Folksam

Folksam Test of Equestrian Helmets

2026

Why does Folksam test equestrian helmets?

Equestrianism is a popular activity in Sweden, with approximately half a million individuals riding on a regular basis. Equestrian sport is also one of the country's largest youth sports (The Swedish Sports Confederation 2024). Among the approximately 140,000 members of clubs affiliated with the Swedish Equestrian Federation and insured by Folksam, around 1,400 sustain injuries each year according to insurance data (Stigson & Klingegård, 2024). This corresponds to an average of 26 injured riders per week, or an incidence of approximately nine injuries per thousand insured individuals.

Folksam's injury statistics clearly demonstrate that the head is the most exposed body region. Approximately twelve riders per week sustain head injuries, with concussion being the most common diagnosis. The most frequent accident scenario is a fall from the horse during riding (81%). This is particularly important to highlight, as brain injuries represent the leading cause of severe injury and fatality in equestrian sports (Meredith et al., 2019). Concussion is classified as a mild traumatic brain injury; however, the term "mild" may be misleading. Research shows that symptoms resolve within a few weeks in most cases, but a substantial proportion of individuals experience persistent symptoms such as headache, memory impairment, difficulties with concentration, and other neurological deficits (Wood et al., 2025). Furthermore, repeated concussions increase the risk of long-term consequences. The most effective measure to reduce the risk of head injury in equestrian sports is the use of a helmet. However, continued development of safer helmets remains essential.

Since 2014, Folksam has conducted consumer tests of equestrian helmets to highlight that current helmets do not provide adequate protection against head injuries and that further improvements are needed. The aim of this test is to support consumers in making safer choices when selecting helmets and to promote the development of safer helmets. Folksam also participates in standardisation work within SIS/TK 525 Helmets, and experts from Folksam contribute to the FEI Helmet Working Group to promote more realistic and representative helmet test methods, including those addressing oblique impacts.

Method

A total of 15 equestrian helmets available on the European market were included in this year's test, selected in collaboration with the Swedish Equestrian Federation to reflect commonly used models, Table 1. All helmets had previously been tested and certified in accordance with the European standard for equestrian helmets (EN 1384:2023), which means that the energy absorption of the helmets has been tested with radial impacts to the helmet. However, such test conditions do not fully reflect typical real-world accident scenarios in equestrian activities, such as in falls from a horse or kicks. The impact to the head will in these scenarios be oblique. To better replicate these conditions, oblique impacts were included in the test, recognising that angular acceleration is the dominating cause of brain injuries. The objective was to evaluate the safety performance of helmets currently available on the European market using test conditions that more closely represent real-world impacts.

Of the helmets included, eight out of fifteen were equipped with rotational impact protection systems (Multi-directional Impact Protection System, Mips). The price ranged from 1,300 SEK to 6,800 SEK, with an average price of approximately 3,800 SEK.

Table 1. Included helmets

Equestian Helmets 2026	Rotational Technologies	Price (SEK)
Antares Premium Eclipse		5,400
Back on Track Strixx	Mips	3,000
Charles Owen Kylo Mips	Mips	2,500
CRW CRW® Ridhjälm Ovation Mips	Mips	1,300
Equiline Xanto		5,000
FreeJump Voronoï		6,600
GPA Global TLS		5,800
Hansbo HS Vision Mips	Mips	2,000
Jacson Philly Mips	Mips	1,600
Kask Star Lady Pure Shine		6,800
KEP Smart Nova Polish Polo		3,700
LAMI CELL Adele Mips	Mips	2,700
Samshield Miss Shield 2.0		4,500
Uvex Exxential III Mips	Mips	1,900
Yelm Hybrid Helmet 2.0	Mips	3,900

Five physical tests were conducted: two shock absorption tests involving radial impacts and three oblique impact tests (Table 2). A total of 120 physical tests were performed, comprising 30 radial impacts and 90 oblique impacts. Each of the 15 helmet models therefore underwent eight test configurations to ensure statistical reliability and coverage of different impact vectors. All tests were performed using a Humanetics headform (size 570 mm), compliant with EN 17950 and equipped with a wireless data acquisition system. Kinematic data, including translational acceleration and rotational velocity, were recorded for every impact. The linear acceleration and rotational velocities were filtered at CFC1000 and CFC180 according to ISO 6487. Pre-impact orientations of the helmeted headform are illustrated in Table 2. Computer simulations were subsequently carried out to assess the risk of concussion. Both the physical tests and the simulations were performed by Royal Institute of Technology (KTH), Sweden.

Shock absorption test (Radial Impact Tests)

The helmet was dropped from a height of 1.8m (impact velocity 6.0 m/s) onto a horizontal surface according to the European standard (EN 1384:2023), which sets a maximum acceleration of 250 g. The shock absorption test is included in the test standard for helmets, in contrast to the oblique tests. The helmet was impacted at two different locations: one at the top of the head and one at the side of the head, see Table 2.

Oblique Tests

The helmeted headform was dropped against a 45° inclined anvil with friction similar to asphalt (80-grit abrasive paper). The impact speed was 6.3m/s. Two helmets were tested in each test configuration to minimize variations. The test set-up used in the present study corresponds to an additional test under consideration within the CEN Working Group's 11 "Rotational test methods".

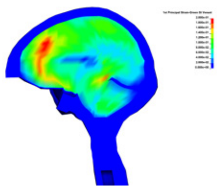
Computer Simulations with FE Model of the Brain

Following the physical experiments, numerical simulations were performed for all oblique impact tests. Translational and rotational kinematic data served as input to the KTH head model. The simulations were conducted using a finite element (FE) model that has been validated against cadaver experiments (Kleiven and Hardy, 2002; Kleiven, 2006) and reconstructed real-world accident scenarios (Kleiven, 2007; Patton et al., 2013). Previous studies have shown that a maximum principal strain (MPS) exceeding 30% corresponds to a 50% risk of concussion (Kleiven and Hardy, 2002). The FE brain model used in this study is described in detail by Kleiven (2006, 2007).

The maximum principal strain (MPS) in brain tissue was calculated for all oblique impacts. Using injury risk functions established by Fahlstedt et al. (2022), the probability of concussion was estimated for each helmet model based on the simulated brain response. Strain data were extracted using LS-PrePost (version 4.12, 17 December 2025, 64-bit). The peak whole-brain MPS was determined based on the nodal average across all brain elements.

Table 2. Included tests

Included tests

Shock Absorption Test (EN1384:2023) Helmets were dropped from 1.8 m onto a horizontal surface in accordance with CE standard EN 1384:2023, using a Humanetics EN 17950 headform (570 mm). Tests were conducted at 18°C, with impacts at the top and side of the head (see figure), at a velocity of 6.0 m/s.	 
Oblique Impact – Rotation around X-axis Contact point on the side of the helmet resulting in a rotation around X-axis. Initial position of the headform X-, Y- and Z-axis 0°. The EN 17950 headform (Humanetics), size 570 mm, was used. Velocity 6.3 m/s	
Oblique Impact – Rotation around Y-axis Contact point on the upper part of the helmet resulting in a rotation around Y-axis. Initial position of the headform X-, Y- and Z-axis 0° The EN 17950 headform (Humanetics), size 570 mm, was used. Velocity 6.3 m/s.	
Oblique Impact – Rotation around Z-axis Contact point on the upper part of the helmet resulting in a rotation around Y-axis. Initial position of the headform X- and Z-axis 0° and 65° around Y-axis. The EN 17950 headform (Humanetics), size 570 mm, was used. Velocity 6.3 m/s	
Computer Simulations Computer simulations were carried out for all oblique impact tests. As input into the FE model, the measured rotational and translational accelerations from the headform in the three tests above were used. A strain above 30% corresponds to a 50% risk for concussion.	

Rating of helmets

To assess the overall safety performance of the helmets, the highest recorded acceleration values from the two radial impact tests and the estimated risk of brain injury from the three oblique impact tests were used. Helmet performance was evaluated relative to the median value for each sub-test. For each test, a relative metric (T_i) was calculated to describe the deviation from the median, according to $T_i = (Result_i - Median_i) / Median_i$, after which the results were aggregated across all tests. A relative deviation from the median was used instead of a direct ratio in order to achieve a more stable and symmetric comparison between helmets.

As concussion is the most reported head injury in equestrian accidents and is most often associated with oblique impacts, the three oblique impact tests were given greater weight in the assessment than the two sub-tests reflecting the helmet's linear energy absorption capacity. The weighted overall score was calculated according to the equation below, where T_1 and T_2 represent the results from the two radial impacts and T_3–T_5 represent the results from the three oblique impacts. Oblique impacts were weighted twice as heavily as radial impacts.

$$\frac{\frac{T_1+T_2}{2}+\frac{2*(T_3+T_4+T_5)}{3}}{3}$$

How does a equestrian helmet obtain our ”Recommended” label?

Helmets that obtain the best overall results in the equestrian helmet test by Folksam are given our “Recommended” label. To be awarded Folksam’s “Recommended” label, a helmet must perform at least 10% better than the median helmet. Helmets are rated on a three-point scale, where a score of 3 corresponds to “Recommended”, a score of 2 is assigned to helmets with average performance (±10% of the median), and a score of 1 is given to helmets performing more than 10% worse than the average.

Results

In total, four helmets obtained the Folksam “Recommended” label (Table 3). These four helmets (Back on Track Strixx, Hansbo HS Vision Mips, LAMI-CELL Adele Mips, and Yelm Hybrid Helmet 2.0) performed more than 10% better than the average helmet in the test. The best-performing helmet was the Hansbo HS Vision Mips, which performed 29% better than the average. Folksam’s test demonstrates a wide variation in performance between helmets, indicating significant potential for further safety improvements.

Table 3. Overall results

Eqestrian Helmets 2026	Overall Result	Rating	Rating label
Antares Premium Eclipse	56% lower than the average	1	
Back on Track Strixx	15% above the average	3	Recommended
Charles Owen Kylo Mips	8% above the average	2	
CRW CRW® Ridhjälm Ovation Mips	5% lower than the average	2	
Equiline Xanto	8% lower than the average	2	
FreeJump Voronoï	32% lower than the average	1	
GPA Global TLS	20% lower than the average	1	
Hansbo HS Vision Mips	29% above the average	3	Recommended
Jacson Philly Mips	7% above the average	2	
Kask Star Lady Pure Shine	7% lower than the average	2	
KEP Smart Nova Polish Polo	27% lower than the average	1	
LAMI CELL Adele Mips	18% above the average	3	Recommended
Samshield Miss Shield 2.0	20% lower than the average	1	
Uvex Exxential III Mips	2% above the average	2	
Yelm Hybrid Helmet 2.0	14% above the average	3	Recommended

Helmets equipped with rotational technologies generally performed better, ranging from 5% worse than the median helmet to 29% better, compared with helmets without such protection, which ranged from 6% to 56% worse than the median. The results also show a negative relationship between price and test performance (Figure 1). Helmets awarded the “Recommended” designation had an average price of approximately 2,900 SEK, which is considerably lower than the overall average price of 3,800 SEK for the full sample.

Safety of eqestrian helmets in relation to price

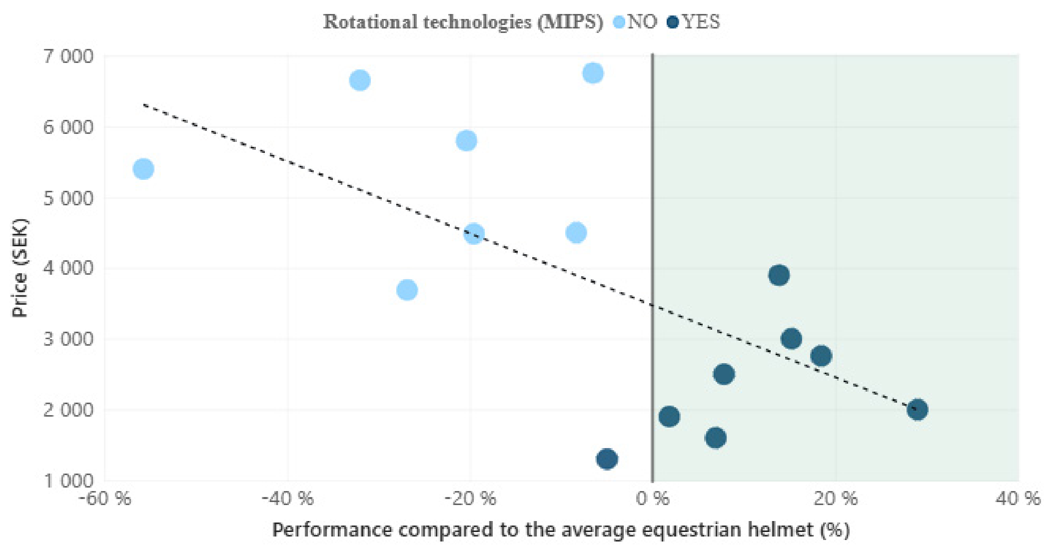


Figure 1. Test performance compared with price for helmets with and without rotational technologies (Mips).

Shock Absorption Test (EN1384:2023)

All measured values in the shock absorption tests were below the threshold limit (250 g) required for approval according to EN 1384:2023 (Figure 2). The lowest values were measured for the FreeJump Voronoï helmet (156 g for impacts to the crown and 155 g for impacts to the side). The highest values were observed for the Kask Star Lady Pure Shine (230 g for impacts to the crown and 228 g for impacts to the side). The mean and median values for all helmets were 186 g and 193 g, respectively, for impacts to the crown, and 186 g and 194 g, respectively, for impacts to the side.

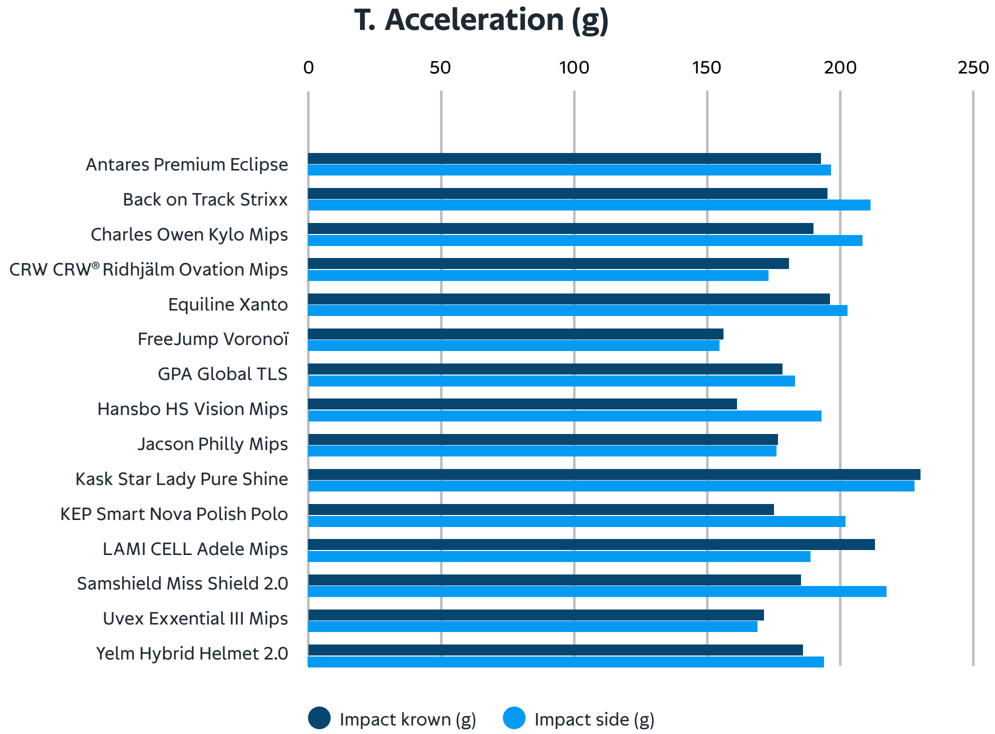


Figure 2. Shock absorption measuring linear acceleration

Oblique impacts

Table 4-6 presents the measured values from tests reflecting the helmets' protective performance in equestrian accidents involving oblique impacts to the head (rotation around the X-axis, Y-axis and Z-axis). The simulations indicate that strain in the grey matter of the brain varies considerably between the tested helmets, ranging from 14% to 43%. For six helmets (Back on Track Strixx, Charles Owen Kylo Mips, Hansbo HS Vision Mips, LAMI-CELL Adele Mips, Uvex Exxential III Mips, and Yelm Hybrid Helmet 2.0), values corresponding to a concussion risk below 50% were observed for all oblique impact tests. In general, the lowest values were observed for impacts to the side of the helmet (rotation about the X-axis, Table 4). The median value corresponded to a 16% risk of concussion, and all helmets remained below the 50% risk threshold. The difference between the best- and worst-performing helmets represents a fivefold increase in concussion risk.

For impacts to the top of the helmet (rotation about the Y-axis, Table 5), values corresponding to a concussion risk below 50% were observed for eleven of the fifteen helmets tested. The worst-performing helmet exhibited up to an eightfold higher risk of concussion compared with the best-performing helmet. The median value corresponded to a 30% risk.

For oblique impacts to the front of the helmet (rotation about the Z-axis, Table 6), only six helmets met this threshold. The median value corresponded to a 49% risk of concussion, and the difference between the best- and worst-performing helmets corresponds to more than a threefold increase in concussion risk. Oblique impacts to the front of the helmet (rotation about the Z-axis) therefore represent the highest risk of concussion.

Table 4. Oblique tests (rotation around the x-axis)

	Oblique impact a (x-axis)					
Helmet	**T. ACC. [g]**	**R. ACC. [rad/s²]**	**R. V [rad/s]**	**BrIC**	**Strain [%]**	**Risk of concussion [%]**
Antares Premium Eclipse	146	4,999	21	0.32	24	30
Back on Track Strixx	125	2,589	13	0.26	16	9
Charles Owen Kylo Mips	128	2,764	15	0.28	20	19
CRW CRW® Ridhjälm Ovation Mips	123	3,110	18	0.32	25	33
Equiline Xanto	138	2,720	14	0.26	17	11
FreeJump Voronoï	114	3,547	20	0.32	24	29
GPA Global TLS	125	2,686	18	0.31	19	16
Hansbo HS Vision Mips	128	2,720	16	0.28	17	12
Jacson Philly Mips	145	2,562	15	0.26	18	14
Kask Star Lady Pure Shine	136	2,548	13	0.25	17	12
KEP Smart Nova Polish Polo	139	3,336	18	0.32	24	30
LAMI CELL Adele Mips	173	3,100	10	0.21	14	7
Samshield Miss Shield 2.0 Shadowmatt	142	3,096	18	0.29	21	22
Uvex Exxential III Mips	119	3,175	14	0.26	21	21
Yelm Hybrid Helmet 2.0	121	2,608	13	0.25	17	11
Mean	133	3,370	16	0.28	20	18
Median	128	2,764	15	0.28	19	16

Table 5. Oblique tests (rotation around the y-axis)

	Oblique impact a (y-axis)					
Helmet	**T. ACC. [g]**	**R. ACC. [rad/s²]**	**R. V [rad/s]**	**BrIC**	**Strain [%]**	**Risk of concussion [%]**
Antares Premium Eclipse	144	4,939	22	0.39	31	55
Back on Track Strixx	96	2,581	18	0.37	23	26
Charles Owen Kylo Mips	135	3,042	16	0.33	23	26
CRW CRW® Ridhjälm Ovation Mips	135	2,137	15	0.26	16	9
Equiline Xanto	141	4,056	21	0.38	27	39
FreeJump Voronoï	117	3,789	20	0.38	29	49
GPA Global TLS	122	4,290	21	0.42	33	62
Hansbo HS Vision Mips	133	2,119	12	0.25	15	8
Jacson Philly Mips	133	3,754	19	0.34	24	30
Kask Star Lady Pure Shine	156	4,255	21	0.35	25	34
KEP Smart Nova Polish Polo	123	3,687	20	0.37	28	44
LAMI CELL Adele Mips	130	2,927	18	0.36	23	27
Samshield Miss Shield 2.0 Shadowmatt	156	4,590	19	0.35	27	39
Uvex Exxential III Mips	107	3,174	18	0.35	24	30
Yelm Hybrid Helmet 2.0	116	3,064	18	0.34	22	24
Mean	130	3,494	19	0.35	24	33
Median	133	3,687	19	0.35	24	30

Table 6. Oblique tests (rotation around the z-axis)

	Oblique impact a (z-axis)					
Helmet	**T. ACC. [g]**	**R. ACC. [rad/s²]**	**R. V [rad/s]**	**BrIC**	**Strain [%]**	**Risk of concussion [%]**
Antares Premium Eclipse	132	6,899	27	0.59	43	90
Back on Track Strixx	151	4,300	18	0.41	27	40
Charles Owen Kylo Mips	120	3,274	17	0.38	23	28
CRW CRW® Ridhjälm Ovation Mips	126	3,648	21	0.45	29	47
Equiline Xanto	128	4,781	21	0.47	33	63
FreeJump Voronoï	124	4,813	23	0.52	35	69
GPA Global TLS	126	4,411	21	0.46	30	50
Hansbo HS Vision Mips	128	3,390	20	0.44	27	39
Jacson Philly Mips	130	3,879	20	0.44	29	49
Kask Star Lady Pure Shine	147	5,322	20	0.44	31	56
KEP Smart Nova Polish Polo	128	4,832	20	0.44	29	49
LAMI CELL Adele Mips	127	3,835	17	0.39	26	36
Samshield Miss Shield 2.0 Shadowmatt	119	4,097	21	0.47	31	57
Uvex Exxential III Mips	109	3,272	18	0.39	27	40
Yelm Hybrid Helmet 2.0	132	3,597	19	0.41	27	42
Mean	129	4,290	20	0.45	30	50
Median	128	4,097	18	0.44	29	49

Discussion

With the aim of guiding consumers in the purchase of the safest equestrian helmets and influencing helmet design and the safety standard, this test series was conducted by Folksam Insurance Group in Sweden. The test of 15 equestrian helmets shows variation in protective performance. Although all helmets met current regulatory requirements with a margin (down to 155 g compared with the 250 g limit), the results demonstrate that compliance with CEN standards does not necessarily prevent concussion. Only six helmets showed values corresponding to a concussion risk below 50% in all oblique impact tests. In European certification tests only the energy absorption in radial impacts is evaluated, which is linked to skull fracture risk. However, equestrian head impacts often involve rotational forces, which are strongly associated with concussion risk. The present study highlights that differences between helmets are greatest in their ability to mitigate rotational loading, with up to an eightfold variation in concussion risk between the best- and worst-performing helmets.

A new more biofidelic headform was used in this study. Designed for both linear and oblique impacts, its properties, such as mass, moment of inertia, and centre of gravity, more closely resemble those of the human head than the Hybrid III headform previously used in Folksam's helmet tests. A key improvement is the more biofidelic outer surface interacting with the helmet (SS-EN 17950:2024). However, this change limits direct comparison with previous tests. Additionally, the updated EN 1384:2023 standard introduces more demanding test conditions, although oblique impacts are still not included. Therefore, no direct comparison with earlier equestrian helmet tests has been performed. Among other changes, helmets fulfilling EN 1384:2023 are now tested at a greater drop height in radial impacts to better reflect a fall from a horse. The updated standard also includes impacts against uneven surfaces, more stringent penetration requirements and improved criteria for lateral strength. Although these aspects are not included in Folksam's test, it is likely that helmets have become more robust following the introduction of these requirements.

Since 2014, Folksam has conducted four helmet tests to support riders in selecting safer helmets and to encourage manufacturers to improve helmet safety. Over this period, the proportion of helmets incorporating rotational technology has increased. In the present test, 8 of the 15 helmets were equipped with rotational technology (Mips). Helmets equipped with rotational technology generally showed lower brain loading and lower estimated concussion risk. These findings are consistent with results from other consumer tests, such as those conducted by Virginia Tech in the United States, which have demonstrated that the difference between the best- and worst-performing helmets may correspond to several-fold differences in concussion risk (Duma et al. 2025). Despite methodological differences, these results collectively support the importance of including oblique impacts in helmet testing. However, epidemiological studies are needed to confirm the real-world effectiveness of rotational technology.

Discussions on including oblique impacts in helmet standards have been ongoing for many years, and the working group CEN/TC 158/WG 11 (“Headforms and test methods”) has proposed methods for such testing. The methodology used in Folksam’s helmet test is broadly aligned with approaches currently under consideration at the European level. However, revisions to regulatory requirements are time-consuming and are unlikely to be implemented in the near future. Consumer tests, such as Folksam’s, therefore play an important role in driving safety improvements. In parallel with standardisation efforts, the Fédération Équestre Internationale (FEI) has proposed new requirements for evaluating helmet performance under oblique impacts (FEI 2023). The FEI recommends testing at an impact velocity of 6.56 m/s, with acceptance criteria including a maximum linear acceleration below 150 g and a rotational acceleration below 5.500 rad/s². Although this represents a slightly higher test velocity than that used in Folksam’s study, it reinforces the importance of including rotational loading in helmet assessment. Taken together, consumer testing and emerging requirements from organisations such as the FEI are likely to be key drivers of helmet safety development, incentivising manufacturers to improve performance ahead of future regulatory changes.

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