Ball Joint Failure

Front suspension design is the fastest growing segment of aftermarket ATV racing components. There are so many companies building a-arms that it is almost hard to keep track. This is a great thing for the consumer to have so many options available, but there are a few things that the consumer should be aware of when dropping their hard-earned bundle of money on a nice new shiny set of arms. One of the biggest areas of interest should be the joint connecting the arm to the spindle.

There are three basic designs available on the market today. The first design uses high strength heim joints. Fairly new to the market, this design has been popping up everywhere primarily due to their ability to handle high misalignment angles at a moderate price level. This set up is a great solution to satisfy the market shift toward extended travel front suspension geometries. The design is light weight and quite strong. Heim joints are somewhat maintenance intensive requiring periodic washing and lubricating in very dirty environments. Teflon lined heim joints as well as rubber boots have helped reduce this required maintenance.

The second design, which is commonly referred to as the T-pin design, has the ability to handle practically an unlimited range of motion. This design replaces not only your a-arms but also your spindle. The T-pin design works well in dirty conditions but does require periodic greasing and typically an annual replacement of the numerous bronze pivot bushings used in the assembly. When maintained properly, the T-pin design does offer a very smooth action. The major down fall of the T-pin design has been the rather high cost associated with the additional parts and special manufacturing processes required.

The third design, and the primary focus of this article, uses automotive style ball joints. The use of ball joints is a fairly economical option for both the manufacturer and consumer alike. This design typically provides an adequate range of motion for standard travel a-arm geometry and stands up to dirty environments very well. The ball joint design also has its limitations. Because of its original design intent (automotive tie rod ends) the ball joints used do not have very good longevity when submitted to extreme load cases such as flat landing from a big jump. When a ball joint is used in an a-arm application, it is being subjected to bending stresses. In its automotive application, ball joints are primarily subjected to tensile and compressive loading. The following illustration depicts what can happen to a ball joint when subjected to bending forces surpassing its intended load carrying capacity.

Illustration #1

Illustration #2

Illustration #3

Illustration #3 helps us to determine the type of failure that has occurred. The half moon shaped marks around the left edge are commonly referred to as "beach marks" resembling the marks that waves leave in the sand on a beach. These marks are a tell tail sign that the fracture was initiated from a fatigue crack, in this case, forming at the root of the thread. Another bit of information that can be obtained from this sample is that even though the failure was initiated from a fatigue crack, the crack did not propagate very far before the brittle fracture occurred. The ultimate strength of a material is the stress level that a part can withstand before a catastrophic failure occurs. Because the stress in a part is equal to the applied force divided by the cross-sectional area of the specimen ($\sigma = F/A$), as the area decreases, the stress increases. In this case the reduction in cross-sectional area was very small when the part fractured. This tells us that the loads being applied to this sample were generating stresses that were approaching the ultimate strength limit of the material even before the reduction in area occurred. The only way to combat this failure mode is through a material composition change or an increase in shank size. This is the very reason why our MX Tech arms use heims with such a large diameter shank. This particular failure occurred while the rider was skying a 70 foot table top. The rider landed a little front heavy and upon impact, snapped the ball joint off. This resulted in some bumps and bruises and a moderate concussion.

Does this mean that all arms that are built with ball joint are bad? No, it just means that you need to purchase components that are designed for your intended use. Because of the low price point and their maintenance free design, arms constructed using ball joints are a great choice for the recreational trail or dune rider who wants to add stability and increase cornering performance. If your intended use is motocross type applications, we would strongly recommend going with the higher priced, more robust designs. Arms constructed using heim joints are a great alternative that won't break the bank.

For more information on this topic, feel free to contact us at Janssen Motorsports. We will be more than happy to answer questions you may have.