Why Does Your Harley Davidson® Wobble?

By Tim Stone (2016-Sept)

The rubber mounted Harley is a great thing. It provides us with an enjoyable (and distinctive) riding experience. The design however lacks an adequate stabilizer system. The result is that under certain conditions, the rear wheel will move (in and out) of alignment while the motorcycle is in motion. The condition is felt as instability and can develop into a wobbling event.

This “Rear Steer” is dangerous but fortunately it can be corrected.

Background:

The HD rubber mounted design divides the motorcycle into two assemblies.

- (A) Engine/Trans/Rear Swing Arm/Rear Wheel. (i.e. Engine Assembly or Power Train Unit “PTU”)
- (B) Frame/Rider/Front Tree/Front Wheel (i.e. Frame Assembly or “Frame”)

These two assemblies are connected together by rubber mounts.

- 2008 and before Models have 3 rubber mounts. One is located at the bottom front of the engine, and two more are located on each side of the rear swing arm pivot shaft.
- 2009 to Present Models have 4 rubber mounts. Two on each side bottom front of the engine and two more on each side of the rear swing arm pivot shaft.

The rubber mounts provide vibration dampening between the two assemblies by allowing the Engine assembly to rock back and forth (move vertically) within the Frame. Allowing the engine to rock back and forth within the frame reduces the amount of vibration transferred to the Frame and the Rider.
Because the rubber mounts are soft they flex (obviously). And flexing that allows the engine to move up and down (rock back and forth) is the whole point of having the mounts... But they also will allow side to side movement (which is a bad thing).

Heim links are typically used for stabilization. These links are connected between the frame and the engine assemblies and their purpose is to maintain parallel alignment between the Power Train Unit (A) and the Frame (B). Because the links allow vertical (up and down) movement, they do not inhibit the rocking action of the engine which is needed to provide vibration dampening.

2008 and Earlier Have 2 Links & 3 Mounts

2009 and Later Have 1 Link & 4 Mounts

In order to maintain complete alignment between the Engine assembly and the Frame, you need at least three points of stabilization between the Frame and the Power Train Unit (PTU). Three points of contact will inhibit the PTU from moving laterally (side to side) within the frame while under stress (like while riding in a sweeping turn or going over uneven road surfaces).

Buell owns the patent (US004776423) on any design that uses three links or more. So Harley Davidson always has less than three links in their design. And because of this, the Harley Davidson design is not completely stabilized.

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Instability is caused due to the front wheel being connected to the frame assembly, and the rear wheel being connected to the engine assembly. Any flexing (or side to side movement) of the Engine assembly within the Frame causes the front and rear wheels to move in and out of alignment.

So you might ask, “Why is the rear wheel not connected to the Frame? That way it cannot flex out of alignment with the front wheel...” Good question. The answer is the rear belt drive. The Rear wheel and swing arm must be connected to the Transmission & Engine to create a rigid Power Train Unit. The belt cannot tolerate any miss-alignment between the front and rear drive pulleys. Because the rear wheel is connected to the PTU is the reason why the belt drive system is so reliable.

Let’s first talk about the older design (2008 and older):

High speed Instability on 2008 and previous year models are worse than the newer 2009+ models. On the earlier models (2 links) the front lower stabilizer link holds the front of the engine assembly in a (laterally) fixed position. The rear rubber mounts at the swing arm are like donuts and can be compressed allowing the rear of the power train unit to move side to side within the frame. The side to side movement at the rear of the PTU creates rear steer. And because the front of the PTU is held in position by the front link it amplifies the condition. It’s similar to a trailer being pulled by a car (the rear moving side to side is amplified because the nose is held in a fixed position).

But that said, the older design is actually easier to correct than the newer design. (more on this later)
2008 and earlier models have another problem in their design. When the rear of the PTU is pushed out of position the misalignment between the front and rear wheels is amplified by the top engine link. This link creates a pendulum effect where the rear wheel will move out of vertical alignment also (not just side to side). What this does is produce an oscillation under conditions like riding through a high speed sweeping turn. While in that turn, if a small bump is encountered, the stress will compress the outside rear mount and the rear will move out of alignment. The rear steer, steers the rear wheel into the turn (and into the force). The pressure is released off the rear mount and it decompresses. But the mounts are made of rubber, and like a ball it “bounces” back out of position aided by the force of the turn itself. The pendulum amplifies the rear steer adding to the problem. This oscillation can actually get worse and worse if the rider does not remove the energy that is perpetuating the condition. And to do that the rider must throttle back while in the turn to stop it. This Oscillation is the “WOBBLE”.

Vertical Misalignment caused by the top link acting as a pendulum is a condition of the older models. However, the top link becomes a good thing to have when a proper rear stabilizer is added!
Let’s talk about the newer bikes.

On 2009 and later models Harley uses only one link positioned at the upper middle front of the engine. They also changed the front rubber mounts to an axial type design with two mounts, one positioned on each side of the lower front engine.

The new configuration is an improvement in some ways, yet in other ways it’s not (more on that later). The motorcycle feels more secure when moving at speed. Stability is better than the previous models for a couple reasons. First, the lower front of the PTU is no longer locked into position like the older design. This may sound odd... But by allowing the lower front of the engine assembly to move a bit, it removes much of the “Trailer whip Effect”. Secondly, the removal of the top link got rid of the “pendulum effect” (in other words, when the front and rear wheels do go out of alignment, at least the rear wheel remains vertical and does not lean left or right).

The PTU will still move out of alignment however, so do not think that the stability problem is resolved. The newer bikes DO still have stability issues because the rubber mounts can (and still DO) flex allowing the front and rear wheels to move in and out of alignment.

Under stress, all the rubber mounts flex allowing the power train unit (and rear wheel) to move left and right. The result is rear steer and instability.
Although the new configuration is less likely to produce high speed oscillation (or wobble), the newer design actually feels a bit more “Squirrely” when riding at slow speeds or over uneven road surfaces. The instability problem still exists; it’s only the symptoms that have changed along with the conditions when we feel it.

The instability of the new design feels sort of like riding a Quad. It does not feel “solid” when going slow; especially over uneven road surfaces. It makes sense really. The older bikes’ PTU was laterally locked into position with two links that did their job well. The rear mounts did a fairly good job of holding the rear of the PTU in position while going straight or slow. The older bikes were lighter. It was only when the rear wheel was under lateral stress did the rear mount(s) flex and become unstable. The new bikes are heavier, and the PTU is not as well secured into position. Even going slow the PTU will shift and it can be felt. With increased speed it’s less noticeable. Because of the new configuration of the “link” & mounts, the design is less likely to amplify any misalignment when it does happen at higher speeds.

**The Solution:**

You might think the obvious answer to the unwanted lateral movement of the PTU is to “add the missing link(s)”, and you would be right. It is the “Obvious” answer. But it is not the only answer.

**In Closing…**

I hope this paper has helped you better understand the stability issues of your Harley Davidson. And I hope it helps you make more informed choices on what you can do to improve your safety and riding experience. I've added stabilizers on both my 2002 Road Glide and 2015 CVO street glide. The difference in both (and more-so on the 2002) is amazing. I did not even know how bad the problem was until I fixed it. The 2002 rides like a different machine. FYI: I did not add a link to stabilize the rear of the PTU. Feel free to contact me (Tim) with questions at info@STA-BUL.com

Best wishes... Keep the rubber side on the road and may God bless you and keep you safe.