

Special

BMC

SPECIAL TUNING

FOR THE

MINI-COOPER S

970, 1071 & 1275 C.C.



Issued by:

THE B.M.C. SPECIAL TUNING DEPARTMENT
THE M.G. CAR CO. Ltd., ABINGDON-ON-THAMES, ENGLAND

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THE M.G. CAR CO. Ltd., ABINGDON-ON-THAMES, ENGLAND

Model AUSTIN & MORRIS COOPER 'S'
970cc, 1070cc, 1275cc.

Sheet A - 1 Issue 5

These engines are tuned to a fairly high degree in standard form, but further power can be obtained at the expense of some tractability at lower speeds. Full information on carrying out work on these cars is contained in Workshop Manual Part No. AKD 4061.

Copies of up-to-date R.A.C. Forms of Recognition are available ONLY from the R.A.C. Competitions Department, 31 Belgrave Square, London, S.W.1., who will also be able to answer any queries concerning eligibility of modified cars.

Cylinder Head

Remove all frases from combustion chambers and ports, but leave the locating sleeves in place when matching the manifold ports. Raise the compression ratio either by fitting flat top pistons to 1071cc and 1275cc engines, or machining the cylinder head only on 970cc. Removing 0.012" (.305 mm) from the head face reduces the capacity by approximately 1cc. Fitting 3 ring pistons C-AEG 190 (4 off) or 4 ring pistons 8G 2432 (1 set) will make the compression ratio 11:1 on 1071cc and 12:1 on 1275cc engines.

Examine the waterways to ensure all sand and core wires have been removed. Use the standard head gasket AEG 226 and ensure that there are no burrs at the base of the head studs.

Bore

Engines may be up to +.040" (1.016 mm) but DO NOT RE-CHAMFER TOP EDGE OF BORE as gasket burning may result. Flat top 4 ring pistons are available for this size Part No. C-AEG 043043 or 6 (4 off). The 1275cc should not be bored more than +.020" (0.508 mm) to 1293cc otherwise the 1300cc class limit will be exceeded. Calculate appropriate combustion chamber capacity to give required compression ratio. 12:1 is the best maximum, but 100 octane fuel is required.

Camshaft

For rallying, use the latest standard camshaft AEG 510 to give reasonable low speed pick-up, but for racing and maximum power fit camshaft C-AEA 648. (See sheet Z-2 for camshaft details.) This camshaft will require longer tappet adjusting screws C-AEA 692, or machine 0.050" from base of rocker shaft brackets if using standard screws.

Valve Springs

Standard valve springs will avoid undue load on the valve gear, but stronger ones are available to increase valve crash speed to 8,400 r.p.m. The new bottom locating collar must be used in place of the existing standard part.

Valve spring inner	-	C-AEA 652	8 off
Collar-locating	-	C-AEA 654	8 off
Valve spring outer	-	C-AEA 524	8 off

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Carburettors

On right hand drive cars, fit $1\frac{1}{2}$ " carburetter pair C-AUD 178 using installation kit C-AJJ 3301, or for left hand drive cars use carburettors C-AUD 176 and kit C-AJJ 3302. These carburettors are fitted with blue piston springs AUC 4587 and CP4 needles. Use flare pipes C-AEA 485 (steel) or C-AHT 10 (glassfibre) to reduce turbulence at carburetter intake. Track testing may show the following needles and ignition settings to be best, but may be modified to suit the particular engine. The standard distributor is quite satisfactory.

	Static Ign. setting	Needle	Part No.
970cc	12° B.T.D.C.	CP4	AUD 1118
1071cc	7° B.T.D.C.	MME	AUD 1265
1275cc	5° B.T.D.C.	BG	AUD 1067

Plugs

Champion N57R, N62R or N60Y are recommended for racing and N64Y for rally work. N60Y and N64Y are extended nose type and the ignition should be retarded 5° from the above setting.

Exhaust Manifolds

Fit the homologated competition exhaust manifold C-AEG 365 for 1275cc or C-AEG 432 for 970 and 1071cc engines. The standard exhaust system is quite satisfactory, but may be strengthened and upawent at the rear for rallying.

Dynamo

To avoid damage to the dynamo at high speed, it is advisable to fit larger dynamo pulley C-AEA 535 together with longer fan belt C-AEA 756. The coil should be remounted upright on the wing panel at the rear of the engine to reduce the load on the dynamo brackets. The 6 bladed fan 2A 998 is the most efficient, but for racing one or two fans C-2A 997 may be fitted, together with stiffener 2A 803.

A spare fan belt of the correct type can be clipped around the water pump and timing cover to facilitate a quick changeover should breakage occur during competition.

Fuel Pump

When regulations permit, fuel pump AUF 400 has dual electrical components and can be connected up in place of the existing pump, or moved inside the car and re-piped. Ensure that all connections are in perfect condition and that the pipes cannot chafe anywhere. See Mechanical Parts List for details of the twin fuel tank if this is not already fitted.

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Model AUSTIN & MORRIS COOPER 'S'
970cc, 1070cc, 1275cc.

Sheet A - 3 Issue 4

ALTERNATIVE TRANSMISSION GEARS

Alternative gearbox and final drive gears are available for these vehicles. The gearbox ratios are as shown, top gear being direct in all cases.

GEARBOX RATIOS & GEARS

FOR COMPETITION USE

	Std. Ratio (helical)	Close Ratio (helical)	Std. Ratio (spur)	Close ratio (spur)
<u>Ratios</u>				
1st & Rev.	3.200	2.568	3.077	2.573
2nd	1.916	1.780	1.875	1.722
3rd	1.357	1.242	1.307	1.255
<u>Part Numbers</u>				
1st Motion Shaft	See	C-22A 985	C-22G 427	C-22G 430
2nd Speed Gear	Parts	C-22A 986	C-22G 428	C-22G 431
3rd Speed Gear	List	C-22A 987	C-22G 429	C-22G 432
Laygear	AKD 3509	C-22G 210	C-22G 335	C-22G 306
<u>Numbers of teeth</u>				
1st Motion Shaft	20	23	20	22
2nd Speed Gear	28	29	27	28
3rd Speed Gear	24	25	23	24
Laygear	26, 23, 19, 13	24, 21, 17, 13	25, 22, 18, 13	25, 20, 17, 13

These gears must be fitted in sets, and can be used in all Mini Cooper 'S' gearboxes, Mini Cooper 998cc gearboxes, 848cc Mini gearboxes after Engine Number 815140, and 1100s fitted with 'B' type gears only (See Mechanical Parts List).

On all earlier Minis and 997cc Mini Coopers it may be possible to fit a complete late type transmission assembly to accept the close ratio gears. For further information refer to the parts list.

ALTERNATIVE FINAL DRIVE GEARS

Notes: 3.15 = 83/6 = 12.5

RATIO (teeth)	3.44 (18/62)	3.765 (17/64)	3.938 (16/63)	4.133 (15/62)	4.267 (15/64)	4.35 (15/65)
Wheel	22A 411	22A 401	C-22G 340	22G 101	C-22G 370	C-22G 443
Pinion	22A 413	22A 399	C-22G 69	22G 99	22G 99	22G 99

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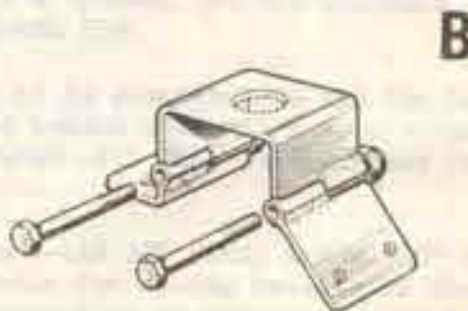
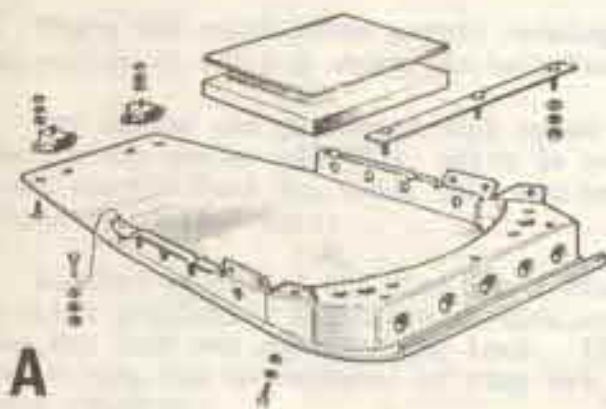
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Model MINI COOPER 'S'

Sheet A - 4 Issue 6

The following additional equipment is available for competition purposes.

Description	Part Number	Qty./Car
Lighter valve rocker (Standard from Engine No. 9P-SA-Y 34540)	AEG 425	8
Pair 1½" Carburettors - fixed jet type (BG needles) LHD	C-AUD 165	1
" " " " " (MMB needles)	C-AUD 59	1
(See also Page 2 Sheet A-1 for Installation Kits and Carbs.)		
Competition clutch cover and diaphragm spring assy.	C-AEG 481	1
Clutch driven plate - for competition use.	C-22G 247	1
Competition brake pad set (DS11)	C- 8G 8996	1
Competition brake shoes set (VG 95)	C- 8G 8997	2
or Competition brake lining set (VG 95)	C- 8G 8998	1
Competition Bonnet securing straps - Buckle half	C-AHH 5518	1
" " " " " Tongue half	C-AHH 5519	1
" " " " " Retainer	C-AHH 5517	2
Wing extension kit, for use with 4½" wheels	C-AJJ 3316	1
'Scottish Rally' Sump Guard - Complete Kit (Illustration 'A')	C-AJJ 3320	1
Very substantial Works guard for serious competition use (35 lbs.)		
Pivoting competition lamp bracket (Illustration 'B')	C-AJJ 3318	A/R
Ringes forward to give access through grille without upsetting focus. One required for each lamp.		



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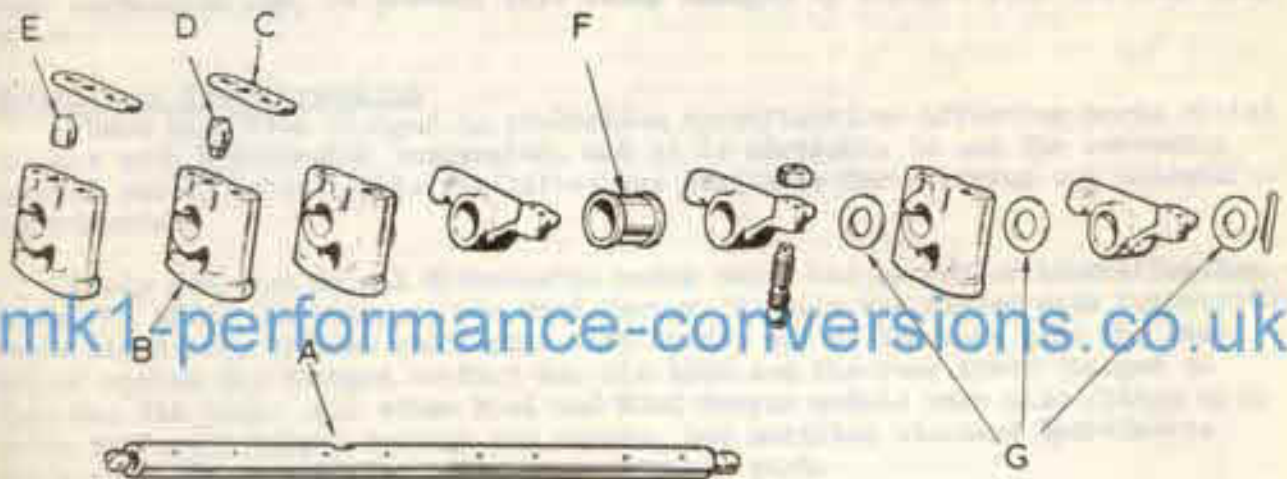
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Model MINI COOPER 'S'

Sheet A - 5 Issue 3

Cancelling Issue 2

A strengthened rocker shaft (A) Part No. C-AEG 399 is now available, which requires an additional tapped pedestal (B) AEG 165, locking plate (C) 2A 515 and locating screw (D) 2A 258. The locating screw (E) in the rear pedestal should be cut off flush with the end of the thread, so that the oil feed to this pedestal is still maintained. The location is now maintained by the adjacent pedestal (B) which should line up with the repositioned hole in the new rocker shaft.



To reduce friction, the coil spring rocker spacers can be replaced by solid distance tubes (F) Part No. C-AEG 392 (3 off) and spacing washers (G) AEG 168 (6 off). These should normally be either side of the end pedestals, but may be moved to ensure each rocker is immediately above the valve stem. The latest standard valve rockers AEG 425 can be further lightened by careful grinding and polishing.

Where the regulations permit running without a dynamo, use the standard water pump pulley 2A 601 and short fan belt Part No. C-AEA 539.

For racing and prolonged high speed driving it is essential to use the large capacity oil cooler ARO 9809, which is now fitted behind the grille as standard. A complete kit Part No. C-AJJ 3309 has been prepared with full instructions for fitting to earlier cars.

Limited stocks of the flat top 3 ring piston C-AEG 190 (Std. and +.010" only) are still available, which are particularly suitable for racing because of the wider top land and reduced ring load. If oil consumption is important, the early scraper ring may be replaced by ring set 8G 2433, but this increases the friction losses slightly.

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Model MINI COOPER 'S'

Sheet A - 6 Issue 1

SUSPENSION MODIFICATIONS

Cone Rubber Type

A maximum of 0.312" (7.9 mm) may be removed from both the front and the rear struts, but modified shock absorbers must be fitted, to ensure that the shock absorber and its mounting brackets are not strained. Armstrong Patents Ltd. manufacture competition shock absorbers modified to suit lowered suspension and different travel. It is essential to move the brake pipe away from the top of the rear suspension arm, to prevent this being damaged by contact with the rear bump stops.

Hydrostatic Type Suspension

There have been changes in production specifications affecting parts fitted to cars with Hydrostatic suspension, and it is advisable to use the correctly matched parts, unless ample facilities are available for carrying out scientific experiments.

Early cars had normal Hydrostatic units which had no colour identification bands. * After the changes, the Mini Cooper 'S' only was fitted with Competition units identified by Blue and Double Blue bands, and at the same time the rear helper spring was changed to Part No. 21A 1806 and the rear strut changed to Part No. 21A 1805. All other Mini and Mini Cooper models were also fitted with these different helper springs and struts, but modified standard Hydrostatic units were fitted and identified by one Orange band.

Alternative Hydrostatic Units

	EARLY CARS		LATE CARS	
	Marking	Part No.	Marking	Part No.
Normal setting - front	NIL	21A 1477	1 orange band	21A 1804
- rear	NIL	21A 1703	1 orange band	21A 1804
Stiff setting - front	1 yellow band	C-21A 1693	2 orange bands	21A 1811
- rear	1 yellow band	C-21A 1705	2 orange bands	21A 1811
Hard setting - front	1 red band	C-21A 1819	1 blue band	21A 1872
Very hard " - rear	2 red bands	C-21A 1821	2 blue bands	21A 1874

N.B. Part No. C-21A 1705 has a rubber gaiter, but is otherwise identical to C-21A 1693.

After fitting new displacer units, ensure that the ball sockets do not become displaced at the start of pressurising. Take the pressure up to 350 lb./sq.in. (24.6 kg./cm²) and wait at least 30 minutes for vehicle to settle, before reducing to the correct running pressure of 263 lb./sq. in. (18.41 kg./cm²) for early cars or 282 lb./sq.in (19.74 kg./cm²) for late cars.

Hydrostatic units incorporate internal dampers, and the fitting of any additional shock absorbers is not recommended or approved by B.M.C.

* See Mechanical Parts List for change-points.

(See also Sheet A-7)

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Model MINI COOPER 'S' (Hydrolastic Only) Sheet A - 7 Issue 2

Rear Bump Buffers

If the front end of the car has a tendency to rise on fierce acceleration, this may be remedied by fitting progressive rear bump stops, which are available as a car set in Rear Bump Buffer Kit, Part No. C-AJJ 3313.

These bump buffers will also tend to improve the handling of the car when the rear is heavily laden, but are only suitable for Hydrolastic cars.

Raising Ride Height

Excessive packing of the displacer struts can be dangerous and under no circumstances should a washer thicker than 0.1" (2.54mm) be fitted. Spacers as shown 'A' are available as follows:

- | | | |
|-----------------|-------|---------------------|
| 0.050" (1.27mm) | thick | - Part No. 21A 356 |
| 0.080" (2.03mm) | thick | - Part No. 21A 363 |
| 0.1" (2.54mm) | thick | - Part No. AJH 5322 |

Cars should not normally be run with pressures exceeding 300 lb./sq.in. (21 kg./cm²) but to compensate for extra weight on the front i.e. sump guard and extra lamps, it is satisfactory to fit stronger rear helper springs 21A 1806 to early cars. As well as affecting the handling, damage will result if the car is driven whilst making continual contact with the rebound stops.

Ensure the Hydrolastic pump pressure gauge is occasionally checked against a steam gauge or similar accurate equipment.

Lowering Ride Height

For circuit racing on relatively smooth tracks, the suspension may be lowered by machining accurately 0.2" (5.1mm) from the front displacer pistons, and 0.3" (7.6mm) from the rear displacer strut. Before refitting these parts, it is ESSENTIAL to see that the ball sockets 'B' still seat properly, if necessary by filing or drilling to clear any ridges. Do not use the standard rear bump buffers, but if the parts in kit Part No. C-AJJ 3313 are considered to provide too much resistance, bump stops 21A 1728 R.H. and 21A 1729 L.H. may be used with the same special securing screws and washers. It is essential to pack the rebound stops to compensate for the lowering of the car to ensure suspension movement is controlled. Fit anti-roll bar kit C-AJJ 3317 and the Red and Double Red displacers to early cars, or Blue and Double Blue displacers to late cars. *

After allowing the new displacer units to settle as explained on sheet A-6, the pressure can be lowered until the car is just clear of the bump stops. Note that the car will settle lower when the fluid is cold, and DO NOT use pressures less than 220 lb./sq.in (15.5 kg./cm²). It does not matter if the pressures are uneven from side to side.

* See also Sheet A-6, and Mini Cooper Mechanical Parts List for Changepoints



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Model MINI COOPER 'S'

Sheet A - 8 Issue 1

Limited Slip Differentials are available for these cars as follows:

	Part No.	Qty.
Limited Slip Differential Kit (For cars with rubber drive couplings only including Mini, Cooper, 1100 and Moke)	C-AJJ 3303	1
Includes: Limited Slip Differential Unit	C-22G 412	1
Bolt for wheel	C-22G 434	1
Locking plate	ATA 7385	3
End cover complete	22G 419	2
Oil seal	22G 423	2
Driving flange	C-22G 422	2
Collet for driving flange	22G 424	4
Nut for flange	C-22G 426	2

Limited Slip Differential Kit (For Cooper 'S' cars with needle-roller drive shafts only)

C-AJJ 3326 1

Includes: Limited Slip Differential Unit	C-22G 490	1
Bolt for wheel	C-22G 434	6
Locking plate	ATA 7385	3
Driving flange	C-22A 1120	2

(Earlier kit C-AJJ 3315 can be used providing 2 off flanges C-22A 1120 are fitted)

N.B. On early Mini Cooper 'S' cars only, the rubber drive shaft couplings can be replaced to take the latest drive-shafts and limited slip differential by using the following standard parts.

End cover	22G 419	2
Seal - for end cover	22G 423	2
Collet - for driving flange	22G 424	4
Seal - rubber, for flange	22A 1135	2
Washer - plain	22A 1124	2
Washer - spring	22A 1125	2
Setscrew - for driving flange	22A 1104	2
Nut - for bolt	LNZ 205	8
Driveshaft R.H.	21A 1857	1
Driveshaft L.H.	21A 1856	1

If a conventional differential is required after converting to needle-roller couplings, differential gears 22A 1151 (2 off) will be required.

Replacement pawls C-22G 417 (8 off) are available for both limited slip differential units.

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Model GENERAL

Sheet Z - 1 Issue 2

The following information is issued in order to facilitate the choice of a suitable final drive ratio for any particular application.

The table indicates the wheel revolutions per mile for the tyre size commonly used on B.M.C. vehicles. From this the vehicle speed per 1000 engine revolutions per minute can be calculated using the formula.

$$\text{M.P.H./1000 R.P.M.} = \frac{60000}{\text{axle ratio} \times \text{wheel revs per mile}}$$

$$\text{or K.P.H./1000 R.P.M.} = \frac{96560}{\text{axle ratio} \times \text{wheel revs per mile}}$$

This formula gives the speed in direct top gear only but the equivalent road speed in any intermediate gear can be calculated by dividing this by the gear box gear ratio.

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Tyre Size & Type (Dunlop)	Wheel revs per mile @ 30 MPH	Tyre Size & Type (Dunlop)	Wheel revs per mile @ 30 MPH
520 x 10 C41	1058	520 x 14 C41	865
145 x 10 SP	1095	560 x 14 C41	853
520 x 10 CW44	1060	590 x 14 RS5	842
550 x 12 C41	960	590 x 14 C41	831
145 x 12 SP	980	145 x 14 SP	892
155 x 12 SP	960	155 x 14 SP	873
550 x 12 CW44	955	165 x 14 SP	854
520 x 13 RS5	914	560 x 15 C41	814
520 x 13 C41	917	590 x 15 RS5	807
560 x 13 C41	884	590 x 15 C41	803
590 x 13 RS5	871	165 x 15 SP	820
590 x 13 C41	867		
145 x 13 SP	934		
165 x 13 SP	892		
175 x 13 SP	874		

For further information contact the tyre manufacturers direct.

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Model 'A' Series General

Sheet 2 - 2 Issue 3

The following details apply to B.M.C. camshafts currently available for 'A' series engines.

Camshaft Part No.	2A 297	AEA 630	AEG 148	2A 948	AEG 510	C-AEA 731	C-AEA 64B
Alternative Part Nos.	8G 712	12G 165		12A 122	88G 229		
Marking	-	2 rings	-	1 ring	1 ring	3 rings	AEA 64B
Cam lobe width	$\frac{3}{8}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "
Inlet opens BTDC	5°	5°	5°	16°	10°	24°	50°
closes ABDC	45°	45°	45°	56°	50°	64°	70°
Exhaust opens BBDC	40°	51°	51°	51°	51°	59°	75°
closes ATDC	10°	31°	31°	31°	21°	49°	45°
Inlet Period	230°	230°	230°	252°	240°	268°	300°
Exhaust Period	230°	252°	252°	252°	252°	268°	300°
Cam Lift	.221"	.250"	.250"	.250"	.250"	.252"	.315"
Valve Lift	.285"	.318"	.318"	.318"	.318"	.320"	.394"
Running clearance	.012"	.012"	.012"	.015"	.015"	.015"	.015"
Standard Use	Mini	ADO 16, Midget	Cooper '5' 1964/S Midget II	Cooper 997cc	Cooper 'S' 1966 *	Tuning	Racing

N.B. Identification may be made by a combination of markings and the cam lobe width. $\frac{3}{8}$ " = 9.5 mm., $\frac{1}{2}$ " = 12.7 mm.

* Fitted from Engine No. 9F/SA-Y/40006.

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Model GENERAL

Sheet 2 - 3 Issue 2

Overheating

Assuming that the cylinder head gasket is not leaking due to distortion and that the correct sparking plugs, ignition timing and mixture are being used, the following possible causes should be checked.

Examine the bottom hose 2A 245 on 'A' series engines, as in some cases the heater outlet portion protrudes into the main bore, thus restricting the flow. Cut off the surplus with a sharp knife, and the grinding of a slight taper into the bore of the water pump intake will also assist the flow. Old hoses will often start flaking on the inside which reduces the flow, and should therefore be replaced.

Assuming the thermostat is working correctly, overheating can result if it is removed without fitting blanking sleeve 11G 176 in its place. Where regulations do not permit removal of the thermostat, the by-pass connection between the cylinder head and water pump should be sealed on 'A' series engines.

If the car is fitted with a heater, overheating in traffic can often be prevented by opening the water valve and running the heater so that this acts as an extra radiator. For running under hot conditions, it may be desirable to fit a thermostat which opens at a lower temperature, such as 13H 2526 (74°C, 165°F).

After continual use in dusty conditions, the radiator core may become partially blocked, possibly with leaves and insects. This can be cleared by compressed air or a jet of water used in the opposite direction to normal air flow.

Obstructions to air-flow, such as badges, extra lights and rally plates can all cause overheating, and should obviously be reduced as much as possible. If a sump guard is fitted, it is essential to use a large capacity oil cooler, and this is also desirable for competition or motorway use. On the Mini, Cooper and Cooper 'S', use a cooler such as that contained in kit C-AJJ 3309. On the M.G.B., Midget and Sprite full details of oil cooler installations are shown in the Mechanical Parts Lists, but a larger M.G.B. oil cooler is available to Part No. C-ARO 9875, and Part No. ARO 9809 can be fitted to the Midget and Sprite.

On the Mini Cooper 'S', the radiator efficiency has now been improved by changing from 13 gills per inch (25.4 mm) to 16 gills per inch (25.4 mm). This may be checked by counting vertically the number of horizontal fins in a given height of the radiator core. The latest Part No. ARA 2064 MUST be used with the correct cap ARA 1633 and improved top hose 12G 751 on the 'S' only.

This same radiator ARA 2064 and cap ARA 1633 can also be used on the Mini Cooper, but top hose 12G 104 must be used on this model.

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