



A Vintage View of the Lotus 18

It's a special thrill to see Lotus Formula Juniors from the late Fifties and early Sixties, to watch them race as they did nearly 30 years ago, to hear the sounds of their small, but strong, engines echoing through trackside woods. Club members who attended the Pittsburgh Vintage Grand Prix at LOG V last year had a chance to savor that experience from a spectator's point of view. At this year's event, I was able to spend a whole weekend getting a team's-eye view from the pits.

The Saturday morning skies over Schenley Park were a dim gray on August 16th as the vintage weekend got under way. But it appeared the rain would hold off, and I was able to take a delightful stroll through the exotic car show, where I caught a good look at club member Jack Crescenzo's beautiful 1971 Europa.

Then I was off to meet Bob Akin. Bob, whose Coca-Cola Porsche 962 won this year's 12 Hours of Sebring, had returned to the Pittsburgh Vintage Grand Prix with his son, Bobby, hoping to do a repeat performance of the 1985 race. Last year, Bobby won both the Formula Junior class and the grand finale to the event, a handicap race with a field made up of the top three finishers in each class.

Joining the Akins this year was Jerry Morici, who brought along a superb 1961 Lotus 22 Formula Junior and a lovely Series One Seven. All three cars were immaculately prepared by auto technicians J.R. Mitchell and Bob Pezanowski, who have both put in some time preparing and testing the Porsche racer.

When it was new, the Lotus 18 was never accused of lacking in technical imagination. The original car was a multitubed frame, covered by an aluminum body. Both front and rear springing were done by combined coil/damper units. The front suspension consisted of typical unequal-length A-arms, while the rear was a Chapman-designed, fully independent assembly. All this would have set you back about \$4,450 in 1960.



The 18 employs a lot of technology that is outdated by today's standards. Although it chalked up the first Lotus Grand Prix win—for Rob Walker's team, in the hands of Stirling Moss at Monaco in 1960—it actually was a stepping stone from the old, front-engined racers to the

(See VINTAGE, page 4)

Caterham 7:

New Improvements Maintain Old Standard



[Jez Coates, development engineer at Caterham Car Sales, was interviewed for LOTUS reMARQUE by Claude Gagne.]

LOTUS reMARQUE: Jez, tell us how you got involved with the development of the Caterham Seven.

JC: I joined Caterham in January 1983 as the production buyer, after leaving Leyland. This led me to the installation of a computer system in 1984-5 for the purchase of supplies. With this system, we can now produce a full report on the parts used to build the last 200 cars. At the same time, in 1984 and in 1985, I got involved in the development of the Super Sprint engine with Peter Cooper. Then, in late 1985, I took over the development engineer job from Clive Roberts, who had held the position for eight years, but was leaving to join Lotus Cars. I must point out that, at that time, the design of the De Dion rear end was already done; all that was left to do was to bring it into production.

LR: Let's talk about this De Dion suspension right now, since this seems to be quite a major development. How did it come about?

JC: As we were anticipating running out of axles eventually, we realized that we had to redesign the rear end. Then, since we like to keep a link with the past (for example, with Ford or Cosworth), the De Dion set-up looked natural, as it was fitted to the Seven a long time ago. Another advantage, of course, was that it was also the cheapest. So the design started in 1983 and was presented at the Motor Show in 1984. The development continued in 1985 with one car, and was again displayed at the Motor Show. About 50 cars have been built with the De Dion in 1986. We now have in full production the definitive version, with the five-speed gearbox (a Ford close-ratio, as fitted to the Granada and Capri 2.8-liter V6s) and the differential slightly moved backward. This last development project was my own.

LR: Are these kinds of developments tested in racing before being implemented in production?

JC: Yes, much of the development flows directly from our racing involvement. For example, we race the De Dion with a rear anti-roll bar. This is

(See COATES, page 4)

STARTING LINE

It has been several years since we put out the call for technical articles for the newsletter. Longtime Lotus, Ltd. members know well how often we used to beat the bushes for material—cajoling, pleading, threatening members with vast numbers of reprints—or areas of white space—if they didn't come across.

In recent years, we've usually been fortunate to have at least some backlog of material being readied for publication. This, combined with the occasional goodies that have landed unsolicited in Box L, has allowed us to spare you the constant clamor for contributions.

But that time is fast coming to an end. A monthly newsletter that consumes material at a rate of 1600 words per typeset page is a voracious beast! The pile-in-process has been steadily diminishing, and before it vanishes entirely—sending the editor into even more of a panic mode than he usually is in—we're renewing the call for technical material.

Dozens of members with technical expertise have indicated a willingness on their survey forms to contribute to the newsletter. Just one article from each would put us in "fat city" for a long time to come. If you have an idea for an article, please put pen to paper—or call the editor at (301) 441-1955, if you're not sure whether the subject is appropriate or has been covered before.

Today, we're asking. Tomorrow, we'll be pleading. Threats will follow.

COVER: A wave from Lotus 18 driver Bobby Akin. (Photo by Ray Shaffer)

TRANSMISSIONS

As suggested by John Entwistle in the July issue, the addition of a manual radiator fan switch is an excellent idea, when used in conjunction with the fan motor relay and the thermostatic switch. (I recommend that this switch not be defeated.)

Also, before deciding the thermostatic switch is defective (short the wire connectors to test), I recommend checking the points contact operation of the fan motor relay. If these points have lost their spring tension and opened too far, the fan motor will not operate. To correct this problem, file and clean the points contact and readjust the points gap to .045".

Rick Keffer
Hartville, Ohio

Over the years I have read many articles concerning electric cooling fans. However, none of them have recommended using a "fail-safe" circuit. In other words, if the thermal switch, relay, etc., fail, the fan will run continuously instead of not at all. This type of circuit would be especially advantageous in those cars which relay entirely on electric fans for cooling.

The only changes required are the use of a relay with normally closed contacts, instead of normally open, and a thermal switch which opens (not closes) on increasing temperature. Both of these items are readily available.

Power for the relay and fan should, of course, come from a "switched" source.

Ed Phelps
Mt. Pleasant, South Carolina

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I was gratified to receive several letters of advice on autocrossing my Europa. I must say that the A001Rs are a revelation, even compared to the Phoenix 3011s.

I have also found that, just as Lloyd Cayes suggested, chassis stiffness has an effect on the best tire pressure for autocrossing. My Europa has a 7/8-inch front (hollow) antiroll bar, and an adjustable rear bar. It may be surprising to many Europa owners, but this has had only a slight effect on ride quality. In addition, I lowered the front end one inch by cutting the springs, and installed Konis. This has noticeably stiffened up the ride. The car now feels especially tight.

With all of the modifications, I have found that my best tire pressures are at least seven pounds less than the mid-thirties that many have recommended.

My main problem with autocrossing this season is that my driving skills are not up to the capability of the car!

David Roth
Kohler, Wisconsin

Some more notes concerning the Westfield Seven are in order. Having completed some suspension adjustments, several things have come to light:

1) The Westfield chassis differs from the Lotus/Caterham Seven in several important ways. The front suspension is true double wishbone. The rear uses dual trailing arms and a panhard rod in lieu of the A-arm. Most importantly, there is a fully boxed-in frame section down the center of the chassis which greatly stiffens the entire unit.

2) We found a lot of problems when getting serious about suspension settings. Several fittings had to be modified in order to get the camber set evenly. The left side in particular required some modification to the upper control arm. We also found that the upper control arms were both rubbing on the front mounting bracket and required some grinding to fit.

3) Most disturbing are cracks in the paint around the suspension mounting points that clearly indicate flexing of these points. These points will receive some serious gusseting.

4) Having said all this, I would like to point out that my car is the third Seven built by Westfield, and Chris Smith has assured me that later cars have benefitted from considerable development. The pictures that I have seen of later cars would seem to bear this out.

Cortes Pauls
Richmond, VA

Mr. Paul's chassis is pre-20 and, as we have made well over 100 now, the standards are much higher.

C.K. Smith, Chairman
Westfield Sports Cars Limited
Kingswinford, West Midlands
England



Stan Swartz, who authored the article in the June issue on air deflectors for the Europa, passed along this picture of one installed on his car.

Buyer Beware!

It is not lightly that we bring to your attention the names of specific individuals you might do well to avoid in buying parts for your Lotus. Isolated disputes, after all, are not uncommon, and it's often difficult to fix the blame for who did what to whom in such cases. Short of the systematic, blatant rip-off artist, therefore, we have a big grey area populated by sellers who leave a trail of occasional unsatisfied, shortchanged or ripped-off buyers in their wake.

Ira Seinfeld, of Brooklyn, was one. We were able to document nearly a half dozen unsatisfactory transactions over a period of years in which he was involved—and recently we learned of a couple more. He was, when we last checked, in jail in New York on an unrelated felony weapons charge.

We cannot say whether we have another Ira in the making, but two unsatisfactory transactions involving club members and one Dave Caponigro, 95-23 107th St., Queens, NY 11416, (718) 441-1519, have been brought to our attention.

The first was a transaction between Caponigro and member Bob Ogle for some used Europa parts advertised in *Hemmings* in late 1984. The transaction aborted in early 1985, amid mutual accusations of bad faith, after Ogle had advanced several hundred dollars for a lot of parts, the first of which he subsequently received and found were not what he had been led to believe. Despite considerable efforts at intermediation, Caponigro was unwilling to agree to any face-to-face meeting or inspection of the parts to complete the transaction on a cash-on-the-spot basis, instead insisting that he be mailed additional money before he would continue sending parts. To our knowledge, the transaction was never completed and Ogle was out substantial money for parts that did not fit his Europa.

Recently, member Phil Mitchell brought to our attention a problem he is having with Caponigro, involving a radiator advertised in *Hemmings*. Mitchell sent Caponigro payment for the radiator, and received a heater box instead. Despite numerous attempts over most of the summer, he has been unable to get his calls or money returned, or his merchandise exchanged.

Hemmings has been alerted to the problems with Caponigro. *Caveat emptor!*

MAYBE IT'S SOMETHING IN THE WATER DOWN THERE...

Gee, it's only September...and another Florida Turbo Esprit driver has made the national news.

Already this year we've reported the story of the stockbroker who was arrested for embezzling millions from his clients, and the one about the vice cop who was arrested for dealing drugs.

And you didn't think it could get any worse?

Now comes the story of the dead laughing gas addict.

Early last month, in the climax to a real-life soap opera, tobacco heir Steven Benson was convicted in Fort Myers, Florida of the 1985 bombing murder of his wealthy mother Margaret and his adopted "brother" Scott. Scott, it emerged at the trial, died at 21 without ever learning that Margaret's daughter Carol, who survived the blast, was in fact his natural mother—not his older sister by adoption, as he had been told.

Margaret was worth \$10 million and knew the truth about her daughter's illegitimate son. According to her secretary's testimony, she "paid for everything for Scott": his tennis lessons, his van, his Cigarette speedboat, his apartment and furniture, his clothes, his gas credit cards, his auto repairs, and his cars—two Lotuses. She also paid for the monthly deliveries of cannisters of nitrous oxide (laughing gas), to which he was addicted—a habit that started with repeated trips to the supermarket to sniff Reddi-Whip cans.

"Even though he had a fancy car," Carol testified, referring to the Lotuses, "Scott didn't like to drive. And Steven usually drove when we were together." It struck her as odd, therefore, when Steven insisted that Scott get behind the wheel of the family station wagon on that fateful July morning. Steven also dictated precisely where everyone else in the car should sit, she said, and then abruptly headed back to the house to pick up something he claimed to have forgotten.

A moment later, Scott turned the ignition key—and the car exploded in flames.

Wayne Kerr, the family lawyer who was staying overnight at the house, described the sound of the blast for the jury. "I thought at first it was one of the Lotuses blowing up again!"

LOCAL LOTUS

Despite foreboding weather, five Lotuses showed up at Summit Point Raceway on August 17th to attend a high performance driving school with D.C.'s Mazda RX-7 club, and four of the five took to the track. Brian Carroll's Europa Special was put back together just in time for the event and, even though it wasn't in "race-ready" condition, he wanted to prove to the other club members that he really does have a Lotus! Bob Murray's Rotary-powered Europa S2 was very quick, even though the chassis had not been set up for high speeds; the car has tremendous potential. Other participants included Jacques Smith in a Lotus Seven, myself in a Europa TC, and Tom Blazer in a Rotus 7. Bob Grenier and Andy Doring served as instructors.

Everyone had a great time, and we're looking forward to doing it again next year, hopefully with more Lotus participation—so start preparing your cars now!

—Phil Mitchell



Phil Mitchell

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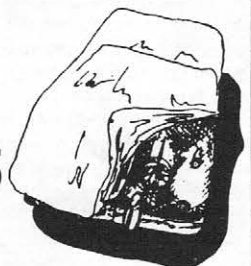
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Bobby Akin's Lotus 18 leads the pack at the 1986 Pittsburgh Vintage Grand Prix.

(VINTAGE, from page 1)

mid-engine layout so common today. In one short year, the Type 18 evolved into the 20/22, which included such items as Girling disc brakes and wider tires, instead of very skinny tires and drum brakes all round, and made the 22 a superior car. The engine/transmission layout on the 18 was typical; a Renault Dauphine transaxle was used, later to be replaced with a newer, stronger unit. The 18's older-style suspension caused the car to appear higher off the ground than the 22; this was, basically, because of the fuel tank, which was located above the driver's legs.

The competition at Pittsburgh looked tough for Bobby Akin. There were two other 18s entered, two Lotus 20s and one 20/22, which was an evolutionary model driven by Canadian Chris Ball. After the first practice session, I was surprised by the competitiveness of the class. After all, isn't vintage racing just for fun? I put the question to Bobby.

"There's no sense in racing if you're not out to win!" he declared. By the way he was driving, it was clear that this was an Akin family philosophy.

In the paddock area, I had a chance to talk with Bobby. His future seems clear. He plans on working his way up through the ranks of auto racing, and hopes eventually to end up in Formula One. However, vintage racing seemed to me to be an odd starting place for such an ambitious career.

"Basically, vintage racing is for experience," Bobby said. "If you can handle the 18," he added, "you can just about drive anything!"

It was on the third practice lap that Bobby came driving into the pits, and we all rushed over to see what was wrong. Mechanic J.R. Mitchell proclaimed the ring-and-pinion to be the culprit. Now, a transaxle for a vintage Lotus racer is about as common as a two-dollar bill, but fortunately Jerry Morici just happened to have an extra one that would work.

With all the parts in hand, it was left for Bob and J.R. to work some of their magic. Bobby left for the hotel, not knowing whether or not he would have a ride for Sunday's race.

Leaving the paddock, I got a chance to ride in Jerry's Lotus Seven. The acceleration was brisk, planting me firmly in my seat, and the car, in its racing tune, was...well, let's put it this way: You thought that the Elite was loud! I could even stick my hand out the side and touch the ground with my palm—a sports car in the original sense of the word!

I headed home with two thoughts in my head: Would they be able to replace the transaxle—and would the rain hold off?

On Sunday morning, the sun was shining as I walked through the paddock and examined the survivors of the previous day's activities. After all the ripping and roaring of the Saturday track sessions, the cars seemed so lifeless—but no less romantic. These cars were thoroughbreds, built with one thought in mind: to race.

In comparing these early Sixties models with some of today's state-of-the-art machines, one can see the improved safety that is engineered into today's racing equipment. The early racers were termed rolling gas tanks by some engineers and, despite the risk, some of these cars—especially Bobby Akin's—are still driven at ten-tenths. However, Bobby's Lotus is equipped with a complete roll cage, plus an ample, modern safety harness. And, while drivers of that bygone era could be seen driving in short-sleeved polo shirts, for Bobby it's Nomex everything—from face mask to underwear. When it comes to safety, no one cuts any corners.

The Akins arrived at the trailer about the same time I did. After saying our good mornings, we stood in silence and awaited the verdict. Would Bobby be racing today, or would we be watching from the grandstands?



Bobby Akin in the Lotus 18, father Bob (behind) and J.R. Mitchell relax in the paddock.

As J.R. rolled the 18 down the ramps, everything was deemed ready to roll! I later found out it had not been an easy job. Apparently, testing a Formula Junior at 11:30 P.M. wasn't exactly Bob's and J.R.'s idea of cruising the boulevard on a Saturday night—especially when they were trying to explain to the police why they were driving a race car with one hand and, with the other, holding a flashlight to see where they were going!

All that was left to do was to run through the hardship practice and survive for the race. The car was gridded and ready for practice. A handshake for good luck, and Bobby stormed off onto the track. All went well, the Lotus held together, and even the corner workers commented how smooth and consistent the run was. But consistent the sky was not! As dark clouds started to roll in, we hoped the rain would hold off until the race was over.

The time up to the feature race was uneventful, but finally the hour arrived. Bobby's Lotus was fifth on the grid. In front of him was Jerry in a 22, and directly behind was club member Keith Winterson, also in a 22. The teams grew restless waiting for the start while an accident was cleared from the track. After the drivers were warned of the oily conditions, the signal to start their engines was finally given. Several pace laps were taken to make sure all the drivers knew where the slick spots were.

Then the pace car pulled in as the green flag dropped. The Lotus contingent was off! Bobby's 18 was quick to move up, and in no time he was in the lead. His ability to forge ahead of the pack in a relatively obsolete Lotus was indicative of the amount of talent he possesses.

But, on the fifth lap—no sign of Bobby...

The race blazed onward, and soon it was over. The top finisher was Chris Ball in the number 14 Lotus 20/22.

After the checkered flag fell, the Akins walked back to the trailer to await Bobby's arrival—and just then the heavens broke loose. When it rains, it pours, so the saying goes—and, boy, it surely did!

When the flatbed pulled in with the Lotus on board, it was learned that the car apparently had gone up over a curb and the right rear suspension pieces had broken in two. Had the incident not occurred, clearly Bobby Akin would have been the victor...

I think vintage Lotus sports and Formula Junior cars, racing wheel to wheel, are a sight all Lotus lovers should see. They provide a look at the heritage of all the Lotus cars we drive and admire. Any person who races them will surely agree.

As for Bobby Akin and the Lotus 18, they make a rather stunning pair. But, in 1987, I understand, the Akins are planning to run a Lotus 22 Formula Junior that is now in the restoration process.

So I certainly plan to be there—same time, same place—next year!

—Ray Shaffer

(COATES, from page 1)

required on the track only, because understeer is apparent at racing speeds only. Another example might be the A-frame and radius arms, which were originally fitted with rose joints to allow the rear suspension to roll freely without having rubber bushes binding up. But the rear of the car rolled too much, so we reverted to rubber bushes.

LR: What about the chassis development?

JC: At the same time, we were looking at the chassis, aiming not only to improve its stiffness, but also to rationalize its production. Indeed, it is difficult to schedule production when you have 50 to 60 possible versions (short cockpit, long cockpit, LHD, RHD, pre-'81, post-'81, etc.). So,

while we had the development work done at Caterham, we teamed with City University in London to test stiffness. For example, the unpanelled long cockpit chassis had a torsional stiffness of about 700 pound-force per degree, while the panelled version tested at about 1200. Now, the five-speed 1986 chassis goes up to 1640.

This 1986 chassis is also called "universal", since it comes out the same from the main chassis jig, whatever the options. For example, footholes are the same, whether left hand drive or right hand drive is specified. Only the dashboard and the pedal mounting brackets will differ. The universal chassis is also more symmetrical than ever before. In fact, it may well be the ultimate chassis with pushrod and Cosworth engines, as further chassis development will be forced upon us by the necessity of fitting new engines. I will even go so far as to predict that moving the tubes to implement new powerplants will result in future chassis being not as good as the 1986.

Another reason why I consider the 1986 chassis to be the ultimate is that we also tested it with the addition of a half-inch square tube running diagonally from one end of the dash to the top of the roll-over bar on the opposite side, for a [torsional stiffness] of 3000. Since we have to leave room for people in the cockpit, this additional tube can obviously not be retained. The conclusion, therefore, was that any further improvement in the stiffness of the front part of the chassis would be useless, since the rigidity of the whole chassis would be limited by the relative weakness of its middle section anyway.

One last point I might add on this subject is that the tunnel is again a stressed part of the car, as before. In the four-speed chassis, we had made the tunnel detachable for ease of servicing the propeller shaft. But, since improving the tubes and plates at the rear and riveting the tunnel in pure shean was responsible for about ten percent of the total gain in stiffness, we had to sacrifice the ease of servicing.

LR: You mentioned possible changes to the chassis brought about by the need for a new engine. What are the developments in regards to the engine?

JC: We have to look for a replacement engine due to emission control regulations. Let us not forget that the Kent engine is something like 25 years old. We thus require a more modern engine with electronic fuel injection and catalytic converter, since our ultimate goal is to have an engine that would be legal even for California. The engines under consideration are as follows:

- the Ford 1600 CVH from the Escort. Since we would like to continue with Ford, this engine was first on the list. However, it is very harsh and quite tall. We abandoned it in 1983 due to its lack of refinement and noisiness and its lack of willingness to rev. (We decided we'd rather keep the pushrod engine then.)
- the Ford 2-liter OHC. Again, this is a Ford, but it is a tall engine and might be too heavy.
- the VW 1800 16V from the GTI. This is a very good engine, with a bell housing available for the Ford gearbox. Also, the wide availability of parts opens the door to the U.S. It's main drawback: expensive!
- the Austin Rover 2-liter 16V. This engine should be reliable and has a reasonable price tag. We also have a good relationship with this company.

As you can see, there are many considerations to take into account. In any event, only one engine will be retained in the end, for cost purposes.

LR: Is there a hot set-up that can be ordered on a Caterham Seven, apart from a Cosworth engine?

JC: We are working on a competition-oriented package that should be offered soon, initially in the U.K. This "sports package" should also be suitable for the road and would include a Ford 3.62 limited slip differential, or optionally a Ford 3.9 ratio differential (no limited slip), for quicker accelerations and nicer handling on the road; a rear anti-roll bar; stiffer springs (145 front, 100 rear, as opposed to the standard 105 front, 75 rear—note that these springs would be too stiff on the live axled Seven); and negative camber front wishbones (about 1°, as compared to 0° normally).

LR: You seem to have refined the Seven quite extensively over the years. What remains on the menu for future developments?

JC: We have a continuous development policy. For example, improved cooling with an upgraded radiator and fan; more accurate instrumentation (VDO instead of Smiths); taller side screens for better visibility and better weather sealing. As well, we are considering 14-inch wheels with 185/60 tires for better handling, although 70-series give a better ride. The ride quality with the De Dion suspension is so much better that it allows the 14-inch 60-series tires. (The 60-series are not recommended on 13-inch wheels without the De Dion, notwithstanding ground clearance problems.) Another example of ongoing development is the current testing of a 1700 Super Sprint engine fitted with twin 45 DCOEs, hotter cam, and flat top pistons (for durability purposes). This pushrod engine produces a genuine 150 horsepower; however, it may



Claude Gagne

Caterham development engineer Jez Coates makes a technical point at the First Annual Seven Owners Gathering.

well require new rings and bearings every 10,000 miles. For reasons of durability, we may therefore never market it, although it might be a viable alternative for racing—still cheaper than a Cosworth, anyway.

LR: Thank you very much, Jez. I hope you have a nice stay in America. And keep those Sevens rolling!

INAUGURAL SEVEN MEET

The First Annual Seven Owner's Gathering took place in Boston, Massachusetts on August 16 and 17, 1986. Contrary to what the name of the event might suggest, it was not necessary to own a Seven or to drive one to join the party. Being an enthusiast was the only requirement. Participants drove up to 500 miles and flew in from Kentucky and California to attend.

Organized by Chris Tchorznicki of Sevens & Elans, the meeting got off to a fast start Saturday at noon on the Sevens & Elans premises with a seminar led by Jez Coates, development engineer at Caterham Car Sales, England. It featured a partly assembled Caterham Seven with a 5-speed, 1986 universal chassis and De Dion rear suspension. With this neat piece of equipment to substantiate his explanations, Jez spent the afternoon answering questions that ranged from tire pressures and sizes to chassis torsional rigidity.

The fine banquet dinner was followed by two videos: an interesting interview with Graham Nearn of Caterham Cars and a review of the 1973 Formula One season, with commentary by Colin Chapman. There were also consolation prizes to the unfortunate owners whose Sevens could not make it to the event, including yours truly—the result of a blown-up radiator in Montreal's traffic, about one hundred miles away from home en route to Boston.

Sunday featured a drive in the country, capped off with a cookout in lovely New England surroundings and awards to the best Lotus and Caterham Sevens.

All in all, the meet included great technical information and great new friends in a great fun package. I'm already looking forward to next year's.

—Claude Gagne



Claude Gagne

MORE ON TIMING TWIN CAM CAMSHAFTS

I read the September 1985 *reMARQUE* article by Bruce Chandler and Greg Zelazek about adjusting cam timing on the Lotus twin cam engine and found the piece interesting and basically correct, but perhaps confusing. My attempt here is to eliminate some confusion.

There are four methods that can be used to check cam timing: 1) lift at running clearance; 2) max lift; 3) split overlap; and 4) lift at .050" from the base circle.

Method #1 is not practical. Due to the very gradual clearance ramps, it is not nearly accurate enough.

Method #2 is not recommended and seldom used.

Method #3 requires symmetrical cam lobes, identical cams on intake and exhaust, and symmetrical specified timing. It so happens Lotus designed the twin cam engine with symmetrical cams, so that the intake and exhaust cams could be interchanged. The opening and closing sides of the lobe are identical, which is unusual in "modern" cams. Most cams designed since the mid-Sixties have considerably faster opening rates, as compared to closing rates. This bangs the valve open rapidly, yet allows more gentle closing, so that the valve spring can cope with inertia.

In the Lotus twin cam engine, we have almost everything necessary to time the cams using the split overlap method. With this method, the cam timing is checked at top dead center on the overlap stroke—at the end of the exhaust cycle. At exactly TDC, both valves should be open the same amount. Our only problem is that Lotus does not provide this specification, or even the checking clearance on the specified 26-66-66-26 split timing.

This leaves us with method #4—cam timing using .050" off the base circle. The timing mentioned above provides a duration of 272°; the intake opens at 26° BTDC (before top dead center), and then the cam travels 180°, with the valve closing at 66° ABDC (after bottom dead center). By checking my cams at various lifts from the base circle, I determined that the above duration is achieved at .010 TOTAL tappet movement off base circle. With total tappet movement of .050" (.043" tappet movement plus .007" lash on intake, and .040" tappet movement plus .010" lash on exhaust), I came up with a duration of 224°. Two hundred twenty-four less 180 equals 44 degrees. Compare this to 92° on the original specifications. Now, follow closely or you'll miss this point: A percentage comparison of the Lotus timing to the timing at .050" lift results in 28.26% of the 44° on the opening side and 71.74% on the closing side. This computes to 12½° BTDC and 31½° ABDC on the intake cam. The exhaust is, of course, identical; it closes at 12½° ATDC and opens at 31½° BBDC.

Now we can make a precise cam timing adjustment. Afterward, it's easy to measure the amount of tappet movement, including lash, to come up with the split overlap opening at TDC on the exhaust stroke. Be careful of what I call tappet rock. Any overhead cam engine using direct cam action against the tappets is susceptible to a slight wear in the tappet bore. Tappet rock can account for an error in degree wheel readings of 1 or 2 degrees or more.

I use an 11-inch Crane degree wheel. It has a 7/16-inch center hole matching the bolt diameter of the Elan crank pulley bolt. Cut a length of heavy wall steel tubing 13/16" O.D. and 2.0" long. Machine both ends so that the spacer will allow the degree wheel to rotate without any noticeable lateral runout. A longer 7/16-inch SAE bolt will be required to reach through the front washer, the degree wheel, the spacer and into the front of the crank. The 2-inch long spacer will allow the degree wheel to clear the water pump pulley. The 11-inch diameter allows readings as precise as ½°.

I use two Starrett dial indicators with .500" range and 3-inch tip extensions. The graduations are marked to .0005-inch readings, just right for our purposes.

I prefer the positive-stop method of determining top dead center. To do this, first thread the inside of an old spark plug shell with a 3/8-inch US coarse tap. Install a length of 3/8-inch USS threaded bolt so that you have a 2-inch measurement from the spark plug seat to the end of the bolt. (This dimension is not critical—1-7/8" to 2-1/8" or so is fine.) With the engine on the compression stroke on the #1 cylinder, back the crank up to 90° BTDC, install the positive stop, and torque the spark plug shell to, say, 10 ft.-lb. Now move the crank in the normal direction of rotation until the piston contacts the rounded end of the bolt. Note the degree wheel reading. Remove the positive stop and rotate the engine past TDC to 90° ATDC; then reinstall the positive stop, and retorque to 10 ft.-lb. (The reason for this step is to prevent possible valve interference, which occurs on some engine designs if one should rotate the engine backward, rather than passing over TDC with both valves closed.) At this point, rotate the crank opposite to the normal direction until piston contact is made with the positive stop. Again, note the degree wheel reading. Total the readings and divide by two. Then bend the pointer to

this new reading. Recheck this to be sure you have exactly TDC.

If you have cams other than stock, use the manufacturer's specifications and method of timing the cams. If this information isn't available, measure the actual duration. You'll need the precise lash. Let's say this is .007" on the intake. Install the dial indicator and zero the gauge with the toe of the cam pointing 180° away from the tappet. Slowly turn the engine in the normal direction until you have moved the tappet exactly .043". This, plus the lash of .007", is the .050" total lift off the base circle. Note the degree wheel reading. Continue to rotate the engine through maximum lift and back down to the same .043" reading. Again, note the degree wheel reading. The number of degrees of crank rotation is the duration at .050". Subtract 180° from this figure. Take 28.26% of this figure for the degrees BTDC on the intake valve opening and 71.74% for the intake valve closing.

For those who want to cross-check their cam timing, the split overlap figures on my stock .3485" lift cams are .0935" on the intake and .0935" on the exhaust at TDC. This is a good cross-reference. If you get the intake and exhaust valve lifts within .005" of each other, that will do.

If you think this process is difficult and time-consuming, it's really not bad. (On the Aston Martin DB6, in order to adjust valve lash, one must pull the head to remove the valves, then grind the valve to reduce lash or grind the stem end to increase the lash, then reassemble and time the cams in order to see if you've got it right. No silly valve adjustment shims on this British jewel!)

Adjustments on the Lotus twin cam are best carried out with the engine removed from the chassis and installed in an engine stand. In order to make these instructions complete, the following is from the Elan + 2 shop manual—

To remove engine:

Remove engine and transmission after removing bonnet and withdrawing motor mount bolts, remembering to disconnect ignition wire from coil.

To install engine:

Reverse above, remembering to readjust throttle cable.

Now you've got everything you need to give that Lotus twin cam engine a precise cam timing adjustment, and obtain a whole bunch of hidden horsepower!

—Charles F. Seabrook, II

ADJUSTING THE SMITHS WATER TEMPERATURE GAUGE

The water temperature gauge in my Europa TC (Smiths No. BT 2221/00) indicated that the engine was overheating when no steam or excess pressure was present. If you are having this problem, proceed as follows:

First, check to make sure that the gas gauge is reading correctly. If both your gas gauge and water temperature gauge are incorrect, then a faulty voltage stabilizer may be the source of the problem.

In order to accurately check the temperature gauge, I bought an oven meat thermometer at the local hardware store for about \$5.00. It has a six-inch metal probe and a dial indicator for readings. You can check the accuracy of the gauge by inserting it in boiling water. Run the car to normal operating temperature and insert the probe into the header tank. Note the readings on your gauge and the thermometer. A further and more accurate check can be done by removing the thermostat and its housing and placing the probe as near to the temperature sending unit as possible. If the temperature readings do not match, the next step is to replace the sending unit. If your gauge continues to read incorrectly, then the problem is with the gauge itself.

Remove the gauge, sending unit, voltage stabilizer and battery from the car. Connect them as shown in the factory wiring diagram. Insert the sending unit in a pot of antifreeze and place this on a stove. A solution of 100% antifreeze will not boil during the temperature range of the gauge. Place the oven thermometer next to the sending unit. Heat slowly to ensure even heating. Remove the two circular cork tabs from the back of the temperature gauge. Adjustment of the gauge is made by sliding either one of the two plates that were under the cork. The procedure is similar to adjusting a distributor contact plate. Then put everything back in the car and check the gauge again.

My only problem was that the earth on my voltage stabilizer was grounded to the casing of the stabilizer and not to common, as shown in my wiring diagram. A voltmeter indicated 12 volts across the stabilizer ground and battery negative.

(Special thanks to Lotus, Ltd. member Jerry Blaine for his assistance.)

—Ron Dawson

THE COST OF RESTORATION

As the proud owner of the concours-winning Europa at the LOG V annual meet, I would like to share, from my experience, what one should expect to encounter during the restoration of one of these cars.

Your greatest expense will be your time. It required me a total of five years of twenty-plus hours per week, on the average, to complete my car. Ninety percent of your time will be spent disassembling, cleaning, inspecting and refinishing each and every part of your car. The breakdown of my time was as follows: 75% to refinish the body and interior, including the removal of all paint and primer, the repair of all stress cracks, the removal and replacement of all glass and body trim, and the renewal of the car's interior; 10% to rebuild the suspension and braking systems; 10% to rebuild the engine and transaxle unit; and 5% to remove and recondition all other parts by system.

Your second-greatest expense will be money. You will be surprised at how few parts you will actually need to purchase. However, I recommend you always purchase OEM parts or their equivalent, and deal only with the more reputable Lotus parts suppliers.

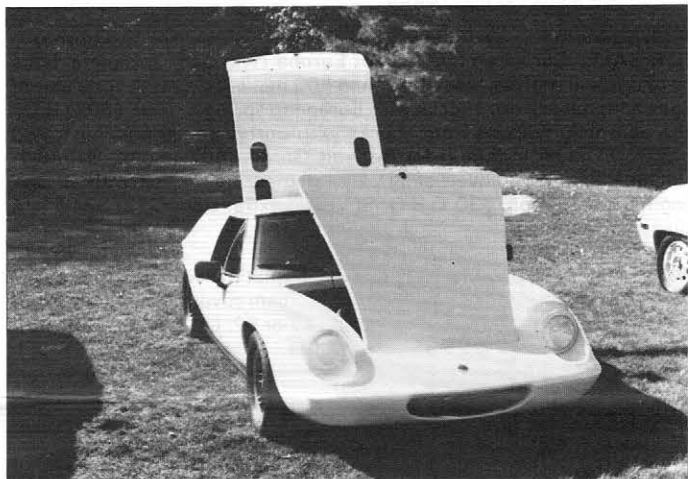
The cost of my restoration was as follows:

\$3,000.00 purchase price of car	236.34 braking system
2,141.33 body & interior	199.69 cooling system
376.18 front suspension	293.95 fuel system
591.47 rear suspension	223.17 electrical system
667.75 engine	148.80 exhaust system
272.01 transmission	\$5,496.85 TOTAL PARTS
345.90 wheels & tires	\$8,496.85 TOTAL CAR

In closing, now is the age of restoration for these cars, and anyone contemplating the purchase of one should understand and appreciate its character and make the necessary commitment of time and money to restore it properly.

As for the value of the car when finished, do not expect to recoup your investment. Instead, reap your reward in the pride of owning a fine example of a world-famous marque.

—Rick Keffer



PARTS & TECH

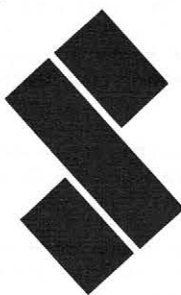
Freebie. *Auto-X Magazine* would be happy to send you a free copy. Write Tim Studdard, Auto-X Publishing, P.O. Drawer A, Daytona Beach, FL 32018, and mention you're a Lotus, Ltd. member.

Freebie, too. New member Bradley Taylor—writing from one of the larger sand traps in the U.S.—is the golf pro at Furnace Creek Golf Course in Death Valley, CA. He's offering a free round of golf—including cart—to any Lotus, Ltd. members who wish to drop by.

Old Elite (Type 14) tech rep. Club Elite secretary Mike Ostrov has kindly volunteered to serve as a tech rep for club members with questions about the old Elite. His address is 6238 Ralston Ave., Richmond, CA 94805, and his phone number, (415) 232-7764, has been added to the masthead.

READERS NOTE: LOTUS reMARQUE cover dates may be "old", but contents (including classifieds) are current unless otherwise noted. Renewals are based on issue dates, not calendar dates.—Ed.

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WANTED: For 1969 Elan—steering wheel and horn button assembly. Jim Weismann, 233 Sandpiper Ct., Foster City, CA 94404, (415) 341-2851 eves.

FOR SALE: Engine/gearbox for 1974 Elite, both complete and assembled but in need of rebuilding. Engine \$500, gearbox \$250, both for \$700 O.B.O. Michael Abramson, (804) 873-0540 days.

FOR SALE: 1973 Elan Plus 2, yellow, brown interior, Panasonic cockpit stereo, Firestone S-660 tires on K.O. alloy wheels. Needs minor fix-up. Spare engine, trans and miscellaneous parts. Must sell, leaving the country, no reasonable offer refused. Bob, (919) 323-8865 eves.

FOR SALE: 1967 Elan S3 SE coupe, RHD, lovely. New paint, carpet, alloy fuel tank, electric fuel pump, Spyder Engineering tubular steel nickel-plated A-arms and wishbones, front shocks, Panasport "minilites" (plus original steel wheels), P3s, front discs, donuts, generator, starter. \$7,500. Allen Weiss, (919) 832-0250.

FOR SALE: Parts from 1966 Lotus Cortina Mk. I—almost everything except engine, transmission and bodysell. Car had less than 50,000 mi. and many new or refurbished parts, including front Konis. Prefer to sell as one lot. \$500 O.B.O., may deliver. Phil Jones, (201) 261-4924.

WANTED: For Esprit S1—pair of taillights and housings from S2 Esprit to update; set of Turbo-style panels from 1983 Turbo Esprit (side rocker panels, front spoiler, rear valance, front and rear wraparound bumpers); very good set of Compomotive or Epsilon 4-bolt 15-inch wheels. Jim Auclair, (401) 732-0721.

FOR SALE: From 1977 Esprit S1—one set of Wolfrace wheels (1 okay, 3 good-to-excellent), \$325 (pix on request); front and rear bumpers, excellent except for one-inch slice on front near bottom of parking lights (not included), \$100 each; two side rocker panels, damaged/repainted, need paint, \$80 ea.; one Esprit S1 or S2 side view mirror, for left or right, excellent, with gasket and screws, \$40; one pair of rear taillights, with housings (black ABS), \$110; one rear under-valance panel with screen, very good condition, \$90. Shipping extra. Jim Auclair, (401) 732-0721.

FOR SALE: 1977 Esprit S1, white, 35,000 mi., Alpine stereo and amp. New brakes, rear wheel bearings, tires. No overheating with newly modified cooling system. Never in accident. All shop and parts manuals, complete spare 907 engine on stand, four spare mags and winter tires, car cover. Very clean, dependable, always maintained with synthetic oil and lube. \$13,500. Pete, (516) 732-6630.

WANTED: For 1973 Europa TC—Weber head, with or without carbs, in good condition; or uprated legal Solo II A Prepared engine with Webers, must be nationally competitive. Peter Butte, 17 East Penn St., Long Beach, NY 11561, (516) 432-6181.

WANTED: For Elan Plus 2S—stainless undergrille trim pieces (especially the left half, as viewed from inside the car); also wood floors for the trunk or patterns to make new ones. Roger Sieling, 367 Glenmont, Columbus, OH 43214, (614) 262-8279 home, (614) 461-9466 work.

TRADE: Swap good Renault-Europa shop manual for 1972 Europa Twin Cam shop manual. Jack Street, 3046 East Broadway, Long Beach, CA 90803.

FOR SALE: 1979 Esprit, black-and-gold commemorative edition #49 of 100 made, excellent condition, must sacrifice. \$19,500 O.B.O. Gary, (301) 699-3040 work, (301) 345-9558 home.

FOR SALE: 1974 Europa S6 Twin Cam Special, gorgeous condition. New radials, brakes, electronic ignition, rebuilt carbs. \$8,500. Charles Clancy III, (201) 678-6000 days, (201) 635-3574 eves.

FOR SALE: 1967 Plus 2, RHD. Car disassembled for body-off restoration. Financial problems force sale. May part out if unable to sell whole. Many new parts, including uninstalled Spyder frame and sill member kit, interior door panels by The Lotus Workshop. Weber head motor. Must sell. (301) 239-7334.

FOR SALE: 1970 Europa S2, low miles, excellent condition, new paint, new battery, 1,500 mi. on totally rebuilt engine. Have receipts and manual. Need room in garage, will consider reasonable offers. Jacques Smith, (301) 972-0499.

FOR SALE: 1972 Europa S2. Konis, Weber/header, otherwise original, unbutchered with everything working. Stripped for repaint. Owned six years, bored, offers/trades considered. Steve Huggins, 34 Dover Lane, Yonkers, NY 10710, (212) 765-7500 x3053 days, (914) 969-3479 eves.

WANTED: 1979 Esprit S2, good condition, with A/C and capable of operating in Phoenix summers. Prefer southern or western car. Jim Schlemm, (602) 821-1456 eves.

FOR SALE: 1970 Plus 2, completely restored, 35,000 mi., reliable, original. Frame has been removed and reinforced. New hoses, belts, body rubber, wiring, windshield, facia, battery, rings, bearings, brakes, silicone fluid, timing chain, water pump kit, headliner, carpets, donuts, bushings and tie rod ends. Rechromed bumpers, beautiful red Deltron finish with no stress cracks. Compression 160-168 psi. Original no-crack wheels with Avon tires. Air conditioning included but not installed. Bill Bailey, (504) 272-4014.

FOR SALE: Complete engine and kit for 215 Buick to Esprit. Everything new. 266 cu. in. Buick, balanced and assembled, Chev. rods and pistons, hyd. cam, kit, shafts, etc. Aluminum rockers, heads ported, Huffaker intake, headers, Holley 4-bbl., engine mounts, adapter, flywheel. High-volume oil pump, pick-up, modified oil pan. Have new Lotus project and lost interest. Over \$4,000 invested. Don, (612) 564-4179 eves.

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FOR SALE: European headers for Europa Twin Cam, complete, bolts up to original muffler, used less than 500 mi., \$100 O.B.O.; one pair of Spax adjustable front shocks with European springs, used, \$80 O.B.O.; one pair of Armstrong front shocks with European springs, new, \$80 O.B.O.; exhaust manifold for Renault Gordini 807 engine, 4-into-1, similar to manifold advertised by PF Engineering for use with an 807 engine in a Europa, \$30 O.B.O. Shipping extra. Don, (312) 334-2174 eves.

WANTED: Cam cover for Europa TC with just the word "Lotus" at the top, will buy outright or swap a "big valve" cam cover; owner manual for Europa S2 or TC; information on Lotus 47 or 52; Lotus Seven S3 or S4 for restoration. Don, (312) 334-2174 eves.

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