Bicycle Test Newsletter 2006-2

25. Oktober 2006

EFBe Prüftechnik
Hiberniastr. 2, D-45731 Waltrop
tel +49 (0) 2309 93785-1 fax -2
info@efbe.de www.efbe.de

Frame rigidity – a road test

Following the comprehensive rigidity measurements on bicycle frames carried out by our student intern Frank Engelmann (see our February 2006 Newsletter), we wanted to determine the relevance of the laboratory results in practice. We knew from the start that rigidity differences of 5 to 10 percent are practically unnoticeable for the rider. But what about the extreme variations that we had measured in the lab: Would a rider feel those?

To find an answer, we took the frames with the highest and the lowest measured rigidity and equipped them with the same components (thanks to Merida/Centurion). The lateral track rigidity values of these frames were 4.2 and 8.7 N/mm respectively and the out-of-saddle rigidity values 60 and 178 N/mm.

The two frames had the same height and a similar geometry. The Weight difference between the frames was evened out with added weights. To prevent the test riders' preconceptions about the respective makes affecting their judgement, the frames were completely covered with adhesive tape.

We instructed sixteen riders with various levels of experience on racing bikes to carry out particular manoeuvres – including out-of-saddle and freehand riding – on specified test tracks with a range of gradients. They were then handed a questionnaire in which they were asked to give their opinions about which bike had the stiffer bottom bracket and the better ride characteristics.

Result: Fourteen of the sixteen testers agreed with the out-of-saddle rigidity lab results. The results for the freehand riding tests were equally conclusive, with fourteen of the testers feeling that the bike with the higher lateral track rigidity had the smoother ride.

Conclusion: Although this was not a representative investigation, the results clearly show that most riders do notice a significant difference in frame stiffness. Although not all riders are able to tell the differences in rigidity recorded in a lab tests, it is especially the frequent cyclists that notice a differences most clearly.

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Newton metres per degree?

Ever since trade magazines started using EFBe's rigidity tests, we are frequently asked: What is the difference between Newtons per millimetre and Newton metres per degree in frame rigidity data?

Rigidity is, in general, a measure of the extent to which a component experiences elastic deformation when a force (measured in Newton) is applied to it. Elastic deformation means that the component returns to its original shape when the force is removed again. The distance (measured in mm) by which the point on the component at which the force is applied is displaced from its original position is measured in the direction of the force. The component's rigidity (or stiffness) is determined by dividing the applied force by the displacement and is given in Newtons per millimetre (N/mm).

Example: A mass of 5 kg causes a displacement of 10 mm. The force, then, is 5 kg × 9.81 m/s^2 = 49.05 N. The stiffness is 49.05 N/10 mm = 4.905 N/mm.

This is true for all rigidity measurements. Where the displacement takes place along a circular path, an object's rigidity can, alternatively, be expressed as torsional stiffness, i.e. as torque per angle of displacement. The corresponding unit of measurement is Newton metres per degree (Nm/°). Because lateral track rigidity tests involve the application of a purely torsional load, the frame's rigidity can also be given as a torsional stiffness value:

For the standard lever arm of 850 mm from the steering head bearing's centre, as used in most **lateral track rigidity tests**, the following rule applies:

1 N/mm equals 12.6 Nm/°

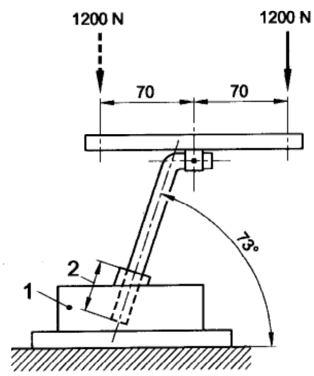
In out-of-saddle rigidity testing, the displacement of the force application point is caused by a combination of a bending and a torsional force. Because the resulting displacement is not purely circular, **out-of-saddle rigidity** can **not** be given in Nm/°.

Comparability of rigidity values

The EFBe test conditions are briefly described in the order forms. They apply to all tests performed to EFBe standard, so that their results can be directly compared with each other. (An exception is the *Velomotion* magazine, which gives only the deflection in millimetres. Here, the test load must be divided by the deflection to obtain the EFBe test value.)

The results of other tests can **not** be directly compared with the EFBe values. Unfortunately, our efforts to establish a common standard have not been successful.

Warning: saddle pillar testing to new EN 14781 standard fraught



Saddle pillar testing to EN 14781

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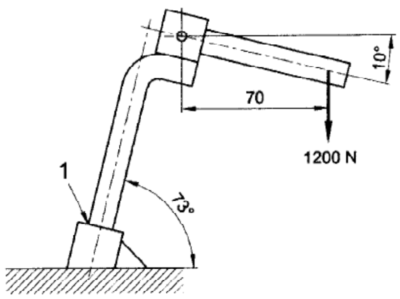
As well as positive changes, the new EN standards include several problematic regulations, for example relating to fatigue testing of racing bike saddle pillars: According to paragraph 4.13.7 a vertical test force is to be applied in turn 70 mm behind and 70 mm in front of the saddle clamp, so that an alternating bending load is induced on the critical cross-sections in the area of the saddle clamp.

But service load measurements have shown that, in practice, dynamic loads through the rider's weight are applied mainly to the rear part of the saddle, not to the front. The new EN-standard test does not, therefore, reflect realistic riding conditions.



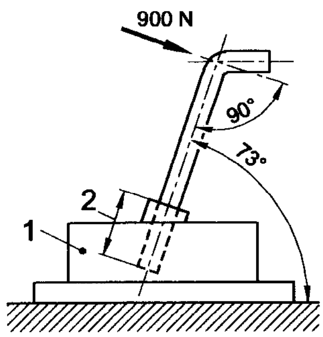
Saddle pillar testing to EN 14766

As well as being a closer approximation of practical conditions, the existing test involving dynamic load application at the rear has been successfully used for more than 15 years. Moreover, it is also specified in trekking/city bike standard EN 14764 and in MTB standard EN 14766.

It is hard to understand why the racing cycle standard is specifying a method for testing saddle pillars that is completely different from the method defined in the standards for MTBs and city/trekking bikes.

In addition, at an alternating load of 100 000 × 1200 N the required force withstand capability of the saddle mounts is disproportionately large. This results in many proven saddle pillars failing the test and effectively prohibits the use of high-quality, lightweight designs.

In addition to this questionable test, EN 14781 specifies a second test, in which a bending load is applied to the shank only and not to the saddle bracket clamp. This additional test likewise does not correspond to the load application found in practice and causes an unnecessary additional expense.



Additional test to EN 14781

For this reason EFBe rejects the performance of a test to EN 14781. Our recommendation to our partners is to test racing saddle pillars according to the EN standard for MTBs or to the proven EFBe standard.

EFBe test conditions for saddle pillars

Adherence to the new EN standards would force manufacturers, suppliers and dealers alike to draw a strict distinction between MTB and racing bike saddle pillars. The EFBe standard, in contrast, follows the convention commonly adopted for other components of providing a uniform testing method for all saddle pillars, with different performance classes for different bicycle types. Although it largely complies with the EN 14764 and

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EN 14766 standards, it features the following improvements and specifications:

1. The angle of the saddle pillar is a uniform 70 degrees for all bicycle types. This means that the force on the pillar's shank at the clamping point in the saddle tube is slightly higher than in the EN tests at 73 degrees. This means that the EFBe-standard test is slightly more stringent in the clamping area at a given test force.
2. The saddle bracket is generally inclined downwards towards the back by 10 degrees. The geometry parameters 70°/10° allows virtually all commercially available saddle pillars to be fitted.
3. The dimension 70 mm is specified more precisely: the measurement is taken from the centre of the saddle bracket clamp.
4. An important point is that suspension saddle pillars are tested at maximum preload to simulate the worst-case scenario.
5. The saddle clamp is tightened to the manufacturer-specified torque. If no tightening torque data is available, the bolts are tightened to the values for to property class 5.6. If this does not provide secure clamping, the torque values for property class 8.8 are used.
6. The bolts are greased before mounting only if explicitly specified by the customer.

Stem fatigue testing without handlebars

Because handlebars and stems affect each others' durability, our recommendation is to test these components together as an assembly. This is also specified by the applicable standards. Because several of our partners have approached us with the wish to test at least stems separately using dummy handlebars, we have specified two standard geometries: for straight bars and for drop bars. In addition to the type of bars to use, the customer must specify the greatest permissible handlebar width.

For **drop bars**, the straight dummy bars are offset in the direction of travel. Two standardized offsets are used to simulate the different force application points specified by the EN standard (at the brake lever) and the EFBe standard (in the handlebar bend – s. EFBe NEWS 12/2003):

EN: Offset 115 mm
EFBe: Offset 30 mm

Frame weights

With immediate effect, our test protocols, certificates and EFBe website list only comparative weights. In other words, if any components, such as a saddle pillar clamps, are missing, the determined weight is increased by a specified fixed value. You can find detailed information about how frames' comparative weights are determined on our website under "Test results / Frame Full Test".