SUNBEAM TIGER OWNERS ASSOCIATION

TECHNICAL TIPS

ON THE SUNBEAM TIGER

January 2000

# Failure of the Front Frame Tubenuts

My personal feeling is that this is one Tech Tip that has been put off for way too long. As a Senior TAC Inspector, I have observed many, many Tigers in all levels of current condition. This experience and observation combined with my engineering background, has provided me with an understanding of the common modes of structural failure that Tigers are destined to develop. At this point, I can state with certainty that the failure(s) depicted in the attached photos are eventually going to occur in all Tigers. Those that are "used" under more highly stressed conditions or that have suffered significant frontal accident damage will develop them sooner than those that spend most of their life in the garage.

This knowledge is certainly not intended to discourage the active use of your Tiger, but rather to point out that you need to be observant and aware that structural degradation is cumulative and that at some point you need to take corrective action to prevent severe damage and potentially dangerous conditions.

Background information.

The front frame components of the Tiger unibody are under several severe cyclic loading conditions. When you consider that they transmit all the power, braking, and suspension loads to the main body, you begin to understand how well they perform these tasks. I have written several tips on the front crossmember: how to spot typical degradation and steps to increase the capability of this "suspension system".

It will therefore come as no surprise to many owners that the connections that transmit the loads developed in the front suspension to the frame are also susceptible to cyclic fatigue and eventual failure. There are actually two modes of fatigue and they are both typical but not necessarily related.

The first mode of fatigue is the reduction of the space between the frame rails. When you observe that the front crossmember is essentially a U shaped structure with the suspension arms, shocks, springs, etc. attached to the outsides of the U, you see the possibility that eventually the U will begin to collapse or close at the top. Many Tigers have a reduction between the frame rails of 1/8" to 3/8". This is not normally an observable movement because the crossmember collapses at the same rate, but it will certainly be more obvious if you try to install a set of tube headers with this condition.

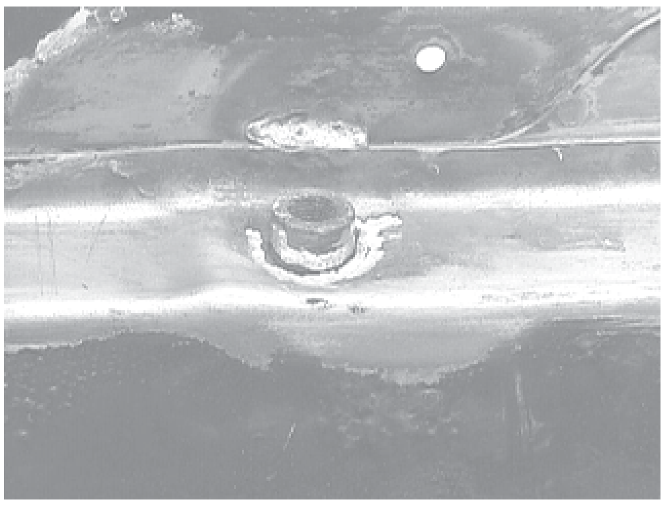

***Figure 1. This is a shot of the front frame rail with the tubenut protruding. The original weld has been ground away in preparation for the installation of a reinforcing plate. It's hard to get a picture that shows the depression in the top frame rail surface but it is evident in this photo. It's much easier to spot when you've seen it on a Tiger.***

The second mode of fatigue is actually a structural failure. This failure is the loss of integrity of the tubenuts in the front frame rails. In case you hadn't noticed, these tubenuts are what hold the front crossmember to the unibody. These tubenuts were placed in the U-shaped front frame rail as it was welded together at the factory. The tubenut assemblies actually consist of the threaded tubes and some sheet-metal welded to the bottom of each tube. They are placed inside the frame and the sheet-metal bases are tack and spot welded to the inside of the lower flange before the outer face is installed. The top portion of the tubenut protrudes from the upper frame flange, and this is the only area you can see. A reasonably small bead of weld attaches the top of the tube nut to this upper flange.

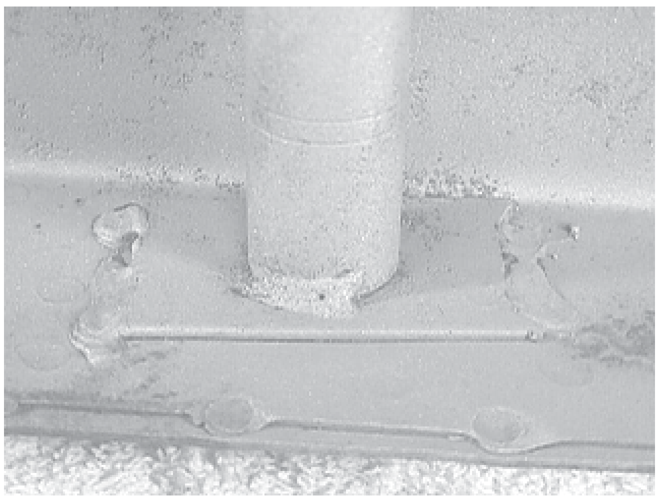

*Figure 2. Here's a rarely seen piece of your Tiger. This is the inside of the front frame showing the lower framerail, the tubenut, and the small sheetmetal flange between the two. In typical failures, these components move downward as a unit. The outer spot welds tear away from the top portion of the outer flange and the loading shifts 100% to the upper flange. At that point there will not be any outward indication. As the crossmember attachment bolt continues to pull down on the tubenut, the top surface deforms and eventually the top weld breaks.*

Although the typical cracking of this tube to frame weld and the depression that forms in the top of the frame rail is the "observable" damage from this mode, the more critical failure is that of the lower frame flange connections. The lower frame flange is a spot welded assembly and when these welds fail the bottom of the frame begins to separate from the top. The result is that the tube begins

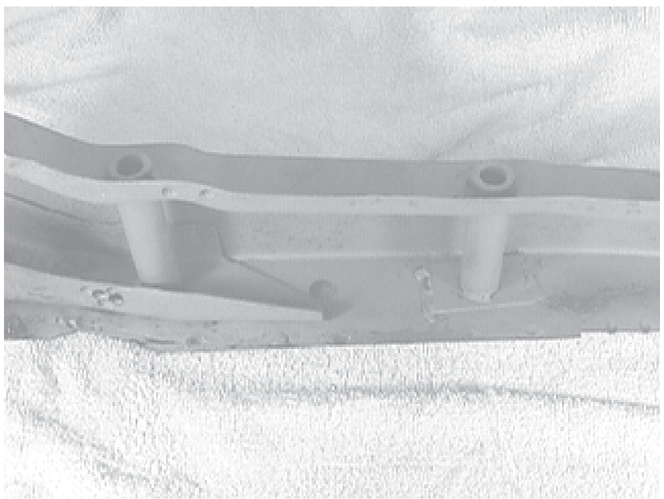

*Figure 3. This shows both front and rear tubenuts and the stamped frame reinforcement inside the frame in the area of the hump and motor mounts. The plug welds you see on the side in the area of the rise connect to this internal stamped member. (Too bad the designers didn't bring this piece forward to the front tubenut!)*

to sink in the top flange long before the cyclic fatigue causes this top weld to fail. In fact, it has been observed that the top frame rail always becomes depressed in the welded area of the tubenut once failure begins to occur. Repairs to this area are observable on the factory race Tiger #55 currently owned by Bill Miller.

The explanation for this mode of failure is actually pretty simple. Every time you step on the brakes the resulting reaction of the tires with the ground applies a torque load on the connections between the crossmember and the unibody. The crossmember pulls down on the frame at the front tubenut, and pushes up at the rear. Eventually these load cycles begin to break down the original welds and things start to move. The more frequently and the more aggressively you apply these loads (good brake compounds, sticky tires, competitive activities), the sooner this failure will occur. If you have seen these small depressions starting to form at the front tubenut it is time to take action to prevent further degradation to the unibody.

### What to do!

The first step in resolving this situation is the removal of the front crossmember. It is certainly possible to make the appropriate repairs with the engine in place but you will need reasonable access to accomplish the necessary grinding and welding. This access typically includes removing the accessories from the engine, the radiator shroud, reservoir tank, steering links, etc. If you intend to re-spread the frame rails, your selection of pressure points is severely limited by the engine. To obtain the best frame rail alignment, the engine should be removed so that you can apply the hydraulic ram near the rear tubenuts. We will assume at this point that you are aware of any required repairs and reinforcement to the front suspension and steering. This is a great time to take care of those items if you haven't already.

The next step is to clean the areas you will be welding on. This means a thorough degreasing and removal of all traces of undercoat and paint including the frame flanges. It's a lot of work to get to bright metal, but dirt, rust, or other debris in the weld area will degrade the weld process and it's ultimate strength. I like to use those small stainless "toothbrushes" to get into the tight areas.

Next comes the process of pulling the lower frame flange and tubenut back into proper position. I made a tool to accomplish this task. It fits both top frame rail surfaces and spreads the load so that a bolt can pull the lower frame and tubenut together back into position (Figure 4). You want to pull the tubenut and lower flange back up to the point where the lower flange is again flat. At that point you can clamp the outside edge of the lower frame rail near the front tubenut in place with a couple pairs of Visegrips.

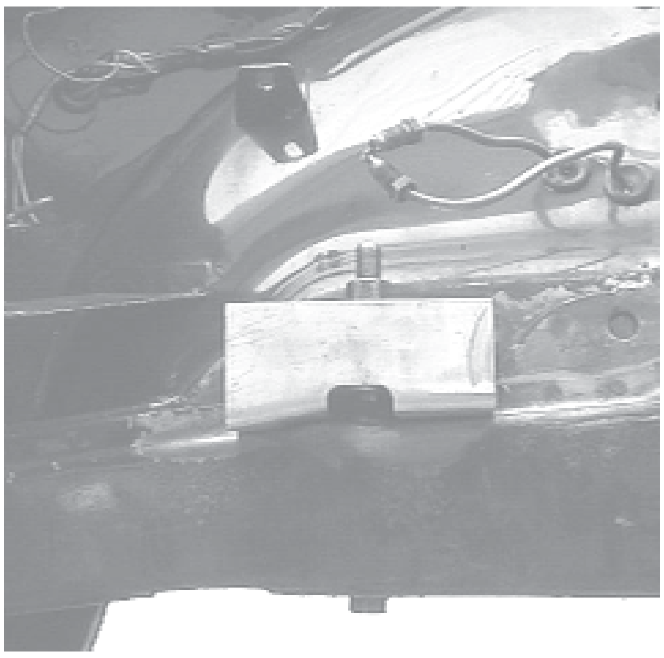

*Figure 4. Here's a shot of my aluminum tool which helps pull the lower flange back into position. It is shown with the 7/16 bolt in place to apply pressure in the proper places. It does not pull the depression out of the top of the frame. That will be covered with an added piece of plate.*

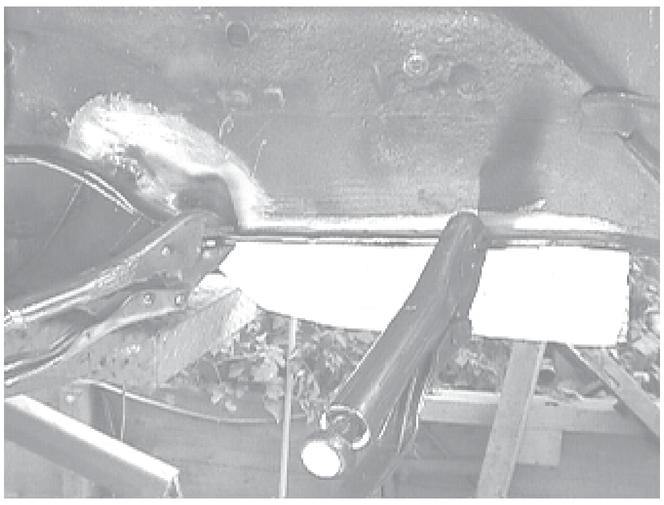

*Figure 5. Here's the outer framerail clamped back in position with Visegrips. This entire length should be welded, from the arch forward the the end of the three layer lamination. You can simply fuse the edges together or drill holes and plug weld this flange. Be sure to grind any weld bead that protrudes below the flat surface.*

Now it's time to remove the traces of weld from the top of the tubenut that used to attach it to the top surface of the frame rail. Figure 9 gives the design of the re-enforcing plate that I use for this application. It is not necessary to install a piece any heavier or larger than the one shown. Spreading the load is important but overkill will only add weight and not provide any additional structural benefits. I like to weld the tubenut to the new plate and the plate to the frame all around the edges. This is more weld than necessary but allows me to dress up the weld beads with an abrasive wheel and make the repair look cleaner. After the top frame flange is welded, it's time to weld the lower frame flange in the fender well. Start by tack welding close to the Visegrips near the tubenut and working your way outwards from that point. The ultimate objective here is to fuse the edges of the three laminated pieces of frame together. I like to weld the entire length of the edge of the frame from the upturn at the rear to the front of the three layer lamination. After welding you will want to grind off any weld bead that protrudes below the plane of the lower flange. You might also examine the three plug welds in the side of the frame at the arch, and add weld in those areas to make them flush them to the side surface. The thin piece on the side of the frame in front of the tubenut area and the front portion of the framehorn are a subject of future discussion.

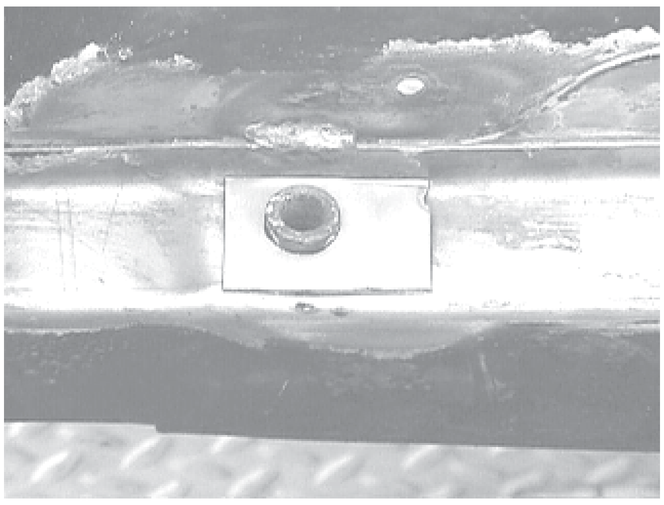

*Figure 6. This is the new reinforcing plate in position. This is all you will need to properly cure this problem.*

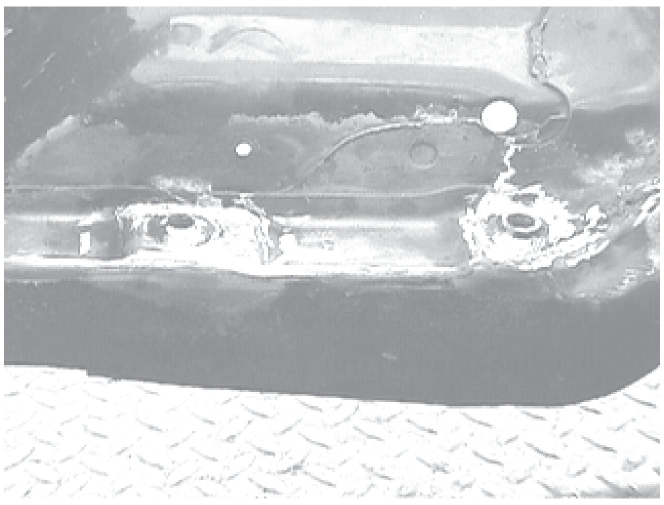

*Figure 7. Now the plate is welded all around as is the tubenut. Since we were in the area, the welds in the vicinity of the rear tubenut were also rewelded. This was followed by a cleanup grinding of the welded areas to neaten things up before painting.*

At this point it's time to smooth the welds and chase the threads in the tubenuts. Prepare the base metal properly for paint with an etching metal prep; use a rust preventitive paint such as POR-15 on the external areas if desired. Finish this prep work with finish paint on the inner frame and bottom flange. Undercoat the fender well, and you're ready to re-install the crossmember and get back on the road.

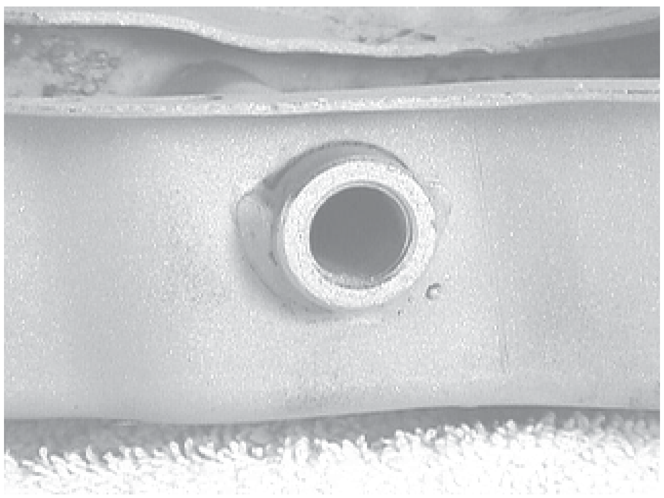

***Figure 7. This is a closeup of the front tubenut "as built" by the factory. Notice that the weld is only on the outside of the tube where it was accessable, and furthest from the vertical flange which could have provided additional strength.***

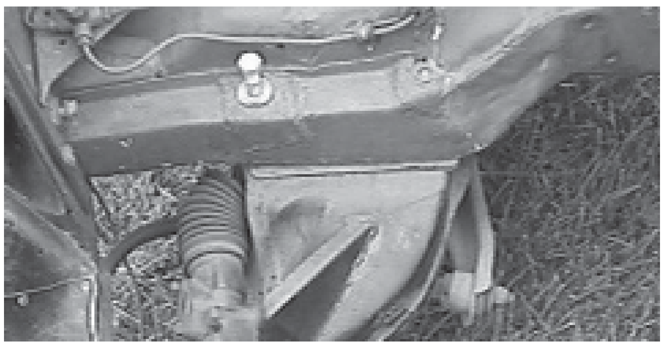

***Figure 8. I'm sorry that this photo is not clearer, but this is a picture of the factory race car #55, now owned by member Bill Miller. It does show that the structural failure areas discussed in this Tech Tip were relevant even in the first year of racing activity. My illustrated methods may be slightly different, but the message is the same.***

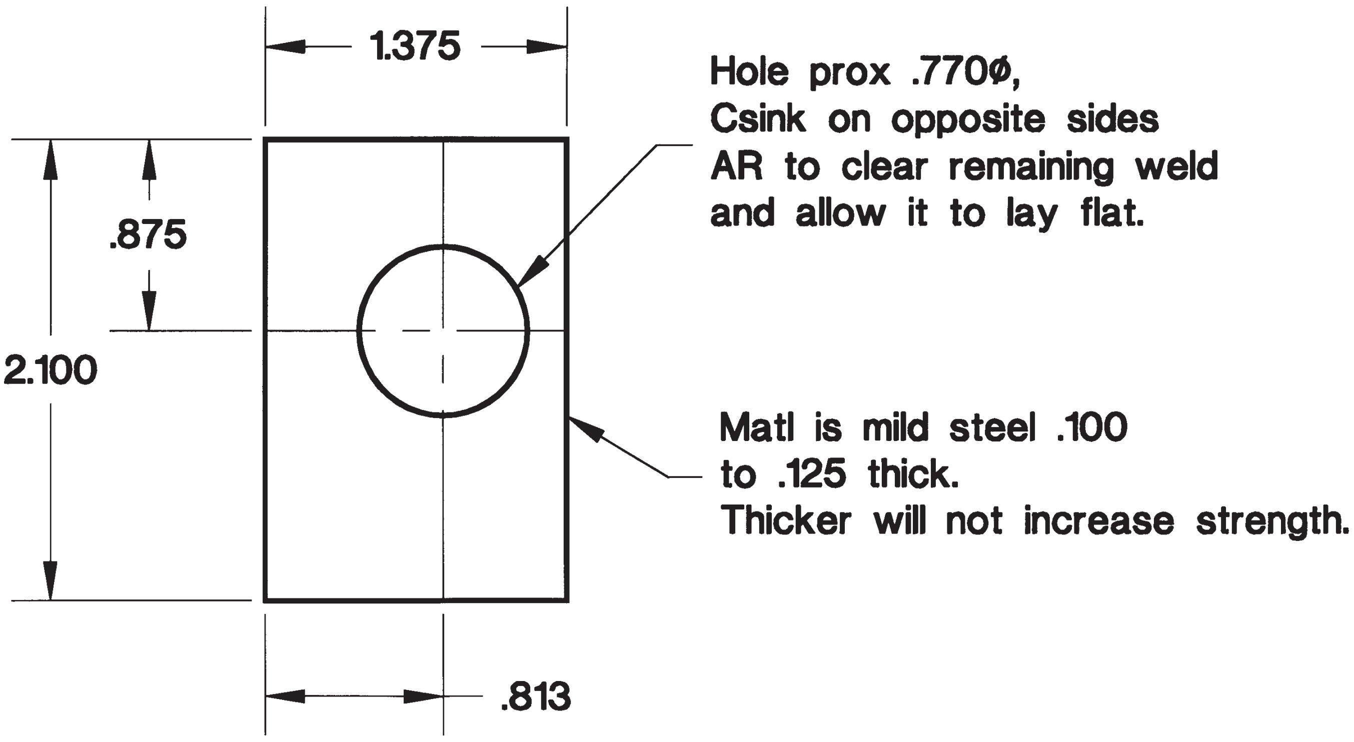


***Figure 9. Here's a drawing of the reinforcement plate that I use to accomplish this repair. You will need to make two, one for each front tubenut.***

***by Tom Hall***