STEERING RACK

This article, the accompanying photos and captions the stripping inspection and rebuilding of a Mk2 Mini steering rack. First though, a list of thanks to all those who helped during its progress. Nick Rogers from Min-E-Bitz, my local classic car pals Andy, James and Tony plus former Jaknight from the USA who had the yoke and pinion plate shims reproduced. The actual tube assembly was a joint venture by Accles and Pollock for the tube, Cam Gears the mechanism and final machining and ALCAN the alloy casting process.

Where I identify bits and pieces and to avoid any ambiguity I'll refer to the AKD 5104 parts list and section J3 in the standard workshop manual (the wkspman hereafter). I have to say that whereas the old standby Haynes manual is much derided, when it comes to the steering rack description and drawings, it was good. But alas, it doesn’t clearly differentiate the differences between the various racks – or maybe it’s just me!

I’m sure that the mention of that wording ‘….worn or undue play steering rack or mechanism….‘ on the MoT failure certificate will bring on the quakes and shivers. A bit like a hydrolastic fault! Nope, Ok then, I agree, nothing can be that bad but…. There’s nothing complicated about a rack, it’s just a VERY simple gearbox that transfers direct rotary movement to direct lateral movement through 90 degrees. In fact, the worst part of this whole job is getting the bugger out of the car! I’m not even going to go there because no one can simplify the operation easier than the manual.

Now it’s confession time....... big time! While I was writing up this article I confess to reading back articles on the forum to aid my task and refresh my memory from rebuilding mine in the early 80’s and a couple of others since. I also spoke at some length to my old Aussie pal and mechanical maestro, Chris, known to us forumers as Spider. Spider told me that he’d already written a comprehensive rebuild article on another forum. So, to save myself a load of writing I’m going to refer you to THAT superb article and where I’ve done something different or offer a different explanation, I’ll chime in. Chris has graciously allowed me to refer to his article that I’ve piggy-backed onto. Many thanks Chris

http://www.theminiforum.co.uk/forums/to ... type-mkii/

The first question is this. How do I identify a Mk2 type rack from a pile of them? Here’s a few of the visual and readily identifiable differences.

a) There’s a distinct white (or painted black!) threaded plastic PLUG, HOUSING, 37H-3780, in the housing at the opposite end to the pinion.
b) The Mk1 rack requires 2.3 turns from lock-to-lock whereas: the Mk2 rack requires 2.7 turns from lock-to-lock. Easy to test off the car. Lightly grip the pinion with mole grips and rotate from end to end.
c) There SEEMS to be a serial number stamped into a flat the pinion end that starts 2E, 2K, 9E but whether these codes followed by a series of numbers/letters mean anything is a mystery!

Unipart did an exchange replacement rack service that burned their fingers very slightly according to my senior Unipart exec neighbour, Terry. That was because one of the conditions for the exchange was that the rack tube must not be bent, crushed or otherwise distorted. OR damaged to the cast-in alloy ends. General wear and tear was perfectly acceptable of course. This was because Unipart and the small sub contracted engineering company engaged with the refurbishment task price was based on 80% (?) renewed internal parts except certain parts subject to close inspection, all re-assembled into a stripped and rebuilt tube. If the main tube or casing was damaged, the remainder was scrap – save for small recoverable but useful parts – and that amounted to a virtual total loss on that deal AND an exchange rack.

Stripping a rack is pretty straightforward and I’m minded to suggest that if you’ve got this far you bin the outer steering joints and inner boots UNLESS you are certain that they are in perfect condition. One of the PITA’s that you’ll encounter is the dimpled locking/punch marks in the circumference of the LOCKNUT, item 11/17H 6379 – identical and interchangeable with the Mk1 rack incidentally. Lifting the inner punch mark was simple. The outer punch mark was a bit more difficult. I sharpened a bit of 1/8” steel rod to a chisel point and lifted the punched area upwards until it was semi clear – and then just backed it away from the BALL HOUSING, item 29/37H 2078. There is a service tool for this but the photos show the simple tool I used to start and tighten the locknut.
Both pretty well self explanatory. A steel rod, approx. 1/8” - .125” or so dia ground down to an unequal edged chisel shape shown. It’s then a simple matter to sit the shorter edge in the flat of the actual rack and the ball housing, up against the indented punch marks and with a few hammer blows, to lift the stake marks – ready to use the lock nuts again.

It’s a simple one-way-trip tool for your usual home restorer. This one was hard steel but there really was no need. A simple mild steel rod will do for a couple of uses and then regrind the tip.

Here’s the first tip. The workshop manual tells us clearly that all the mating surfaces MUST remain mated together. This includes the tie rods item 26/17H 8864, the ball housings 37H 2078, the ball seats, 37H 1443 and the lock nut 17H 6379. Fair enough……., but the lock nut isn’t part of the matched set so ignore that. Make sure that you deliberately SWOP the left and right side lock nuts over because doing this will pretty-well ensure that the previous punched locking marks WON’T coincide with the locking recess on the opposite side. So you re-use the locking nut/tab and lock the ball housing to the rack with a fresh part of the locking tab. Simple and it’s saved you a few ££’s already.

I simply stamped a number into the matching parts but you could easily just stamp a centre punch dot or two dots but don’t mix them up. It’s poor engineering practice and equally so, to stamp anything into the thin locking nuts for fear of distorting them.

You can see the small figure 1 on the track rod and ball housing. I just scratched a figure 1 into the matching nylon cup to keep them together on re-assembly. What you can see clearly is the groove into which we insert the small tool (photos 7 and 8) to lift the staked part of the lock nut.
One thing that I did find particularly difficult was the fact that while the lock nuts were being removed, presumably burrs on the edges of the locking slots in the rack had slightly damaged the internal corresponding thread in the lock nut. So once the lock nuts are removed/unscrewed with the special ‘C’ spanner or other ‘grippers’ (yep, I mean a stilson or other round-jaws…..) make sure that before you start any reassembly, this potential problem is solved by thread cleaning/clearing. If not, it means that the accurately set up and assembled pinion and yoke rack support item 12/37H 2084 has to be disassembled and all your work will have to be undone and the rack stripped in order to correct the tightness. It’s not a problem with the ball housing threads but the ball housing, track rods and nylon spring loaded cups must remain as a matched set.

Pretty well self explanatory. All cleaned and ready to reassemble including the cleaned up track rod to rack lock nut and a new track rod end lock nut. Don’t forget to replace the ball seat washer (not shown but attached to the underside of the nylon ball seating and protects the seating from being gouged by the thrust spring.

As for removing THE RACK BUSH (21A 1797), I’m with Spider here in that I also used a length of threaded studding but turned down an oversize diameter washer, retained by a nut either side and whacked the backing disc or spacer (Item 7/BTA 786) bush and sleeve (item 6/37H 2079) out with a mallet after removing the locating screw (PTZ 608). I have to say that I’ve only ever encountered tight bushes/sleeves so any notion that the locating hole for the screw in the sleeve and bush will re-align on re-assembly is pie in the sky. It ain’t!
My home made rod and washer used to drift out the rack bush. The thick washer .890” dia or so was able to clear the inside of the tube but engage on the narrow shoulder of the old bush and sleeve. There’s not much of a shoulder but a couple of taps with a mallet will start it and push it out. Simple but it works

Like Spider says, I simply machined a new bush from a piece of bronze off-cut. As I recall, the i/d was .840” / 13/16” while the o/d is best described as a tight push fit into the steel sleeve. But having said that, machine yours to suit your rack. Whether you machine your new bush to fit inside the steel sleeve or fit directly into the 1.375” dia alloy housing is entirely a matter for you. Or indeed, whether you simply use a new nylon type bush item 5/21A 1797. Like we all know and learned at an early age, all oily well lubricated bushes must be a PERFECT sliding fit on the member for the best performance...........!!! Well....., it had to be said!

When it comes to refitting the new nylon or bronze bush and outer steel sleeve in the rack, here’s something you MUST know. Allowing the sleeve to ‘cock’ slightly as it is being gently tapped back into place in the passenger end of the rack is easily done. Yep, that’s JUST what I did. It meant knocking it out again, to re-start it - , SQUARE this time! And doing so, I damaged the inner edge of the new bush. Buggers........ But because I hadn’t gone too far, I was able to scrape the slight damage clear. Phew.......!

Don’t make the same mistake. This time I turned a piece of old broom handle with a square shoulder as shown in the next photo. Simple to do, with the small diameter being approx .475” or so (to fit into the .480” hole in the bush don’t forget), square shoulder, and the outside diameter a sliding fit into the bush-end of the rack. Now a few hefty taps with a mallet on the wood drift knocked the new bush and sleeve squarely into the housing to sit on top of the internal backing disc or spacer item7/BTA786. I didn’t even bother attempting to align the old retaining screw (PTZ 608)) hole
The wood drift used to knock the new bush and sleeve squarely into the rack. A perfect fit and square shoulder means that the bush and sleeve will be square-on first time. Simple –

Instead of using the self tapper PTZ 608 to retain the sleeve and new bronze bush in the housing I simply drilled through the original screw hole and used a 4BA screw or the metric equivalent instead. Make sure that the thread is sealed with sealant with a fibre washer under the head. The thread must not intrude into the path of the rack of course.

As shown, the round head 4BA screw with a fibre sealing washer. Whether you use wavy, fibre or a star washer as shown is a matter for you just so long as it remains oil tight and the screw is a few threads short of the bush.

It has been reported by my UNIPART contact that the real reason for the original felt and later nylon type rack bearings was to allow a small degree of articulation by the rack in the tube. This could/might be caused by the rack bearing at the passenger end not being bored square against the accurately/square boring, taken from the transverse pinion and yoke boring in the steering column end. Yep……., you’ll need to think about the mechanics of
that before it sinks in….. Anyway, there it is but I’d suggest bronze is the way to go.

Fitting the track rods and ball housings.......... Yes........ Ideally, the manual tells us to tighten the ball housing up to lock the tie rod and then back-off 1/8 turn to allow complete articulation of the tie rod ball in the housing. But clearly something wasn’t quite right on mine because there were one or two slightly discernable – or feelable - tight spots as I articulated the tie rod round and round/up and down. Making sure that the case hardening was still intact, I used a sliver of grinding paste and just lapped the ball and housing in for a minute or so until it was perfect. Don’t forget we’d already done the same to lap in our notchy suspension ball joints.

**The BEARING, Pinion, item 20/17H 8263 or BTA 662.** I’m of the same opinion as Spider that these don’t wear out from use as such - but they do corrode through neglect! As simple bearings they don’t do much load bearing mechanical work. In fact, thinking on my feet and stating the bleedin’ obvious, throughout their life they can only rotate through 5+ complete rotations from one lock to the other at most. There is very little pre-load (or friction) to speak of and certainly the bottom/lowest pinion bearing will/should remain oil bathed throughout its life so physical wear is limited except for the rare exception when the wheel might be grabbed from your grasp when the front of the car or wheel is battered.

This is where the problem lies. The upper bearing isn’t continually oil bathed but is protected by a SAE standard oil seal (item 19/88G499) which together with the SEAL, Rack or boots (item 30/17H 6298) to prevent water and crud getting in. Once they leak, that’s the start of the problem. Certainly when I rebuild my racks* I examine the bearings under a magnifying glass on a light table. Alas, so far as I can tell now, these bearings aren’t available in the UK/EU but I bet you, with a bit of thought and a detailed search of the bearing manufacturers sizing data that given the standard imperial inside (.567” – 9/16” or so) and the outside (1.359 –1 23/64” or so) diameters of the races then suitable alternative hybrid sets can be made up.

On the other hand, those doughty Antipodeans DO have rack pinion bearings, available from:

On that basis, if you have a rack with knackered bearing(s) don’t bin it. Sometime in the future some budding mini enthusiast or trader will search the data sheets and make up a suitable alternative. Or simply order a set from Oz. Or if you’re in dire straits, what about machining up a set from oilite or bronze (* it’s only a few mini ones I have to confess.....)

Anyway, for my part I pack both bearings with standard bearing grease and fill the rack with oil as specified

As for the Viton O ring item 13/37H 2085, they are actually to BS 212 spec and available for a £1 or so from SEALSUPPLIESUK on Ebay (ask for:)

**Imperial Viton Rubber O Rings 3.53mm Cross Section BS211-BS223 (20.22-40.87mmID)**

I got 5 for a fiver, post free

In the UK, the same applies to the JOINT, pinion or gasket item 22/CCA 27 that’s usually stuck firmly to the COVER, Pinion end, item 23/CCA 23. If you damage it or wish to renew the .010” paper-like FLEXOID gasket material is available in A4 sheet form in the thickness you require, enough to make 10 for a couple of ££! I’ve been reliably informed that these strange CCA part numbers indicate to BMC Service/Unipart that they are a Cam Gears identifiable and sourced part. Totally irrelevant I know - but you never know when it might crop up in a mini themed quiz or crossword!

Incidentally, just a little warning. The SHIM, Pinion shown at item 21 (in 3 different thicknesses and NLA) is drawn totally disproportionately inaccurate in the parts list and looks confusing. The shims are approx. 1.3” or so in diameter and easy to cut from simple steel or brass shim material to suit your needs.

As for the lubrication…… During some period (unknown), the lubrication within the racks went from hypoid oil to grease – and back to oil! This was supposedly to cure oil leaks. While I can see the benefits of both (but I’d suggest graphite instead of LM.....) I would take the oil route as later draining and refilling, in situ is easier . To this end, what I’ve done is to assemble the rack dry and put it on the car like that. Then I temporarily fill an old oil can with the correct hypoy oil (or have the correct amount handy for a couple of fill-ups) and slip the nozzle into the track rod end and pump the oil in. Wiggle the steering wheel every so often until it’s done and replace the track rod boot clip.
The small oil can with a small nozzle that will slip under the small end of the track rod boot and can easily be used to top up the rack with 1/3" pint of Hypoy 80 gear oil.

And while we’re here, here’s a little tip. While the rack is apart, might I suggest that you carefully file off all rough edges, pips, joint lines and any other blemishes from around the periphery of the 3/8” or so wide area at the far ends of the housing. That’s the area where the rack gaiters seat and are sealed by the clips or cable ties. When they’re cleaned off, just tear a 3/8” or so strip of medium to fine emery cloth and polish that radial area up a bit. It’s these blemishes that are the culprit for oil leaks. Being smooth ensures that the new gaiters sit and seal close to the housing. Thereafter you can safely use ¼” wide cable ties knowing that they’re correctly sealing the boot on the smooth housing surface.

And something else. Make sure that the cable tie clicker joint is positioned at the TOP of the housing _AS THE HOUSING IS INSTALLED ON THE CAR._ (To simplify that…. pinion end closest to you, hold pinion upright at 12 o’clock, cable tie joint to be at 1o’clock. From the passenger end, pinion at 12 o’clock, cable tie join to be at 11o’clock). The reason for this simple suggestion is that the only weak link in the cable tie oil tightness is at the joint. The oil level is well below the top so if the joint is at the TOP it can’t leak.