solution proved to be a removable disc that could be changed in minutes.

With the Mark II now thoroughly proven, Ford could turn its attention to a radical new car designed by the Corporate Styling Studios in conjunction with Lunn's Advanced Concepts Department. Called the 'J' Car because it was built to new F.I.A. appendix J rules, it employs adhesive bonded honeycombed-aluminum construction.

Lighter than the Mark II and outfitted with an automatic transmission, the J-Car showed great potential in the April LeMans trials. Although it had the fastest time, subsequent tests indicated the car was not ready for a 24-hour run and none was entered in the LeMans race itself.

An eight-car effort was formed to make Ford the first American manufacturer to win the 24-Hour LeMans race. Three cars were run and prepared by Shelby American under the supervision of Carroll Shelby; three by Holman and Moody with John Holman heading the effort and two by Alan Mann Racing with Alan Mann in charge.

It was a quietly confident group that accompanied the cars to Europe. The race already had been run successfully in the dynamometer building at Ford Engineering and Research center. Their engine and transmission had undergone a 48-hour durability test under conditions to be encountered at LeMans.

Drivers proved to be a last-minute problem. Three men originally selected to drive were disabled by injuries -- A. J. Foyt, Ruby and Jackie Stewart. Dr. Richard Thompson, Stewart's replacement, then was disqualified in practice for allegedly failing to report an accident in which he had been involved.

The final run-down of drivers was:

Shelby American -- Ken Miles and Deny Hulme; Dan Gurney and Jerry Grant; Bruce McLaren and Chris Amon.

Holman and Moody -- Ronnie Bucknum and Dick Hutcherson; Mario Andretti and Lucien Bianchi; Paul Hawkins and Mark Donohue.

Alan Mann -- Graham Hill and Brian Muir; Sir John Whitmore and Frank Gardner.

Ford Mark II's were fastest in practice right from the start. Hill's record was broken repeatedly with Gurney establishing the quickest lap of 3 minutes, 30.6 seconds. Miles was right behind at 3:31.7. The fastest Ferrari time was 3:33.

There were disappointments during the race but things generally went well. The Hawkins-Donohue car had trouble from the first lap when the half-shaft broke and it was retired after a very few laps. The Whitmore-Gardner car was involved in a slight collision at the start and eventually was parked after clutch trouble forced a lengthy pit stop.

The Bianchi-Andretti car overheated and was eliminated, while the Hill-Muir car retired with a broken front suspension. The remaining four Mark II's ran well, occupying the first four places much of the night. Late in the morning the Gurney-Grant car overheated and had to be scratched while leading the field.

The remaining three cars completed the 24 hours with no problems. The frantic early pace, which had seen Gurney equal his practice mark of 3:30.6, had eliminated all of the faster Ferraris. The McLaren-Amon and the Miles-Hulme cars were running within seconds of one another as the race neared its end, with the Bucknum-Hutcherson car handing back as insurance.

A decision was made in the Ford pits to have the cars finish side by side in what hopefully would be considered a dead heat. All three cars went over the finish in formation but any chance for a dead heat disappeared when officials discovered a rule that in case of a tie, the car that had started farther down the grid had traveled the farther distance.

Since McLaren and Amon had started 60 feet behind Miles and Hulme, they were declared the winners. Both New Zealanders who now reside in England, it was the most important victory yet for the two youngsters. McLaren, who builds his own Formula and sports cars, is 28. Amon 22, is the youngest winner in the history of the event.

It was a record shattering performance as the winning car covered more miles (3,009.3) at a faster speed (125.38 mph) than any previous entry. It demonstrated that production engines could compete with racing powerplants and that an American-built car could top Europe's best.

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7/5/66



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FORD AT LE MANS -- 1966

<u>Car No.</u>	<u>Drivers</u>	<u>Distance</u>	<u>Speed</u>	<u>Place</u>
2	Amon-McLaren	3,009.3 miles	125.38 mph	1
1	Miles-Hulme	3,009.3 miles	125.37 mph	2
5	Bucknum-Hutcherson	2,908 miles	121.207 mph	3
3	Gurney-Grant	Retired with blown head gasket		
7	Hill-Muir	Retired with broken front suspension		
8	Whitmore-Gardner	Retired when it was determined car would be disqualified for failing to run close enough to the leader after a pit stop to correct clutch troubles.		
6	Bianchi-Andretti	Retired after overheating		
4	Donohue-Hawkins	Retired with broken differential locker		

Dan Gurney established a lap record of 3 minutes, 30.6 seconds --
142.979 mph. This equaled the practice lap record he set Thursday,
June 16.

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2- Chris Amon interview

Chris Amon interview

Chris, going into the race, who were your biggest rivals – Ferrari or the other Ford GT cars?

I was driving with Bruce McLaren in the #2 GT40 and we both knew our main competitors would be the other Fords. We ran at Le Mans in '65 in the GT40 and we were so much faster than Ferrari until we had reliability issues. We knew Ferrari had improved, but so had we, especially on the reliability front, and that proved to be the case in the race.

Tell us about the start?

Bruce drove the first stints. I recall it was damp and we were running on intermediate Firestone tyres and at 210-220 mph on the Mulsanne Straight, the tyres were shedding tread. I took over from Bruce and he spoke to Firestone and they generously said we could switch to the Goodyears the other GT40s were running. Bruce said to me we had to drive the doors off the thing so we did.

Was that the moment that he shouted 'Go like hell!'

Yes, and there was a bit of history to that. We had both driven the first two 7-litre cars at Le Mans the previous year: Bruce with Ken Miles and myself with Phil Hill. We were warned to be careful with the gearbox as they were new and unproven and both cars retired with gearbox failures. The McLaren team was commissioned by Ford to build a lightweight version of the GT40 for possible use in 1966. I did the testing of this and drove it in some Can Am type events in the US in late '65. Around that time I was also doing testing at Sebring and Daytona with the standard car and was experiencing a few mechanical issues.

As a result of the above when I went to Daytona for the 24 hours paired with Bruce. I was not fully confident on the reliability front if we were to drive hard the whole race so I suggested to Bruce that we set a fairly conservative pace for the race, and whilst we might be running out of the top three in the early stages, we might be the only one there at the end. We finished fifth.

Our attitude for Le Mans, because of the Daytona result was obviously different. We decided to set a pace for ourselves, which would keep us in touch with the lead and then go for it later in the race. This strategy fell apart when our tyres started losing treads early in the race and we lost considerable time. Bruce and I were both contracted to Firestone so it was a difficult thing for Bruce to negotiate a switch to Goodyear. When I was called in to change tyres I think Bruce's frustration had reached boiling point, he put his head through the car door and said 'Go like hell'.

What happened at the finish?

The idea was that the leading GT40s would cross the line together but in practise it wasn't possible to have a dead heat. We weren't sure who had won initially.

What was the toughest part of the race for you?

Back in those days the top speed of the GT40 was 100mph more than some of the other cars on the track so it could be quite hairy especially at night in the rain with mist hanging in the air, bearing down on these cars when you couldn't see much. I found driving at dawn and dusk especially tricky because the light was so poor. Another thing was the cars back then chucked out quite a lot of oil so as the race went on, and the rain came down, it got very slippery. Our throttle was also sticking a bit which isn't what you needed going into a corner.

Did you get any sleep?

I didn't get any. We were stopping every hour and a half for fuel and we weren't allowed to drive for more than four hours at a time. Bruce could sleep anywhere at any time but I couldn't. I would take a shower when I got out of the car and change my overalls because you would get drenched in sweat driving the GT40. I also had some interesting conversations with Henry Ford II and his wife Cristina, during the night.

Tell us about the podium celebration at the end?

I have to admit I was only 22 at the time and I was overawed by the situation. Henry was on the podium and I believe his wife was also there. I can't remember exactly what was said but it was a very joyous occasion.

So which is toughest – Le Mans 1966 or Le Mans 2016?

It's difficult to say because the speed differential was higher in my day and the cars didn't provide as much protection. The circuit was also more dangerous. Our cars didn't have power steering or paddle shift gear boxes so they were physically very demanding to drive. You would get huge blisters on your hand from changing gear. Another thing was you really had to manage the brakes because at the end of the Mulsanne Straight they would be cold and then subjected to tremendous heat as you slowed from 220 mph.

There was a real risk the discs could crack. It was certainly more dangerous in my day but if you wanted to race, that was the deal. I think today's drivers are subjected to much higher G-forces and they also have to manage different settings in the car so they have more to think about during the race. At the end of the day, endurance racing is the ultimate test for man and machine and that hasn't changed a bit in the last 50 years.

Was that win the highlight of your racing career?

At the time I was probably more interested in F1 than sports car racing. It's been said that I was an unlucky F1 driver because I should have won a lot of races but the fact is many of my contemporaries were killed in F1 so I think I'm lucky to still be around. There's no question that winning Le Mans with Ford was a very special moment in my career.

What would a Ford victory mean to you in 2016?

I would be delighted for Ford. I won with Bruce and he wasn't with us for much longer after that race so it would be especially poignant for me personally to see history recreated. I wish the team all the best.

New Zealander Chris Amon was born in 1943 and was active in F1 racing in the 1960s and 1970s. Widely regarded as one of the best F1 drivers never to win a Grand Prix, he died in August 2016 shortly after this giving this interview to Ford Chip Ganassi Racing.

This story was first published on Motorsport.com in June 2016.



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3- Ken Miles interview

Ken Miles Interview

"When properly set up," Ken Miles says, "this is the easiest car in the world to drive. If not, it's awful—but then, this is typical of any really modern racing car. Small changes in chassis tune produce large changes in handling. The suspension is designed for a particular ride attitude; as speed goes up this attitude changes. We spent two days getting the car to handle right at Le Mans, found that the spoiler setting needed to be 2 inches, not 1. Most critical thing is precise control of rear suspension geometry with 4-link arrangement used today—tires are still an area of much ignorance—even after arriving at basic suspension geometry with help of IBM, I have to get it adjusted on the track.

"It's a cooking engine. I can lug it down to 1000 rpm in 4th. When does it come 'on the cam?'—oh, about 3000 rpm! We babied them. The thing's safe for 7400 rpm, but we never exceeded 6200 in the race.

"It's a bloody oven inside! It takes a fair amount of physical effort to drive—steering is heavy—you brace yourself in banked turns so you can hold onto the controls. This is due largely to the fact that the car has been developed so far past its original state. The steering feeds back quite a lot, and I get big blisters. . .

"Cornering is pretty neutral, takes severe provocation to hang the tail out, and then it's only briefly. She really wants to stay put. I say neutral, but that's my car. Ron Bucknum likes a little noseplow, Lloyd Ruby wants the tail hanging out—we get three different patterns of tire wear.

"The gearbox is easy to shift after broken in and has completely unbeatable synchro. It could be lighter if it weren't built around Galaxie internals, has an extra shaft to bring drive back through.

"Brakes are high-effort. Can't possibly lock wheels. They are our Achilles heel; there's just not room for a brake big enough. Running 1650° F, there's too much variation in temperature— I planned my driving so only one disc change would be necessary. Unfortunately, one of the new discs was bad and I had to stop again. At the end of the race, this set was in good condition, ready for another go.

"The seating is very comfortable, yes. Hard to get into, but no aches at all after the race. For rear vision, pick the mirror glass off the floor and hold it in your hand. The wipers work well at high speeds, but the washer hardly works at all.

"Throttle linkage is very important. It must achieve two things: it must be smooth, and progressive—slow at first opening, getting faster. I have these qualities, but I don't like the suspended pedal. Not natural."

Riding with Ken, I found that indeed the Mk II is a flexible car. It isn't quiet, of course, but with the big noises going out the back it's not horrendous; the ride is about that of a street Cobra. There's a realization of great structural strength, but there are rattles all over. And it *is* possible to lug from 1000 in 4th. Acceleration in the indirect gears, once past 3000 rpm, is simply indescribable.