on 10/26/02 6:39 AM, Tony Jackson at tonyjackson@zetnet.co.uk wrote:

> Given that all such people are likely to wish to make their own
> copies, I wonder whether Freda might be prevailed upon to give us a
> few constructional details?

The following description is not of the tool pictured. It is of a later model which was modified to make it lighter and more compact.

You take 2 pieces of solid steel, each 1/2 inch thick, about 4 inches long, by 2 inches wide. Clamp the two pieces together so you have a block 1 inch thick by 4 inches long and 2 inches wide. Lay it down as if it's a sandwich and drill 2-half inch holes in the top of the block, one near each end. These holes are to accommodate a bolt on each end to hold the two halves of the tool together. Fasten the two halves with a 1/2 inch bolt through each hole. Use a flat washer and a nut to hold securely. Then drill 2 holes centered on the seam to accommodate the tubes for the hydraulic lines, one 4.5 mm and one 6.5 mm. The holes should be drilled very slightly UNDER size so that the tubes will fit very snugly. At one end of each hole, enlarge the above holes to 1/2 inch for about half the depth. Get a 1/2 inch bolt for each hole, cut so that you have a 3 inch length without any thread. Drill a hole in the centre of each bolt. The hole is about 1/2 inch deep and has to be drilled so that it has 2 steps. For the 4.5mm tubes, the bottom of the hole is 4 mm diameter, and the remainder of this hole is 4.5mm. The hole for the 6.5mm tubes would be about 6mm for the first step and 6.5mm for the second step. The bottom of the hole in each of these bolts needs to be beveled very slightly. The bottom of the corresponding holes in the body of the tool also need to be beveled to match the bevel on the bolts.

At this point you take the tool apart, split it into its 2 halves. This description will not exactly match the tool as shown. The new improved later model did not have the thick pipes that stick up on the top of the tool. (Photo 3, bottom half of tool).

Lay each drilled bolt in the wide area of the groove in one half of the tool body. Allow 3mm clearance. Mark a line on the bolt, at the top of the tool, for a temporary reference. Then put the tool back together loosely, insert a hydraulic tube all the way through the groove in the tool so it protrudes out of the top about 1 inch. Insert the bolt with the hole over the tube and push the bolt and the tube together to the reference mark. Tighten the two halves together well with the other bolts and washers. Then take a hammer and bang down on the bolt holding the tube until you feel the tube bottom out. Before you release the two halves of the tool, remove the plunger bolt (the one with the hole for the tube). Release the tool, take out the tube and check to see if the flare is correct, not too flat or not flared enough. You may have to experiment with moving the reference line slightly and redoing the flare if it doesn't come out right. Once the flare is satisfactory, mark a permanent reference line on the bolt. Repeat for the other size tubing.

> E.g. the size of hole which clamps the tube, is it slightly undersize?

Yes, it is, very slightly undersize so it's a tight fit.

> Is the overall size of the thing to do with having enough mass to
> strike against when forming the flare?

Actually, this was the first tool we made. Later ones were much smaller and lighter, as described above. You could make it even smaller than the size above, if you wanted to. You don't need a whole lot of mass because you don't have to strike very hard. A small hammer is sufficient for striking the end of the bolt.

> The dowel arrangement on the ends was done by cutting a slot, then
> welding a piece of strip into one half, yes?

If you're referring to the little pointy pieces sticking up at the end of one half and the groove on the other, yes, this is a guide, but we found out that it wasn't needed so didn't put it on later models.

> And yes, what is the answer to Denny's question!

The tube cannot collapse inward, because there is no room for it to go except expand outward into the open area left after making the clearance tolerance in the hole. That is why you have to experiment a bit with the amount of clearance as outlined above. If there is too much clearance, your flare could be uneven. When the groove left for the flare is correct, the flare will be perfect. If the plunger is misaligned with the body of the tool, your flare could be deformed. But if the tool is carefully made and adjusted, the flares will be correct every time, and take only a moment to do.

I hope that this is understandable and helpful to everyone. You have no
idea how hard it is to explain all this when one is not an engineer :-).

Best regards,
Freda

on 10/27/02 7:29 PM, Bob Alexander at sloughds@yahoo.com.au wrote:

> The holes drilled in the bolt bits. Why do you drill the first part
> of the hole tube size, then a bit further under tube size?

This is because the end of the finished tube has to fit into the female
fitting on the car. The tool squeezes the end of the tube so that it
becomes a bit narrower so it fits.

> Do I understand correctly, that the tube goes up into the bolt bit

> hole till it hits the step, which pushes it down? Presumeably the
> length of the hole (drilled tube size) determines how much straight
> tube is on the end of the tube past the flare. What does the further
> drilling (under tube size) do?
Yes, the length of the hole determines where the flare is. And the narrow part of the hole makes the tube narrower so it fits into the female fitting as I described above.
Hope this clarifies it.
Best regards,
Freda

on 10/28/02 12:30 AM, Tony Jackson at tonyjackson@zetnet.co.uk wrote:

> Seems to be my time of life to ask the dopy questions, but in the
> interest of clarity, (and in the hope that there are others who have
> the same difficulties I have...)
>
> It is very generous of Freda to take the time to explain for us all
> how to make this important piece of kit, but there are still bits
> that I don't understand!
>
> Bob asked:
>
>>> The holes drilled in the bolt bits. Why do you drill the first part
>>> of the hole tube size, then a bit further under tube size?
>
> Freda replied:
>
>> This is because the end of the finished tube has to fit into the female
>> fitting on the car. The tool squeezes the end of the tube so that it
>> becomes a bit narrower so it fits.
>
> The size reduction is given (below) as .5mm (in 4.5). Doesn't this
> cause the pipe to stick? Do you have to 'unscrew' it?
No, it doesn't stick. We presume you're referring to the tube when it's in the tool. Don't forget you can unscrew the two halves of the tool to take out the tube. Just loosen the bolts holding the tool together enough to slide the tube out.
> Is this to make it easier to enter the finished tube into the hole it
> is to be sealed to? Thus, if there were a way, would a taper be
> better? But surely, the amount by which the tube enters the 'bolt'
> is critical to where the flare will be formed.
>

>>> Do I understand correctly, that the tube goes up into the bolt bit
>>> hole till it hits the step, which pushes it down? Presumeably the
>>> length of the hole (drilled tube size) determines how much straight
>>> tube is on the end of the tube past the flare. What does the further
>>> drilling (under tube size) do?
The tube initially goes in up to the step in the hole. Then when you
tighten the tool and bang on the holed bolt with a hammer, the end of the
tube goes into the smaller hole, compressing it to the smaller diameter,
and the flare is formed at the same time. That's why when you make the
tool, you have to experiment a bit with the depth you need to insert the
tube. Reference to temporary mark and permanent mark on the drilled bolt
in explanation.
>> Yes, the length of the hole determines where the flare is. And the narrow
>> part of the hole makes the tube narrower so it fits into the female fitting
>> as I described above.
>
> As I understand it, the 'length of the hole' is the length of the 4mm
> or the 6mm part, as after striking the tube will have been forced
> into that section of the drilling.
Correct.
> Or are we just talking of this reduced diameter acting to form a
> shape on the very end of the tube? In which case reforming the end
> of a 4.5 and a 6.5mm drill would do the same job, the re-formed drill
> being entered into the hole like a little milling cutter, after the
> hole is drilled.
Yes, you could do that but you can also do it, as we did, by using two
different sizes of drill bit.
>>> --- In DSeries-L@y..., Freda Vasilopoulos <fvasil@s...> wrote:
>>
>> You take 2 pieces of solid steel, each 1/2 inch thick, about 4
>> inches long, by 2 inches
>> wide. Clamp the two pieces together so you have a block 1 inch
>> thick by 4 inches long and 2 inches wide. Lay it down as if it's a
>> sandwich and drill 2-half inch holes in the top of the block, one
>> near each end. These holes are to accommodate a bolt on each end
>> to hold the two halves of the tool together.
>
> Given that every D owner has an 11mm spanner already in his best
> hand, might one use a 7 mm bolt (or stud) for this. Anyone know
> whether two 7mm bolts would exert enough force to secure the tube?
Yes, you could. We are now using 3/8 inch bolts for this on the improved
smaller tool. The hydraulic tubes are not that thick, relatively easy to
compress; lighter equipment would work as well. The versions of the tool we

made for Peter Wells and for Adrian Harper were smaller than the tool pictured, and it may be possible to make it smaller yet.
>> ....   Then drill 2 holes centered on the seam to accommodate the
>> tubes for the hydraulic lines, one 4.5 mm and one 6.5 mm. The holes
>> should be drilled very slightly UNDER size so that the tubes will
>> fit very snugly.
>
> Is this .1mm undersize (the smallest diameter reduction easily
> available in metric drill sets). Or, given the drilling of the
> 'bolt', does it need to be more than .5mm undersize. Or does one put
> a shim between the two halves of the tool when drilling the holes.
> If the latter, what sort of thickness?

No shims. The tool's only moving parts are as shown in the photos. The bolt is drilled 4.5mm and then the bottom is 4mm. The groove in the body of the tool is undersized by about .4mm (.1mm either way wouldn't make much difference) so I guess you would have to use whatever size drill bit will give you that result. (You see, the problem in Canada is that fine differences in metric drill bits are often hard to find so we often substitute an Imperial drill bit of the size we need if we can't get the exact metric one.)

>> At one end of each hole, enlarge the above holes to 1/2 inch for
>> about half the depth. Get a 1/2 inch bolt for each hole, cut so
>> that you have a 3 inch length without any thread. Drill a hole in
>> the centre of each bolt. The hole is about 1/2 inch deep and has to
>> be drilled so that it has 2 steps. For the 4.5mm tubes, the bottom
>> of the hole is 4 mm diameter, and the remainder of this hole is
>> 4.5mm. The hole for the 6.5mm tubes would be about 6mm for the
>> first step and 6.5mm for the second step.   The bottom of the hole
>> in each of these bolts needs to be beveled very slightly. The
>> bottom of the corresponding holes in the body of the tool also need
>> to be beveled to match the bevel on the bolts.
>
> The bevel - is this something other than what is achieved by the
> normal cutting angle of the drill? And are we talking here of the
> bottom of the smaller hole, or the point where the diameters change.
> Come to that, should the entry to the hole be chamfered or formed to
> 'start' the flare (and to make it easier to get the tube in)?

The bevel is just done by the normal cutting angle of the drill. This is at the top of the hole in the bolt (ie the end of the bolt). The bottom of the hole in the bolt has to be flat, not angled or beveled in any way. To do that, grind flat the end of the same bit you used to drill the small hole and use it to get rid of the bevel it would otherwise make.

>> At this point you take the tool apart, split it into its 2 halves.

>> (At this point the description will not exactly match the tool as
>> shown. The new improved later model did not have the thick pipes
>> that stick up on the top of the tool. Photo 3, bottom half of tool).
>>
>> Lay each drilled bolt in the wide area of the groove in one half of
>> the tool body.   Allow 3mm clearance.
>
> That is to say, put the bolt in 3mm less than all the way?
Yes, that's correct. You have the half inch hole (for the half inch
bolt)which is about a half inch deep (wide end of the groove in the half
body of the tool)(it would be deeper than half an inch on the later tool
without the round guides attached--this is not all that critical-the
critical thing comes in the marking on the holed bolt, ref. below). You lay
the drilled bolt in there with 3mm clearance between the bottom of the bolt
and the bottom of the wide section of the groove.
>> Mark a line on the bolt, at the top of the tool, for a temporary
>> reference.   Then put the tool back together loosely, insert a
>> hydraulic tube all the way through the groove in the tool so it
>> protrudes out of the top about 1 inch. Insert the bolt with the
>> hole over the tube and push the bolt and the tube together to the
>> reference mark.
>
> At this stage the tube has entered only the 4.5mm drilling in the 'bolt'.
Yes, that's correct.   However, the 3mm reference is only a guide. You have
to experiment with this clearance until you have the flare in the correct
place on the tube. Then you make the permanent mark on the holed bolt.
>> Tighten the two halves together well with the other bolts and
>> washers. Then take a hammer and bang down on the bolt holding the
>> tube until you feel the tube bottom out.
>
> So the tube has shortened by 3mm, but I don't see where the flare was
> formed. I'd imagined you'd need a hole of flare-outside-diameter in
> either the 'bolt' or the tool proper.
Not exactly.   We just realized our earlier explanation may be a bit
confusing.   So please ignore the section on the reference mark in the
earlier explanation. Here's the new procedure:
Lay a section of hydraulic tube in the groove in the body of the tool with
about 12-14mm protruding from the end of the tool. Tighten the two halves
of the tool together firmly. Slide the drilled bolt over the protruding end
of the tube. Gently bang on the bolt head until you feel the tube bottom
into the narrow section of the hole in the bolt. Then undo the tool into
its two halves. Then pull the bolt with the tube in it back in the wide
section of the groove until you have about 3mm clearance between the end of

the bolt and the bottom of the wide part of the groove. Make a temporary mark on the drilled bolt at the top of the tool. Put the tool back together as tightly as possible, bang the head of the drilled bolt until it bottoms. Remove the drilled bolt from the tube by twisting it off, using pliers or vise grip if necessary. Take the tool apart and observe the flare. If the flare is too flat or not flat enough, repeat the above operation with a new section of tube, making an adjustment to the clearance before proceeding. This whole operation will only usually take 2 or 3 attempts until you get the flare right. The actual measurement from the body of the tool to the reference mark on the drilled bolt will be approximately 9.5mm. This is to allow for the 6.5mm (1/4in) section of the tube which will be driven into the narrow area of the hole in the bolt. That is how we arrived at approximately 3mm clearance to make your attempts until you get the flare correct.

Don't forget that when you bang on the head of the bolt with the tube inside, the bottom end of the tube goes into the narrow (4mm) section of the hole. The flare occurs when you bang on the top of the bolt with the tube inside. The clearance you figured (3mm or so) is the space where the flare occurs. The bevels on the tool's hole and the end of the drilled bolt are on each side of the flare which give the correct angle to the flare.

When the flare is satisfactory, make the temporary mark on the drilled bolt permanent. This way you will always be able to line the mark up so that it is just at the body of the tool whenever you want to flare a line and thus ensure that the flare is correct.

I hope this clarifies it and that everyone can understand it. Just to give John (who is is 61 today--happy birthday, dear husband) credit, he has only elementary school education but has worked with machinery all his life--the main reason he didn't take much to formal schooling--he wanted to work on machinery. He had never even seen one of these flaring tools, yet he figured out how to make one by experimenting until he got the result he wanted. Having lived with him for more than 33 years, I guess I kind of take it for granted that he can make almost anything but after writing this description of the tool, I am absolutely blown away by the complexity that went into it.

Best regards,

Freda

Freda wrote:

on 10/28/02 2:36 AM, Bob Alexander at sloughds@yahoo.com.au wrote:

> Thanks Tony,

>
> I think you asked all the necessary questions......
I hope I answered them adequately in today's message to Tony.
>> The size reduction is given (below) as .5mm (in 4.5). Doesn't
> this
>> cause the pipe to stick? Do you have to 'unscrew' it?
It doesn't stick. It slides out pretty easily.
> Yes, I would have thought that 0.2 undersize was enough.
It may well be. We measured our groove and it was about 0.4mm undersize but
a bit more or less wouldn't make much difference. When the tool was clamped
together with a 4.5mm tube in it, we could just slide 4 layers of 20# bond
paper in the seam between the two parts.

> Also if the undersize part of the hole was just a bit too long, it
> could mean that the tube doesn't flare at all before the tool
> bottoms out.
If I understand your comment correctly, you are right. If the undersize
part of the hole was too long, the tube wouldn't bottom out and thus
wouldn't flare. It "has" to bottom out to put pressure on it to create the
flare.
> Maybe we need to get a dimensioned drawing into the files.
We could make a dimensioned drawing (John is very good at that sort of
thing), and using it to show the various sections might make it clearer but
at the moment he doesn't have the time to do the drawing (he's trying to
body-prep a CX before the weather gets too cold). Not only that, we have no
way of putting it in an email or posting it in the files of the list because
I have neither a scanner nor a digital camera.
> I'll go & play on the lathe & report.........
Yes, we'd love to hear how you make out. Please see also my earlier message
to Tony to get the rest of the details on the questions you've asked.
Best regards,
Freda

Freda wrote:

on 10/29/02 1:27 AM, Tony Jackson at tonyjackson@zetnet.co.uk wrote:

> Hi Freda,
>
> First, let me admire your eloquent description of the quiet, unsung
> experimentation and skill which went into the development of this
> tool.
Thank you. It means a lot to John to be appreciated for his rather quirky brain. Of course, esp. in Canada with no Citroen dealers, necessity is indeed the mother of invention.
> I don't know whether you have a copy of Jon Pressnell's book Citroën
> DS - the complete story', but in case not, I'll copy a bit for you:
That book is unfortunately not in our collection but I had read the quote you mention somewhere before and had told John that he would have fitted perfectly with this group :-). He's always noting how some of the machines on Junkyard Wars have design faults that will cause some kind of failure or breakdown and he is always right.
> And I absolutely share your admiration for the woderful, intangible
> skill which I'm sure John shares with the people Boulanger fostered
> and promoted.
Thank you, thank you. (bows)

>
> I'll bet, like me you have a set of 'Number' and 'Letter' drills,
> yes? I mentioned their modern metric equivalent because I thought
> they'd be easier for people to find nowadays!
Yes, of course we do, like pretty much every mechanic in Canada. Like England, we use an odd combination of metric and imperial in our daily lives, not just for machinery.

> The actual flare shape is smoothly curved, there is no sign of it
> having been constrained by a bore during its formation.
See also below.
> I dare say that the John/Freda tool does better than that, in that
> its end is not fattened like the factory pipes, and perhaps it makes
> a form which is easier to insert and start the thread on in
> consequence.
Exactly. John took all the properties of metal, and particularly tubing, into consideration when he designed the tool.
> But I'll stick my neck out and say I believe that the hole in the
> bolt is actually 4.5mm diameter to the (flat) end, and 8.2 + 4 = 12.2

> mm deep. Then a larger diameter, around 5.7 or 5.8 mm is drilled
> into it to a depth of 4 mm. It is into this bore in the bolt that
> the flare expands as it is formed.
Your interpretation of my explanation is basicly correct. However here either I'm not understanding what you're saying or vice versa. There is a small space between the bottom of the drilled bolt and the bottom of the wider area of the groove in the tool when everything is correctly made and adjusted. Remember the section in the explanation about making trial flares and adjusting this space. This is where the flare occurs, in this space, and because of the bevels, the flare would be perfect every time, smoothly curved as you mention above.

Meanwhile Tony wrote

... the factory (steel) tube I just measured is as follows:

Tube diameter - 4.5 mm
Flare diameter - 5.7 mm
Flare length - 4 mm
Tube diameter beyond flare - 4.7 mm
Tube length beyond flare - 8.2 mm

The actual flare shape is smoothly curved, there is no sign of it having been constrained by a bore during its formation.

I dare say that the John/Freda tool does better than that, in that its end is not fattened like the factory pipes, and perhaps it makes a form which is easier to insert and start the thread on in consequence.

> The initial light tap on the bolt is to seat the tube properly into
> it, so that any tightness does not corrupt the measurement of how
> much the tube must be shortened to form the required flare. With the
> tube fixed in the tool, and a measured clearance between bolt end and
> the bottom of the 1/2" bore in the tool, a firmer blow is used to
> start forming the flare, and the process is complete when the sound
> and feel changes as the bolt bottoms in its bore in the tool body.
Exactly.
> I'm going to look awfully foolish and presumptuous if I'm wrong!
I'm glad I was able to explain the tool in such a way that you could understand it. What's really interesting is that the factory tool you measured has almost exactly the same dimensions in the critical areas that John's tool has--and he's never seen the factory one. It's amazing.
Again, if you're ever in Nottingham, go see Peter Wells and ask to see the

flaring tool John made which we gave him last summer. He'll be glad to show you.
Best regards,
Freda

Frieda wrote:

Hi, again, Tony,
You were almost 100% correct, and do not look at all foolish. And what I meant to put in my other message was the line from My Fair Lady, slightly paraphrased: by George, he's got it. By George, he's got it!
Best regards,
Freda

Frieda wrote:

on 10/30/02 5:18 AM, Tony Jackson at tonyjackson@zetnet.co.uk wrote:

> Hi Freda,
> I can't see how the flare can be formed anywhere other than in a
> counterbore in the bolt. The space we've just been describing closes
> up as the bolt is driven home. The flare would either have to be
> formed in a third diameter in the tool, which I can't see John going
> for, because the two halves of the tool are not fully closed together
> when they are clamped over the tube, and this could risk raising a
> 'flash' on the workpiece. So I'm sure that the flare must be formed
> in the larger of the two bores in the bolt, which must then be of 5.7
> or 5.8 mm (or its number equivalent, a No 1).

Tony, there is no counterbore in the bolt, only the bevel, with the equivalent bevel in the tool. Don't forget, you "are" dealing with 3 diameters (maybe even 4 although 2 of them are almost the same), the groove in the tool which holds the tube, and the wider area in the tool where the flare is formed. Plus the 2 part hole in the drilled bolt. The drilled bolt sits in the wide part of the groove on the tool and when you drive it down with the tube inside it, the flare is formed. The flare is not made in the hole in the bolt, but just below the bolt, in the space between the bottom of the bolt and the wider groove of the tool. I don't know of any other way to explain it.
Best regards,
Freda

Bob wrote:

Hi flarers,

I've made a start (in between real work today):

Freda... you first mentioned 3.5 as a size for the tool, maybe in error, maybe because there is a real need for this size. Not on Dees, but my C35 has much more of 3.5 than any other size. It has LHM system just for the brakes, and has an amazing amount of plumbing, probably extended by the RHD conversion.

I guess the CX also uses 3.5mm fairly extensively ?

So, I started making a triple one for 3.5, 4.5 & 6.4
By my measurement it is 6.4 not 6.5

So far I have made the main block using 3.3, 4.3 & 6.2 drills with a 0.2 shim between the halves.
I also made a 6.4 driving mandrel/socket, using a 6.5 main hole with a 6.2 for the last 3mm. I ground a 1/2" (12.7) drill to a 90 degree point to bevel the flaring faces of both the main block & the mandrel. There is no o.d. limit to the flare cavity (just the 12.7 hole) so flare o.d. is determined by how much tube you try to squish into the space.

Results:
Excellent flare! A nice bi-conical symmetrical smooth bump.
the "nose" is a bit too long because I made the hole in the mandrel too deep.
There is a distinct step down in the nose corresponding with the hole diameter change.
The mandrel bottoms out on the main block when the flare is done.
Pre positioning of the tube is critical to getting the right amount of flare.
It seems that the nose metal will expand to fill whatever space you give it. Ideally I'd suggest a slight taper from 6.5 to 6.2 over the length of the mandrel hole. The taper has 2 advantages. 1) it would give a smooth stepless nose with "lead in" to engage the hole in the female fitting. 2) it would be more easily removed from the mandrel. The straight hole tried to hold the tube fo all its length, making removal a bit of an effort. (not major but probably an improvement)

The mandrel hole had a normal drill point shape (not squared off)
and did not seem to have any adverse effect.
There was absolutely no slip in the main block, with only slight
marking of the tube. (about 16mm grip length).

As the flare is needed ONLY for the male fitting to push on, the
exact flare shape is not critical. The soft tubular seal is
compressed between male & female fittings, with the tube/flare
forming the inside boundary. The shape doesn't matter.

I've seen some flares with a fairly flat face for the male fitting
to push on, some with a long taper, it all works......except the
flat faced one creates a more severe stress point and might lead to
earlier cracking (with fatigue from pressure pulses & unsecured
pipes. A longer more gentle taper would most likely have better
fatigue resistance & longer life.

Overall I think the tool design is very good, & John & Freda are to
be thanked heartily for sharing their technology.

More later as I get the 4.5 & 3.5 done & tested.

Bob >>