

**FORD 3 LITRE FORMULA ONE ENGINE – COSWORTH TYPE DFV 1973**

<b>Capacity:</b>	182.64 cu.in. 2993cc	<b>Bore:</b>	3.373" 85.6 mm	<b>Stroke:</b>	2.550" 64.8 mm
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**Compression ratio:** 11 to 1 (approx.)

**Configuration:** 90° Vee 8

**HP rating:** 450 bhp @ 10 500 rpm (min)

**Torque:** 245 lb. ft @ 8 500 rpm (min)

**Cylinder numbering:**

L.H. BANK

8 7 6 5

REAR

FRONT

4 3 2 1

R.H.BANK

**IMPORTANT DIMENSIONS:**

<b>Crankshaft:</b>	End float	.004" / .009"
	Main journal dia.	2.3755" / 2.3750"
	Conn rod journal dia.	1.9375" / 1.9370"
<b>Connecting rods:</b>	End float (big end)	.006" / .012"
<b>Gudgeon pins:</b>	End float	.001" interference .001" clearance
<b>Piston rings:</b>	Gaps on all rings	.017"/.022"
<b>Valve timing:</b>	Inlet valves fully open	102o a.t.d.c
	Exhaust valves fully open	102o b.t.d.c
<b>Valve lift:</b>	.410" less tappet clearance	
<b>Tappet clearance:</b>	.009" / .010" inlet	
(Cold)	.015" / .016" exhaust	

**Valve springs:**

See drawings Nos. DA 0622, DA 0623, DA 0624 and DA 0625 for identification and fitting details of valve spring arrangements. Any cylinder head may be fitted with any arrangement, since no change in machining details is involved, but it is not recommended that different arrangements be used on the same cylinder head. DA 0625 is the current arrangement.

**Oil filter:**

Use only paper element, Cosworth Part No PP 0404 (see Torque Settings).

**Fuel injection timing:**

No 1 starts to inject at 30o A.T.D.C No4 firing

**Ignition:**

Firing order 1- 8 – 3 – 6 – 4 – 5 – 2 – 7

Ignition timing is set at 7 000 rpm on test, approx. 35o B.T.D.C. This should not be altered, but if it has been, the following procedure should be adopted.

Unscrew the banjo on No 1 cylinder fuel outlet and carefully remove the banjo body from the fuel metering unit, N.B. when replacing, this should be tightened to 90 – 100 lb. in. (the sealing is by 'O' rings). Remove excessive fuel and turn the engine in the direction of normal rotation until the inner rotor port just starts to crack open. This point should be 30o A.T.D.C. No 4 cylinder firing. Fit the distributor rotor arm shaft with the slot at the bottom one of the two positions possible. Fit the distributor housing, turn the engine backwards 90o – 100o and then forward again, to take up the timing gear backlash, to 35o B.T.D.C (the engine flywheel is marked T.D.C 30o, 35o and 40o before T.D.C, the datum point being the sump split line on the right hand side of the engine). Fit the distributor drum so that the red spot is in the nearest of the four possible settings to the mark on the distributor housing near the L.T. electrical leads outlet. With the drum clockwise against the natural spring pressure in the fully advanced position, slacken the three distributor housing lock nuts and rotate the housing until the timing marks on the drum and casing line up exactly. Tighten the lock nuts in this position; any slight adjustment may be made by means of the adjuster screw mechanism on top of the housing.

**INSTALLATION AND RUNNING DATA:**

See also Drawing Nos. DA 0662 and DA 0774

**Engine mountings:**

The top mounting 5/16 UNF bolts should have washers (Part No DA 0017) against the magnesium cover, carefully tightened to 16-18 lb. Ft. to avoid crushing the magnesium alloy.

On lower mounting points, flat washers of .06" min thickness must be used under the chassis bolt heads.

The lower front mounting is marked "RT" (right top). If the lower front mounting is removed, it should be replaced with the letters "RT" towards the top of the engine.

**Oil system:**

See Drawings Nos. DA 0506 and DA 0626. 1971 ENGINES ARE FITTED WITH A NEW TYPE OF Oil Scavenge Pump (Part No KK 0084, which requires some new pipework as shown on DA 0626). Pressure when hot 70 psi min. – 80/90 psi at normal running speeds. Care must be taken to allow the engine oil to reach 50oC before exceeding 7 000 rpm as bearing failure may follow running at high speeds with cold oil. Max oil temps 100oC (measure in tank).

If oil pressure cannot be maintained at above 70 psi using Cosworth approved oil, it is possible that too much air is being drawn from the oil tank, and the de-aeration system on oil returning from the scavenge pumps should be improved.

Oil tanks should allow for approximate consumption of 6 pints during a G.P.

**Fuel system:**

See Drawing No DA0327 – this system has proved itself in service.

The fuel cam is set to the correct angle during assembly and test, and should not be altered. See auxiliary Data Sheet for alternative fuel cams at high altitude circuits. (D50151)

Fuel should be 101o octane (M.M.) min.

The mechanical pump driveshaft seal must be lubricated each time the engine is installed, via the hole on the tope of the driveshaft housing sealed by the small plastic plug. Oil should be gently fed into this hole until it comes out of the other small hole ½” away. Replace the plug afterwards.

**Electrical systems:**

See Drawing Nos. DA0471 and DA0359

Current engines use DA0471 (Thyristor Speed Limiter). The engine must be connected to a Negative Earth (ground) system.

It is advised that all electrical connections are smeared with silicon grease (we suggest Midland Silicons MS4) especially when the engine operated in wet conditions.

**Spark plugs:** Autolite PG 403 or equivalent.

Before removal, clear all dirt from recess. Use special pliers to remove H.T/ leads – do not pull directly on leads. Always put a small amount of graphite grease (or equivalent) on Sparking Plug threads before fitting.

**Throttle linkage:**

Each brass-bodied ball Joint Part No. PP 0251 is especially assembled to its control rod in order that the ball is held captive in the joint. It is imperative that a control-rod is not unscrewed from its ball-joint. We advise that the joints be regularly lubricated with oil.

1974 engines are fitted with special steel ball joints Part No DA 0638. These are assembled for minimum “play” when new, and lubricated with Anti-scuffing paste. After some use they may require to be re-adjusted and re-lubricated: we recommend that new split pins be used on re-assembly.

1975 engines have steel ball joints. DA 0781 LH thread and DA 0782 RH thread

If spares are required for the throttle-linkage, it is important to specify the type of Ball Joint in use.

The four throttle return springs are not designed to return car cable, pedal etc. and will require supplement to suit each installation.

**General:**

The engine must not be allowed to idle under 2 000 rpm or excessive cam and tappet wear may be experienced.

The rev limit is governed by the control system with is set to cut out above 10 500 rpm. When driving, the maximum speed should not exceed 10 500 rpm at any time.

If a "Smith's Chronometric" tacho-head is fitted, the specification the head is "4:1 clockwise".

**Summary of drawings applicable:**

DA0662	Engine General Assy (2 Shts)	DA0643 Wiring Diagram
Tyristor		
DA0774	Starter Assy	DA0625 Valve Assy
(German)		
DA0327	Fuel System	DA0653 Exhaust System
DA0626	Oil System	DA 0724 Cooling System

**STARTING FROM COLD AND WARMING UP:**

Set mixture datum pin to full rich, switch on electric fuel pump, fully open throttle and crank form 3 – 4 seconds, with starter motor. Ease off throttle to approximately 1/3 open and switch on ignition whilst engine is still being cranked.

Close throttle when engine fires.

Observe that oil pressure has come up, adjust rpm 2 300 and hold steady at this rpm – or a reading near this which gives a minimum mechanical clatter. The electric fuel pump should now be switched off since the mechanical pump is designed to take over at above 2 000 rpm. If this procedure had been followed, several serious engine failures might have been averted since failure of any one of the auxiliary pumps usually to mechanical fuel pump failures, which thus stops the engine.

As soon as the water temperature gauge needle is off its stop, i.e. 30°C increase rpm to between 4 000 and 4 500, again choosing a point where clatter minimised. Turn mixture-adjusting pin to the middle notch to weaken mixture.

Keep rpm steady till water temperature is 60°– 70°C and oil temperature is rising.

**COLD WHEATHER CONDITIONS:**

It has been found that some fuel metering unit failures have been attributable to attempting to start the engine in very cold weather. We therefore suggest that when the general engine temperature is below 5°C, the metering unit is warmed before any attempt is made to rotate it.

**STRIPPING AND ASSEMBLY NOTES:**

It is of the utmost importance that a torque wrench is used on all assembly work. We recommend that only a "Bending beam" type be used.

The cylinder head side stud nuts must be release before the main head nuts are released. The cylinder head nuts must be replaced gradually and evenly, starting from the centre and working towards the outside. The same procedure must be followed form the cam covers and crank case lower-half stud nuts.

Order of tightening		7 3 1 5 9	
	Front		Rear
For head and sump		8 4 2 6 10	

For camshaft removal, take off breather (pre 1970 engines). Tacho drive and spindle and cam covers. Remove cams from only one bank at a time.

R.H. Bank: Turn engine to T.D.C. No 1 cylinder  
Line up timing gears with marks on cover  
Remove cams, N.B. take care that cam lifts  
Evenly, otherwise the front end locating  
Flange will be broken.

L.H. Bank: Turn engine 450° in direction of engine rotation  
From No 1 T.D.C. to No 5 T.D.C. Line up marks  
as above. Remove cams.

When replacing, make sure correct marks line up as above, and that the gear mesh as the cam is lowered.

N.B. Cam must be pulled down evenly.

Before the cylinder heads can be removed, the alternator/distributor/metering unit assembly must be removed.

It is suggested that the engine be rotated until T.D.C. No 1 firing. The ¼ UNC plug near the alternator air-inlet gauze should then be removed, and the engine turned slightly so that the nearest gap between the alternator drive gear teeth is directly below this plughole. A pointed ¼ UNC screw should then be used to lock the gear in position. Care must be taken not to rotate the engine while this screw is in place. Mark the position of the flywheel so that the distributor assembly may be replaced in the same position. Remove the high-pressure petrol pipe linking manifolds, throttle cross shaft etc. After removing the four retaining screws, the unit may be taken out by sliding it towards the rear of the engine, off the quillshaft splines.

On re-assembly it is imperative that the distributor unit is replaced with the correct splines in engagement or the fuel and ignition timing will be wrong. Use anti-scuffing paste on splines.

Do not strip the throttle assembly whilst the manifold is fitted to the engine, or rollers may fall down the inlet tract.

The centre distance of the timing gears is very critical, and nothing should be done which affect them. If idler gears are removed it is essential that they go back on the same bank as they were when removed, otherwise the gear backlash may be altered and cause gear failure.

Note. The six external main-bearing stud nuts should be tightened to a "proving torque", released, and then re-tightened to the final assembly torque.

#### Crankshaft Bungs

If the crankshaft oil galleries are threaded, they should be bugged with a steel bung, Part No DA 0605 (see special data sheet B50219)

Later crankshafts have plain reamed galleries.

The earliest of these having 5/8" dia. Reamed galleries using bungs Part No DA 0634 (or DA 0635) with circlips Part No PP 0981.

Current crankshafts have 15mm dia. Reamed galleries using Bungs Part No DA 0645 with circlips DA 0652.

Tool No MT 0247 is required to insert and extract Bungs Part No DA 0634, DA 0635 and DA 0645.

**CARE TO BE TAKEN WITH:**

All 'O' rings connected with oil pressure pump and scavenge pump. Particular care to be taken with 'O' ring fitted to oil pressure pump inlet flange. Damage to this 'O' ring – allowing suction of air- will give low oil pressure reading and possible lead to bearing failure.

When refitting cylinder heads, ensure that all 'O' rings and seals are in place, especially the 'O' ring between the head and cam carrier for camshaft oil feed. New compression seals should be used on re-assembly.

Special washer Part No DA 0272 – the flat face must go against the Magnesium Cam Cover.

**Torque settings:** Engine oil on thread and underhead, unless otherwise stated.

Big End Bolts	41 – 42lb ft	Anti scuffing paste under head engine oil on threads
Main bearing stud nuts (6 External)	50lb ft 43 – 45lb ft	Initially for proving, Final assembly
Main Cap Stud Nuts (Tapered Dowel Type)	43 – 45lb ft	
Main Cap Side Stud Nuts 5/16 UN	13 – 14lb ft	
Main Cap 7/16 UNC screws	53 – 55lb ft	
Main Cap Side 5/16 UNC screw	18 – 20lb ft	
Cylinder Block Side Stud Nuts (Cad plated – bright)	13 – 14lb ft	
Sump Sideplate 10 – 32 UNF screws	25lb in	Loctite 'B' underhead
Cylinder Head Stud Nuts	48 – 50lb ft	
Cylinder Head Side Stud Nuts (Cad plated – bright)	13 – 14lb ft	
Cam Cap Stud Nuts	13 – 14lb ft	
Cam Carrier Cover Stud Nuts	16 – 18lb ft	
Flywheel Bolts	53 – 55lb ft	
Clutch Bolts Nuts	13 – 15lb ft	
Front Eng. Mtg. 5/16" Screws	18 - 20lb ft	
Front Eng. Mtg. 3/8" Screws	34 – 36lb ft	
Cam Cover 10 – 32 UNF Screws	32 – 35lb ft	
Metering Unit Outlet Banjo Bolts	90 – 100lb ft	
Injectors	6lb ft	
Sparking Plugs	9lb ft	Graphite grease under head and on thread
Oil Filter Bowl	4 – 6lb ft	after initial tightening to 10lbft and slackening

Mechanical Fuel Pump. Non return Valve Hsg.	8lb ft	
Alternator Drive Quill	30 – 32lb ft on threads	Loctite 'A' under head and
All ¼ UNC Soc Cap Hd Screws See separate sheet for stud fitting details	46 – 48lb in	