

Toyota 2009 Type RVX-09 Specn. H: SO26

Toyota announced that it was to compete in the Grand Prix arena in 1999 and made its first entry in 2002. The cars and engines were designed and developed at the company's motor sport base in Cologne. There followed 8 seasons of racing with minimum success, no wins being secured with 4 years of 3L V10 engines and 4 years of 2.4L V8 engines. The firm retired at the end of the 2009 season with best results totalling 5 x 2nd places.

Toyota also supplied engines to Jordan in 2005 (best result 1 x 3rd place), to Midland (ex Jordan) and Spyker in 2006 and to Williams over 2007 to 2009 (best results totalling 2 x 3rd places).

Although not therefore anywhere near "Car of any Year" Toyota did publish a considerable amount of engine data after their retirement in DASO1091 (*Race Engine Technology* No. 49 Sept/Oct 2010). This has been analysed as follows. Official Toyota data is underlined.

$$\underline{90V8} \text{ Bore B} = \underline{96.8 \text{ mm}}$$

$$\text{Stroke S} = 40.75 \text{ mm*}$$

$$\text{Swept Volume V} = \underline{2,399 \text{ cc}} \text{ (Rule maximum 2,400 cc)}$$

$$\text{B/S} = 2.375$$

$$100/\text{Smm} = 2.454$$

$$\text{PP} = 772 \text{ PS} = 761 \text{ BHP} \text{ (deduced from official data)}$$

$$@ \text{NP} = \underline{17,350 \text{ RPM}} \text{ (rule maximum} = 18,000 \text{ RPM)}$$

$$\begin{aligned} \text{TP} &= 231 \text{ lb ft} && \left. \text{produced by analysis and plotting} \right. \\ @ \text{NT} &= 16,050 \text{ RPM} && \left. \text{from DASO 1091, p.26.} \right. \end{aligned}$$

$$\left(\frac{\text{NP} - \text{NT}}{\text{NP}} \right) = F = 7.5\% \quad (\text{Inlet tract length (LIN) not variable, by rule})$$

$$\text{R} = \underline{13.6} \text{ on RON102 fuel containing 0.6% Ethanol}$$

$$\text{ASE} = 0.648$$

$$\text{IVD} = \underline{41 \text{ mm}} \text{ (42.4% of B)} \quad \left[\frac{\text{IVA}}{\text{PA}} \right] = 0.359$$

$$\text{IVL} = \underline{15.4 \text{ mm}} \quad \left[\frac{\text{IVL}}{\text{IVD}} \right] = 0.376$$

4 v/c; PVRS; Finger followers; Solid Ti-alloy valves.

$$\text{VIA} = \underline{21.2^\circ + 3.2^\circ \text{ in the plane of valve pairs, i.e., longitudinally}}$$

$$\text{PP/V} = 317.2 \text{ BHP/Litre}$$

$$\text{MPSP} = 23.57 \text{ m/s}$$

$$\text{BMPP} = 16.36 \text{ Bar}$$

$$\text{ECOM} = (\text{EV} \times \text{EC} \times \text{EM}) = \left[\frac{\text{BMPP}}{38 \times \text{ASE}} \right] = 66.4\%$$

$$\text{BMTP} = 16.4 \text{ Bar}$$

$$\text{W} = \underline{95 \text{ kg}} \text{ (rule minimum, using some ballast)}$$

$$\text{PP/W} = 8.01 \text{ BHP/kg}$$

*Official Stroke = 40.77 mm but this gives V = 2,400.3 cc, so Stroke has been adjusted to official 2,399 cc

MGVP = 65.7 m/s

BNP = 28.0 m/s
 MVSP assuming IOD = 320^0 = 10.0 m/s

$$\begin{aligned} MJ &= \frac{44 \text{ mm}}{\text{MJ}}; \left(\frac{\text{MJL}}{\text{MJ}} \right) = \frac{18}{44} = 0.41 \\ CP &= \frac{36 \text{ mm}}{S}; \left(\frac{CP}{S} \right) = 88.3\%; \left(\frac{CPL}{CP} \right) = \frac{17.5}{36} = 0.49 \quad \left(\frac{CP\%}{S} \right) / V(\text{BNP}) = 16.7 \\ \left(\frac{CRL}{S} \right) &= \frac{111}{40.75} = 2.724; \quad MPDP = 8,114 \text{ g} \end{aligned}$$

A Power Curve for the RVX-09H is given on P.3.

A section of the cylinder head is given on P.4.

DASO 1091 also provides data on some of the 90°V10 3L RVX engines
 This is analysed below.

	All	
	90V10	
B	= 96.8 mm	
S	= 40.75 mm	
V	= 2,999 cc	
<u>Year</u>	<u>2002</u>	<u>2005</u>
Specn.	C	F
PP	848	937 BHP
@ NP	16,850	18,600 RPM
MPSP	22.9	25.3 m/s
BMPP	15.02	15.03 Bar
R not given; assuming 13 then ASE	= 0.642	
```and ECOM	61.6%	61.7%
TP	274.8	284 lb.ft.
@NT	14,600	15,600 RPM
BMTP	15.6	16.1 Bar
F	13.4%	16.1% LIN variable for both.
BNP	27.2	30.0 m/s
W	Less than 95	kg

**POWER CURVES**

Eg.	SO26
DASO	1091
YEAR	2009
Make	TOYOTA
Model	RVX-09 Specn. H

Vcc	2399
Ind. System	NA
Confign.	90V8
Bmm	96.8
Smm	40.75

N kRPM	P HP	MPS m/s	BMEP Bar
12.2	452	16.57	13.82
13	518	17.66	14.86
13.5	528	18.34	14.59
14	555	19.02	14.79
15	647	20.38	16.09
16.05	706	21.80	16.41
17	746	23.09	16.37
17.35	761	23.57	16.36
17.75	746	24.11	15.68

Powers as published were German PS and have been divided by 1.014 to convert to HP

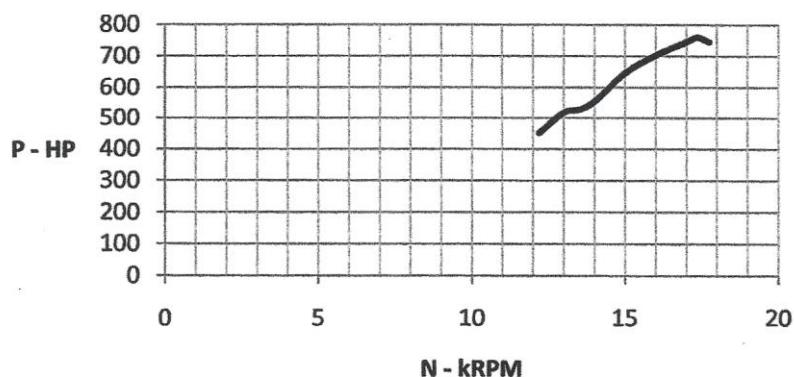
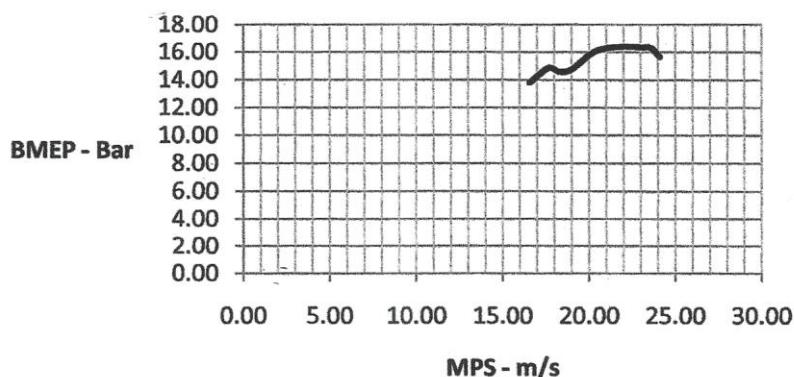
**TOYOTA RVX-09 Specn. H****TOYOTA RVX - 09 Specn. H**

Fig. SO26A

2009 Toyota RVX-09 Specn. H

90V8 96.8/40.75 = 2.375 2,399 cc

Note the large diameter, thin-walled camshafts; although suggesting a built-up construction the shafts and the (heavily-relieved) cams were actually 1-piece in accordance with FIA F1 rules.

Finger followers and PVRS.

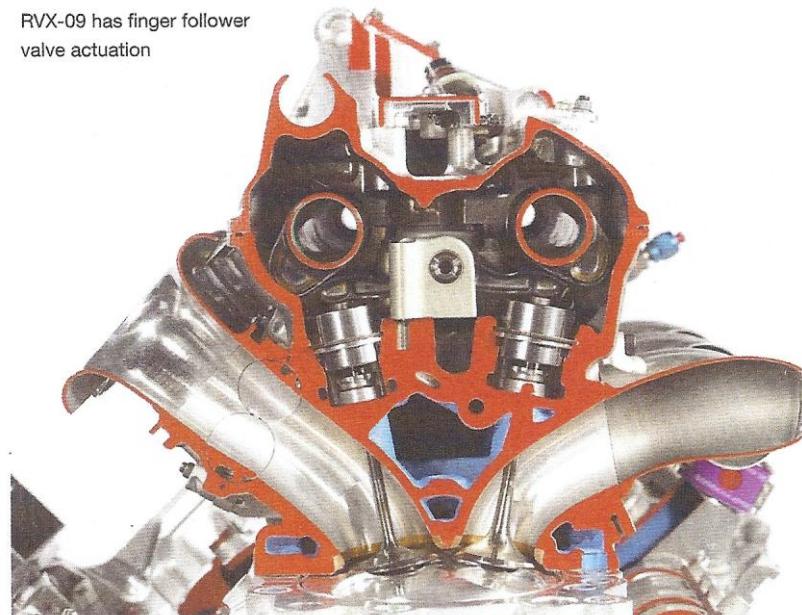
All rubbing surfaces were DLC coated as well as lubricated.

The camshaft driving gears contained an 8-roller pendulum damper.

VIA =  $10.2^\circ$  inlet +  $11^\circ$  exhaust =  $21.2^\circ$ , with  $3.2^\circ$  between valve pairs in the fore-and-aft plane.

The inlet tract is shaped to provide in-cylinder "Barrel Turbulence" (aka "Tumble Swirl").

RVX-09 has finger follower  
valve actuation



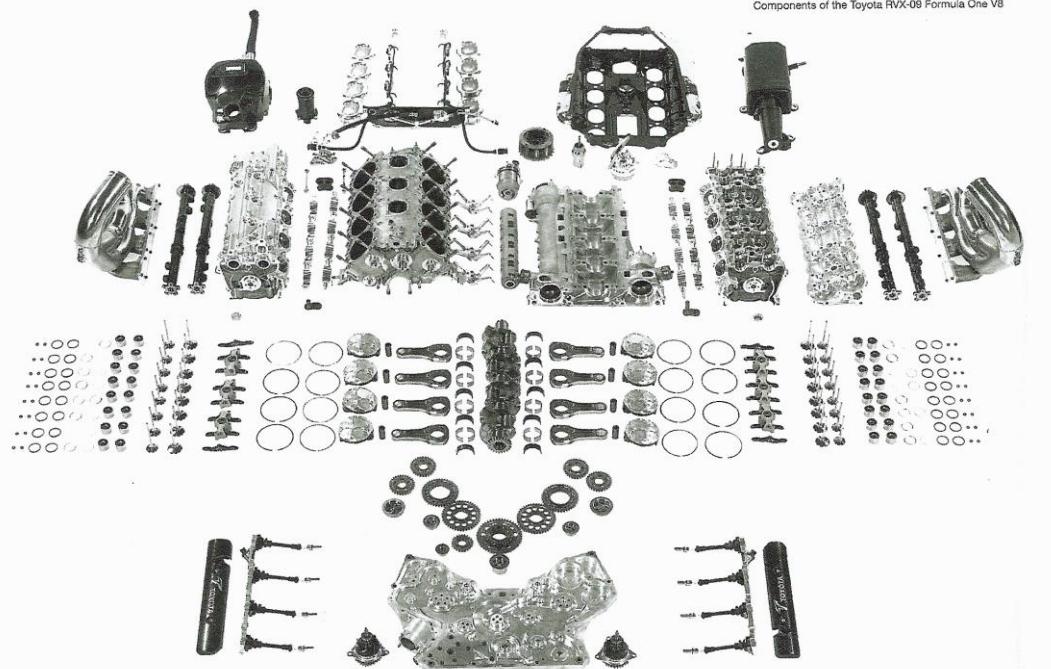
DASO 1091

Fig. SO26B

Components of the RVX-09/H

FIG. SO26B

Components of the Toyota RVX-09 Formula One V8



DASO 1091

P.S.

Some thoughts on the lack of success of the Toyota Grand Prix campaign

The official Toyota data for the RVX-09H shows that its power was on a par with, eg the Cosworth CA (see Note 108). Nevertheless, a former senior Cosworth engineer closely associated with the CA told the author in 2010 that he thought the RVX was about 30 HP less powerful.

This opinion must have been judging the poor Toyota results as stemming from the engine alone. If this, on the evidence of the data released shortly afterwards, was *not* the case, then the chassis and/or the drivers must be identified as “equivalent” to 30HP deficiency.

Success breeds success *and vice versa* where availability to a team of front-rank drivers is concerned. Toyota over 2002 to 2009 did not have the services of Michael Schumacher, or Alonso, or Raikkonen, or Hamilton or Button – to name the Champions of 2002-2004, 2005-2006, 2007, 2008 and 2009.

Ferrari engineers certainly did not think that the Toyota lack of success was due to the engine. Luca Marmorini, an ex-Ferrari man, oversaw the 3L V10 and 2.4L V8 developments from the start in 1999 to January 2009. By then the RVX-09H was specified and also very probably the Toyota board had by then decided to quit at the end of the season. In October 2009 Marmorini was invited to take the place of Gilles Simon as head of Ferrari’s Engine & Electronics department - a large vote of confidence.

It may be that Toyota provided the 2009 engine data to show that it was *not* deficient and so justify their knowledge of basic engine technology. Deducing that perhaps chassis technology *was* lacking in the arcane F1 area – quite unrelated to road cars - would not reflect on the firm’s basic normal production.

---