



84. 1999C Ferrari 048; 2997cc; 750 HP @ 16,500 RPM (574)

(This engine is not included in Appendix I)

As described in Eg. 83 Ferrari were handicapped badly in 1999 when Schumacher was unable to score in 7 races. The rear brake failure at the 8th race (British), when a bleed nipple came loose (1014) left his car in a head-on collision with a tyre barrier and the driver lucky to escape with a broken leg. Nevertheless the team, profiting from McLaren's missed victories – Jordan-Mugen took 1 win and the new Stewart-Cosworth team took another while Schumacher was *hors-de-combat* – was able to win the 1999 Constructors' title with the type 048 V10 engine powering the F399 car.

1989 – 1994 3.5L V12s

This 1999 season was Ferrari's 1st title since 1983, during the TC era (see Eg. 65). Ferrari's later 1.5L TC-engined cars (developments of the 120V6 of Eg. 65 and a later 90V6, all of the same B/S ratio of 1.67 (81/48.4), the latter designed by Jean-Jacque His, ex-Renault) had been unsuccessful against, firstly, the McLaren-Porsche combination, then the Williams- and McLaren-Hondas, as already described. In the 3rd NA era beginning at 3.5L in 1989, Ferrari had for 4 ½ years (1989 – late 1993) pinned their faith to a 65V12 5 v/c configuration (types 036 to 040), gradually raising the B/S ratio from 84/52.6 = 1.6 (1989), then 86/50.2 = 1.71 (1990) finally 88/47.9 = 1.84 (1991 – part 1994), adopting along the way PVRS, VIS and even variable-length exhausts (later banned by the FIA). J.J.His had a hand in the 1989 engine (said to have been 30% more costly than the 1.5V6 TC engine)(574), before returning to Renault, and Claudio Lombardi headed the engine department from August 1992 (938). The basic 65V12 design won its 1st race in 1989, mated to the pioneering Semi-Automatic Gearbox (SAGB) which has been described earlier, and scored twice more that year. In 1990, with the triple World Champion Alain Prost aboard, Ferrari ran 2nd in the title with 6 wins. After that, however, no further victories were credited to the 65V12 series. Honda having retired at the end of 1992 Ferrari secretly (at first) sought their help. Osama Goto was involved in this technical assistance. This resulted in a 4 v/c redesign which was available from the 13th race (Italian) in 1993 and into 1994 (types 041 and 042). A further Honda feature, the 75V12 configuration (their last 1992 engine had been 75V12 88/47.9, see Eg. 74) was then introduced as type 043 at the 3rd race in 1994 for Qualification and was raced 1st at the 9th race (German), which it won. There were no further victories. This final 3.5L V12 was 90/45.8 = 1.96 (565).

1995 3L V12s v. V10s

For the new 3L rule in 1995 Lombardi designed in 1994 not only a 75V12 (type 044/1) for the racing team (and an 044/3 shorter-stroke version came later (938)) but also, with the assistance of both Gilles Simon (ex-Peugeot, brought in by Jean Todt, the new Ferrari Racing Manager, who had joined in July 1993 after running Peugeot's successful 3.5LV10 sports-racing cars) and Osama Goto (returned to Ferrari after a short spell at McLaren) a 75V10 for comparison (believed to be type 045). The V10 may have been 88/49.3 = 1.78 since it is known to have been of longer stroke than the next version (see below)(938). It would have been logical to use a Bore which was the same as a previous engine because then most of the cylinder head detail drawings and the associated tooling would exist, probably with many spare parts. Even with the large funds available from FIAT and sponsors this would have been a consideration. It ran 1st in May 1995 (938) and there was already a further development under a new Ferrari racing-engine department chief, Paolo Martinelli, which ran in September 1995 (938). This was probably the type 046 (or 'Evolution 2') 90/47.1 = 1.91 engine which later was used 1st in Qualification at the 7th race in 1996 (San Marino)(725,938). Note that this Bore was also the same as a previous engine. According to (938) the V10 required 10% less cooling surface than the V12, suggesting lower friction at lower RPM (higher Mechanical Efficiency). The V12 was successful only once in 1995 and was compared with the V10 car at Fiorano in October by the Ferrari test driver Nicola Larini. The 10-cylinder car was 2.5% faster (106.2mph v. 103.6)(574). According to John Barnard, the chassis designer, the V10 had nearly the same Peak Power as the V12 (1009) so the better lap speed presumably reflected a more useful Torque curve. This test must have settled finally the car which Ferrari's new driver, double World Champion Michael Schumacher would use in 1996 (if that had not already been his condition for the transfer).

1996 – 1999 3L V10s

The new 75V10 did not achieve a maiden victory in 1996, unlike the 65V12 and the 75V12, but with the later 046 Schumacher did win 3 times that year. Initially it was found that the vibrations of the engine, which did not have a balance shaft, cracked the Ti-alloy casing of the gearbox carried over from the smoother 1995 V12 where it had been satisfactory (1009). An earlier gearbox had to be adopted hastily, grafted on complete with the rear suspension since the pick-up points were different (938). Nevertheless, there were 5 DNFs later in the year from gearbox faults (curiously 4 of these affected the No. 2 driver, Eddie Irvine). Only 2 DNFs were attributed directly to the engine and one of these (9th race, French) was caused by faulty piston machining (1009) i.e. not a design fault. After early poor starts with the original Daiko (Japanese) clutch, which had an abrupt action that at the 8th race (Canadian) actually caused a half-shaft failure on Schumacher's restart from a fuel stop, a Fichtel & Sachs 117mm (4.6") driven-plate diameter clutch was fitted before the 9th race (French)(938). This was 3-plate carbon-carbon, the type by then universal in F1.

Engine development continued steadily through 1997 – 1999. Ref.(987) stated that Ferrari mostly did this on whole engines unlike, eg. Ilmor, who it stated used many 1-cylinder rigs, no doubt a reflection of the size of Ferrari's budget and it can certainly avoid misleading conclusions (see Note 106). One Ferrari test bed included the drive system and another had an appropriate air-blast into a chassis-type intake ((987) claims a 100% pressure recovery which cannot be true). Ferrari have had use of their private test track at Fiorano, specially built, since 1972 plus another circuit at Mugello bought in 1989. They have dispensation from local noise regulations!(987).

It can be presumed that B/S was increased by 2mm bore steps as occurred with the 3.5L V12. A known significant change was an increase in Vee angle in 1998 – 1999 from 75⁰ to 80⁰ in order to lower the Centre of Gravity, which was also reduced by other design changes (probably the B/S increases) from 204.5mm height above track level in 1998 to 197.5 (3.4% drop) in 1999 (987). The 1999 engine was also 5% lighter (574). At the 5th race in 1998 the exhaust systems were re-routed from having low exits up to the top of the bodywork into open metal-lined channels. This was possibly to obtain the optimum shorter lengths required as RPM were forced up with shorter strokes. Ref. (1041) notes, however, that the 1998 rules had enforced a reduction in maximum car width from 2m to 1.8m so that the space available inboard of the rear wheels was cut by 100mm each side and removing the bulky exhausts from this area eased the airflow past the wheels. Whatever the theory, the benefit convinced all competitors to follow suit eventually.

The progress of the V10-powered Ferraris in the Constructors' Championship was as follows (*italics indicate that data is uncertain*):-

	<u>1996</u>	<u>1997(N2)</u>	<u>1998(N4)</u>	<u>1999</u>	
<u>Engine type (987)</u>	045 & 046 (N1)	046/2	047	048	
B/S	88/49.3 = 1.78	90/47.1 = 1.91	90/47.1 = 1.91	92/45.08 = 2.04	94/43.19 = 2.18
Vee angle	75 ⁰	75 ⁰	80 ⁰	80 ⁰	
WCC position	2nd	2nd	2nd	1st	
WCC points	70	102 (N3)	133	128 (N5)	
No. of Wins		3	5	6	

(N1). Apparently at the 6th race (Monaco) and onwards.

(N2). Ross Brawn and Rory Byrne, who had been at Benetton during Schumacher's Drivers' Championship years with that team (1994 & 1995) joined Ferrari in early 1997 as, respectively Technical Director and Chassis Chief Designer (replacing John Barnard). Paolo Martinelli was Engine Chief Designer throughout.

(N3). 17 races, other years 16. The points scoring system was the same throughout.

(N4). It is interesting that a *theoretical* study of a F1 3L V10 engine by Alberto Boretti (of the FIAT Research centre) and Giuseppe Cantore (University of Modena) in 1998, clearly aimed at assisting the Maranello company, chose B/S = 94/43.2 = 2.18 (704). Perhaps they chose Ferrari's next step, which

would have been already in the design stage. They actually concluded that in theory a 3L V12 engine of $B/S = 89/40 = 2.23$ would be 6% more powerful than the V10.

However, apart from other technical and practical reasons, the FIA settled the matter in 2001 by changing the rules to limit the number of cylinders to 10.
(N5). Schumacher unable to participate in 7 races (44% of the season).

There were revised versions of the 047 and 048 engines partway through the seasons (987).

During 1997 – 1999 only 1 engine-related racing failure occurred in each year, i.e., about 6% of starts, a remarkable achievement.