

# Standard for the minimum strength of frangible/deformable cross country fences

Version 22

## Foreword

This standard has been prepared by the Fédération Equestre Internationale (FEI) Eventing Committee according to the FEI Risk Management Policy and Action Plan. The aim of this standard is to define minimum strength requirements for frangible/deformable fences used in FEI cross country competitions.

The FEI Eventing Committee wishes to thank all parties for their contribution in the development of this first standard.

This represents a necessary step in order to integrate frangible/deformable fence construction technology alongside the traditional cross country fence construction while maintaining the fundamental principles of the Cross-Country test.

Frangible/deformable fences are one part of the bigger picture of the Eventing Risk Management Action Plan where the correct education of responsible riders and officials joined to the progressive training of horses are still expected to be the fundamental prerequisites of any effective risk management action.

*This standard will be reviewed by the FEI after the first year and then according to the FEI rule revision process.*

*It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## Introduction

Although they do not occur often, falls involving riders are an inevitable part of cross country events, with riders occasionally receiving serious and sometimes fatal injuries during these falls.

Research commissioned by British Eventing and the FEI has shown that the likelihood of a rider receiving a serious or even fatal injury as a result of a fall, increases if a horse somersaults (rotates 'head over heels') during a fall. Specifically, this research has shown that somersault falls present a 30% chance of a rider receiving a serious or fatal injury, compared to 10% for horse and rider falls where the horse does not somersault, and 3% for riders who are unseated and the horse doesn't fall.

Research and experience has shown that frangible/deformable fence construction technology can help reduce the number of somersault falls that are induced by contact with a fence. Frangible / deformable fences work either by removing the fulcrum point on the fence that the horse rotates about, and/or by limiting the force that the fence exerts on the horse.

As part of its Risk Management Policy and Action Plan, the FEI Eventing Committee wish to allow the use of frangible/deformable fences, provided that they can reduce the risk of rotational falls while maintaining the integrity of the 'Cross Country Test', i.e. jumping fixed fences. To fulfil this expectation, the following requirements for a frangible/deformable fence were identified. The fence shall:

- Not expose rider or horse to a higher risk of injury than an equivalent current fixed cross-country fence, in particular when activated;
- Have a minimum strength to ensure that it is representative of a fixed fence;



- Have a repeatable activation performance throughout the competition in order to be fair to all competitors, i.e. contact of the fence by one horse should not lower the impulse or force required to activate it by a following horse.

This standard details the requirements (and associated testing) that frangible/deformable fences shall meet in order to be used in FEI events.

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## **1 Scope**

This FEI standard specifies requirements for frangible/deformable fences used in FEI competitions.

It is not the intention of this standard to bar from consideration fences of improved quality or performance not known at the time of development of this standard.

## **2 Referenced standards**

The following specifications or standards are referred to in this standard and form part of the specification for this standard.

SAE J211-1 Rev. Dec 2003. Instrumentation for Impact Test – Part 1 – Electronic Instrumentation. SAE International, [www.sae.org](http://www.sae.org)

## **3 Terms and definitions**

### **3.1 Frangible/deformable fence**

A frangible/deformable fence is defined as a fence that is designed to break and/or deform to help prevent somersault falls that are induced by contact of the horse with the fence. Currently, frangible/deformable fences operate either by removing the fulcrum point on the fence over which the horse rotates, and/or by limiting the force that the fence exerts on the horse.

### **3.2 Product**

The product is defined as the package supplied by the manufacturer. It may consist of a complete frangible/deformable fence and associated instructions. Alternatively it may consist of the key components (e.g. frangible pins) and associated instructions required to build the frangible/deformable fence with non-key components supplied from other sources.

## **4 Requirements**

### **4.1 General**

#### ***4.1.1 Information to be supplied by the manufacturer***

Before a product can be assessed against this standard the manufacturer is to supply FEI experts and an approved inspection authority appointed by the FEI Eventing Committee with certain information. The requirements for this information are described in the following sub-sections.

##### ***4.1.1.1 Instructions***

The product shall be provided with a comprehensive and clear instruction manual written in English regarding its installation, use, replacement and disposal.

This shall include as a minimum:

- A list, including diagrams, of the fences that the product is suitable to be fitted within. Note: the product can be a complete fence.
- Clear instructions regarding correct installation of the product, including diagrams
- Clear information regarding the concept of how the fence operates, how it should be used and what type of impacts it is designed to offer protection against to help ensure that it is used in an appropriate manner. (e.g. how it is activated and the position and magnitude of loads required to activate it)
- Clear information on how to assess if a product has been correctly installed
- Clear information to ensure that users are aware of the implications of incorrect installation

#### *4.1.1.2 Information for testing*

For each different fence construction listed in the instruction manual for which the product may be used, the manufacturer shall supply the following information:

- For the strength test:
  - The horizontal positions at which impactor tests should be performed to represent:
    - The position on the fence where a horse strike is most likely to activate it (worst case testing position).
    - The position on the fence where a horse is most likely to jump it (most frequent case testing position).
- For the repeatability test:
  - The critical pendulum impactor test configuration for activation of the fence for both the worst case and most frequent horizontal striking positions, i.e. the test configuration for which the fence is on the verge of activation, i.e. [25%] less energy and it never activates, [25%] more energy and it is activated every time.
    - Impactor mass
    - Strike angle
    - Drop height

The range of conditions specified for assessment via physical testing should reflect the complete range of conditions in which the product can be used. For instance, if a range of rail sizes and shapes can be used with the product then the testing needs to encompass a suitable range.

#### *4.1.1.3 Information regarding product conformity*

Manufacturers shall supply details of the procedures used (e.g. control of specification of materials used to make product and batch testing) including quality control procedures (e.g. ISO 9001) to ensure that all products supplied conform to the requirements of this standard.

### **4.1.2 Assessment of product for different fence constructions listed in the instructions**

The product shall be tested with all the fence constructions listed within the instructions, unless the construction of the fence does not mechanically alter the load, impulse or mechanism by which the product is activated when compared to the construction or constructions that have been tested, i.e. that the construction of the fence is in principle the same fence from a product activation perspective. For instance, a post and rail fence fitted with a vertically activated frangible pin, where there is a lower rail attached to the fence, which does not interrupt the fall of the rail when activated, would be deemed as the same fence as one in which the lower rail was not fitted.

The assessment of whether or not a fence construction is the same or different will be made by an FEI approved inspection authority.

#### **4.1.3 Labelling of the product**

Each product must be marked indelibly with the following information so that it is legible to the user and likely to remain legible throughout the life of the product:

- Country of manufacture
- Manufacturers name
- FEI registration number

#### **4.1.4 Product conformity**

Manufacturers shall have procedures in place to ensure that all products made conform to the requirements of this standard. Manufacturers shall supply details of these procedures to the FEI approved inspection authority as mentioned previously in Section 4.1.1.3.

The FEI reserves the right to test a product at any time to ensure that it still meets the requirements of this standard.

#### **4.1.5 Register of products**

The FEI will maintain a register of all products which have met the requirements of this standard and therefore are eligible to be used in FEI governed events. Products will be added to this register and a registration number issued following receipt of a completed test report from a FEI approved inspection authority which shows the product met this standard.

The FEI reserve the right to remove a product from the register, and therefore its eligibility to be used in FEI governed events, if evidence shows that a product poses a greater and/or additional risk than a fixed fence or if it activates when deemed inappropriate. In this event manufacturers will have a right to appeal the decision to remove the product according to FEI legal procedures (FEI General Regulations).

Manufacturers shall have a system in place to recall their product from the market if FEI remove the product from the register, i.e. if evidence shows that a product possesses a greater and/or additional risk than a fixed fence or if it activates when deemed inappropriate.

#### **4.1.6 Inspection authority and test report**

Tests will be witnessed by a FEI approved inspection authority. The inspection authority will be responsible for ensuring that a valid test report is completed.

The test report should contain as a minimum:

- A copy of the information supplied by the manufacturer
- Information showing that the test equipment used met the requirements detailed in this standard, e.g. copies of calibration certificates
- For each of the requirements:
  - Minimum strength of fence without activation
  - Repeatable use without fatigue

A list of all the tests performed which includes the test configuration and the results of these tests.

An assessment of whether or not the fence met the requirement.

- For the requirement:
  - Must not present a greater and/or additional risk than a fixed fenceReport from FEI experts appointed by the FEI Eventing Committee documenting the assessment of the fence(s) and whether or not the requirement was met.
- A clear statement whether or not the product met the requirements of this standard

#### **4.2 Must not present a greater and/or additional risk than a fixed fence**

The manufacturer shall ensure that the product when installed does not present a greater risk to the rider or horse than that of an equivalent fixed fence. This includes and is not limited to the period of time during which the device is being activated and thereafter. For instance, in a post and rail fence construction, once a product has been activated, the upper rail should not become free to roll away from the uprights, because it may roll onto a rider who has become dismounted during the period in which the fence activated.

At least two independent FEI nominated experts shall assess whether or not the product might present a greater and/or additional risk than a fixed fence. The result of this assessment shall be documented and supplied to the inspection authority for inclusion in the test report. Manufacturers shall also consider how the product may be incorrectly installed and the implications of incorrect installation, in order to minimise the risk of incorrect installation (for instance improving the instruction manual) and where practicable eliminate the risk of incorrect installation.

#### **4.3 Minimum strength of fence without activation**

Each type of frangible / deformable fence construction that the product is registered for shall meet the following requirements to ensure that it is representative of a cross country fence, i.e. the product should not be activated if just clipped by a horse:

1. For the following two horizontal testing positions specified by the manufacturer (see Section 4.1.1.2):
  - Worst case testing position
  - Most frequent case testing position

The fence shall not activate when subjected to a pendulum test as specified in Section 5.1 with the following configuration:

- a. A pendulum mass of  $120 \pm 3$  kg
- b. A striking angle of  $-5 \pm 5$  deg
- c. A drop-height of pendulum centre of gravity  $140 \pm 5$  mm

Note: The activation of a fatigue indicator is deemed acceptable, provided the fence does not activate.

#### **4.4 Repeatable use without fatigue**

Each type of frangible / deformable fence construction that the product is registered for shall meet the following requirement to ensure that it has a repeatable use performance, i.e. contact of the fence by one horse should not lower the impulse or force required to activate it by a following horse.

The manufacturer shall provide the critical pendulum impactor test configuration and force recorded for fence activation for both the worst and most frequent case horizontal testing positions as detailed in Section 4.1.1.2:

- Impactor mass
- Strike angle
- Drop height of pendulum centre of gravity

The following tests shall be performed using the pendulum impactor (Section 5.1) test configuration according to the information provided by the manufacturer **for both the worst and most frequent case horizontal testing positions**:

1. Five tests with the drop height (i.e. energy) decreased by between 10% and 25% compared to the critical reference test configuration supplied by the manufacturer, unless a visual fatigue indicator activates in which case no further tests are performed
  - The fence shall not activate in these tests
2. Test with the drop height (i.e. energy) increased by between 10% and 25% compared to the critical reference test configuration supplied by the manufacturer. A new device shall be used for this test, i.e. one that has not being subjected to any impact tests previously.
  - The fence shall activate in this test

## 5 Testing

### 5.1 Pendulum impactor

The pendulum impactor shall consist of an impactor and an arm as shown in Figure 1. The arm shall be rigid and have a length from the pivot centre to the centre line of the impactor head of  $2800 \pm 10$  mm. The impactor and arm shall be connected rigidly. The impactor shall consist of an impact head and a rigid mass. The rigid mass of the impactor should be changeable so that total mass of pendulum impactor (impactor and arm) can be varied between 120 kg and 300 kg at least. The mass of the arm should be such that the centre of gravity of the pendulum impactor (impactor and arm) is no more than 730 mm vertically above the centre line of the impact head. The front of the impact head should be no more than 400 mm in front of the centre of gravity of the pendulum impactor. The impactor face should be vertical ( $90^\circ \pm 5^\circ$  to the horizontal) with the pendulum hanging in a neutral position.

The impact head shall consist of a polyurethane cylinder of dimensions: diameter 200 mm; length 200 mm ( $\pm 5$  mm). It shall be made from polyurethane which has the following properties:

Property	Unit	Method of measurement	Value
Hardness	Shore A	ASTM D2240	60
Tensile strength	MPa	ASTM D412	24
Elongation	%	ASTM D412	530
Stress at 100% strain 300% strain	MPa	ASTM D412	2,0 2,7
Brittleness Temperature	Deg centigrade	ASTM D746	-50

Compressive Modulus	MPa		
5%			0,3
10%			0,6
15%			0,9
20%			1,3
25%			1,8
Density	g/cm3	ASTM D792	1,2

Suppliers of this material include:

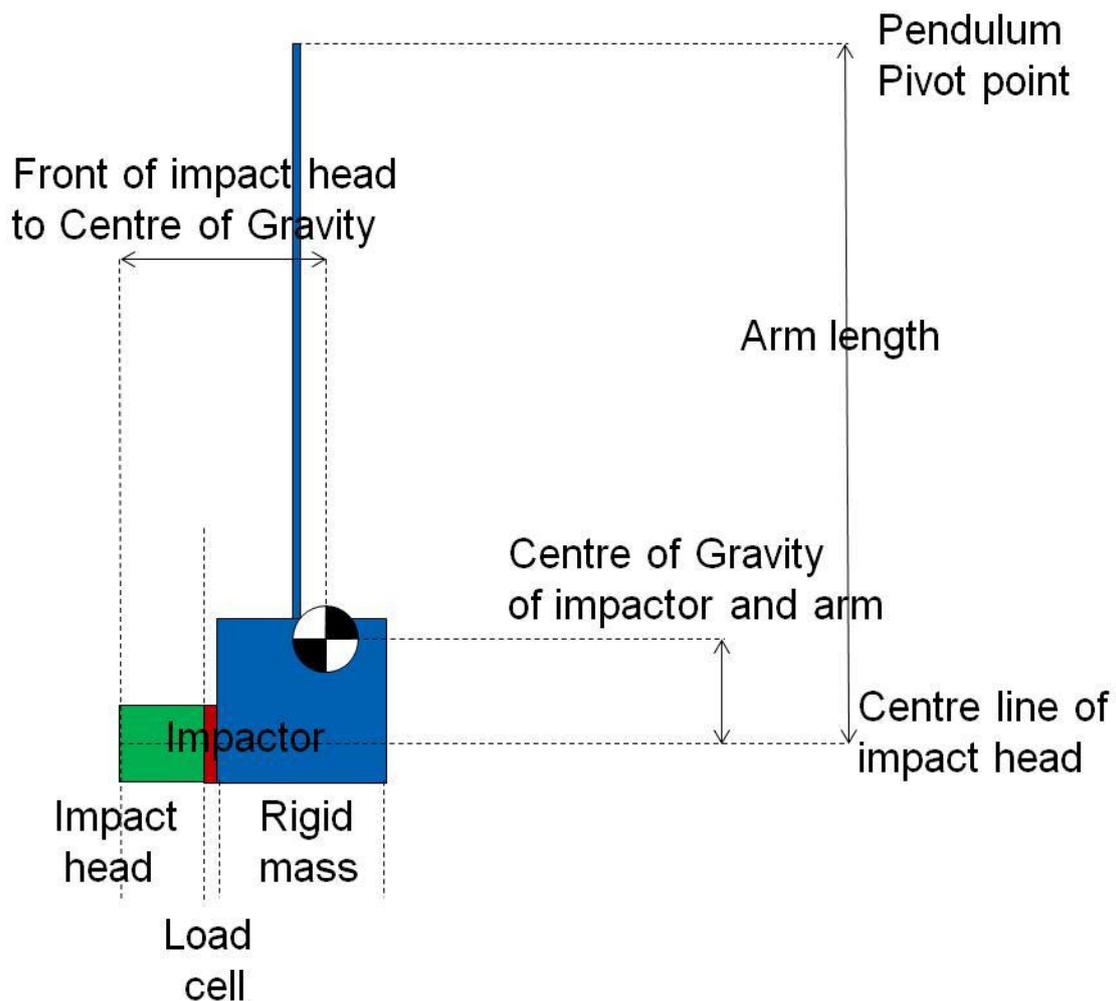
- UW ELAST

The polyurethane which meets the specifications above is a fully cured polycaprolactone urethane sold under the brand name of Slitan 60A-03.

Company website: <http://www.uw-elast.com/>

The load cell shall be positioned between the impact head and rigid mass. It shall meet the specification given in Section 5.2:

The pendulum shall be capable of achieving strike angles from -10 deg to 90 deg.



**Figure 1: Pendulum Impactor**

### 5.1.1 Test configuration

This section specifies how to perform a test for a known pendulum impactor mass, strike angle and drop height at a given horizontal testing position.

The pendulum shall be aligned with the test object (fence) to achieve the specified strike angle as shown in Figure 2.

The pendulum must be aligned along the face of the fence to strike the fence at the given horizontal testing position. Information regarding this position shall be provided by the manufacturer (see Section 4.1.1.2).

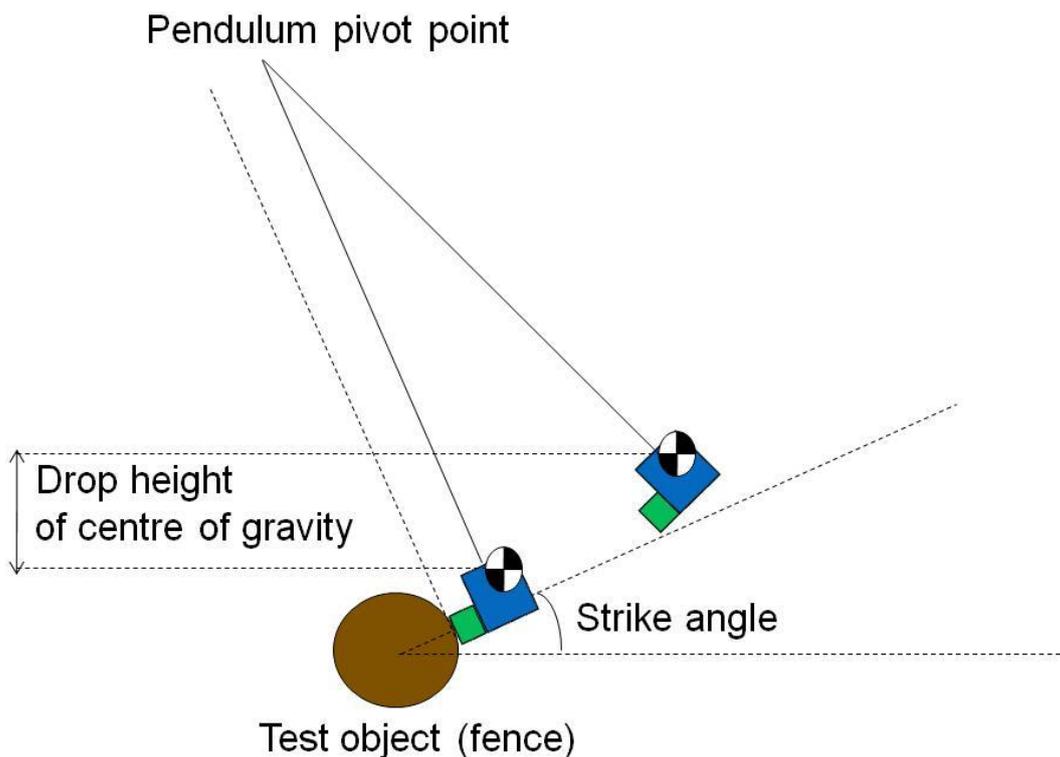


Figure 2: Test configuration

## 5.2 Load Cell and data processing

If a load cell is used in the pendulum impactor to collect data for research purposes, it is recommended that it should meet the following specifications:

- Full scale capacity  $\geq$  [50 kN] and  $\leq$  [150 kN]
- Non-Linearity (% of 50 kN)  $\leq$  [1.0%].
- Temperature Range: [5°C to 30°C]

Data from the load cell should be collected at a minimum data rate of [10,000 Hz] and filtered using a CFC60 filter as defined in SAE J211-1:2003.

## 6 Acknowledgements

The following organisations contributed to the development of this standard:

- MIM Construction AB
- Transport Research Laboratory (TRL)
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