Dave Kamp's book of
IH Cub Cadet Modifications:
U-joint Driveshaft

WHAT IS THIS 'MODIFICATION', AND WHAT PROMPTED THE DESIGN?

First Answer: necessity. These darned pin-couplers worked, and most are still in service, but they wear and fail at what I consider to be a 'consumeable' rate. Frankly, I hate consumable parts that can't be removed through a drain-plug, using a catch-pan... and can't be replaced using a funnel and a few paper towels... I especially hate consumable parts that can't be changed in under 4 minutes. Oil and air filters, spark plugs, fuel, and oil are enough of a PITA, I'd rather put my tools to WORK, rather than WORK on them. Not only am I a busybody, with an eternal to-do list, I'm also lazy- hate doing things that shouldn't've had to be done in the FIRST PLACE.

You'll find, in reading through, that not only do these modifications improve the mechanical considerations of the machine, there's a few aspects where it actually makes maintenance easier, faster, etc... Again- I'm a busybody, always working on something, but I HATE having to work on something that I just fixed the other day.

May God bless Harold Schramm for introducing this Cub Cadet to the world- without it, I'd have no reason to be documenting what I've done, but worse yet, I'd have no Cubs to help me do all the work that I'd rather THEY bear the heaviest burdon of. Harold was undoubtedly one of the nicest, sharpest guys I've ever met, and an extremely astute engineer in both terms of product design excellence, but also in Quality Control. There's three aspects of Quality Control- first being... getting quality HIGH enough to get customer satsifaction... next, getting quality NO HIGHER THAN what's necessary to meet the marketplace with a competetive product (that's profit). The LAST, is designing something so that it hits the UPPER level, at the cost of the LOWER. Example being: excess precision. People think that manufacturing parts is expensive... it's not... but manufacturing with PRECISION is VERY expensive. If you design something that requires substantial attention to precision, it may be a nice product, but it'll be not only too expensive to be competetive, it'll also be too finicky when in a varying environment. Agricultural environments being what they are, the LEAST amount of precision is typically the best. Putting all these things together is what old-school engineers refer to as making 'successful design compromise'.

In the realm of the General Consumer market, There's only a few natural weaknesses to the Cub Cadet... the coupler is one of them... there's a few other minor things. We Cub Cadet enthusiasts, however, exceed the realm of "Joe Consumer" who was purchasing these things new between the 1960's and '80's... we hang incredible amounts of ballast, hop up the engines, fit implements, and thrash them like a red-headed stepchild... and these machines soldier on through it all, like they were intended to from the git-go. In a sick... perhaps sado-masochistic sorta way, we love it... but every so often, the steed gets an Achilles Heel. I purposely go looking for these 'heels', and find ways of resolving 'em.

Follow along as I show you what, and how I've modified on my IHCCs to make some of the natural design compromises a little bit less compromising. As you're looking, keep in mind that Harold DID see most of these modifications before passing on, and noted to me that... if during his tenure on the Design Staff, had some of the materials and products that I employ been available, as well as the insight into long-term wear and use weaknesses, they likely would've made some of the same decisions I did. I consider that one of the most respectful comments one could ever recieve, but it isn't warranted- hindsight engineering is much easier to do, than foresight engineering.

ABOUT THESE U-JOINTS

The modifications to follow don't revolve around any one single part, rather the entire assembly. The most noticeably obvious component, is the addition of a cardan-type U-joint assembly between the transaxle and the driveshaft. The unit you see is commercially available (details below) through a number of sources, but sometimes your local counter-attendant won't have the determination, patience, or experience to know how to 'find' them. If that is the case, and you're cornered with frustration, I've left you with contact information on how to acquire these parts through the same source I use. Note that I have no pecuniary interest in the sale of these parts- they just happen to be one of my common suppliers, and they try very hard to assist me find all the wacky stuff I need for my 'projects'.

These yokes are high-quality, but compact versions of automotive-style cardan joints. The crosspiece has precision needle-bearings, and have an injectable grease-fitting. SKF has joint listings for a wide variety of shaft types and sizes- the ones I've listed work on Cub Cadet drivelines that use a 5/8" driveshaft. They're suitable for speed and torque applications several times HIGHER than what's available or commonly used in Cub Cadet tractors. They also have more angular swing, and are well-balanced from the factory. The yokes come with a keyway AND drilled/tapped for a set-screw. You buy two yokes and a crosspiece to have a complete unit. The total assembly is suprisingly inexpensive.

I do just a little modification to these joints to make 'em drop-fit into a Cub Cadet- I drill through the rest of the way, using the same drill-size to fit the roll-pin OD, and Instead of using a roll pin, I cut the threads off of, and turn down the shank of an allen-head machine screw. Although it takes additional (and somewhat tedious) machinework, The pin doesn't require a hammer to install or remove, and it's very secure.

DRIVESHAFT U-JOINT KIT FOR 5/8 SHAFTS

-Yoke is SKF 10-4373 (supplier #70719 72) $11.75 each (2 req'd)

-Joint is SKF 1-0170 (supplier #70719) $6.00 each (1 req'd)

These joints are made by SKF, and distributed through Chicago Rawhide (the same folks that make most lip-seals!). Most local bearing companies can obtain Chicago Rawhide products, however, they may not know that they can order products other than seals.

If you can't get progress from your local bearing retailers, call Bearing Distributors, Davenport, Iowa (563-386-4159), and ask for Joe or Dorla. Tell them that you'd like a U-Joint kit like what Dave Kamp buys... (I've listed the part numbers above!) and they'll fix you up pronto.

DRILLING YOKES FOR PINS

The SKF U-joints come (from supplier) with two fixing methods in place... a keyway and a hole drilled-and-tapped for a set-screw. We won't use the former, but the latter will become HALF of our pound-less pin retention method. The process is extremely simple- drill just one perfectly straight hole directly across the yoke from the set-screw. This, unfortunately, is easier said than done... but I've fallen off the horse, so read on, and you'll see what I'm talking about.

The problem with getting precision here, is that you're attempting to drill a hole perfectly opposite (in diameter) from an already drilled hole. Not normally a big problem, but in this case, you're opposite a hole which is LARGER than what you'll be drilling... and next, it's THREADED... that means, you can't just use it as a guide to bore the other hole.

My inital reaction was to make a drilling jig that, once properly fitted to the drill-press, would repetetively, and accurately hold a U-joint for drilling. It used the yoke's keyway to locate the set-screw hole, so when the joint is properly slid on, locked in place (with a quick-clamp), there was essentially 'no' discernable variation that could appear between drilling any two, or twenty yokes. Matter of fact, it was so good, that I could drill the BACK side of the yoke (not through the hole), and get a perfect center-of-yoke drilling axis.

Therin lies a minor problem... the yokes... are factory-machined with the keyway orientation at a 90-degree angle from the set-screw, but the manufacturing tolerance for that angle is kinda high. This made my drilling jig (although fantastically accurate, repeatable, convenient, and secure), totally irrelevant.

SO... don't do this. Make a simple bored-bolt drilling jig like I illustrate later in this document, drill your yokes, and be done with it.

Here's what a properly-drilled yoke looks like.

INSTALLING THE U-JOINT DRIVELINE

Now, recall that in the stock arrangement, it's quite a task to get a driveshaft into, or out of the tractor... it always involves either breaking the rearend out, or removing the engine mount bolts and sliding the motor forward. Did I mention that I really hate stuff that's tedious to maintain? The U-joint kit resolves that!

Install the U-joint kit (using one of the special pins you've made) onto the transaxle. Point the grease-fitting towards the REAR! It'll slide on to 'perfect' depth, then insert a pin through the threaded-end, line it up to the hydrostat input shaft's crosspin hole, push it through (it should be rather snug, mebbie even requiring a few taps from a light hammer), start the threads, and run it home with just a hint of end-torque.

Now, insert the shaft from the engine compartment, around the (hydraulic!) steering column, past the lift-cylinder, and into the U-joint yoke. First installation won't go successfully, as you'll have to shorten the driveshaft a little to accomodate the U-joint's added length. Read on about how to install the shaft, and then do as much installation as you can, and carefully (very carefully) mark the driveshaft and slice off a little bit at a time, 'till you have 'just enough' trimmed off so that it'll go into the coupler okay. Then, pull the shaft into the rag-joint, bolt it down, and use the U-joint as a drilling guide to accurately locate the new driveshaft crosspin hole. Finish drilling, deburr the surfaces, install the remaining 'special pin', torque-check everything, grease the U-joint, and head for the proving grounds.

Remember- I wanted to be able to remove or install the driveshaft without having to disassemble the whole world... fortunately, there's quite a bit of depth to my U-joint configuration. See how the shaft is fully bottomed- it's against the U-joint's X-piece, but the front is well-clear of the rag joint- Plenty of room to install/remove the shaft without fighting the 'launch pin'. Notice- the U-joint's grease fitting is on the AFT side of the X-piece- this allows lots of space for the shaft to retract for launch-pin clearance. If you overlooked the installation, and put the U-joint kit in backwards, the shaft will bottom out against the grease fitting, and you won't have enough clearance to get the shaft in. Please don't make the mistake of cutting the driveshaft to slide into the U-joint assembly with the grease-fitting on the wrong side, as it'll screw up your driveshaft cutting length.

Notice that when I slide the shaft's anti-launch pin into the engine-coupler's receptacle and seat it down, the other end winds up flush with the inner face of the yoke. PERFECT, and no need to yank the motor or transaxle!

MAKING A DRIVESHAFT WITH RAG-JOINT END

In doing this conversion to my 2nd victim, I had a CC driveshaft ready to put in, and noticed that the welded-side of the rag-joint was bent, and the launch-pin was very worn on one side. I spent a little while trying to tweak it back in line, and after spinning it, decided that even bent closer-to-square, it just wasn't going to run very true. Didn't have another one at my immediate disposal, and being the impatient candle-burner I am, I made a new one.

Note that you do NOT have to do this if you have a perfectly good IHCC driveshaft... only if yours is trashed, and you want to MAKE a new one. A lathe isn't mandatory, but extremely recommended.

I grabbed a piece of 5/8" shaft stock, chucked it into the lathe, and turned the end down to create the 'anti-launch pin' segment which engages the centering hole of the rag-joint.

My first thought was to just make another steel plate, and drill it with three holes, then weld it onto my new shaft like the original, but decided that the reason why the factory shaft wasn't running true, was because the welding process pulled it out-of-square. Instead, I found that I had an extra rag-joint receptacle. I slipped it over the turned end...

And compared it to the hopeless-case...Much better!

Now, in the stock arrangement, it's quite a task to get the shaft to go into, and out of the tractor. I want to be able to do it without having to disassemble the whole world... fortunately, there's quite a bit of depth to my U-joint configuration. So I run the shaft from the engine compartment, around the (hydraulic!) steering column, past the lift-cylinder, and into the U-joint yoke.

Notice- the shaft is fully bottomed against the U-joint's X-piece, but the front is well-clear of the rag joint- Plenty of room to install/remove the shaft. Notice- the U-joint's grease fitting is on the AFT side of the X-piece- this allows lots of space for the shaft to retract for launch-pin clearance.

But when I slide the shaft's anti-launch pin into the engine-coupler's receptacle and seat it down, the other end winds up flush with the inner face of the yoke. PERFECT!

And the answer you've all been waiting for... (or mebbie not)... the dimensions;

MAKING A RAG-JOINT COUPLER

Half of this modification is about moving the rag-joint coupling up to the front (engine) end of the driveshaft. Later (QuietLine) tractors came with a rag-joint up front, most likely for several factors, including more 'compliance' required to suit the soft-mount engine cradle, and obvious wear-concerns on the drive-pin arrangement. A less obvious bonus to moving the rag-joint to the front, is that the hydrostat cooling fan is much less 'obstructed', likely increasing cooling airflow over the hydrostat housing.

Knowing that the QuietLines came with this 'alternative' drive method, I've been asked why I didn't just go find QL parts. First answer, is that I'm cheap, and QL drive couplers aren't... the next is that all the necessary parts were right there (in the factory-stock tractor), and the last answer is that when it's a quarter-of-two (AM) and I want a running tractor before going to bed, I use what I've got.

The following process illustrates how I converted the pin-drive coupler to accept the rag-joint hardware normally found at the REAR of the driveline.

This was the initial idea- just add the rag-joint yoke to the existing coupler, however, this placed the rag joint FAR back from the driving face of the flywheel, which has some undesireable geometric characteristics, many of which are insignificant to the non-engineering type, but the most obvious is that the rag-joint assembly comes dangerouly close to whackin' a chunk out of the steering system. Gotta shorten-up the stack-height.

First, I started with a stock, but seriously-worn coupler. Notice how the drive-groove is waller'd out? This much slop will cause enough driveline shock to break the drive pin right off... even if it's not a bit worn.

I placed the coupler in a chop-saw, and cut the entire extended portion off, then chucked the coupler in the lathe... then I took a skim-cut to make a nice square surface. You don't really have to, as there's no serious precision lost to having an uneven edge... I just like things to fit firm. I realize that not everybody has the luxury of a lathe... the unit in this picture is especially lousy, but no worries- you could do a similar job by chucking the coupler in a 5/8 rod, chucking the rod into a drill press, and facing it down against a belt-sander or grinding-disk.

Next, I took a piece of shaft-stock, drilled a hole through it (for a Spi-Rol pin), temporarily attached a rag-joint yoke, and slid it into the coupler flush. THEN I MIG-welded the BACK side so that the shaft was permenently retained into the coupler, then removed the rag-joint yoke. It now looks like THIS.

(no, I did NOT hit my thumb with a hammer, I pinched it installing an engine in dad's boat)

Next, I fitted the whole works together, and pressed a Spi-Rol pin into the rag-joint yoke...

Then, I installed it on the engine, took the original IHCC driveshaft, flipped it around (front side now faces rear) and bolted it to the rag joint. Spins true, clears everything fine, and even looks factoryish.

Note that by doing the welding on the BACK side of the coupler, it's totally invisible from anywhere else.

MAKING U-JOINT FIXING PINS

Factory drivelines use roll-pins for retaining rag-joint yokes. For my U-joint conversion, I use allen-head bolts, turned down to 0.250". This allows disengagement and removal of the driveshaft and U-joints without having to hold a drift-pin and swing a hammer around hydraulic lines and a plastic fan. This concept, with the U-joint arrangement's ability to let the driveshaft 'collapse' into the U-joint, thus disengaging the 'anti-launch' pin from the rag-joint, making removal of the U-joint MUCH easier, and MUCH quicker than the factory arrangement. If you're running a drive-belt off the small accessory pulley, you'll find it quick-and-easy to change the belt. Here's how I make the pin;

Take a stainless-steel Allen-head bolt (about 2" long), thread a nut down to the head. Chuck the HEAD of the bolt in the lathe... or if you don't have a lathe, use a drill press.

Cut off all the exposed threads... and turn it down to 0.250". I use a curved-point 'finishing' tool in the lathe- they do a nice job without yanking the workpiece out... mind you, my lathe is geriatric, so I have to do some pretty unprofessional things to get decent results. An alternative to a lathe-tool, one could use a file, or a grinder... whatever you've got will probably work with enough patience.

When you're done, it looks like this:

But you'll see that when installed, there's a little interferance between the bottom edge of the Allen head and the yoke arm. In this case, I...

Chuck the freshly-turned end of the bolt into the drill-press, and chamfer the underside of the bolt with a file, and brighten it up with a sanding disk in one of my 4.5" disk-grinders...

...and while I'm at it, I wipe off the casting mark along the yoke's edge, as it fouls the bolt a little, too... and the end result looks like:

MAKING A DRILLING-GUIDE

While building up a U-joint driveline for another project, I ran into an interesting challenge... On previous U-joints, I used a tool in which the yoke slid onto a section of key'd shaft... it held the yoke with the set-screw opening at a 90 angle to the table, centered-and-square with the drill. But on THIS particular yoke, the keyway was cut slightly off... by about 1 degree. Probably had the bit in the machine slip that day. I didn't want to drill this using my conventional tool, as the pin wouldn't fit properly with the driveline assembled.

So I made a new drill-guide just do deal with this scenario... and to illustrate how some simple concepts can allow one to make a precise tool in even a limited garage. Note that this technique will work for ANY bolt-center-finding application, not just drilling yokes.

To do this task, you'll need to raid your 'junk box'. If you don't have a 'junk box', your garage is seriously challenged... start by roving the streets, gathering up your neighbors' trash, hopefully you'll find some old appliances in there, mebbie some broken tools, a beercan or two that's still got a swig-left... anyway, disassemble it, and throw all the pieces in an old wooden crate. Slide it under your workbench, and refer to it as your 'junk box'. From this point on, never throw anything away until you've disassembled it and thrown all the pieces in your 'junk box'. If the box becomes full, start a new one. Continue adding on to your garage until you can't make more space for more junk boxes.

So now we employ the junk-box. First, I found a bolt which threaded into the yoke properly. This one is a Grade 5 bolt... (I don't recommend you trying this stunt with a Grade 8, unless you've got lots of sharp drill-bits that you'd like to torture). I quick chuck-it in the drill and scrub the top of the head with the 4" disk grinder to take the markings off and leave a smooth surface

What I'm gonna do, is drill down the CENTER of this bolt, so when I'm done, I can use the drilled-bolt as a guide to drill a concentric hole at the OPPOSITE side of the yoke. Better yet, since I've got a lathe, and y'all know I'm not 'fraid to use it, I'm gonna do this task WITHOUT using a LATHE.... yep, you can do it with your own tools!

Again, we'll need to hit the junk-box. You'll need an drill chuck. I had an old Craftsman cordless drill that'd long since bit the dust, but still had some good parts- I 'liberated' the keyless-chuck (oooh... deluxe garage tool!). I grabbed my box of taps, and threaded a few in, to determine what the chuck's thread-size was... turns out, this one was 3/8-24. Went to my junk box, and dug out a stud from who-knows-what... but 3/8-24 on one end, 3/8-16 on the other, and just about the right length, too. I also found a fender-washer and a funk y nut/washer assembly that probably came from the seatbelt assembly of a FORD pickup I scrapped 15 years ago.

So now I'll mount this chuck to my drill-press table, with jaws facing up, and tighten it down good. Then I put a drill bit in the table-mounted chuck, facing UP. I swing the table to line up the two chucks, plunge the press chuck 'till it fits over the drill bit, and temporarily tighten the top chuck over the sharp-end of the drill bit. Then I tighten down the table adjustments... so now I know the two chucks are more-less perfectly centered.

Then, loosen the press's chuck, let it come back up, and chuck the BOLT into the drill press. Start the drill and slowly advance the bolt ONTO the drill bit... it'll drill right-down-the-center of the bolt.

Repeat with larger bits 'till you've reached the desired bore. Note that just 'cause I want a 1/4" hole, doesn't mean I need to make this with a 1/4" hole- I could make the hole just big enough to drill a PILOT hole, and then drill the finish-sizes without using a guide... or you could make SEVERAL guides. In this case, I was lazy, and went straight to finish-bore size.

Cut the bolt off to a desireable size, and try it out...

Boy- it's right-on. Notice the keyway looks slightly rotated? Yep- that's what foiled my other (much more sophisticated) tool, hence, the guide-bolt.

Realize that as one uses a guide-bolt for drilling... that the guide will get worn-away by the bit, just as if you were drilling through something else. It's advantageous to use a small bit to locate the other-end hole, as the guide will see less wear, and you'll get a more precise drilling. IN my case 1/4" did just fine... I cheat- Iv'e got some drill bits that are mostly shank, so there's no cutting edge where the bushing runs.