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C O S W O R T H

DFX 84

2.65 LITRE TURBOCHARGED ENGINE - COSWORTH TYPE DFX

Capacity	161.27 cu.ins 2642.7 cc	Bore	3.373" 85.67 mm	Stroke	2.256" 57.30 mm
Compression Ratio :	10.7:1	Configuration	90° Vee 8		
Max. Torque	350 lbs. ft. (approx.)				

CYLINDER NUMBERING

	L.H. BANK		
	8 7 6 5		
REAR	4 3 2 1	FRONT	
	R. H. BANK		

IMPORTANT DIMENSIONS ETC.

Crankshaft	End Float	.009 / .012"
	Main Journal Dia.	2.3755" / 2.3750"
	Connecting Rod Journal Dia.	1.9375" / 1.9370"
Connecting Rods	End float (big end)	.008" / .012"
Piston rings	Gaps on compression rings	.016 / .020"
	Gaps on O/C rings	.016 / .035"
Valve Timing	Inlet valves fully open	102° A.T.D.C.
	Exhaust valves fully open	102° B.T.D.C.
Valve Lift	.410" less the tappet clearance inlet and exhaust	
Tappet clearance (cold)	.010" / .011" inlet	.015 / .016" exhaust

Valve Springs

DA 0976/7 springs or DY 2332/3 optional ; shim to within .015" / .025" of coil bound.

Oil Filter

Use only paper element, Cosworth Part No. PP2427 - 2 off in DX 8379 assy. or PP0404 in PP1791 steel cannister (see torque data).

INSTALLATION AND RUNNING DATAIgnition - Mallory Magneto

See drawing DX 1105

Firing order 1 8 3 6 4 5 2 7

Set engine to 33° B.T.D.C. No. 1. cylinder on compression stroke, set yellow dot on magneto rotor arm in line with yellow dot on magneto casing. Offer magneto into drive housing spline, selecting correct spline to place the spark plug cable outlets on the cap in the horizontal plane, lightly nip retaining clamp. Hold rotor arm against direction of rotation and rotate magneto body until contact breaker points just open. Tighten clamp and refit cap
Contact breakers gap set at .015" full open.

Ignition - Lucas capacitive discharge

See Cosworth data sheet DS 0203

Maximum ignition advance is optimised whilst the engine is on test; this should not exceed 37° B.T.D.C.
Should the trigger position be altered for any reason, the following procedure should be adopted:-

Connect Cosworth timing box PP 2383 to pick-up signal wires, turn engine to 35° B.T.D.C., rotate trigger disc only slowly in direction of engine rotation until light is energised on the box. Torque 5/8" U.N.F. bolt to 70 lbs. ft. taking care not to disturb setting (N.B. engine oil on threads and bolt underhead). Turn engine against rotation approx. 45° and recheck point at which light is triggered.
N.B. for information 35° of crankshaft rotation is equal to .244" piston travel.

Should rotor arm position be disturbed the following procedure should be adopted:-

With the engine set at 30° A.T.D.C. or .182" piston travel, No. 4. cylinder on power stroke, No. 1. cylinder inlet valves opening the rotor arm should be set at 4° past the lower vertical position i.e. brass contact approaching No. 5. cylinder post. If this is not the case then adjustment may be made as follows;

Remove rotor arm, slacken 10-32 x 5/8 socket headed cap screw and rotate DA 0827 adaptor until desired position is obtained, tighten s.c.h. to 36 lbs. ins.

N.B. adaptor is held on a taper and may require releasing by means of a convenient puller before rotation is possible.

Spark plugs - A504V Annular gap R502R side wire.

Engine Mountings :

the top mounting 5/16" UNF bolts should have washers part No. DA 0017 against the magnesium cover, carefully tighten to 16/18 lbs.ft. to avoid crushing the magnesium.

On lower mounting points, flat washers of .06" minimum thickness must be used under the cassis 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 drawing No. DX 1308

Pressure with engine oil at normal running temperature i.e. 85/95°C (185/203°F) should be 50 p.s.i. min. - 60/80 p.s.i. at normal running speeds. Care must be taken to allow the engine oil to reach 50°C (122°F) before exceeding 7,000 r.p.m. as bearing failure may follow running at high speeds with cold oil.

Max. oil temperature as measured in oil tank 100°C (212°F)
Oil tank design should allow for approximate consumption of 1 imperial (1.2 u.s.) gallon min. to 2 imperial (2.4 U.S.) gallons max. during a 500 mile race.

Hilborn fuel system

See drawing No. DX 1759

This system and recommended settings have proved themselves in service, but require experienced setting of the 'A' valve at the track. If in doubt contact Larry Slutter at Cosworth Engineering Inc. 23205, Early Avenue, Torrance, 90505 California U.S.A. Tel 534 1390.
Fuel used should be pure Methanol.

Cosworth fuel system

See drawing DX 2063

A full description of this system together with fault finding procedure is available in the following Cosworth data sheets:-

DS 0286 Iss. 5. Metering unit calibration
DS 0288 Iss. 4. Fuel pump build
DS 0292 Fuel system fault finding
Fuel cam types available as follows:-
DX 1856 - Single butterfly - std. flow
DX 2225 Single butterfly 10% lean
DX 2272 Slide throttle Std. flow
DX 2258 Slide throttle 10% lean

fuel used should be pure Methanol.

Electrical system

See drawing No. DX 1578/DA 2749

The engine must be connected -ve earth (ground) system

EARTHS ARE TO BE DIRECTLY CONNECTED TO THE BATTERY NOT VIA THE CHASSIS

It is advised that all electrical connections are smeared with silicone grease (we suggest Midland Silicone MS4) especially, should the engine be operated in wet conditions.

12m spark plugs Champion A504 V - R502 R

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 Graphogen (or equivalent) on sparking plug threads before fitting and torque to 10-12 lbs. ft.

Exhaust system

See drawing Nos. DX 1051 - flange layout
DX 1596 - System

Exhaust is to be made from stainless steel tube 321 x 16 swg (.064")

4 primary pipes 2" O/Dia. x 24" long
into 4 into 1 collector 4½" long
into 2½" O/Dia. x 29" long secondary
pipe

Per bank

The system should be welded with a Niobium stabilised filler rod.
(American standards AWS A5.9 - ER 347) on no account should mild steel
be welded to stainless as this seriously effects the strength of the
metal in the welded area.

To hold exhaust flanges to head use all steel ¼ UNF stiffnut PP 0516 with
Coppaslip (or similar) on threads to prevent seizure. Replace nuts each
engine built to prevent nut cracking.

the waste gate exhaust pipe is 2½" O/Dia.

The turbo exhaust is 4" O/Dia. minimum, lengths to suit installation.

General

The engine must not be allowed to idle under 2,000 r.p.m. or excessive
cam and tappet wear may be experienced. the max. recommended speed is
11,000 r.p.m.

If a "Smiths" Chronometric tacho head is fitted, then the specification for the
head is "4:1 clockwise".

Summary of drawings available for installation/assembly:

DX 2008 engine installation
~~DX 2743~~ wiring diagram
DX 1706 inlet manifold arrangement - Hilborn c/w single butterfly
DX 2057 slide throttle arrangement
DA 1769 Cooling system - single pump
~~DX 1305 cooling system - twin pumps~~
~~DA 3439~~ oil system
DX 2073 cable assy. - single butterfly
DX 2063 Cosworth fuel system
DX 2055 fuel filter assy. long
DX 1051 Exhaust flange layout
DX 1596 Exhaust system layout
DX 1306 L.H. Auxilliaries - twin water pump
DX 1307 R.H. Auxilliaries - twin water pump
DX 1819 L.H. Auxilliaries - slimline assy.
DX 1820 R.H. Auxilliaries - slimline assy.
DA 1575 Gearbox assy. - cam driven fuel pump 1st ratio
DX 2009 Gearbox assy. - cam driven fuel pump 2nd ratio
DX 1680 - valve layout assy.
DX 1977 boost valve
DX 2010 Metering unit assy.
DS 0132 stud fitting details
DS 0273 Notes on Cosworth recommended fuel system - Hilborn
DS 0286 Setting procedure Cosworth fuel system
DS 0292 Cosworth fuel system - trouble shooting
DX 2778 Crank Gear Assy

Starting from cold and warming up

Heat water and oil to 50°C before cranking engine. Slowly crank engine with sparking plugs out and fuel and ignition off, until the oil pressure rises. Continue to crank engine with fuel switched on and datum pin set at full rich until vapour is emitted from spark plug holes. Now switch off fuel and crank engine in order to remove excess Methanol from cylinders. Fit plugs, crank engine, switch on ignition then fuel. Run engine at approx. 2,500 r.p.m. or speed near to this which gives minimal engine clatter. As temperature rises fuel datum pin may be moved to mid position.

Always stop engine by switching off fuel before ignition.

N.B. Owing to the close running clearance of the mechanical fuel pump it is advised to warm the Methanol and the pump when operating in ambient temperatures below 10°C (50°F).

Stripping and assembly notes

N.B. these notes are issued only as a general guide.

Before attempting any work contact Larry Slutter at Cosworth Engineering Inc., 23205 Early Avenue, Torrance, 90505, California, U.S.A. Tel. 534 1390.

It is of the utmost importance that a torque wrench of the "bending beam" type is used on all assembly work.

Removing camshaft

For camshaft removal, remove tacho drive and spindle from R.H. inlet camshaft and bevel gearbox plus cam carrier rear cover from L.H. bank.

R.H. bank

Turn engine to T.D.C. No. 1. cylinder, line up timing gears with marks on bearing caps, remove cams N.B. take care that cams lift evenly.

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 gears mesh as the cam is lowered.

Removing cylinder head

Before the cylinder heads can be removed, the slide throttle assemblies and the alternator/metering unit must be removed. As rotor arm position is dependent upon the alternator spline drive position, it is suggested that the engine be rotated to 30° A.T.D.C. (.182" piston travel) with inlet valves on No.1. cylinder opening No. 4. piston on power stroke. The ¼ U.N.C. plug on the alternator housing should be removed, and a pointed ¼ U.N.C. bolt inserted to engage in the root of the driven gear tooth thus locking the assembly, the engine may have to be rotated slightly in order to position the gear root directly below the ¼ U.N.C. thread.

After removing the four retaining screws (5/16" x 2 1/4") and the two retaining screws (1/4 UNC x 1" S.C.H.) that steady the metering unit, the assembly may be removed by sliding it towards the rear of the engine, off the quillshaft splines.

On re-assembly use anti scuffing paste on splines, and check rotor arm relative to engine position.

The cylinder head side stud nuts must be released before the main head nuts are released. The cylinder head nuts must be released gradually and evenly, starting from the centre and working towards the ends. The same procedure must be followed for the cam covers and crankcase lower half.

Order of tightening for heads:

FRONT	7 3 1 5 9	REAR
	8 4 2 6 10	

Order of tightening for sumps:

FRONT	3	1	5	REAR
	4	2	6	

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

Fitting cylinder head seals and cylinder head

The solid cylinder head joints used in the DFX are re-usable and should only be replaced if they show signs of damage on their seating land or if the cylinder liner is changed.

To fit a new set of cylinder head seals it is initially important to ensure that the cylinder liner flanges are pulled down onto their locations properly. Having heated the cylinder block to 100°C (212°F) and fitted the liners using Wellseal as a water sealant under the liner flange, the block should be allowed to cool to room temperature and the liner then pulled down using a plate across the top of the liner and a 1/2" UNC bolt torqued to 65 lbs. ft. and threaded into a mandrel spanning a pair of main bearings. The assy. should be left to cool to room temperature and the depth of the cylinder head seal recesses from the top of the block should then be measured at four points around the top of each liner. From these measurements the individual thickness of each head seal may be calculated so that the head is .005 ± .005 clear of the block and the step between the tops of adjacent rings does not exceed .0005". The head seals should be lapped on both faces and fitted with the chamfer facing the liner flange.

With the sealing rings and all 'O' rings in place and the head finished ground to give a backlash of .002"/.006" between the idler gears the 3/8 U.N.F. head nuts should be torqued to 27 lbs. ft. smearing Silastic on all head nut washers to prevent oil running down the studs and out of the head joint. The six middle nuts should be further tightened to 53-55 lbs.ft. leaving the end nuts at 27 lbs. ft. With no nuts on the 5/16 U.N.F. slide studs the gap between head and block should be measured with feeler guages and a semi circular shim (.80 O/dia. and 5/16 1/Dia.) of the thickness of the measured gap should be pushed in around each side stud. Shims are available Part Nos. DX 1245 - DX 1249 inclusive in .001" increments, commencing at .001". The gap at front rear of the head should then be measured and a 2.70 long piece of .50" wide shim the thickness of the gap placed between the front and rear pair of head studs. Shims are available Part Nos. DX 1250 - DX 1254 inclusive in .001 increments commencing at .001".

The end pair of head stud nuts may then be torqued to 53-55 lbs. ft. and the side stud nuts torqued to 14-16 lbs. ft.

A bead of Silastic air curing rubber should finally be placed across the front of the head to seal the gap between block and head to prevent oil leaks.

Main bearing studs

The six external main bearing stud nuts should be torqued to a "proving torque" of 50 lbs. ft. released, and then be re tightened to the final assembly torque.

Intermediate Main caps

Before removing the intermediate main caps, ensure that the dowels are marked as per the markings on the cap or cylinder block. (dowels are graded on assembly). Release the 5/16" U.N.F. nuts, then the 3/8" U.N.F. nuts to remove cap.

To replace caps, ensure dowels are in good condition and in the correct positions relative to the cap/cylinder block markings. The flats on the dowels to be aligned parallel with split line within 5°. Pull down the cap evenly by hand, tighten the 5/16 U.N.F. nuts finger tight, tighten the 3/8 U.N.F. to 15 lbs. ft. then the 5/16 U.N.F. nuts evenly to 14-16 lbs. ft. finally tighten the 3/8 U.N.F. nuts evenly to 43-45 lbs. ft.

Crankshaft bungs

DX 1375 crankshafts have axially reamed galleries using bungs Part No. DA 1496. Tool No. DA 1378 is required to insert and extract bung.

Care to be taken with

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

Slide throttle engines

Never strip the throttle assembly whilst the manifold is fitted to the engine, or rollers may fall down the inlet tract.

When assembling this configuration of engine it is advisable to assemble in the following sequence:-

Fit left hand manifold, fit bomb assy, fit right hand manifold,
fit cam carriers.

Torque settings - Engine oil on thread and underhead, unless otherwise stated

Big end bolt	41-42 lbs.ft. Anti scuffing paste on bolt underhead, oil on threads
Main bearing stud nuts (6 external)	50 lbs.ft. initially for proving 43-45 lbs.ft. final assy.
Main cap nuts 3/8 U.N.F.	43-45 lbs.ft.
Main cap slide nuts 5/16 U.N.F.	14-16 lbs.ft.
Cylinder block side nuts (cad.plate)	13-14 lbs.ft.
Sump side plate 10-32 U.N.F.	25 lbs.ins.-Loctite underhead
Cylinder head stud nuts (page 6)	53-55 lbs.ft. Silastic under washer
Cylinder head side nuts (cad.plate)	13-14 lbs.ft.
Cam gear screws 1/4 U.N.F.	16-17 lbs.ft.
Cam cap stud nuts	13-15 lbs.ft.
Cam carrier cover stud nuts	16-18 lbs.ft.
Flywheel bolts	53-55 lbs.ft.-oil only on thread and underhead.
Clutch bolt nuts	13-15 lbs.ft.
Front engine mtg. 5/16" screws	18-20 lbs.ft.
Front engine mtg. 3/8" screws	34-36 lbs.ft.
Cam cover 10-32 screws	32-35 lbs. ins.
Spark plugs	10-12 lbs.ft. graphite grease threads and underhead.
Oil filter bowl (steel)	13-15 lbs.ft.
Alternator quill	30-32 lbs.ft. Loctite 602 threads and underhead
Pressure and scavenge pump	38-42 lbs.ft. Loctite 270 on threads + stainless lockwire
Retaining nuts - 7/16 U.N.F.	30-32 lbs.ft. Loctite 270 on threads
Auxilliary drive pulley	
Retaining nuts - 7/16 U.N.F.	
All 1/4 U.N.C. socket cap head screws	46-48 lbs. ins.

See data sheet DS 0132 for stud fitting details.