

FORMULA

ADAPTIVE IMPACT SYSTEM



BENCHMARK DATA TESTING

Testing was conducted by two
separate independent test labs.

SATRA Technology
and
RHEON LABS



WHY WE BUILT THE FLY FORMULA

Helmet safety standards both in the USA and internationally (such as ECE or DOT) require helmets to perform well against high speed linear impacts. However, new research has established that brain injury can also come from repeated low speed impacts, as well as from rotational forces. Even so, MX helmet standards have remained relatively unchanged for the last decade.

At FLY Racing, we believe our greatest obligation is to provide the best products possible to our customers. Our primary goal with the FLY Formula Helmet was to create a highly advanced energy management system that would reduce energy transferred to the brain over a wide range of real world impact scenarios.

The Formula is a technically superior helmet that outranks the competition in a combination of critical tests. These include linear impact tests that meet ECE 22.05 standards as well as rotational impact tests which are designed to mimic real-world impact scenarios.



FLY
RACING®

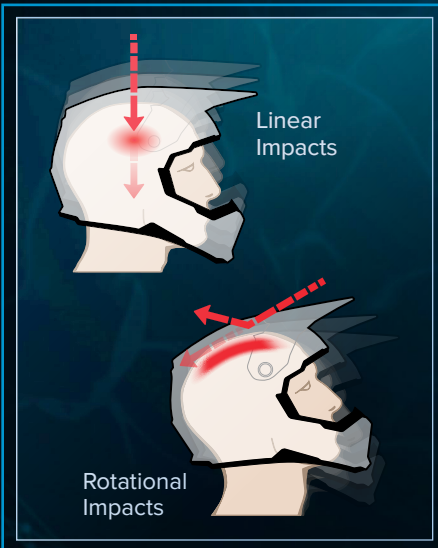
HELMET TESTING PROTOCOL

Testing the FLY Formula was primarily to confirm that this helmet would provide the highest level of performance and protection we set out to achieve, across a wide range of impact scenarios.

We identified the top 10 MX helmet brands in the world at the time of testing and tested their best helmet models. In total 60 helmets were tested between SATRA and RHEON LABS altogether comprising 150 individual impacts.

Three helmets of each model were sent to SATRA to be independently tested to ECE standards, for both crown and front-side impacts. 30 helmets were tested and recorded.

Three helmets of each model were tested on a bespoke test rig at RHEON LABS for a wide range of real-world impact scenarios, gathering a wide range of rotational and linear impact data. 30 helmets total were tested and recorded.



LINEAR IMPACTS



30 helmets were tested at SATRA, totaling 60 individual impacts.

A **linear impact** is considered any impact in the normal direction of the helmet. These often act through the centre of gravity.

Most helmets have been designed to protect against high speed linear forces with the intention of preventing skull fracture. However, lower speed linear forces can also cause traumatic brain injury and therefore it is important to protect across the full range of linear forces.

Linear tests on the helmets were undertaken to ECE standards by SATRA, an independent test house.

ROTATIONAL IMPACTS



30 helmets were tested at RHEON LABS, totaling 90 individual impacts.

A **rotational impact** is considered any impact that strikes the head with any tangential component, these are often called oblique impacts or glancing blows.

Most falls in motocross include some rotational element. These impacts are strongly linked to mild traumatic brain injury (mTBI). However, these impacts are not accounted for by testing standards today.

All oblique testing was undertaken at RHEON LABS on their bespoke test rig according to advanced testing methods outlined in IRCOBI Conference 2016 paper.*

FSL - Front Side Left
FSR - Front Side Right
BSR - Back Side Right
FS - Front Side
C - Crown

*A New Helmet-liner Design for Improved Survivability, in IRCOBI Conference 2016 [online], Malaga, International Research Council on Biomechanics of Injury www.rheonlabs.com/resources

INDEPENDENT 3RD PARTY TESTING

SATRA Technology Centre, UK

SATRA is a leading independent testing house based in the UK. All external testing was completed in accordance with ECE 22.05 using a kerbstone anvil at 7.5 m/s.

ECE 22.05 is a high speed linear impact test for helmets devised to prevent skull fracture in high impact events.

Each of the 10 models of MX helmet was tested in both crown and front-side locations. These tests were then repeated on three separate helmets of the same models. Peak deceleration was noted and a Head Injury Criterion (HIC) score was given for each tested impact.

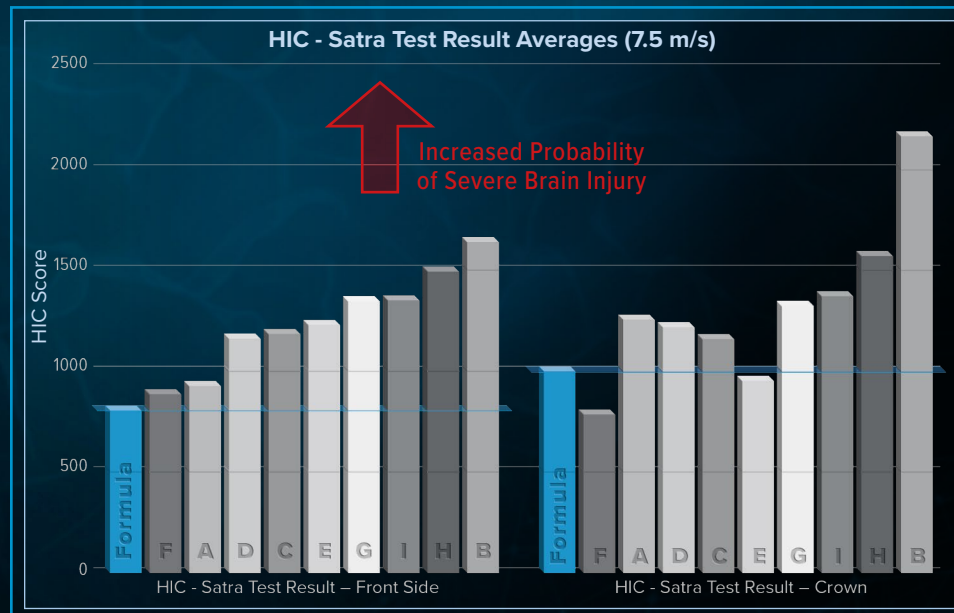


Head Injury Criterion

The Head Injury Criterion (HIC) equation measures the risk of head injury. For helmets this is calculated using acceleration data derived from standard ECE linear drop tests.

An impact with a HIC score of 3000 is representative of a 99% probability of severe brain injury. At an impact with a HIC score of 1000 that probability drops to an 18% risk of severe brain injury and down to 5% at a score of 700.

Whilst these calculations are a useful indicator to measure the safety of a helmet, they should not be taken as universal scores. The possibility of sustaining a head injury from a crash is a highly variable event which is unique to the individual impact.



HELMET TESTING FOR REAL-WORLD SCENARIOS

RHEON LABS

The RHEON LABS state-of-the-art helmet test rig simulates both linear and rotational violence from 'real-world' events. These tests consist of a slider with a 30-degree wedge impacting a highly-instrumented bio-fidelic head (Hybrid III), neck and representative body mass. The tuneable drop rig mimics the inertia of the human body which allows accurate representation of a head impact to be replicated.

In motocross, you never know how you're going to fall – in which direction you're going to hit your head and how hard or fast.

Each of the 10 models of MX helmet was tested firstly at front-side left (high speed 7.1m/s) followed by back-side right (high speed 7.1m/s) and lastly at front-side right (low speed 4.2m/s). The results for both linear and rotational acceleration data were recorded and the peak values noted for reference. These tests were then repeated on three separate helmets of the same models.

This testing method used the basis of the test method as described in IRCOBI Conference 2016 paper.*

**A New Helmet-liner Design for Improved Survivability, in IRCOBI Conference 2016 [online], Malaga, International Research Council on Biomechanics of Injury www.rheonlabs.com/resources*



Front Side Left Impact Test



Back Side Right Impact Test



Front Side Right Impact Test

RHEONLABS LOW AND HIGH SPEED IMPACT TEST

Why We Test For Low and High Speed Impacts

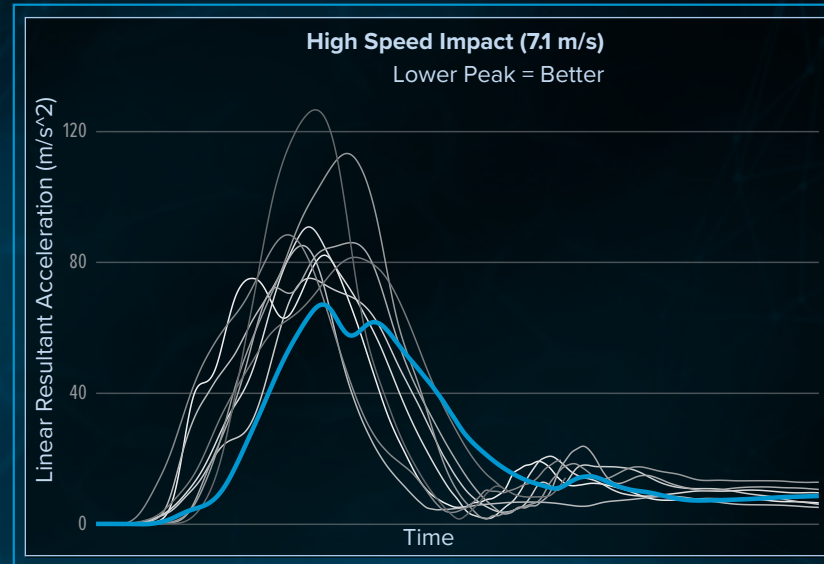
Helmet standards require helmets to pass tests for high speed linear impacts to protect against skull fracture. Recent research tells us helmets also need to work across a wide dynamic range – i.e. for low speed as well as high speed impacts – because in the real world mild traumatic brain injury (mTBI) can be sustained from multiple low speed impacts as well as high. (*Zhang, Yang, King, J Biomech Eng, 2004*) This is why we test 4.2m/s (low speed) as well as 7.1m/s (high speed).

Results

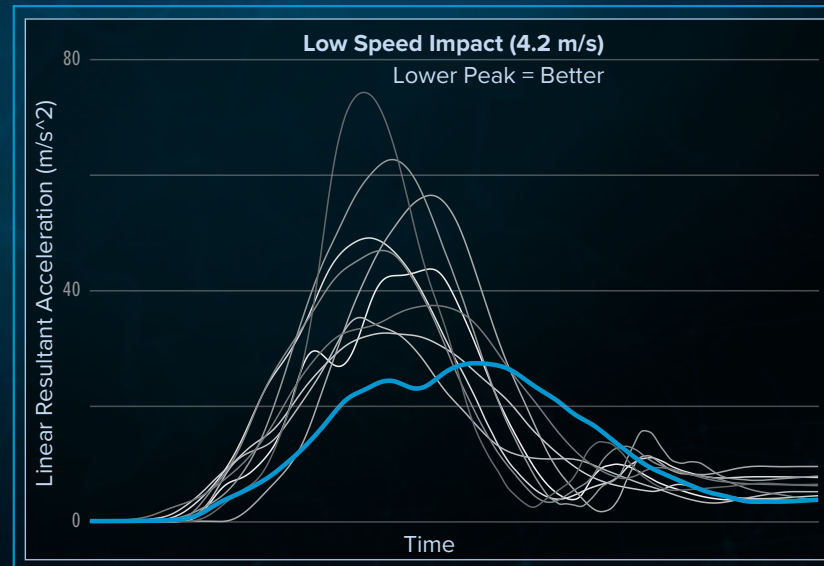
These graphs show the best traces of all models of helmets tested.

The reduction in peak acceleration achieved by the Formula helmet can be seen at high and low impact speeds in the traces of these 2 graphs, demonstrating that the helmet is working over a wide dynamic range of impacts.

The FLY Formula had the lowest peak score over both high and low speed tests.



— FLY Formula Helmet — Competitor Helmets



RHEINLABS ROTATIONAL IMPACT TEST

Why We Test For Rotational Impacts

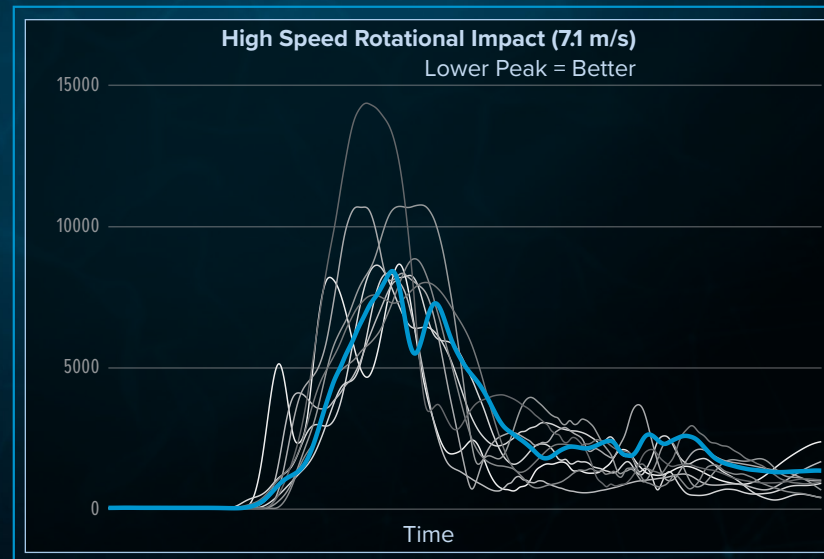
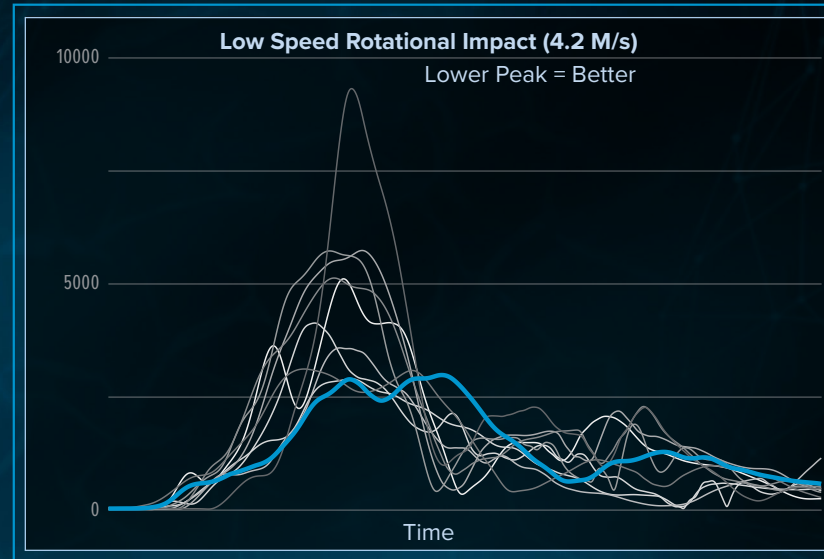
You never know how you'll fall in MX. In the real world most impacts include a rotational element, but helmet standards do not yet require helmets to protect against rotational forces. Recent research has shown that rotational accelerations are one of the key causes of mild traumatic brain injury (mTBI). (*Zhang, et al., J Biomech Eng, 2004*) Therefore we test for both high and low velocity rotational impacts too.

Results

These graphs show the best traces of all models of helmets tested.

The reduction in peak acceleration achieved by the Formula helmet can be seen at high and low impact speeds in the traces of these 2 graphs, demonstrating that the helmet is working over a wide dynamic range of impacts.

These graphs show the Formula consistently performed amongst the best for rotation across both low and high speed impacts.



HELMET PERFORMANCE RANKING

Results show the FLY Formula helmet is significantly reducing both the linear and rotational accelerations experienced by the headform during front oblique impacts.

A ranking system was developed to rank the 10 leading MX helmets tested. It takes into consideration all of the tests undertaken and outlined in this document – from tests for

high and low speed linear accelerations, including HIC scores, as well as for high and low speed rotational accelerations.

The ranking also includes a factor of weight, as we believe reducing helmet mass is critical to our riders. The Carbon Formula is the lightest helmet in this range, beating all nine other leading MX helmets. These are the results based on this ranking:



1268g	1343g	1394g	1396g	1413g	1415g	1486g	1552g	1557g	1597g	

	1	2	3	4	5	6	7	8	9	10
Weight	1	2	3	4	5	6	7	8	9	10
Linear FSL	1	8	7	5	9	4	3	6	10	2
Linear BSR	2	8	4	3	6	10	1	7	9	5
Linear FSR	1	8	4	5	9	6	3	7	10	2
Rotational FSL	4	8	2	5	9	7	3	6	10	1
Rotational BSR	2	8	3	4	7	10	1	6	9	5
Rotational FSR	3	9	4	5	7	8	2	6	10	1
HIC FS	1	10	3	6	5	7	2	8	9	4
HIC C	3	10	6	2	4	7	1	8	9	5

Totals are the sum of the above test rankings. The lowest number represents the best overall performance.

Rank Totals	18	71	36	39	61	65	23	62	85	35
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Testing concluded that the FLY Formula is a very high performance helmet which can significantly reduce linear and rotational accelerations. The FLY Formula is also shown to outperform the competition in an overwhelming majority of cases tested

FSL - Front Side Left **FS** - Front Side
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BSR - Back Side Right