FRAMES, SUSPENSION, FORKS AND SHOCKS

Single Rear Shock / Single Sided Swingarm

FRAMES

Frames, Suspension and Handling

The motorcycle engine, transmission, front fork, wheels, seat – everything that makes up the motorcycle is attached either directly or indirectly to the frame. The neck (steering head) is located at the front of the frame, and the swing arm support for the rear wheel and its pivot points are located at the back of the frame.

The rake and trail geometry of the front end will affect handling. The design and quality of suspension components and the length of the wheelbase also affects handling. The handing qualities of a motorcycle are dependent on the overall design of the bike, its weight, and what the bike was built for.

A heavy and comfortable touring bike will not turn quickly like a sport bike. A heavy touring bike also cannot be safely run at high speeds over surfaces that are hilly, bumpy, or on roads with sharp turns. This is not what the bike was designed for. The touring bike weight and suspension is not designed for these road or track-type conditions.

Bikes differ in the design and purpose they were built for. Touring bikes do not have nimble handling characteristics, but they can be driven long distances in comfort. Sport bikes can turn quickly, accelerate quickly, stop quickly and have extremely stable suspensions. However, sport bikes are not comfortable for long distance riding.

Frames are typically made from steel or aluminum alloys. Round steel tubing is the most utilized component of frame construction. However, sport bikes and motocross bikes have lighter aluminum frames that utilize rectangular or square-shaped aluminum frame pieces. These frames are quite different in construction than frames using traditional round steel tubing.

Cradle Frame

The front of the cradle frame utilizes either one down tube or two down tubes that are situated in front of the engine. The frame that uses one down tube is called a single cradle frame. The frame that uses two down tubes is called a double cradle frame. The down tubes stretch from the neck of the frame, down the front of the engine, and then under the engine to the back of the bike frame.

This aftermarket frame uses a cradle frame to support the engine and transmission.

Heavy bikes such as Harley Davidsons use a double cradle frame to hold their heavy motor. Their frame also has a single top tube, also called a “backbone tube”. Some bikes using a double cradle frame are designed with two top tubes.

Lighter bikes such as motocross bikes or lighter weight street bikes use a single cradle frame that uses a single down tube. These frames may also have a single top tube. Lighter weight street bikes may also use a sub

frame that extends off the back of the frame. The sub frame supports the seat, a rear fender and sometimes the rear suspension.

Cradle frames are reinforced with gussets behind the frame neck (steering head), and sometimes at the axle block area at the rear of the frame. The axle blocks support the rear axle.

Backbone Frame

The backbone frame is not commonly used except on mopeds and scooters. The engine is suspended between the single front down tube and the rear of the frame. The engine itself becomes a structural member as it is bolted to the front and back of the frame. Because the engine is part of the structure, there is no need for a top tube.

Diamond Frame

The diamond frame is similar to the single cradle frame except that the front down tube does not go completely under the engine and attach to the back of the frame. The down tube is short and its function is to bolt to the front of the engine. When the engine is mounted, the engine becomes a structural member of the frame and gives the frame structure strength.

Twin-Spar Frame

The twin-spar frame has two wide aluminum rectangular-shaped beams (spars) that go around each side of the engine. The beams are made of extruded aluminum. The two spars run from the steering head, around the sides of the engine, and to the rear of the frame where they are molded into a supporting bracket that the swing arm is mounted to.

In sport bike frame designs, the engine bolts to the left spar in two locations, and is also bolted to the right spar in two locations. The engine is suspended by the spars, and in this design the engine becomes a stressed member of the frame. In some designs, the swing arm is bolted directly to the back of the engine case – in such case the swing arm is not bolted to a swing arm bracket that is attached to the back of the frame.

Aluminum spar-type frames are constructed with extruded aluminum tubing. The tubing is mostly rectangular in shape. However, pentagonal and hexagonal shapes are also used for more stiffness. Aluminum frames use internal ribs for stiffening and strength because the aluminum walls are thin.

Sport bikes typically use a twin-spar frame. Note the black right-side spar as it curves down to the swingarm pivot.

Motocross frames also utilize a twin-spar design, but in addition they have a front down tube and a cradle under the engine. The down tube attaches to the front of the engine cradle, and the back of the engine cradle is attached to the swingarm pivot area of the frame. The engine sits in the cradle.

Trellis Frame

A trellis frame is similar in shape to the twin-spar frame, but it is tubular in construction instead of using extruded aluminum. The trellis frame has been used somewhat exclusively by Ducati, KTM and MV Agusta on their V-twin motorcycles.

Ducati is well-known for using the trellis-type frame. The engine serves as a stressed member and adds to the overall strength of the frame support.

Close-up view of a trellis frame.

The trellis frame consists of straight tubes welded into a lattice of triangles. It is light and very strong. The engine serves as a stressed member in a trellis frame and the swing arm typically bolts straight to the back of the engine case, and not to a swing arm bracket attached to the back of the frame.