

Topics No.08-02

Checking the Safety of Custom Bikes Using Strain Gages

Hidemi Iwata, Director of Bike Customization School
(The Recipes for Handmaking a Motorcycle)

Director Iwata of Bike Customization School (The Recipes for Handmaking a Motorcycle) took interest in the customization of bikes as a young boy and bought and customized many production bikes using custom-made parts. After a while he began building custom bikes on his own from motorized bicycles with a displacement of 125 cc or less, by modifying all possible components such as the frame, fuel tank and muffler, except for the engine, headlights and other components that must conform to the regulatory standards. In 1997, he set up a website introducing the actual processes of customizing two of bikes, wanting to share with many people the fun of building a motorcycle and riding one's own creation. In 2002, a year after he left his company by taking an early retirement package, Iwata opened a school at his home (Minami-ku, Hiroshima City). His classes, offered at the low prices, teach the basic engineering techniques involved in the customization of bikes in order to expand the community of amateur bike builders.

The school imparts the students on a personal tutorial basis with the various knowledge needed to build a bike each student envisions in his or her head, including how to handle tools and machine tools.

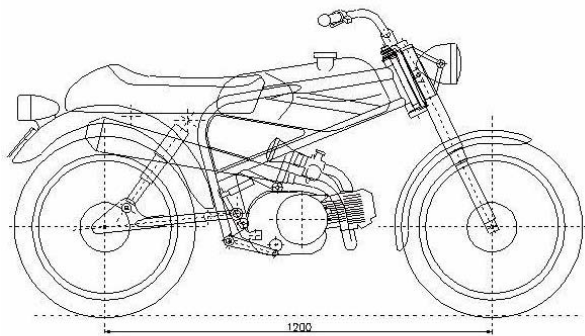


Figure 1 Concept Drawing of Finished Bike



Photograph 1 Finished Custom Bike

Figure 1 shows a drawing of a custom bike (C200S), an example of what prompted Iwata to open his school to teach the fun of building everything from scratch using a pipe frame, while Photograph 1 shows the finished bike. The details of the building process taught at the school are not explained here, because they can be checked on the school's website¹.

Building a custom bike doesn't mean the rider's safety can be compromised. So that the creator can ride the bike safely, the pipe frame must have sufficient strength to assure safety. First, various types of testing were conducted to check the effectiveness of several pipe frame shapes designed with different reinforcements (Photograph 2). Specifically, loads were applied to the frame using weights and the amounts of displacement were measured using dial gages to check the flexural strength and torsional strength. In this example, the results were used to select the center frame shown in Photograph 2 as the best frame design, and this frame was used as the basis to build a bike. The finished pipe frame assembly is shown in Photograph 3.



Photograph 2 Pipe Frames Designed with Different Reinforcements



Photograph 3 Finished Pipe Frame Assembly

* The title was omitted in the text when referring to Mr. Iwata.

* The drawing and photographs were provided by Mr. Hidemi Iwata, Director of Bike Customization School (The Recipes for Handmaking a Motorcycle).

*1 Website of Bike Customization School: <http://www.ne.jp/asahi/rockey/luna/>

Next, the roughly completed, unpainted bike was used to conduct a riding test to measure strain, where strain gages were attached to different parts of the frame (Figure 2, Photographs 4 and 5) and a digital recorder was installed in front of the handlebar (Photograph 6).

The riding test was conducted in the following six modes:

- [1] Full braking of the front wheel when the bike is traveling at 40 km/h
- [2] Full braking of the rear wheel when the bike is traveling at 40 km/h
- [3] Full braking of the front and rear wheels when the bike is traveling at 40 km/h
- [4] Quick takeoff with the throttle wide open

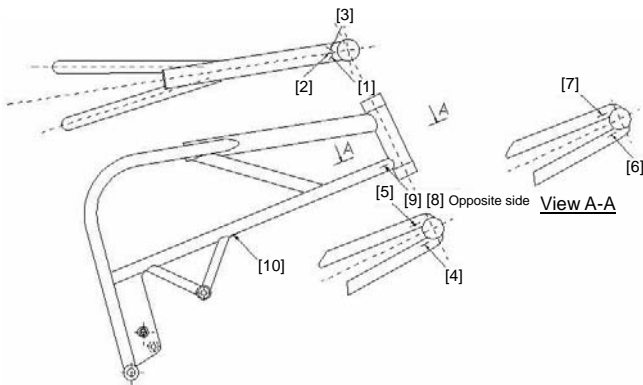


Figure 2 Strain Gages Attached to Frame
 [1] to [3] KFG 3-axis Rosette Gages
 [4] to [10] KFG 1-axis Gages

- [5] Going over a plate of 12 mm in thickness at a speed of approx. 40 km/h, and then going over a plate of 22 mm in thickness at the same speed
- [6] Offroad ride at a speed of approx. 40 km/h

Data taken during the riding test was recorded in the memory of the digital recorder and transferred to a PC via a PC card for processing/analysis using waveform processing software, etc. Photograph 7 shows an example of data taken in test mode [5]. For your information, a static test was conducted prior to the riding test with the bike off the stand and carrying both no load (weight) and a specified load.

Based on the above measurement results, gages 4, 5 and 10 in Figure 2 recorded relatively high strains during offroad ride. However, all measurements were within the allowable range and thus the results confirmed the frame to be safe, that the frame could be used as is without adding further reinforcements. It was also found that the bike could be made lighter by 20% or so if thinner pipes were used. These measurement results can be reflected in the next design.

Iwata's Bike Customization School just completed the curriculum for its 13th graduating class. The school will be closed at the end of 2008 (after the 14th graduating class) because Iwata's home will be demolished under the community redevelopment project starting in 2009.



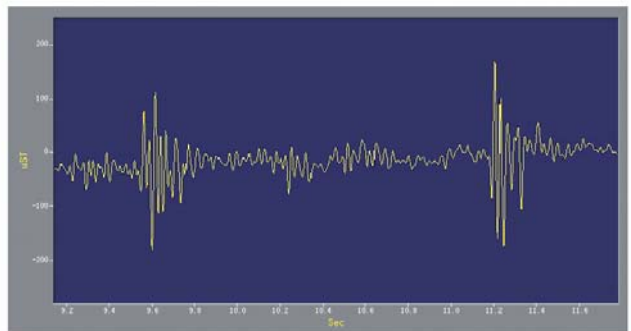
Photograph 4 Condition of Attachment of 3-axis Rosette Gages



Photograph 6 Bike Completing Riding Test



Photograph 5 Condition of Wiring of Gage Leads



Photograph 7 Example of Data Obtained in Test Mode [5]