E2 ISSUES - an EVOLVE TRIKES TECHNICAL GUIDE

2017-July

E2 owners and dealers have alerted us to the following particularly frustrating issues with the E2. This document includes guidance we have provided on the issues.

The E2 trike was manufactured by Cutting Edge Wheels (CEW) under the Edge brand name. Unfortunately we had to terminate their license to manufacture trikes using our technology.

After confirming out that our prototype was indeed solid, CEW management did not clone it as we had always expected, but instead chose to change the key geometry (despite our concerns) and ignore our cautions that checks in the computer model were insufficient and that they needed to always prototype and prove their changes were functional and reliable. They never provided an e2 for us to verify, nor even a copy of the manual they were shipping with the trikes, and they were very selective in the few images they sent us. They also kept us totally in the dark on problems customers were having with their trikes. So we have been almost totally reliant on web images and reports direct to us. It is extremely disappointing to gradually learn that some relatively inexpensive parts have caused major issues.

Summary of issues:

	ISSUE	interim solution	more permanent solution
a	**Bent or broken chain-tube support brackets**	don't roll folded trike backwards	brackets vulnerable, replace with our design
b	**Forward drive chain tube severely bent when folding**	pull the upper drive chain tube forward before folding	brackets vulnerable, replace with our design
c	**Front gear cable getting damaged in the folding mechanism**	re-run cable to our cable route	
d	**The folded trike does not roll true**	replace steering pivot arm nose bolt if missing	align toe-in
e	**Chain tube slipping through chain tube brackets**	add tube clamps	
f	**Chainstay scratches from the chain when folding the rear**	add protective tape to right chainstay	
g	**Folded catch and pin not reliable**	when folded engage the slots of the seat arm on the main Quick release	replace catch with our latest design.
h	**Quick Release always requires re-adjustment to fold**	file/grind a chamfer on the leading edges of the seat arm over-clamp channel.	
j	**E2 Tail does not fold correctly**	unfortunately none	
k	**Inadequate final checking**	thoroughly check	
l	**No lubrication of the folding pivot in CEWs manual.**	Essential to institute a 3 monthly lubrication schedule to avoid excessive wear. (Otherwise can lead to issue 'm'.)	
m	**Boom pivot allowed to rotate in the pivot flanges**	Essential to lock the pivot pin to the pivot flanges. If needed replace with a pin with a straight knurl that positively engages in the flange.	

Some of these issues may relate only to particular trikes but CEW has never provided us the information to know that.

a. Bent or broken chain-tube support brackets

We just can't see how CEW could not have been aware that their production chain tube support brackets were so vulnerable and we see it as a major oversight that they did not include a suitable warning in their E2 Manual to customers.

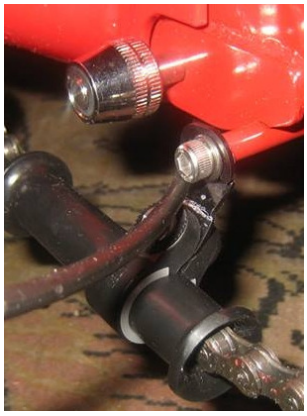
WARNING: <u>The folded trike must not be forced backwards on its wheels.</u>

The freewheel in the rear hub allows the folded trike to be rolled forward indefinitely, but rolling the rear wheel backwards can drive the cranks causing a pedal to jam, usually against the rear of the right tire resulting in high stresses on the chain path components. To be safely rolled backwards the trike's rear wheel should be raised just clear of the ground to prevent the cranks being driven. (see our Easy Folding & Rolling setup Tech Guide)

Our brackets are solid one-piece, but the E2's front two chain tube brackets are more vulnerable two-part, a plastic clamp and a thin folded steel plate hanger. The plastic part is more bulky increasing the

chance of interference and the thin metal plate more vulnerable. Because they have an approx 15mm inherent offset they cannot be arranged to emulate the geometry of our brackets. The two parts are also not reliably fixed relative to each other. When the plate rotates relative to the clamp the chain tube can drop by about 0.5inch (13mm), creating interference with other parts. More interference increases the chances of the brackets catching & bending/breaking.

E2 images, Red: bent bracket. Blue: plate rotated relative to the clamp with brackets labelled.


Unfortunately we can see no easy solution other than being careful not to force the folded trike backwards. One E2 owner reports that this works for him.

The alternative is replacing the E2 chain tube brackets with brackets fabricated to our design. Our brackets are more robust one-piece and we have never had any bending or breakage. See “Replacing the E2 forward chain tube brackets” below.

Replacing the E2 forward chain tube brackets

This will require the assistance of a local fabricator with welding skills unless you have those skills yourself.

Though the chain-tubes and their pivoting brackets are relatively inexpensive parts they are crucial for proper operation and folding. We spent considerable time developing compact robust brackets with the optimum positioning for lowest chain friction, minimizing chain path length variations during folding, and allowing for some chain movement to rotate the cranks when folded to position the right pedal neatly behind the right tire.

Our brackets are more robust one-piece and are much less vulnerable. If trikes with our brackets are rolled backwards the chain tightens and the trike stops rolling without damage. It takes major force to bend our brackets, and it has not happened in many years of normal use.

Both brackets can be simply fabricated from seamless 0.75x0.058in (19x1.47mm) steel tube and 0.125in (3mm) steel plate. The brackets should be set up with approx 12in(30cm) of chain tube through them held one side by a flared end and the other side by a firm cable tie or a 15-17mm eared fuel hose clamp. The M6 mounting bolt should secured using thread lock (Loctite etc) and be set up allow the bracket to freely rotate.

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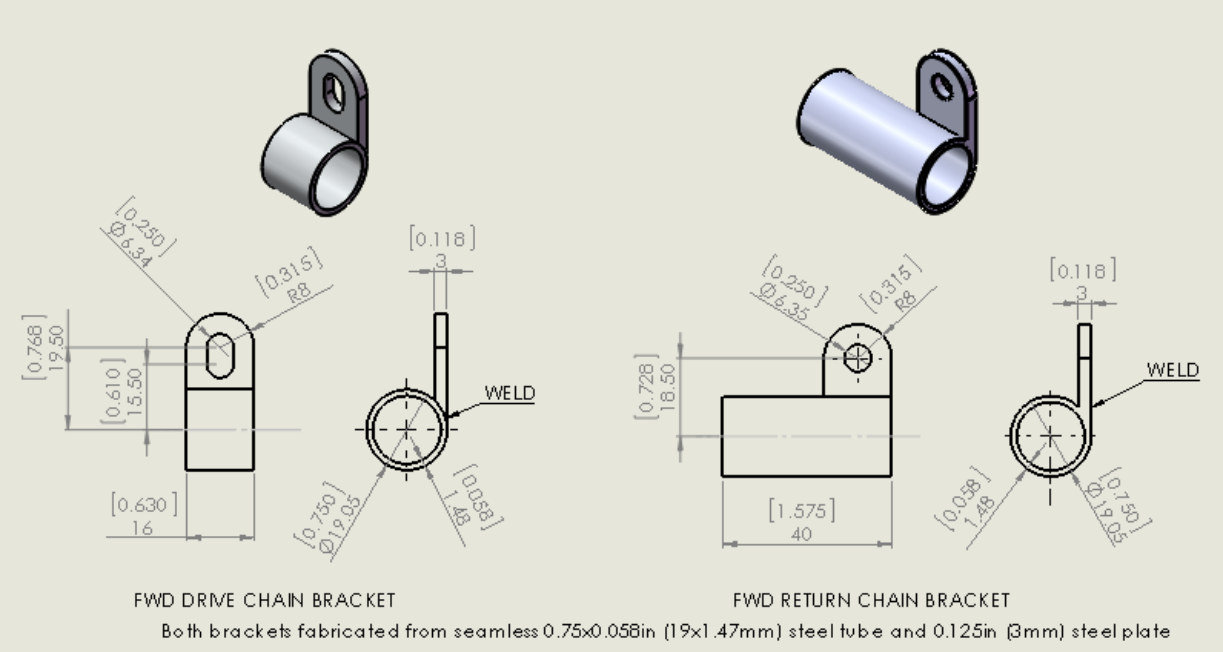
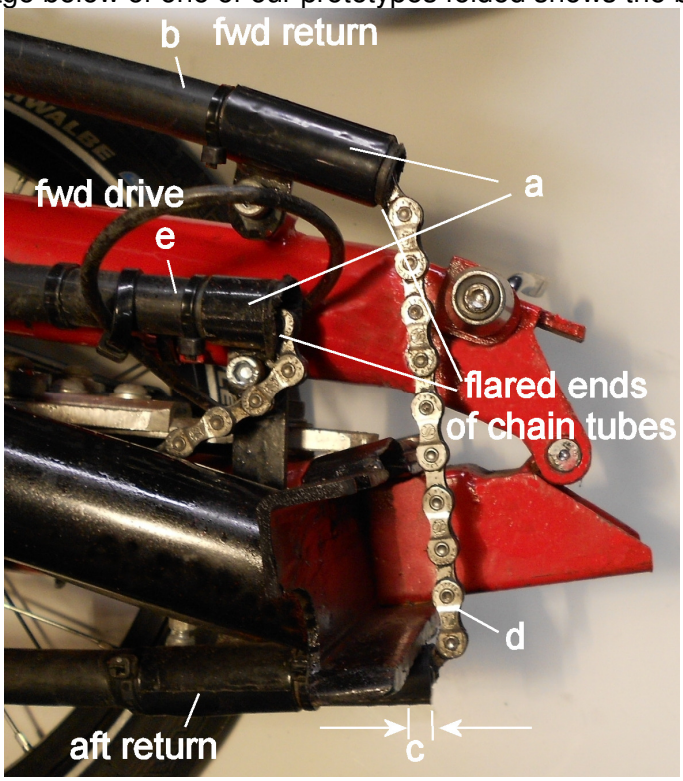


The image below of one of our prototypes folded shows the brackets set up as they should be:



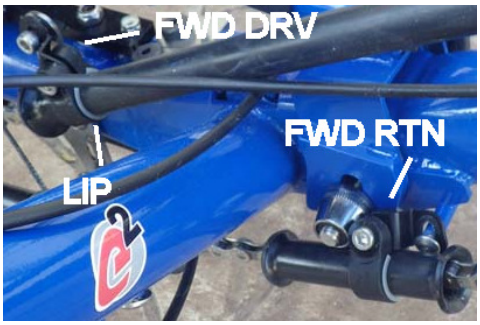
Note that in the above image:

a. The two topmost forward chain tube brackets are those we recommend replacing.
b. the topmost (fwd return) chain tube is long enough to hold itself ~parallel to the boom,
c. the front end of the lowest chain tube (aft return) extends ~3mm forward of the hinge,
d. b+c ensures the unenclosed section of return chain always clears the cross-arm channel.
e. the middle (fwd drive) chain tube keeps the chain path to the idler clear of the hinge.
f. d+e allows the cranks to be rotated when folding the boom to put the right pedal bend the rear wheel without the chain damaging any paintwork.

Left: E2 chain contacting the cross-arm channel,
Right: E2 FWD RTN bracket interference with Q/R nut


b. Forward drive chain tube severely bent when folding

The forward drive chain tube is bent 90 or 180 degrees when folding. The two parts of the E2 chain clamps are not reliably fixed relative to each other. When the plate rotates relative to the clamp the chain tube can drop by about 0.5inch (13mm), creating interference with other parts. When folding the boom back, the lower front lip of the Fwd Drive clamp catches behind the right cross-arm channel and prevents it rotating, causing the chain tube to be bent 180 degrees. The rear of the chaintube can extend back too far and get caught behind the right cross-arm channel, causing the chain tube to be bent 180 degrees, as can be seen in the right image below.



One E2 owner reports that the problem is avoided if he adds a step to the folding – he pulls the chain tube forward before folding.

The alternative is replacing the E2 chain tube brackets with brackets fabricated to our design. Our brackets are more robust one-piece and we have never had any bending or breakage. See “Replacing the E2 forward chain tube brackets” above.

c Front gear cable getting damaged in the folding mechanism.

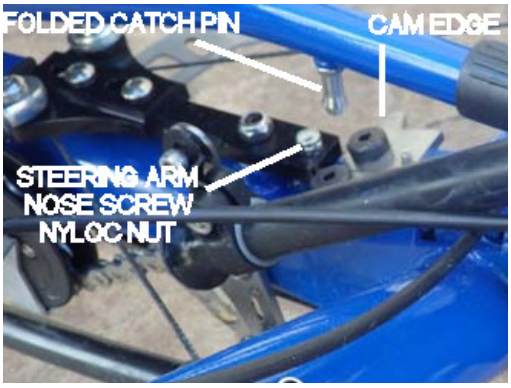
If the front gear cable is not properly routed it can be damaged during unfolding particularly when the hinge is closed. We spent considerable time developing a reliable route to always avoid the cable being caught in the folding mechanism. CEW ignored our experience and changed the routing on the E2.

We recommend re-routing the front gear cable to the route set out in our TECH-GUIDE_Front-gear-cable-route.

d The folded trike does not roll true.

We have had reports from some e2 owners that their trikes do not roll true when folded.
The trike should be set up using our TECH-GUIDE_Toe-in-Adjust and it will roll true.

First, check that the nose of the E2 steering arm has a Stainless Steel Socket Head Cap Screw (SHCS) with head underneath and a nyloc nut on top. One E2 owner reports that fitting the screw resolved his issue. (see left image below.)



The right image shows some rubber bumpers that were added to the E2 to prevent paint damage from the steering arm movement. We presume they were added due to the absence of a proper screw in the steering arm nose and proper setting up.

Fitting screw to nose of the E2 steering arm.
If a Socket Head Cap Screw has not been fitted to the nose of the E2 steering arm we recommend fitting a Stainless Steel Socket Head Cap Screw (SHCS) M5x12mm from underneath and secured with an M5 nyloc nut on top.

Both the left and right hinge cam plate rear cam edges should engage the head of the Socket Head Cap Screw under the front of the steering arm to align that arm and keep the wheels straight when folded. With the steering pivot arm aligned along the main tube, the cam plate contact edges should just touch the M5 bolt head just as the cross-arms properly engage in the cross-arm catches. If the catches do not engage then the cam plate contact edges can be carefully gradually filed to suit. If it is too loose a larger headed SHCS would have to be substituted. After this, check and adjust the folded toe-in using our TECH-GUIDE_Toe-in-Adjust.

e Chain tube slipping through chain tube brackets.

E2 owners have reported that the chain tubes slip through the plastic chain tube clamps causing damage.

We recommend securing the chain tubes on the non-flared side with a firm [minimum 4.7mm (3/16in)] cable tie tightened with pliers, or as suggested by one E2 owner with a 15-17mm eared fuel hose clamp (as in image below).

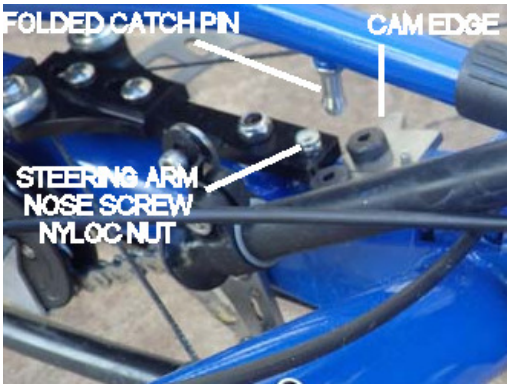
f Chainstay scratches from the chain when folding the rear.

E2 owners report scratches on the right chainstay when folding the rear.

We recommend fitting an approx 20cm(8in) length of cloth (book binding) tape over the right chainstay as shown:

g Folded catch and pin not reliable.

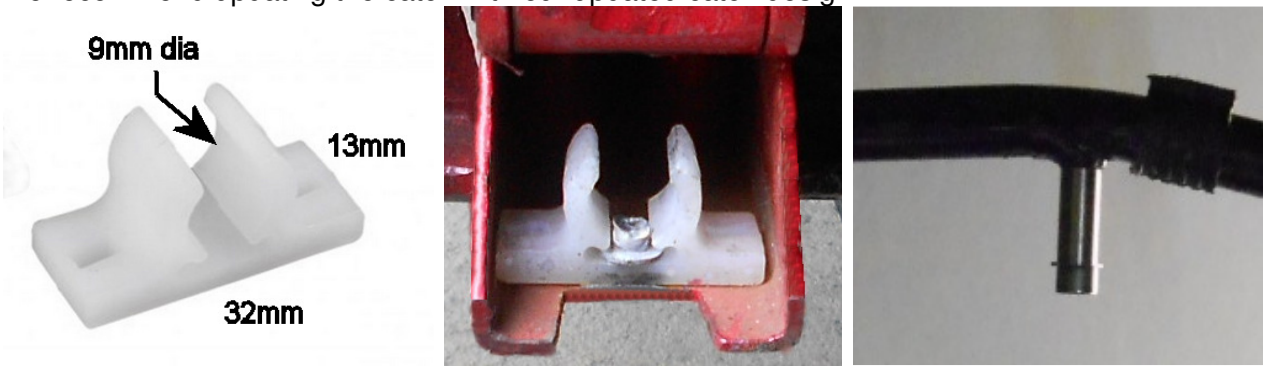
At the outset we told CEW that they would need to source a stronger catch or have a thicker version fabricated, and neither of those happened. We suspect that the catch and pin used on the E2 wasn't as firm as ours.



An E2 customer reported his folded catch pin unscrewed itself and dropped out. The pin should be fitted using thread locker (Loctite etc) on the thread.

An E2 customer reports that when he folds the E2 he engages the slots of the seat arm on the main Quick release which may be satisfactory but not so compact or so quick.

We recommend updating the catch with our updated catch design.



The new catch is a nylon cupboard catch as above. The catches can be sourced on ebay(Australia) using the search term "nylon cupboard catch". It can be fitted to the existing mount hole by drilling a 1/8in hole through the centre of the base, fixed with 1/8in stainless steel rivet and small washer as shown above.

The folded catch pin is a 9.5x1.6mm(3/8x1/16in) Stainless Steel tube 25mm long secured by a 6mm x 25mm long shoulder bolt with M5 thread and a 13mm dia washer. (The E2 requires a shoulder bolt because the E2 pin has an M5 thread, whereas ours has an M6 thread so we use a regular SHCS screw). The diameter of the head of the shoulder bolt should be slightly larger than the tube.

h Quick Release always requires re-adjustment to fold.

Our design includes a bevel on both sides of the lower ends of the seat arm over-clamp to allow it to easily slide into the QR. It also a C-section plastic sleeve on the QR shaft inside the hinge which:
(a) Holds the QR axially to allow the bevelled leading edges of the over-clamp channel to easily slide into the QR.
(b) holds the QR rotationally so the QR lever always remains in the same orientation for quick operation.

CEW chose to not bevel the lower edges of the seat arm over-clamp channel. We don't know if they fitted C-section plastic sleeve on the QR.


Overclamp channel

We recommend to file/grind an approx 4.6mm x 1.6mm chamfer on each side of each leading edges of the over-clamp channel.

j E2 Tail does not fold correctly

CEW made changes to our design without proper consideration of the affects on folding and without proper prototyping. To our knowledge they were never able to manufacture it reliably. In our view their design actually increased the required accuracy on the component parts. On later trikes they substituted a non-folding rear which limited the upper end of x-seam range for riders.

Unfortunately we have no simple solution.

k Inadequate final quality checking

E2 owners have reported issues like bolts missing or of insufficient length to properly engage with Nyloc nuts.

We recommend thoroughly checking the trike.

l No lubrication schedule for the folding pivots in CEW manual

All folding pivots on the trike consist of a pivot pin firmly locked at either end to a flange and rotating within a wide boss. For longevity of the folding pivots they need regular lubrication. Lubricate the boom pivot, the two side-arm pivots, and the twist tail pivot occasionally (~3 monthly) with either a couple of drops of chain lube (or WD-40 White Lithium grease) to keep them free. (For long life all these pivots are designed to be firmly anchored to the narrow flanges and only rotate in their wide pivot boss.)

m Boom pivot allowed to rotate in the pivot flanges

On at least one trike the pivot pin was not locked to the flanges. To avoid excessive wear it is essential to lock the pivot pin to the pivot flanges. If needed, replace with a pin with a straight knurl that positively engages in the flange or lock by another means.

Replace with a new steel pivot pin made from an 8.00mm x 45mm (M6) shoulder bolt. For 3.2mm from one end, FULL STRAIGHT KNURL at 0.6 pitch (with a 28mm dia 0.6 pitch wheel, Ebay) to 8.08mm dia.

END