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AMENDMENT 1
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Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 6: **Full-scale impact-test procedures**

Amendment 1: MATD test helmet

Motocycles — Méthodes d'essai et d'analyse de l'évaluation par la recherche des dispositifs, montés sur les motocycles, visant à la protection des motocyclistes contre les collisions —

Partie 6: Méthodes d'essai de choc en vraie grandeur

Amendement 1: Casque d'essai MATD

Reference number
ISO 13232-6:2005/Amd.1:2012(E)

Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO 13232-6:2005 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 22, *Motorcycles*.

Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 6: Full-scale impact-test procedures

Amendment 1: MATD test helmet

Global changes

Add consequential amendments to this and other parts of ISO 13232, as needed.

Page 5, 4.3.7

Replace subclause 4.3.7 with the following text:

4.3.7 Helmet

The dummy shall be fitted with a MATD helmet specified in ISO 13232-3, according to the procedures described in Annex D.

The MATD helmet shall be new (i.e., the MATD helmet shall not be used for more than one test).

Helmets of the same size and from the same production lot should be used for all tests within a paired comparison[2)].

In footnote 2), replace “Bieffe” with “the manufacturer”.

Page 27, D.2

In the second paragraph, replace the first sentence with the following:

“If helmets other than the specified Bieffe are used, the alignment tool may require modification for use with some helmets.”

Page 37, F.2.2.6

Replace subclause F.2.2.6 with the following text and renumber subsequent figures and tables in Annex F:

F.2.2.6 Helmet (see 4.3.7)

A full face motorcycle helmet is used for two reasons. Firstly, this style of helmet represents approximately 85 % of those manufactured worldwide. Secondly, the provision of protective coverage to the mouth and chin region of the modified Hybrid III head form described in ISO 13232-3 eliminates concern that this part of the head form is not particularly biofidelic. The distributed loading to the dummy face that is induced by the helmet minimizes inappropriate contact phenomena.

In the 1996 and 2005 editions of ISO 13232, a Bieffe B12R helmet was specified as the test helmet. During the 1990s, the Bieffe model B12R helmet was a widely available full face motorcycle helmet and was specified as the test helmet for all ISO 13232 procedures. The Bieffe B12R shell was injection moulded with polycarbonate. The helmet liner was produced from expanded polystyrene bead foam with a density of 52 kg/m^3 to 56 kg/m^3.

The Bieffe B12R was produced by Bieffe Helmets S.r.l., Lucca, Italy; however, in 2004 this company ceased to exist and all assets were transferred to Tecnoplast S.r.l., Italy. Production of the Bieffe B12R was discontinued at all facilities except at a subsidiary of Tecnoplast known as Starplast Indústria E Comércio Limitada, located in Brazil. This factory continued to produce the same helmet and sold them to motorcycle helmet distributors in Brazil. The helmet manufactured in Brazil was no longer tested nor certified to ECE Regulation 22-05; however, the design specifications for this helmet had not changed significantly since the original B12R helmet was developed.

At the time of the drafting of this standard, ECE Regulation 22-05 was the most widely applied international regulation for motorcycle helmets. However, as seen in Table F.1, the application of a typical international motorcycle standard (e.g., ECE 22-05, Snell, DOT, etc.) as a specification would be inadequate due to the wide range in performance of different helmet models that meet the same standard. A performance specification should be based on the performance characteristics of the Bieffe B12R helmet in order to allow for comparisons to tests that have been previously conducted using the B12R helmet and to allow continuity in the application of ISO 13232. At the present time, test data presented in ISO 13232-3, that for a given impact velocity at a given impact site, the variation in response of the MATD helmet is approximately ± 15 g. This is due to differences is helmet liner mass and small differences in helmet placement during the test procedure. As of 2007, the price of the Technoplast equivalent of the Bieffe B12R helmet is approximately 320USD. If the performance range were to be reduced from ± 15 g, it is expected that the associated helmet cost would increase exponentially as shown in Figure 1. Similarly, if the desired ISO 13232 performance range were increased (i.e. ± 20 g), the associated helmet cost would decrease because it would be possible to find other less expensive helmets that would also meet this performance specification (see Figure F.1).

However, a secondary problem that would occur as a result of increasing the performance range is the probability of making a Type II error. This is a situation where the researcher makes the assumption that the helmet that he is using is not statistically significantly different from a MATD helmet when in reality it is statistically significantly different from the performance of a MATD helmet. The probability of committing a Type II error (symbolized as β) is related to the probability of rejecting a null hypothesis (H_0) when it is false:

P(rejecting H_0 given that it is false) = $1 - \beta$

The probability of rejecting the null hypothesis when in fact it is false is generally referred to as the power of a statistical test. Power is calculated by the following equation:

$$power = P\left(Z > z_{\alpha/2} - \frac{\sqrt{n}\,(\mu_1 - \mu_0)}{\sigma}\right)$$

where

- Z is a random variable that has a standard normal distribution;
- z is a specific value in the Z distribution with a probability equal to $\alpha/2$ or 0,025 for a two-tailed test;
- n represents the number of samples tested;
- μ_1 and μ_0 represent the alternative value of the distribution mean and the hypothesized value of the distribution mean, respectively;
- σ represents the standard deviation of the distribution.

If the data from Table F.1 is assumed to be representative of the distribution of helmet performance for a given impact test, the power of a test in which the mean values of the actual distribution and the hypothetical distribution differ by a given value X may be calculated. Furthermore, the probability of making a Type II error as a function of the difference between the actual mean and the hypothetical mean may also be computed.

In simple terms, if the distribution of the data in Table F.1 is used as an example, it is possible to estimate the probability of making a Type II error (i.e., estimating the probability of making the false decision that there is no difference between a MATD helmet and the selected test helmet when in reality there is a difference). This probability is presented in Figure F.1 and is presented relative to the estimated cost of producing test helmets with a given performance difference relative to the MATD helmet.

As can be seen in the graph presented in Figure F.1, as the difference in performance relative to the MATD helmet increases (i.e. the difference in peak g's between the selected test helmet and the MATD helmet becomes greater), the costs decrease but the probability of committing a Type II error increases. The data shows that when the difference between the selected test helmet and a MATD helmet is approximately 20 g's, the helmet may only cost 225USD but the probability of making a Type II error is 90 %. This means that there is a significant probability that different conclusions may be reached about the benefit of a given protective device when there is a large difference in helmet performance. This is in conflict with the original goal of ISO 13232, which was to develop a common test methodology so that data collected by different researchers may be compared and evaluated.

In order to develop an appropriate performance specification, a proper balance must be found between the acceptable performance difference between helmets, helmet cost and the probability of making a Type II error.

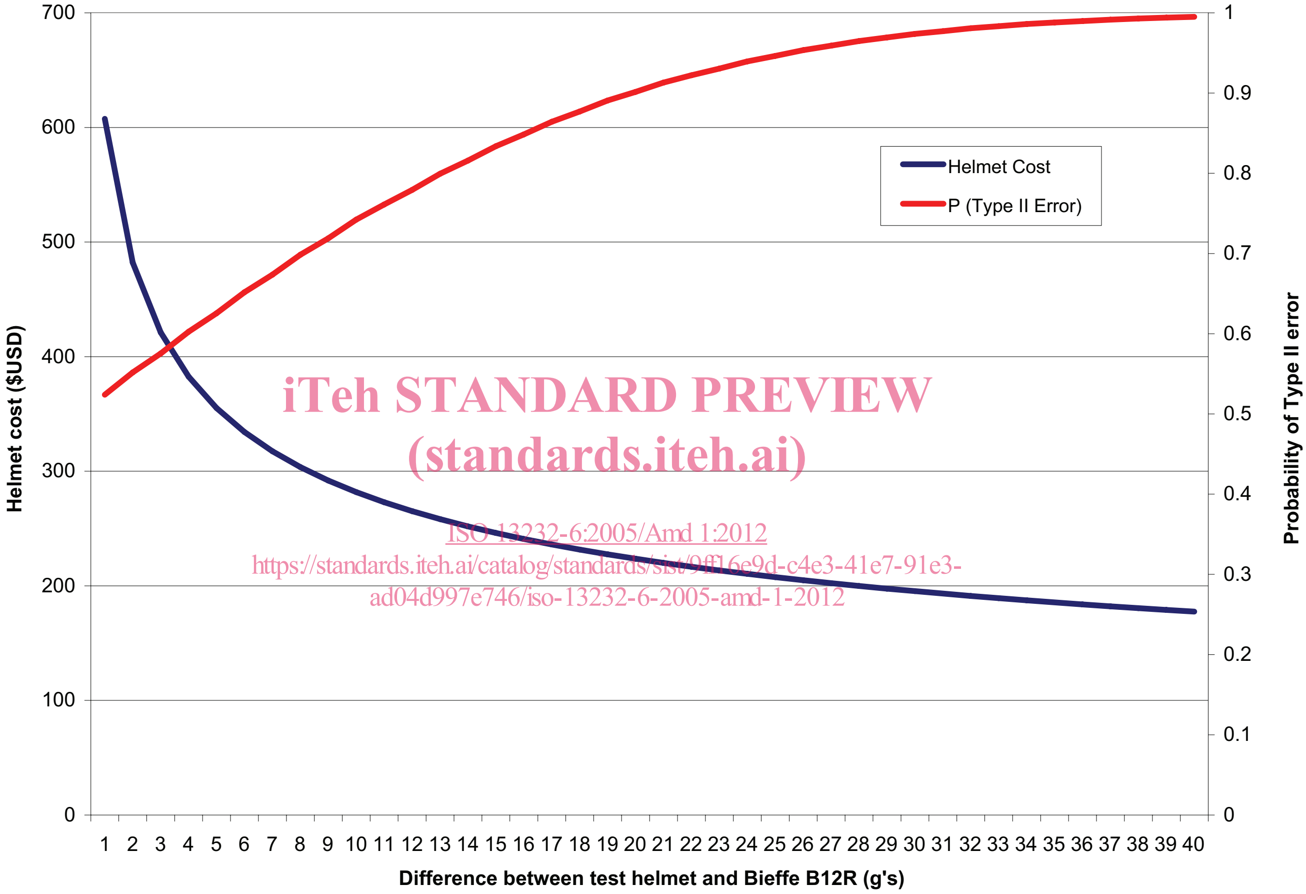

Figure F.1 - Comparison of helmet cost and probability of making a Type II error

To illustrate this situation, a series of identical test configuration simulations were performed with three different helmets fitted to the MATD; a helmet with a soft energy absorbing liner, a helmet with a hard energy absorbing liner and an existing MATD helmet. Helmet liner stiffness was modified by adjusting the force-deflection curve of the existing B12 helmet configuration. This adjustment would be similar to selecting three different helmets for a given full-scale crash test or simulation.

The selected computer simulation configuration was 412 0/45 and for each simulation, the normalized injury cost (IC norm) was computed for two simulation conditions: a baseline configuration and a configuration in which a protective device (leg protection) was added to the motorcycle. The normalized injury cost data for baseline and protective device tests using the three different helmets is illustrated in Figure F.2.

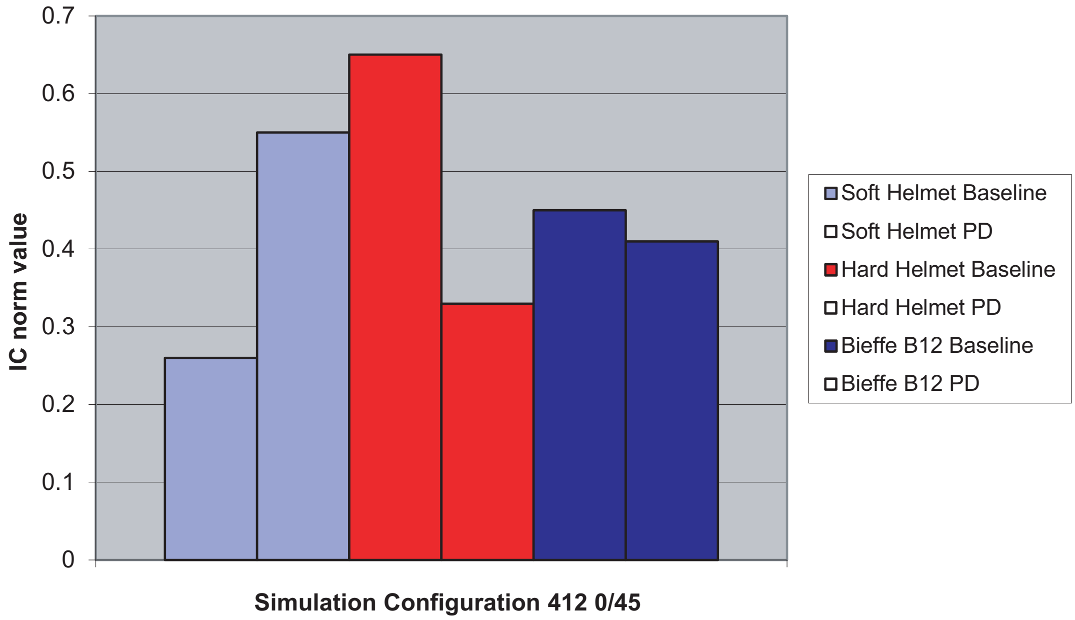

Figure F.2 — ICnorm cost for the computer simulation of the 412 0/45 test configuration using various helmets

The data indicates that depending upon which helmet was selected for the computer simulation (or the full-scale crash test), the IC norm cost may be above or below the baseline test condition. For example, if the soft helmet was selected, the IC norm cost for the protective device configuration would be above the cost of the baseline condition. Conversely, if a hard helmet had been selected, the IC norm cost of the protective device configuration would be below the IC norm cost of the baseline test condition.

This example shows that using test helmets that are different from the MATD helmet may result in different interpretations of identical test configurations. For this reason, it is recommended that a helmet equivalent to the former Bieffe B12 helmet continue to be specified in ISO 13232 and that it be designated as a specific MATD part.

Table F.2 — Helmet impact test results (source: Motorcyclist Magazine, December 2005)

Manufacturer	Model	Material	Certifi-cation	Left Front 2,13m drop onto flat pavement (peak g)	Right Front 3,05m drop onto flat pavement (peak g)	Left Rear 2,13m drop onto flat pavement (peak g)	Right Rear 2,13m drop onto edge anvil (peak g)
Zir	ZRP-1	Polycarbo-nate	DOT	148	176	153	130
Fulmer	AFD4	Polycarbo-nate	DOT	152	173	175	130
Pep Boys	Raider	Polycarbo-nate	DOT	163	199	185	152
AGV	Ti-Tech	Fibreglass	DOT, BSI	156	199	195	129
Suomy	Spec 1R	Fibreglass	BSI	192	215	197	126
Schuberth	S-1	Fibreglass	ECE 22-05, DOT	151	180	176	137
Suomy	Spec 1R	Fibreglass	ECE 22-05, DOT	156	200	190	140
Shark	RSX	Fibreglass	ECE 22-05, DOT	166	187	201	141
Vemar	VSR	Fibreglass	ECE 22-05, DOT	171	198	166	162
Icon	Mainframe	Polycarbo-nate	Snell 2000, DOT	168	217	189	152
Icon	Alliance	Fibreglass	Snell 2000, DOT	179	200	179	175
Scorpion	EXO-400	Polycarbo-nate	Snell 2000, DOT	185	212	193	158
AGV	X-R2	Fibreglass	Snell 2000, DOT	192	226	166	167
Arai	Tracker GT	Fibreglass	Snell 2000, DOT	193	243	203	166
HJC	AC-11	Fibreglass	Snell 2000, DOT	195	230	231	163
Scorpion	EXO-700	Fibreglass	Snell 2000, DOT	207	236	226	176
Mean values				173,4	205,7	189,1	150,3
Std deviation				18,7	21,2	20,7	17,1
Min. peak g				148	173	153	126
Max. peak g				207	243	231	176
Range				59	70	78	50