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Development of the 1994 Yamaha V-10 Engines "OX10A" and "OX10B" - From Specification A to Spec. K3

The "V" format 10 cylinder engine adopted on the Tyrrell - Yamaha Team machine as of the 1993 F1 series continued to be refined through repeated testing and actual race experience until it began to show its real potential entering the '94 season. Here is a brief outline of the development process that took place between the OX10A and the OX10B.

The Yamaha OX10A and OX10B engines used from the '93 season through the '94 season were 3.5 liter 72 ° V format 10 cylinder engines developed under a design concept of a high-level balance between light weight, compactness and high power output.

Their main features were:

- (1) adoption of a pneumatic valve system operating on compressed air in place of conventional valve springs in order to improve performance in the high rpm range
- (2) adoption of two injectors per cylinder in order to achieve optimum fuel supply and air/fuel efficiency in both the low-speed low-load range and the high-speed high-load range.

During the course of the '93 season and into the early stages of the '94 season, the OX10A went through a series of modifications, taking the engine from the initial Specification A version through Spec. H. The OX10B engine was first introduced at round two of the '94 season, the Pacific GP with the designation Spec. J1.

These improvements, aimed at achieving a high level of reliability while at the same time increasing power output through a reduction of friction and an increase in rpm, resulted in a cumulative increase in max rpm of 1,000 (raising the top rpm above 14,000), an increase in power output of 8% and a 10kg reduction in weight compared to Spec. A at the beginning of the '93 season.

Since the introduction of the OX10B, development has continued steadily with the aim of maintaining reliability and further increasing the competitive potential, taking the engine from Spec. J2 through the most recent Spec. K1 and Spec. K3.

The OX10A

From Specifications A to D -- Intake system improvements

Development from the Spec. A engine to the Spec. D engine used in round three of the '93 series, the European GP, concentrated on improving the intake system through reevaluation of the shapes of the pneumatic valves and ports, etc.

In particular, development efforts aimed at increasing the reliability of the pneumatic valves and reducing the amount of compressed air necessary to operate them resulted in a reduction of air consumption to the point that the system's needs could be met by one pressurized air tank instead of the initial three.

Specifications E and F -- Reducing internal engine friction

In order to achieve a reduction in internal engine friction that is vital for increasing rpm, internal engine parts like the pistons and connecting rods were reevaluated from the standpoints of weight reduction and shape. These efforts resulted in a big reduction in friction. By this stage the overall weight of the internal engine parts had been reduced by 25% compared to the beginning of the season.

The Spec. E engine was used in round four of the '93 season, San Marino, and round five, Spain, while the Spec. F engine was used for four rounds beginning with round six, the Monaco GP.

Spec. G -- Friction reduction and improved combustion efficiency

Internal engine friction, particularly in the crankshaft assembly, was further reduced. Meanwhile, a change to a smoother shaped combustion chamber improved combustion efficiency. While adding small specification modifications, the Spec. G engine was used in five rounds of the '93 season from the German GP to the Portugal GP in variations G1 ~ G6.

Spec. H -- Improving the intake system and pump efficiency

In addition to revising the shapes of the intake ports and valves with the aim of achieving higher rpm, improvements were made on the oil and fuel passages in the engine in order to increase the operating efficiency of the oil and fuel pumps. The result was a smoother system with less resistance that causes loss of pumping efficiency.

This is the engine that was used in the '93 Japan GP and Australian GP and several rounds after the opening Brazilian round of the '94 season.

The OX10B

Specification J1 -- Improvement of the intake system, pumps and pneumatic valves

The off-season was used to further the intake system and pump-related improvements begun on the Spec. H engine. Also, the pressurized air tank used to operate the pneumatic valves was replaced by a compressor, eliminating worries about system capacity and at the same time reducing overall weight. This same compressor is also used to operate the semi-automatic transmission on the '94 Tyrrell-Yamaha 022 machine.

In addition, a reevaluation of all moving parts was undertaken in an attempt to further reduce friction loss in parts like the pistons, piston rings and connecting rods. These efforts resulted in a still higher max. rpm level.

This engine was used in round 2 of the '94 series, the Japan GP.

Spec. J2 -- Revising the intake system for increased air volume

A complete reevaluation of the intake system was added to the improvements of the Spec. J1 engine to achieve an increase in air supply volume for added power output. This led to a further boost in max rpm.

This specification was first used in the preliminaries of the '94 Monaco GP and then the final of the France GP. The J2 Spec. is the engine used in the most rounds of in the '94 series.

Spec. K1 -- Reevaluation of the opening/closing timing of the intake valves

This specification was first introduced in the preliminaries and final of the '94 Italian GP. Revision of the opening/closing timing of the intake valves led to higher power output in the high-speed range intended to improve the machine's drivability.

Spec. K3 -- Reducing friction loss in moving parts

Further improvements were made on Spec. K1 with the aim of improving power development in the high rpm range and overall performance. A further reduction in moving part loss, etc., were achieved.

This specification was first introduced in the preliminaries of the '94 Italian GP together with Spec. K1.

Future development -- Developing a new specification for Suzuka

For the Japan GP, 15th round of the series, work is proceeding on a new specification with the aim of further increasing top-end power. We also plan to use butterfly valves on this model. Taking the "U" from "Ultimate," this engine will be designated Spec. U.