



Service

Article #10

www.leylandaustralia.com.au

“Mini Steering Rack Overhaul”

by Tony Cripps.

1. Introduction

This article provides additional information that is not shown in the workshop manuals for steering rack overhaul for Australian Morris Mini. Because steering racks have superficially the same appearance, but may come from a variety of different manufacturers, it is important to become familiar with the differences between them since to interchange parts during reconditioning can lead to dangerous outcomes.

2. Mini Range

In the Mini range, apart from the UK-made racks fitted to early model Morris 850, the most common rack encountered is AYA6001, made in Australia by Cam Gears (Steerings Pty Ltd). There are two versions of this rack, both marked AYA6001, but they have major differences.

When both racks are viewed side by side, it is readily apparent that the pinion protrudes a greater amount from the casting in the earlier rack AYA6001. The later version, given the number AYA6001A by the Parts and Accessories Division, has a raised casting at the pinion to accommodate a ring spacer between the upper bearing and the pinion teeth.

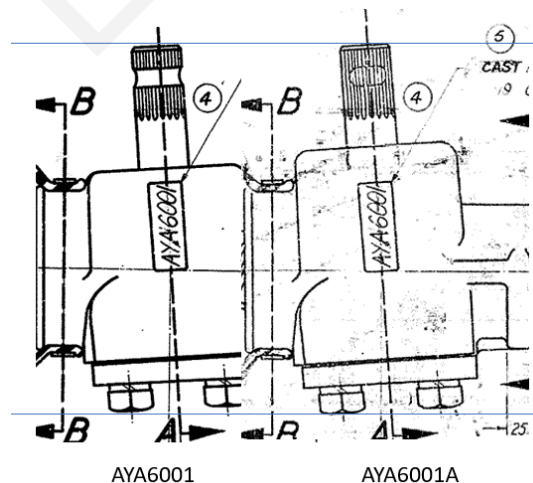


Fig. 1 Comparison of AYA6001 and AYA6001A showing difference in height of housing.

The reason for introduction of the spacer is to address a weakness in the former pinion design. The earlier AYA6001 pinion has a stress-raising undercut at the top of the teeth to allow for the corner of the inner ring of the upper bearing to sit flush against the top surface of the gear teeth. To avoid this

condition (which becomes an issue when the steering column is misaligned with the axis of the pinion – a common circumstance), the AYA6001A pinion is machined without the undercut and indeed, is made a small amount larger in diameter at this location (by 0.010") for added strength. The clearance for the spacer to sit flat is now accommodated by a chamfer on the inside diameter of the ring. Some rings have a chamfer on both upper and lower faces, while others have a chamfer on one side only. The chamfer must be installed so as to be pointing towards the pinion teeth to allow clearance at the corner. As well, putting the bearing higher in the housing puts less load on the upper bearing due to a leverage effect (but with proportionally more load on the lower bearing).

AYA6001A requires the use of U bolt spacers to make the rack sit square with the bodywork. If your car has had its rack changed and AYA6001 has been fitted instead of AYA6001A, then the spacers may be lost and would have to be fitted again if AYA6001A is to be refitted. Shorter height locknuts MYH319 are required for use with the spacers. Early ADO15 models with UK steering rack use nyloc nuts LN2205 (overall height 0.407", thread length 0.304") while later models use MYH319 (overall height 0.278 – 0.318", thread length 0.190")¹.

3. Repair and Overhaul

One of the more difficult parts of overhauling the rack is dealing with the lock rings on the ball housings at each end of the rack. For UK made racks (early model 850 and late model "Enfield" Mini – with racks made in UK), unlike the holes in the lock rings on Australian racks, there are milled axial grooves and the lock rings can be prised up with a suitably shaped punch ground to a chisel shape. Very late model steering racks FAM7306 have a locking pin which passes through the lock ring and ball housing and into the steering shaft. The end of the pin is staked over to stop them falling out. These racks can be easily identified by the presence of a centering hole at the bush housing – the bush in this case being a short length made from a plastic material.

To complicate matters a little further, earlier racks (both 850 and AYA6001) have an annular groove in the spline for the pinch bolt while later ones (from late 1973) have a much safer tangential groove. What isn't always noticed is that the top of the pinion as you look down on it has a scribed line which is supposed to be vertical when the rack is at the straight ahead position. For racks with an annular groove, the significance is that it makes it easier to refit the column and steering wheel from above if you can look down on the end of the pinion and know that the rack is centred. For racks with a tangential groove, the tangential groove (for RHD) has to be horizontal at the bottom otherwise the cancelling pin on the upper half of the column won't be in the right place. The scribed line was discontinued at some point because the tangential groove (if the rack has been assembled correctly) indicates the straight ahead position.

The setting of shims (despite the feeler gauge measurements described in workshop manuals) is probably best done by feel of tightness of the bearings. The pinion should not spin rapidly on its own but have a slight amount of preload – but not enough to cause binding - but not too much to result in any axial movement. Experience is the teacher here although workshop manual feeler gauge measurements are a helpful check.

The spring-loaded plunger should result in a reasonable torque at the pinion. Not too loose, but not too tight. There is a procedure in the workshop manual as to selection of the plunger shims but this setting depends on the tightness of the rack bush at the end, and some of the newer plastic bushes

¹ It is possible that the shorter height nyloc nuts MYH319 are used in conjunction with AYA6001A which is used with spacers AYA6007 since using the earlier nuts LN2205 with spacers reduces the thread engagement in the nyloc ring.

are a very tight fit. The steering has to centre itself after coming out of a turn (via castor action of the wheels). Some feeling and experience is needed to gauge the correct amount of shimming.

Drawings show that the pinion should require 10-12 lbin to start moving with the felt bush removed and 20 lbin maximum with felt bush fitted. The minimum damper load is to be 80lb.

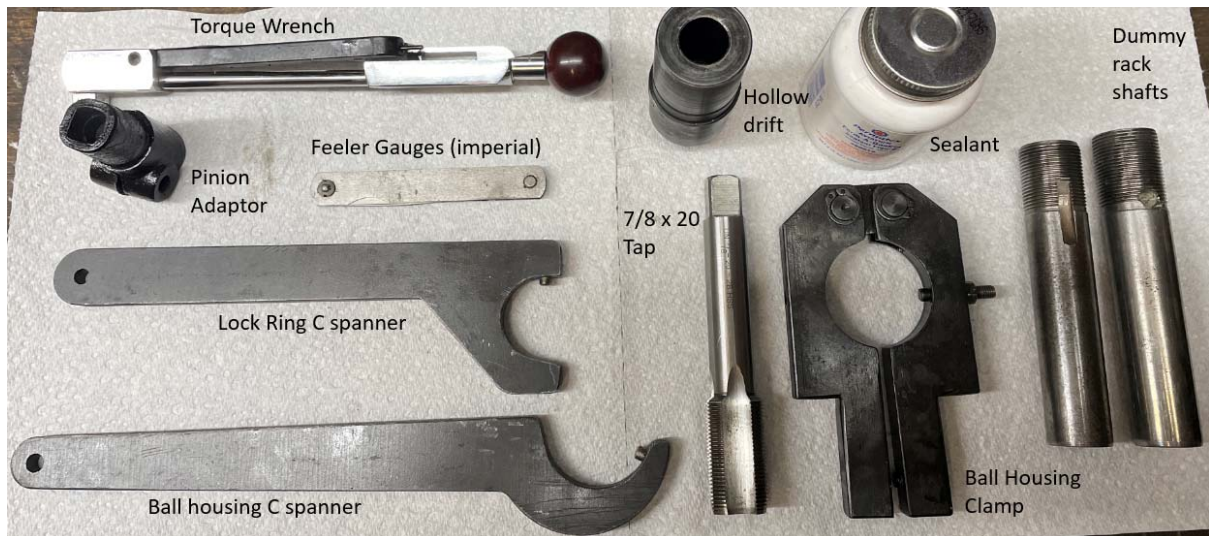
The outer rack bush, originally made from felt, is often replaced with a plastic part with somewhat dangerous consequences. These plastic bushes won't fit inside the metal can which has to be thus removed (and as is so stated in the blue workshop manual). Sometimes these bushes are too tight a fit on the rack. But the ones which appear to give a nice sliding fit on the rack, slip along the inside of the tube (despite the presence of the securing screw) and can pop out the end which may give loss of steering control if it comes out completely. The thick face of the polygon side should face the screw so that the presence of the rack forces the material on to the thread of the screw, and as well, I would recommend using some Loctite product on the outside surface of the bush to make sure it stays in place.

Note also that a UK-made rack has a smaller rack diameter than an Australian made rack, probably on account of the availability of round steel bar stock. There are five pinion teeth on an Australian-made rack and six pinion teeth on a UK made rack. The ball ends, tie rods and even the (short) nylon rack bushes which are often advertised by Mini spare parts outlets are not interchangeable.

4. Special Tools

The picture below shows the special tools required for this work.

- C spanners for ball housing and lock ring – conventional C spanners are not suitable since they are often too large, and the hinged arm makes it difficult to get a tight fit of the pin into the hole and grip on the ring and housing. The proper C spanners can be easily cut out with water jet or laser and make the job much easier.
- Torque wrench for setting plunger shims (if the rack bush is not too tight a fit). This required an adaptor made from a cut-off steering column. The factory tool for this purpose is an adaptor which fits on to a bar which has a sliding weight.
- A 7/8x20 UNF tap (AYA6001/AYA6001A only). for cleaning up the threads on the lock rings
- Imperial feeler gauges.
- Dummy rack shaft for spreading of the rack bush (if replacing with felt).
- Ball housing clamp (makes holding the assembly easier while loosening the lock ring).
- Hollow drift for installation of pinion seal.
- Extractor for felt bush cannister if replacing with plastic bush.



As well, also needed is a quantity of Permatex gasket sealant for the larger ends of the rubber boots and also bush lock screw. 200 mls of gear oil. About a litre of degreaser and a quantity of paper towels. Standard tools such as spanners, punches, screw drivers, etc.

- Parts needed might include:
- Felt bush or poly bush
- Pinion oil seal
- Preferably new lock rings (2)
- Tie rod boots (2) and clamps (not plastic ties).
- Bearings (2) if existing ones cannot be reused.
- Selection of shims both bearing and plunger.

5. Common Issues

Inspection of the rack and pinion teeth, together with the tie rod ball ends is important since nay damage or wear will result in improper and unsafe operation.

A common problem is to find that the central rack tube, which is a press fit into the alloy castings on each end, is bent. Curiously, the bend is usually towards the bush end of the tube. Such a housing should be discarded, and if possible, the whole assembly also since it indicates undue load put on the pinion, rack teeth and bearings.

Other common problems:

- Rusty bearings
- Rusty ball end sockets
- Bent tie rods
- Excessive wear on rack and pinion teeth.
- Cracked teeth.
- Gouges in the rack from bush securing screw and also bearing cover plate screw of wrong length inserted (a short screw goes into the through hole, longer screws into the blind holes in the pinion housing).
- Worn splines on pinion.
- Damaged lock rings from excessive re-use.
- Rounded threads on rack ends from careless removal of lock rings and ball housings.

Points to note not always mentioned in workshop manuals.

- Etched line on top surface of pinion to be vertical with rack at mid-position of rack travel.
- Ball housing and locknut to be tightened to 400-450 lb ins and resulting in 32-52 lbs to produce articulation of tie rod.
- Oil seal to be pressed in (after assembly of pinion) flush with top of casting.
- Total of 3.5" rack travel.
- Belville washer convex faces (small dia) assembled together.
- SAE 140 hypoid oil
- Spray hylomar on shim surfaces.
- Is using AYA6001A with spacers, shorter height locknuts MYH319 are required to provide sufficient nylon locking surface.

This work is safety critical and should not be undertaken by a novice unless under supervision. The greatest problem faced by the reconditioner is the legacy from work undertaken by previous practitioners.

Tony Cripps