

# ENGINE AND ENGINE COOLING

This section should be read in conjunction with the section on skid shield protection for rally cars. A fully effective skid shield under the engine bay may tend to trap hot air in that region, and this makes the cooling radiator's task more demanding.

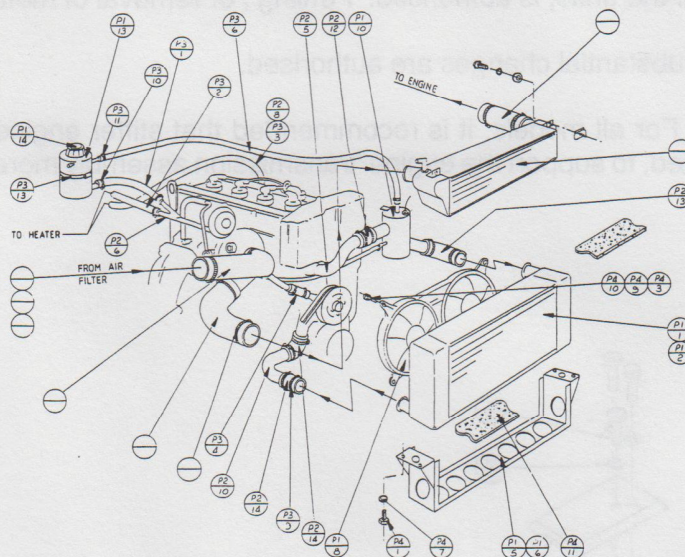
## Group N:

For a Group N car, no changes may be made to the standard cooling arrangements, so the standard radiator fitted to the car when it was originally manufactured, must be retained.

## Group A:

For a Group A car, the radiator may be changed and alternative heavy-duty components, some proved in the heat and dust of the Safari rally, are available. In each case it is strongly recommended that the specially-developed swirl pots should also be fitted.

In the case of the Group A SIERRA RS/RS500 COSWORTH it is strongly recommended that a modified cooling system, as developed by Ford engineers and as illustrated in the diagram which accompanies this section, should be fitted.



The recommended way to lay out the Group A engine cooling circuits of the SIERRA RS COSWORTH.

### Cooling System - Cosworth 'liquid items'

Drawing Reference	Component	Part No	Finis Code
P1/1 or P1/2	Radiator, Brass 4 row or Radiator, Brass 5 row	MS87BB8005CC MS87BB8005BA	9092822 9092332
P1/5	Radiator mounting frame	MS87BB8A168BA	9093291
P1/8	Fan unit	MS87BB8K620AC	9093270
P1/10	Swirl pot assembly	H87WS8507AF	9092588
P1/13	Header tank assembly	H87WS8694AA	9092586
P1/14	Header tank cap	A790X8100AA	5005508
P2/5	Outlet, cylinder head connection	H87WS8594AA	9092910
P2/6	Heater pipe	H87WS8A504AA	9092861
P2/8	Aluminium tube, 5/8" x 50mm	MS88BB8506AA	9093505
P2/10	Aluminium tube, 90 deg bend, 1 1/2" O/D	MS88BB8505AA	9093508
P2/12	Hose	Make as necessary from 41.3mm bore water hose.	
P2/13	Hose		
P2/14	Hose		
P3/1	Hose		
P3/2	Hose		
P3/4	Hose		
P3/6	Hose		
P3/9	Hose clip	A800X8287HA	5007669



P3/10	Hose clip	A800X8287EA	5007666
P3/11	Hose clip	A800X8287DA	5007665
P3/13	Clip	MS88BB8287AA	9093488
P4/1	Bolt	38813GS40	1434772
P4/3	Screw	E602164S72	1471337
P4/7	Washer	E830085S71	1490514
P4/9	Washer	E830057S71	1471561
P4/10	Washer	E630152S71	0206306
P4/11	Insulator	—	—

Please note that Group A homologation regulations changed at the end of 1987. For 1988, all cars running to Group A regulations, must run with the intercooler from the homologated car, with which the original 5,000 cars (or, in the case of the SIERRA RS500 COSWORTH 'evolution' model, the original 500 cars) were built.

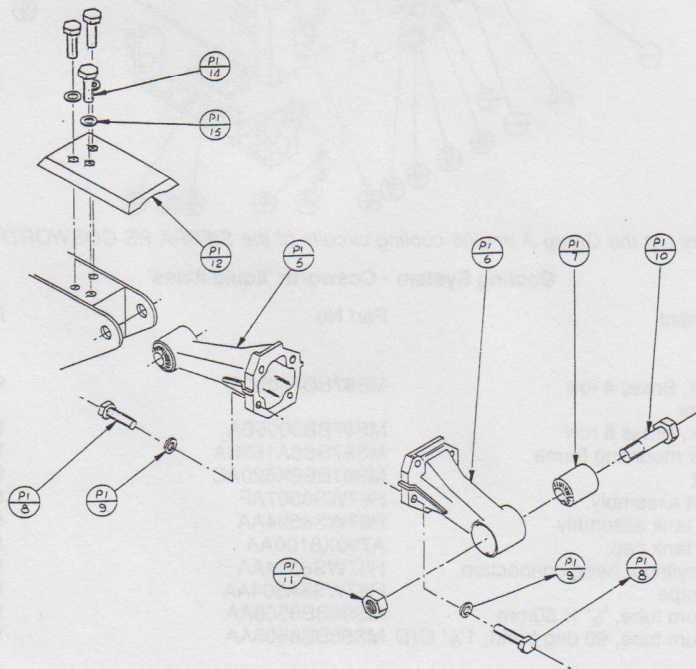
The special enlarged intercooler (Finis Code: 9092331) may not, therefore, be fitted to **homologated** SIERRA RS COSWORTHS from 1 January 1988. Where homologation regulations do not apply, however, this component gives substantially improved cooling of the compressed air passing from the turbocharger to the inlet manifold.

### ENGINE:

For Group N cars the engine must be left almost entirely standard, though balancing, optimisation and 'blueprinting' of the units, is authorised. 'Fettling', or removal of metal, is not allowed.

For Group A cars, substantial changes are authorised.

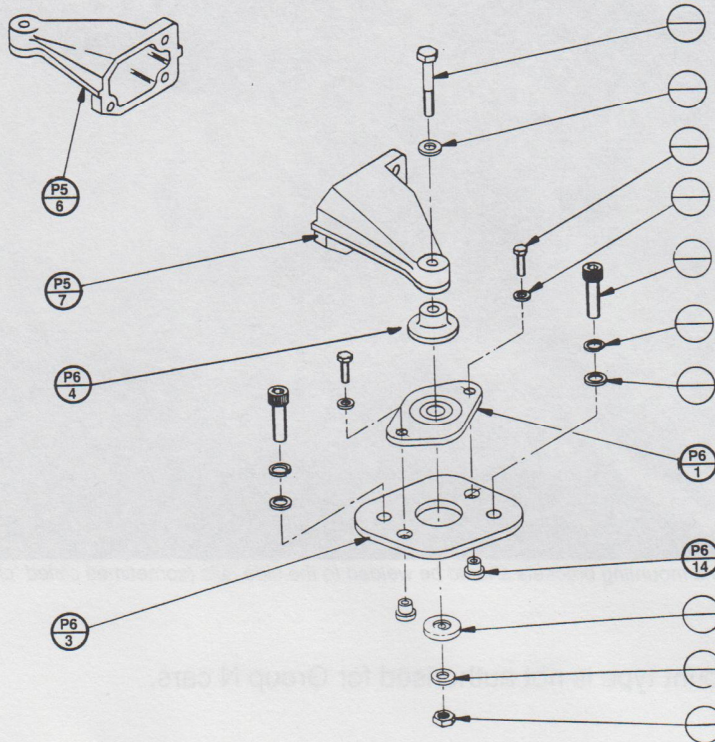
**Engine Mountings:** For all models, it is recommended that stiffer engine and transmission mountings should be fitted, to support the engine/transmission assembly more firmly in the structure.



For the Group A SIERRA RS/RS500 COSWORTH model, this is the recommended Engine Mounting installation.



Drawing Reference	Component	Part No.	Finis Code
P1/5	Engine mounting bracket — RH	MS87BB6030CB	9092883
P1/6	Engine mounting bracket — LH	MS87BB6031CB	9092882
P1/7	Insulator, engine mounting	75AB5781BA	6045486
P1/8	Bolt	—	1472102
P1/9	Washer	—	1523201
P1/10	Bolt	—	1451248
P1/11	Nut	—	1536468
P1/12	Heat shield, engine mounting	MS87BB6C038AB	9093122
P1/13	Spacer, Heat shield	MS87BB6039AA	9093116
P1/14	Screw	—	1515313
P1/15	Washer	—	1459510



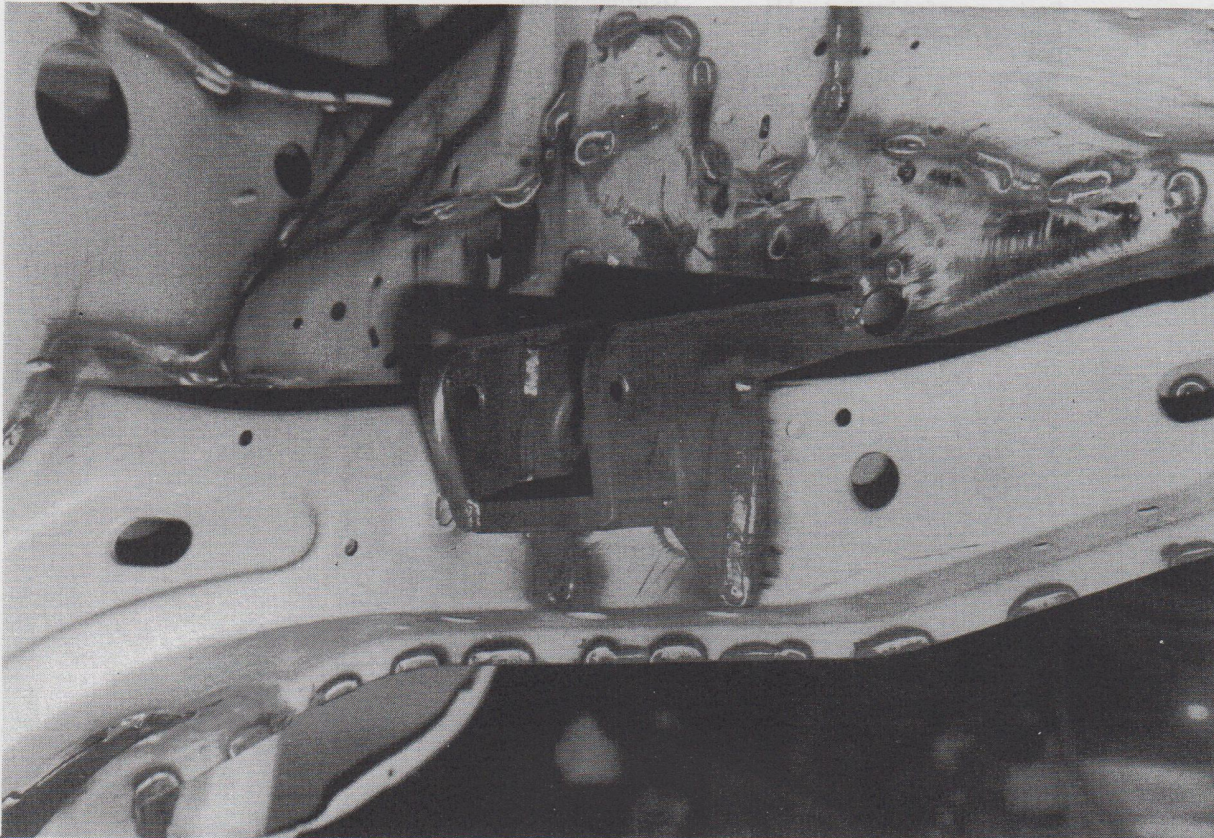
For the Group A SIERRA XR4 × 4, this is the recommended Engine Mounting installation.

#### Engine Mounting - Sierra XR4 × 4

Drawing Reference	Component	Part No.	Finis Code
P5/6	Engine Mounting	V85BB6030AC	1630997
P5/7	Engine Mounting	V85BB6031AC	1634745
<b>Insulator Assembly, Comprising:</b>			
P6/2	Insulator	MS87BB6038AA	9093117
P6/3	Engine support plate	MS87BB6041CA	9093119
P6/4	Engine mounting, top hat washer	MS87BB6042AB	9093325
P6/5	Washer, engine mounting	MS87BB6043AB	9093326
P6/14	Insert	MS87BB6044AA	9093121
	Bolt, M12 × 120		
	Bolt, M8 × 16		
	Locknut, M12		
	Plain washer, M12		
	Spring washer, M8		
	Socket screw, M10 × 30		
	Spring washer, M10		
	Plain washer, M10		



For Group A SIERRA RS/RS500 COSWORTH models, it is recommended that new front engine mounting brackets should be constructed. These should be built up as extensions to the engine bay side members, and should be arranged to mate with the modified aluminium engine mounting arms.



*It is recommended that special engine mounting brackets should be welded to the side rails (sometimes called 'chassis legs') of the SIERRA body shell.*

A change of engine mount type is not authorised for Group N cars.

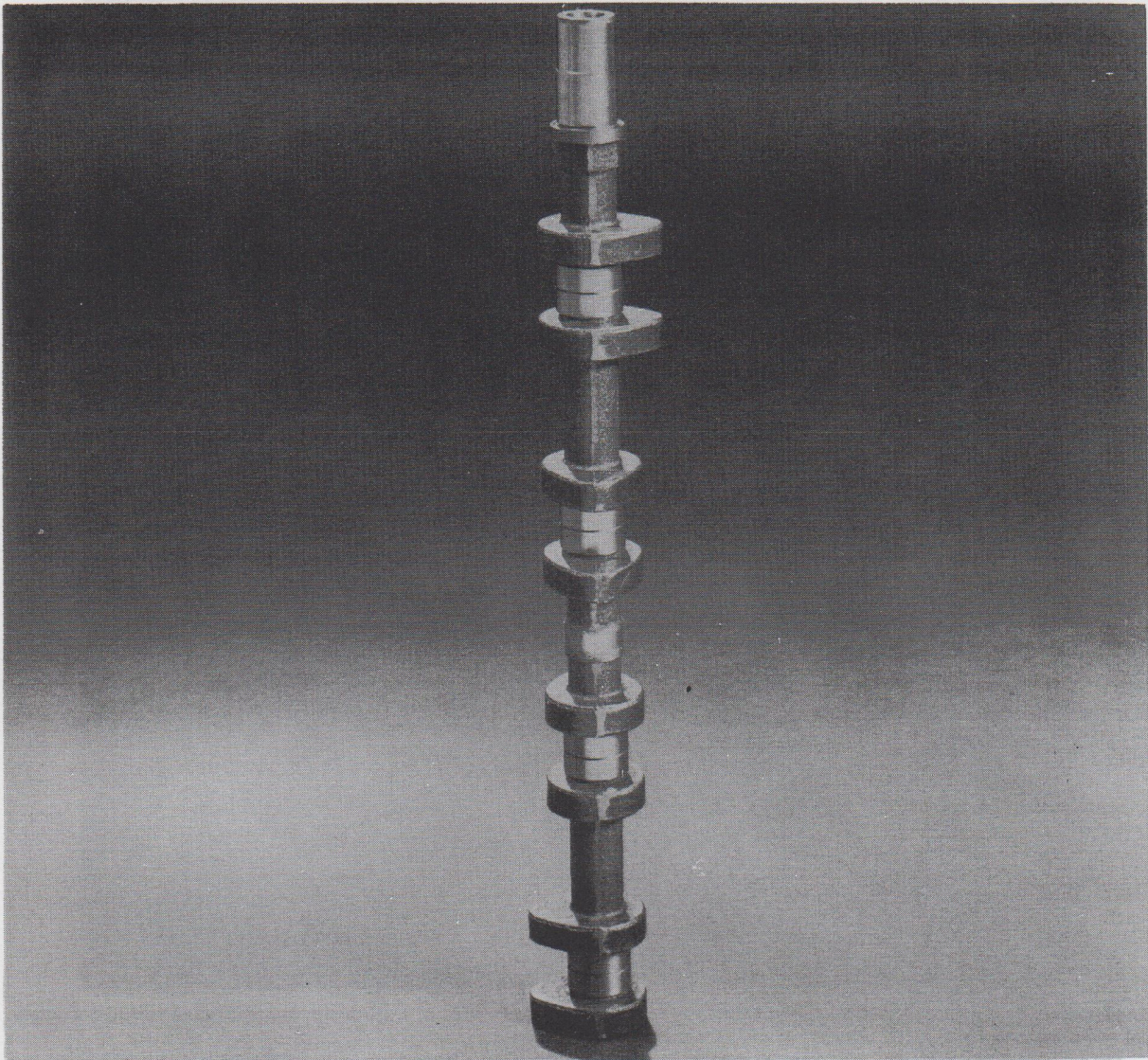
### **Engine Tuning:**

**Group N:** The make and type of spark plugs and the ignition H/T leads may be changed, the rev-limiter removed and the settings in the engine management and fuel injection systems may be changed, but apart from this, the only authorised improvements are those produced by the 'blueprinting' of the engine. The 'blueprinting' process involves the selective assembly of engine parts and a careful choice of tolerances. This is best done by an experienced engine builder. Ford does not market Group N engines, though advice is available from Ford Motorsport staff, about the builders with the most expertise and tuning knowledge of the V6 (SIERRA XR4 × 4) and four-cylinder turbocharged (SIERRA RS COSWORTH) engines.

In the case of the normally-aspirated SIERRA XR4 × 4 engine, 'blueprinting' is a labour-intensive and expensive business and brings only a limited return, with approximately a 10 per cent improvement, in nominal figures, to be gained.

For the V6 engine SIERRA XR4 × 4, please note that only the Bosch K-Jetronic fuel injection system is homologated. Cars sold in Sweden and Switzerland are normally equipped with Bosch L-Jetronic fuel injection, which is **NOT** homologated; such cars must be re-equipped with K-Jetronic injection before they may be used in Group N or Group A competition.





Camshafts with unmachined ('Virgin') lobes are available, so that engine builders can prepare their own camshaft profiles for Group A engines. This is a SIERRA RS COSWORTH camshaft - 'Virgin' lobe cam shafts are also available for vee-6 engines.

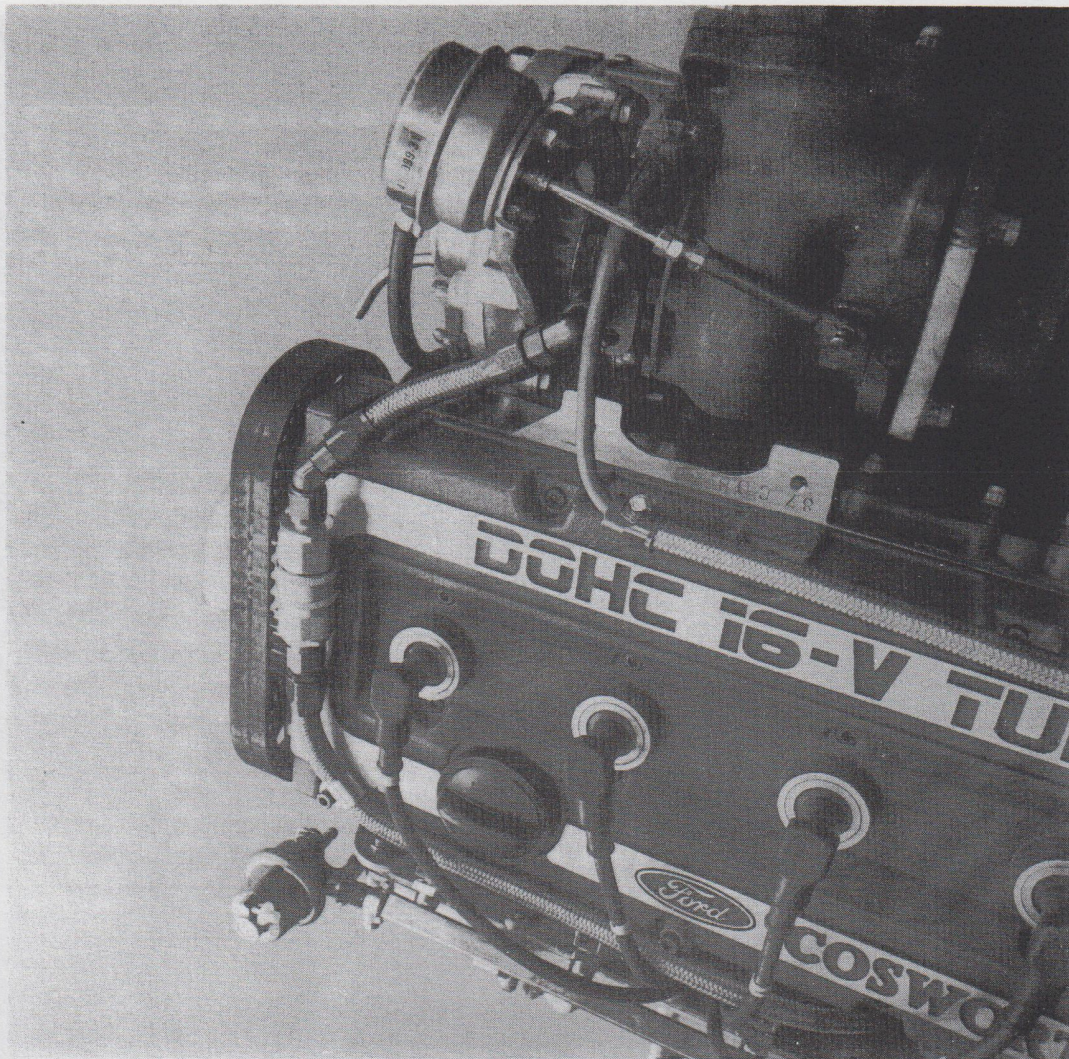
No Group N parts are available from Ford for the V6 engine. In particular, please note that the use of the 'Virgin lobes' camshaft (9092742) is not permissible, even if the standard Ford camshaft profile is subsequently machined on to the lobes.

The relevant extract from FISA regulations states that: 'any part worn through use or accident can only be replaced by an original part, identical to the one which had been damaged. . . .'

In the case of the SIERRA RS COSWORTH engine, more substantial gains are possible in Group N tune, both by 'blueprinting', by fitting the modified fuel injectors and Eprom (electronic engine management system 'chip'), and where specific regulations apply, in certain countries, by adjusting the boost characteristics of the engine. There should be no engine overheating problems, even when using the standard radiator.

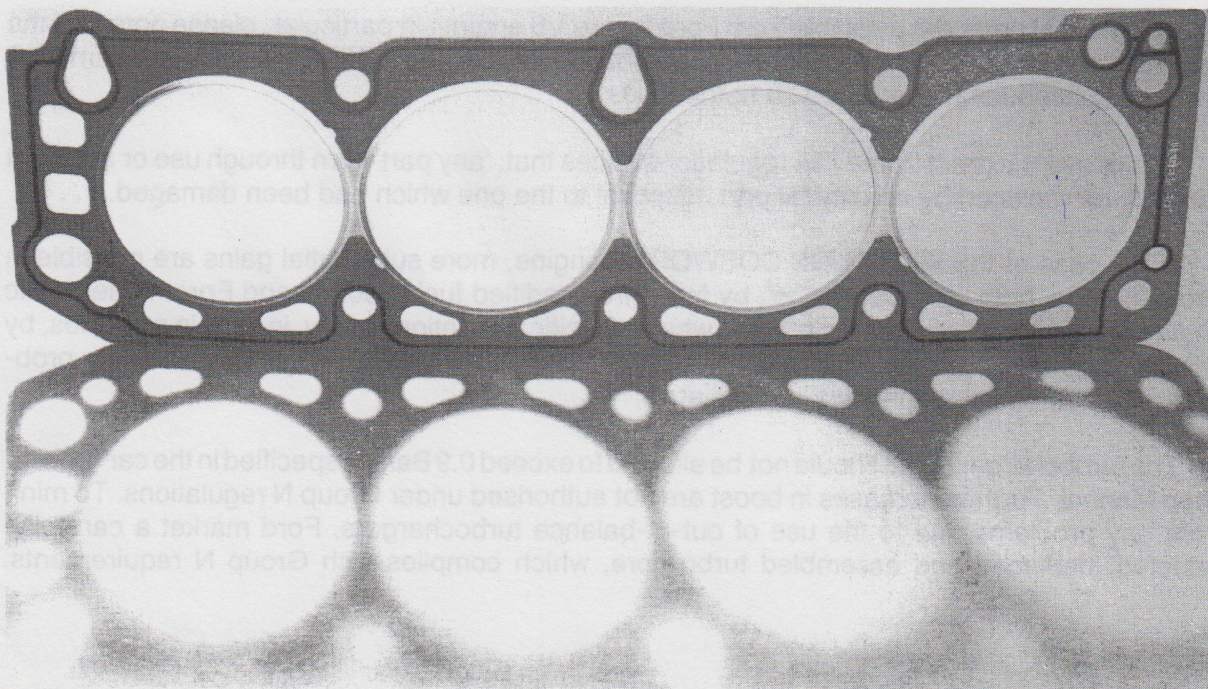
The turbocharger boost should not be allowed to exceed 0.9 Bar, as specified in the car's Workshop Manual. Further increases in boost are not authorised under Group N regulations. To minimise any problems due to the use of out-of-balance turbochargers, Ford market a carefully-selected, balanced and assembled turbo core, which complies with Group N requirements.





*When preparing a Group A SIERRA RS/RS500 COSWORTH engine, always arrange for a 'dry-break' to be included in the turbocharger lubrication pipe.*

Although this is not eligible in Group N engines, for all other engine preparation it is recommended that the competition cylinder head gasket (9092431) should be used.



*The specially-developed cylinder head gasket should be used in all Group A SIERRA RS/RS500 COSWORTH applications.*



When producing a Group N engine, it is important that all the allowable changes should be carried out as a complete package, as the Group N Ford Eproms have been 'mapped' to take account of them all. Note that there are different types of Eprom which are only compatible with particular ECUs and Air Pressure Senders. Full details of which Eprom should be matched to which ECU are listed in the SIERRA COMPETITION PARTS section of this booklet. Privately-developed Eproms have been produced by outside concerns, but Ford experience is that these have not always been completely 'mapped' and that fitment might lead to faulty running, detonation, misfiring or perhaps even damage to the engine.

**Note:** If the lid of the Eprom box has been removed, it must always be replaced the same way round, for its underside includes supports for the circuit boards.

Because the SIERRA RS500 COSWORTH is only homologated into Group A (500 cars only were produced) and it will never become a Group N model, no specific Group N tuning items have been developed.

**Group A:** Ford does not supply complete Group A engines, although special components have been developed for the V6 and turbocharged four cylinder units. For complete engines, Ford can recommend sources of tuning equipment, or can advise regarding the engine builders with the most experience of the engines in Group A tune.

#### **SIERRA XR4 × 4:**

A limited quantity of special equipment has been developed by Ford for the 2.8-litre V6 engine of the SIERRA XR4 × 4 model. In particular, there is a 'virgin lobes' camshaft, where grinding of lobes has not taken place but where the camshaft is otherwise finish-machined; this allows a specialist engine builder to machine his own preferred camshaft profile without the worry of destroying existing heat treated surfaces. The dimensions of the 'as cast' lobes should be carefully measured **before** beginning the machining process. High compression pistons (11.5:1) and competition head gaskets are also available.

Ford also recommends that a close-fitting windage tray be used as part of a revised sump pan layout. Such a tray, with slots to allow oil to drain away, is used to separate the whirling crankshaft from the main body of oil beneath it. On the standard engine the crank actually dips into the oil when it is filled to the level marked as 'maximum' on the dip stick, though this level falls slightly when the engine is running.

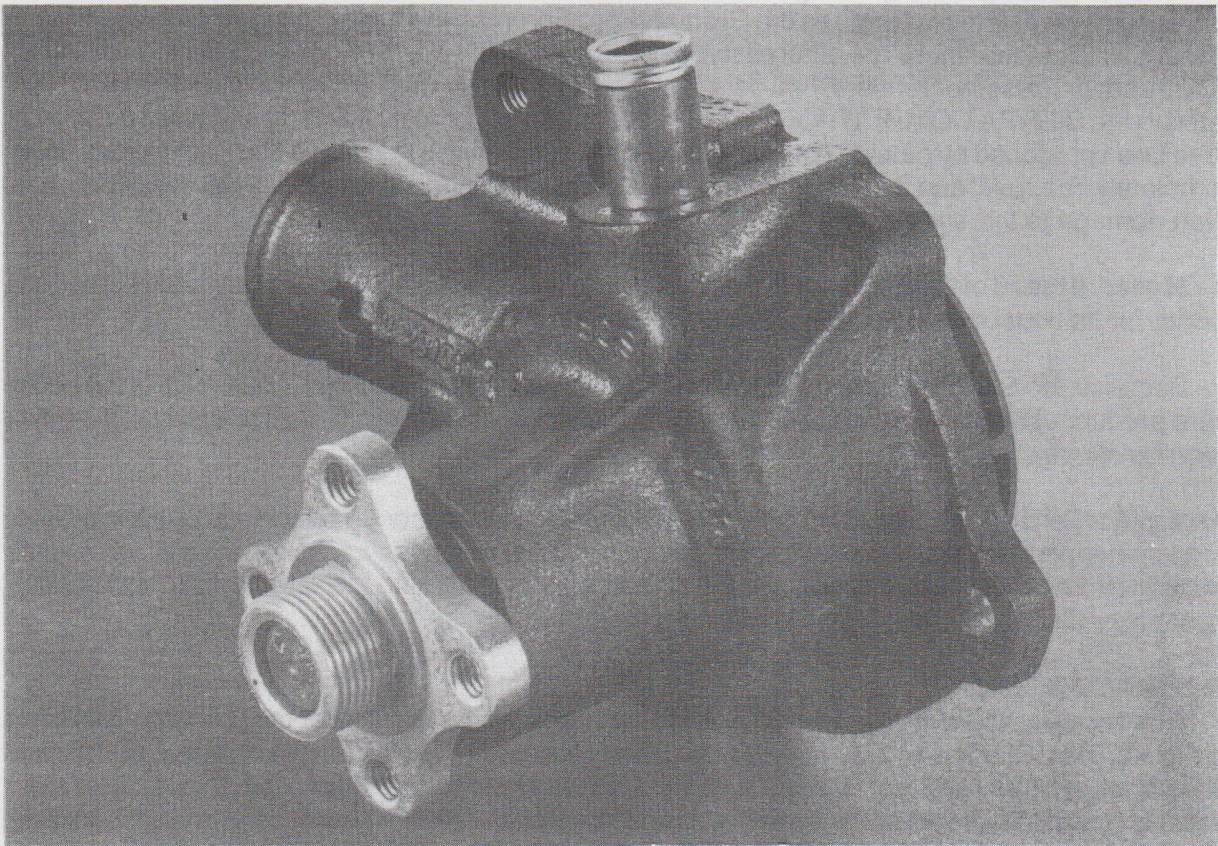
As modified to full Group A specification, the V6 engine produces approximately 200 bhp. More than 210bhp is available if L-Jetronic fuel injection is used, but this can only be done for events where homologation rules do not apply.

#### **COSWORTH ENGINED MODELS:**

The 16-valve turbocharged engine of the SIERRA RS/RS500 COSWORTH models have been designed with competition in mind, and the standard engines are already equipped with a steel crankshaft and connecting rods.

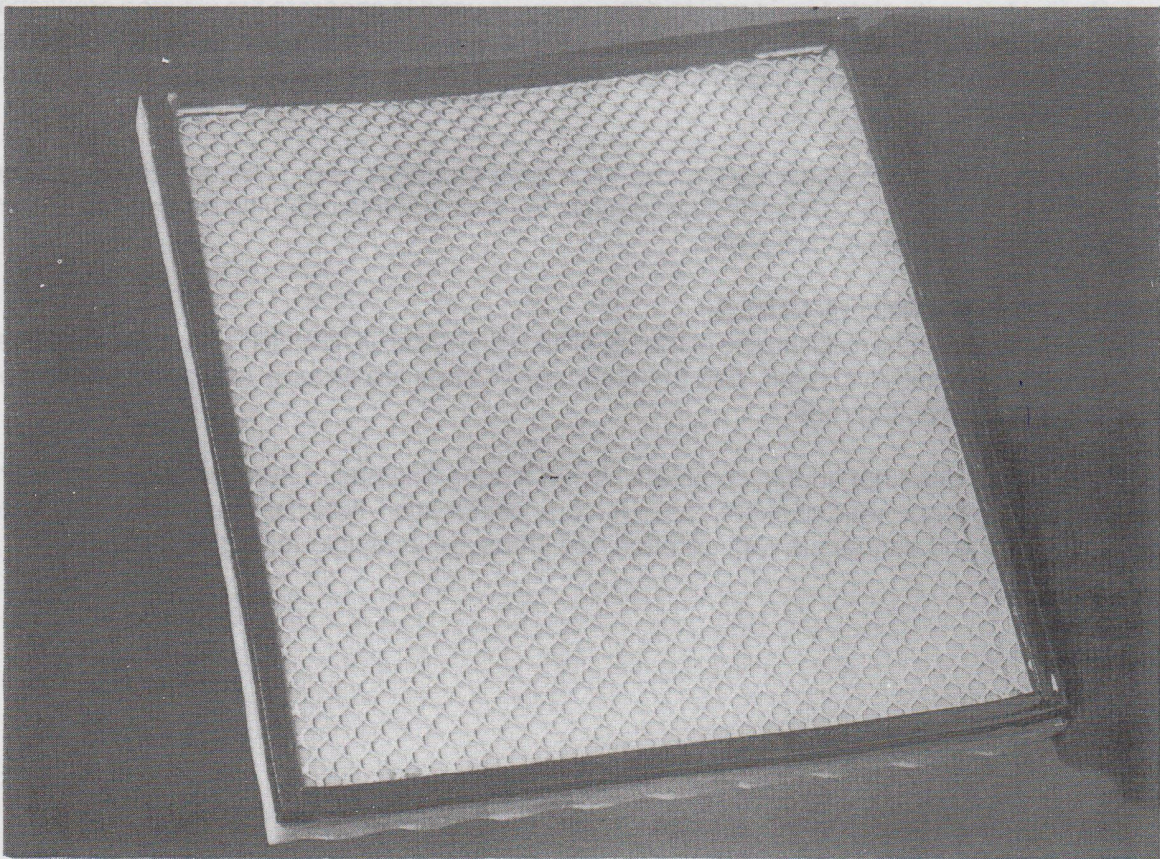
Although Ford does not supply complete Group A-tune engines, a number of special tuning items including cylinder head gaskets, fuel injectors, competition-type Eproms, oil pumps, water pumps, air filters and camshafts with unmachined lobes are available to engine builders.





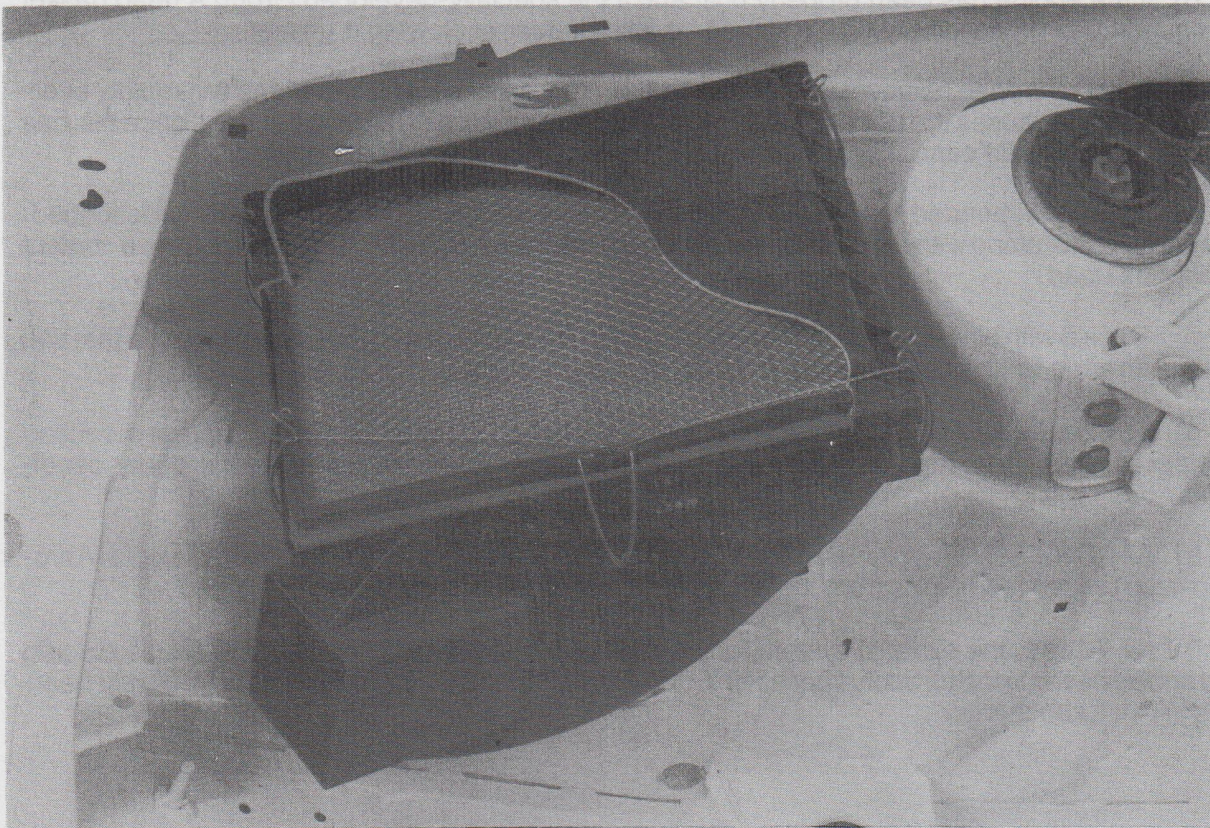
*For Group A use on the SIERRA RS/RS500 COSWORTH engine, a modified water pump is available.*

Complete Group A-tune engines for these cars are now available from several long-established engine builders in the UK and Europe, in several phases of tune, including 'full rally' and 'full race'.



*For maximum aerodynamic efficiency, there is a specially-developed air filter element for SIERRA RS/RS500 COSWORTH applications.*





The air filter box of the SIERRA RS/RS500 COSWORTH model is mounted on the right-side of the engine bay.

Experience with 'works' race and rally engines for the RS/RS500 COSWORTH model, leads us also to offer the following advice:

a) We strongly recommend the use of the specially assembled and balanced Group A turbo-charger core assembly. This has received a machining modification to turbine blades and allows the shaft to be revved much higher than in standard condition. This has allowed 'works' engines to use up to 1.6 Bar - this being measured at 4,000/4,500 rpm.

b) It is strongly recommended that you use a modified large diameter oil feed to the turbo-charger, so that oil pressure is preserved even under high cornering loads. The use of increased cooling water flow through the turbocharger is also beneficial.

c) Experience shows that on the SIERRA RS COSWORTH engine (not the SIERRA RS500 COSWORTH, which has a different, stronger cylinder block), there is a limit beyond which the block should no longer be used. The factory now 'lives' an engine by specifying the use of a new cylinder block after three World Championship length rallies have been completed.

The air blow-by, past the pistons, increases as the bores gradually become slightly barrel shaped.

Part No.	Component	Driving Reference
1210228	Intercooler	F17
1210229	Hose	F17
1210230	Hose	F17
1210231	Hose	F17
1210232	Hose clamp	F17
1210233	Air cleaner element	F17
1210234	Air cleaner element	F17
1210235	Form element	F17



d) If the engine has been properly built and if the specially-developed Group A head gasket has been fitted on assembly, there should be little danger of blowing a gasket.

If this does happen however, the engine is likely to lose its cooling water and will rapidly over-heat. This soon causes the alloy cylinder head to distort and to go soft. Unfortunately, once this has happened, the head cannot be reclaimed and a new component must be fitted.

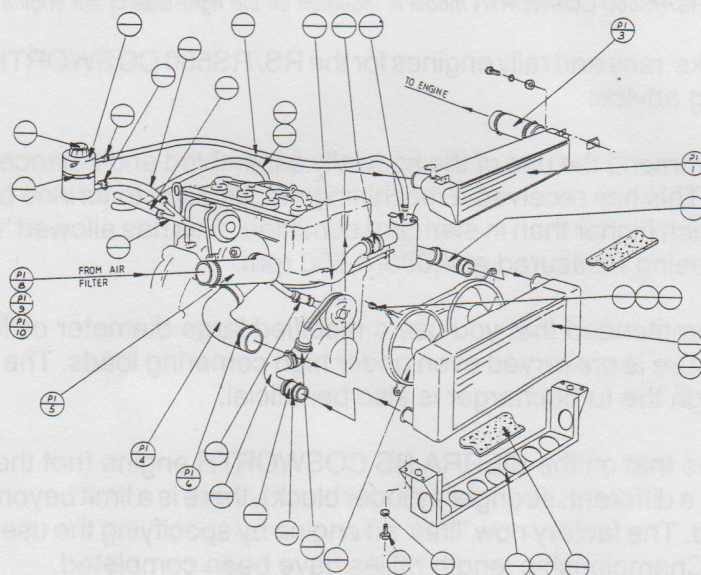
e) It is recommended that the works-developed water cooling system (already described) should be used, along with a high-pressure filler cap and that a 50%/50% water/antifreeze coolant should be used.

f) To deal with blow-by of oil and a loss of oil from the engine sump, it is recommended that you should arrange for the catch tank to drain back into the sump.

g) If a Group A RS500 COSWORTH engine is still fitted with its original turbocharger mounting damper bracket, make regular checks of this component, as it tends to crack under arduous conditions.

h) All COSWORTH engines tuned to Group A specification should be fitted with flexible (Aero-quip-type) water feed pipes from the engine to the turbocharger housing.

i) Air leaks in the exhaust system, down-stream of the turbocharger, tend to cause surging and shock waves in the turbocharger itself. Such derangements eventually destroy the thrust bearings in the turbocharger.



The Intercooler layout of the SIERRA RS COSWORTH, using standard parts in Group A form.

**Cooling System - Cosworth - 'Intercooler Items'**

Drawing Reference	Component	Part No	Finis Code
P1/1	Intercooler	V86BB9L440BE	1640329
P1/3	Hose	—	1638308
P1/4	Hose	—	1638184
P1/5	Hose	V86BB9P842AA	1640330
P1/6	Hose clamp	—	6130115
P1/8	Air cleaner assembly	V86BB9600AB	1637724
P1/9	Air cleaner element	V86BB9601AB	1637725
P1/10	Foam element	H87WS9600AA	9092416



**Note:** Homologation changes coming into force for 1988 mean that some 1987-specification Group A engines may need to be modified, as standard intercoolers (with which the standard production RS or RS500 COSWORTH models were originally equipped) have to be used. This means that the alternative intercooler developed by Ford may not be used in homologated competition. In particular, the need to use standard-size intercoolers means that power outputs will be slightly reduced.

In 1987, however, a Group A SIERRA RS COSWORTH rally engine produced around 300 bhp, whereas a race engine could be tuned to produce about 330 bhp. The SIERRA RS500 COSWORTH is only eligible for racing and rallycross events and can be tuned to give more than 450 bhp.

To date, hydraulic valve lifters have proved to be acceptable for rally engines with a 7,500 rpm rev limit. RS500 engines used in motor racing use solid lifters.

**note** that artificial methods of cooling the standard intercoolers, by water spraying, are not authorised where homologation requirements apply. For 'free formula' motorsport, in fact, the SIERRA RS COSWORTH's engine performance will be improved if an enlarged intercooler is fitted.

