

**TIP**

# Rake And Trail

## The Nuts And Bolts Of Chassis Geometry

Story And Illustrations By James Parker

When *Dirt Rider* talks about the handling and geometry of a dirt bike, we often use words like "rake" or "steering angle" to describe certain traits. Manufacturer specifications usually list some other chassis measurement called "trail." Noted motorcycle designer and chassis expert James Parker offered our sister publication *Motorcyclist* a primer on these terms, and we thought they would be helpful for our readers as well.

Motorcycle steering geometry is determined by four measurements:

- "Trail" is the distance by which the axle "trails" the point at which the steering axis of a motorcycle would contact the ground (see illustration). Any vehicle—a car, bicycle, motorcycle or airplane—needs trail to ensure its steerable wheel (or wheels) is stable. You can visualize trail as a kind of "lever arm" that tends to center the wheel behind the steering direction. More trail means a longer lever arm and greater centering leverage.
- "Rake" is the angle of the steering axis, measured from the vertical.
- "Offset" is the distance from the steering axis to the front axle, the combination of triple clamp and fork offset. This offset number is different from the common use of the word *offset*, which is used to describe the distance between the steering axis and the center of the fork when discussing triple-clamp dimensions. The offset number of the triple clamp would be less than the total offset since virtually all dirt bikes have leading-axle forks.
- "Tire radius" is half the tire's diameter.

When you change rake, offset or tire radius on your motorcycle, you change trail and therefore the relative stability of your bike: More rake angle gives more trail. More offset gives less trail. More tire radius (bigger tire) gives more trail.

Modern bikes have a complex balance of chassis variables to produce stability, turning, feel, balance and traction. Standard, hard opinions like "less offset is better for turning" are no longer reliable. Be careful of chassis changes, and make sure you compare them whenever possible so you don't end up hurting the handling. Just because your previous bike liked a certain triple-clamp combination doesn't mean your new bike will like the same setup.

