

Chapter 2. History, prototypes, and factory production variations

Cylinder heads

Lotus Twin-Cam Cylinder Head Version History

I have been collecting, rebuilding, and modifying twin-cam heads since the mid 70's and the evolution of the head over the years of its production has always intrigued me. In recent years I have tried to understand it in more detail and the summary below is where I have got to. This chapter and especially the cylinder head section is very long as the story is long and complex

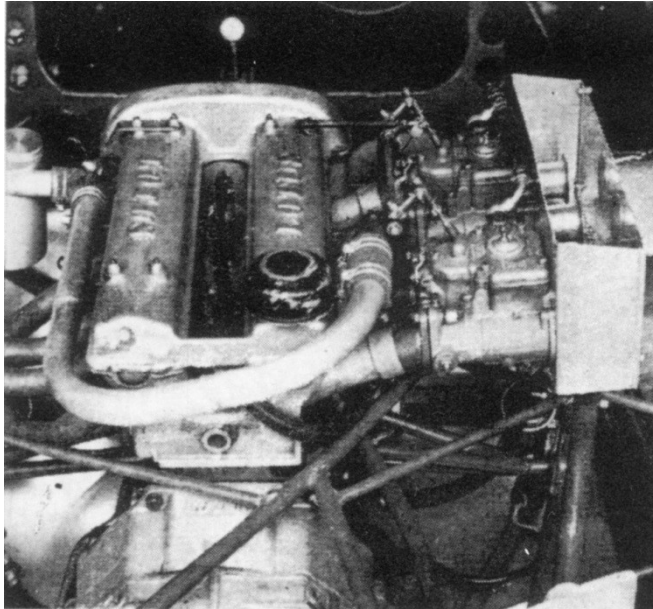
This summary is the best I can do based on all the usual reference sources (e.g., Miles Wilkins book on Twin-Cams) and posts of photos and histories by various people over the years on LotusElan.net and other forums and from the cylinder heads I have personally bought or seen. As with all things Lotus there are many variations that have never been formally documented, but occurred to meet needs, on a particular day. I am sure there are further variations out there I have not seen and would appreciate any information people have that's adds to the story.

I have added photos to illustrate the various versions where I have them. I have tried to acknowledge the source of the photos where they are not of my own cylinder heads, and I can remember where the photos came from.

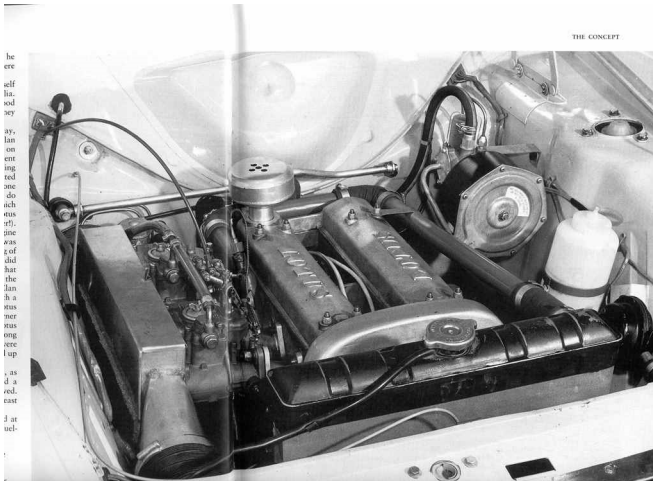
The first prototype and development heads were sand cast by Birmid, and it appears also Williams and Mills (see second pair of photos below). They had many variations including some having a centre rib in the plug well and some not, different length intake runners, the addition of the breather vent oil knockout chamber, only 4 rather 5 bearings per cam and the thermostat housing on the inlet side and bolt on inlet manifolds. The First prototype ran October 1961 and different versions were developed for racing and as part of the Elan and Cortina development programs until production heads appeared in February 1963. I suspect many other versions existed than the ones I have photos of below.

Very early prototype – Appeared in Lotus 23 and Prototype Lotus Cortina. Adjustable inlet lengths, thermostat on inlet side, 5th cam bearing location appears in casting but not used, no webs in spark plug well. The inlet tracts appear to have an adjustable length with the bolt secured outer ends fitted into a spigot (Photos from LotusElan.net)





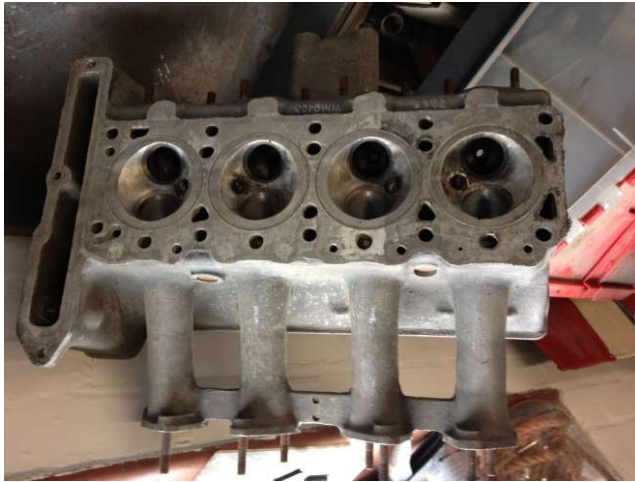
This type head installed in a Lotus 23. The adjustable ends of the inlet tracts appear to be made of steel not aluminium.



A similar head in the Lotus Cortina prototype (photo from the Miles Wilkin Lotus Twin-Cam Engine book). Note that the inlet tracts are substantially shorter and appear to be bolted to the head like conventional inlet manifolds. The picture is distorted as it spanned 2 pages in the book

The cam cover in these prototypes is different to the later production version with a more rounded chain cover and the oil filler on the right hand inlet cam (it is blanked off in the dry sumped Lotus 23 version). The development history of the cam cover itself is also worth documenting at some time with at least 5 or 6 casting versions plus all the colour variations!!

Later preproduction head – Thermostat now on exhaust side and fixed length but longer inlets than production versions, 5 cam bearings installed, webs in spark plug well, no breather vent oil catch box, sand cast by Williams and Mills. Inlets this long would not fit in a Lotus Cortina or Elan easily I think so from the racing development program maybe for Lotus 23? (photos from LotusElan.net)



A similar pre-production version below used in a competition engine but no 5th cam bearing cap. Maybe the 5th bearing cap in the above head was a later addition. Note the pin for the 5th bearing cap location versus the hollow dowels on the studs for the first 4 set of studs



Type 1 Heads – First production heads, by now they are the same for the Elan and Cortina and were die-cast by Williams and Mills and machined by JAP and introduced February 1963. They had half- moons down the centre well and square reinforcing blocks on the inlets and a centre rib in the spark plug well between cylinders 2 and 3, it is not known the number of these produced. At some stage Lotus changed back to sand casting but it is not clear if this occurred with the change to the type 2 style heads at around engine LP 5332 in late 1965 (earliest engine number type 2 head located so far) or prior to that time within the Type 1 head production run without changing the basic casting style. I would need to see more type 1 heads in the LP1xxx to LP4xxx range to see if any change in casting method can be identified



The key identification feature of the type 1 head is the half-moon protrusions into the centre spark plug well. The inlet tracts on the Type 1 head were smaller in diameter than the later Type 2 head and less suitable for race porting so it is rare to see one on an historic race car of the period now.



Another type 1 head but with a boss in front of the No1 sparkplug. The development sand cast heads and later Type 2 sand cast heads have this boss. Is this an example of a sand cast Type 1 head? Did Lotus make some production sand cast Type 1 heads before the diecast heads commenced production given the reported delays in getting the die casting heads to work.?

The first type 1 heads had no steel sleeves for the cam followers, during the production run they were first introduced on the exhaust cam followers and then on the inlet followers. Why this was done has not been recorded but presumably it was due to wear issues.

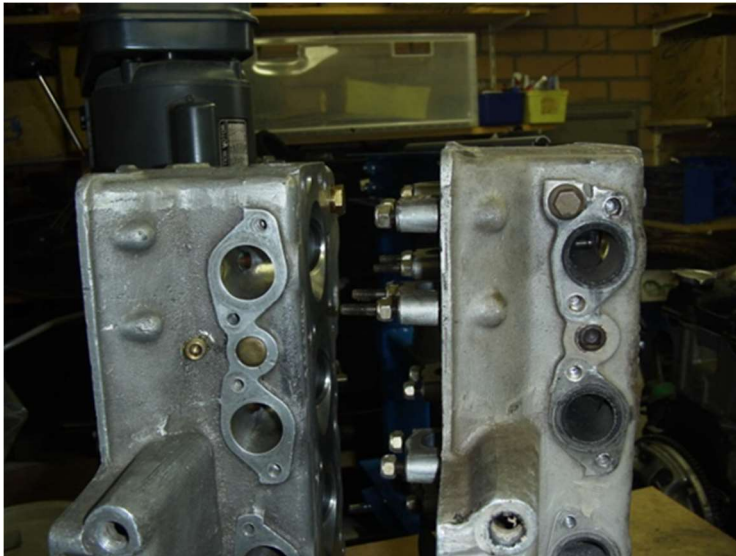


Type 1 head showing the square reinforcing blocks on the front 2 inlets.

Type 2A heads- Earliest versions of type 2 Heads had no reinforcing webs on 1 and 2 inlets, when these webs were introduced is not clear. All type 2 heads did not have the half- moons down the centre well and had larger diameter intake runners than the Type 1 heads.
(Photos courtesy of James Lambert)



Type 2B heads - The next version added the reinforcing webs on the inlets, (not known when) and added the cross drilling behind number 4 exhaust port for oil drainage and / or sand removal from castings. It appears the webs were introduced first and then the cross drilling later as I have seen a head with the webs but no cross drilling. Both these changes appear to have been in place at latest by around 1968 and the 6 bolt crank engines introduction with the Mk2 twin-cam engine and production by Lotus at Hethel commencing.



Cross drilling in Type 2B head on right just next to No4 exhaust port versus no cross drilling on Type 2A head on left. Ignore the plug above the normal core plug on the type 2A head this was a later modification I think to improve oil drainage from the head in lieu of the cross drilling in the type 2B head. The head was used in a dry sump race car before I purchased it. I have seen other dry sump race heads with a similar modification



The webs reinforcing the front two inlets ports added for the Type 2 B heads.

Final versions were variations on the type 2B heads casting with the Stromberg version in 1968 and modification for the Twincam Europa with the extended inlet cam installation driving the alternator in 1971



The Stromberg head with siamesed inlet tracts to suit 2 Stromberg 125CD carburetors for emission regulations purposes versus the previous two dual barrel Weber 40DCOE carburetors (or Dellorto equivalent)



The Europa Twin-Cam head with larger D cut-out on the inlet cam rear to allow mounting of a seal for a cam extension out the back of the head for a pulley to drive the alternator. The Cam cover had a matching cut-out to mount the seal in. This is a Stromberg head originally that has had a John McCoy Omnitech conversion for Webers

The final "Big Valve" heads were the same basic type 2B casting but with machining differences to fit in slightly larger inlet valves on the same seat inserts (1.530 standard and 1.566 inch big valve) and with 0.040 inch reduced thickness 9 from 4.640 inch to 4.600 inch to raise the compression ratio.

After the end of production by Lotus in the mid 70's various other cylinder head developments have occurred that you may come across.

Vegantune who apart from producing race Twincam engines during the 60's was also an authorised Lotus engine reconditioner. In conjunction with Caterham, they did a short production run (maybe 50 engines) using newly cast twin cam heads in the late 70's for the Caterham 7 after supply of new or reconditioned twin cam engines dried up following Lotus ceasing production. Apparently, Lotus withdrew permission to cast these new heads after a while, so Vegantune developed their own VTA engine with a belt driven Twincam head for Caterham to use instead and used it in the Evante that Vegantune were producing by then also.

Stromberg to Weber conversions have been produced by QED briefly and then more consistently by John McCoy at Omnitech in the USA. I have never seen a QED conversion in the metal just the following article from a club lotus magazine in the late 80's and don't know how many were ultimately produced. When I contacted them a couple of years after this article appeared they said they has stopped doing the conversions as they were planning to restart production of the original heads which they have subsequently done

Lotus twincam cylinder head conversion from Stromberg to Weber or Dellorto carburettors

IN the late 60's Lotus started to fit Stromberg CD carburettors to their twincam engines to meet us Anti-pollution legislation. These were fitted to Elans, Plus Two's and some Europas on the UK and export markets. At the same time a new cam profile was adopted to bring the engines back up to their advertised power. This eventually became the "Sprint" or "Big Valve" cam when Lotus reverted to Weber and Dellorto in the 70's.

Quorn Engine Developments now can convert an owner's Stromberg head to accept Weber or Dellorto 40's, 45's or even 50's. This is done after a thorough inspection of the head for cracks and other defects. They then remove the Stromberg section of the inlet tracts to a point beyond the curved section. A new set of machined castings is then welded in place,

fettled and polished so that only an expert can detect that the cylinder head started life as a Stromberg equipped unit.

Commenting on his conversion Ken Snailham, proprietor of QED said "We took a long hard look at the challenges and approached them slowly and methodically. We knew we would have to cut off the manifold flanges, but where to cut was a problem. We decided to cut it as near to the head as possible to eliminate the curved section of the inlet tract. Then we had to face up to the problem of how best to attach the new Weber or Dellorto compatible castings. We considered modern "glues" interference fit, bonding etc. In the end we elected to weld and fettle as this would make the conversion almost impossible to detect." Ken then added one note of caution. "Due to variations in the original basic castings some heads may not be capable of conversion although we have not experienced this situation so far."

The conversion costs £495 and is not available on an "exchange head" basis.

For more information contact Ken Snailham on 0509 412317. QED are sponsors again in 1990 of the historic Formula 3 1600 series.