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CEN/TC 158 Head protection
WG 9 Helmets for alpine skiers

Shock absorption test

Please find enclosed a recommendation from EMPA as a contribution to the revision of EN 1077, Helmets for alpine sports.

Regards,

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Enclosure: Shock absorption test according to EN 1077: problem of helmet positioning

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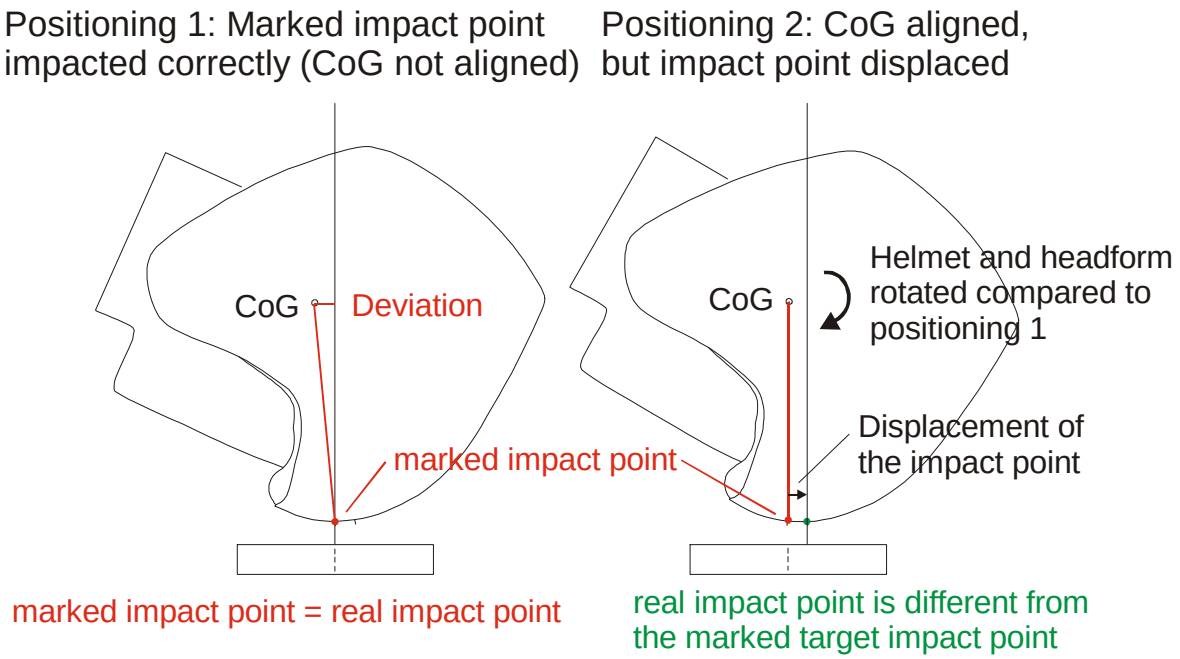
Shock absorption test according to EN 1077: problem of helmet positioning

Problem
According to EN 1077 the impact point, the anvil centre and the centre of gravity of the headform should be aligned for a shock absorption test. Depending on the helmet shape it is for geometrical reasons not always possible to align the three points, even if the position of the centre of gravity is known exactly.

Two possible interpretations of EN 1077
The following two positioning methods both seem consistent with standard EN 1077, see also figure:

1. Alignment of the marked impact point (=target impact point) with the anvil centre, whereby the anvil surface is approximately tangential to the helmet shell at the marked impact point. The impact is directed only approximatively towards the centre of gravity of the headform.

2. Alignment of the marked impact point with the centre of gravity of the headform and the anvil centre. Compared to positioning 1, the helmeted headform has to be rotated which leads to the fact that actually a point different from the marked impact point is impacted in the shock absorption test (this is evident from the analysis of the damage to the helmet liner, see photographs 1 and 2).



Situation in frontal impacts
According to the experience of EMPA, the difference between the positioning methods can be very important in frontal impacts, because the helmet liner gets thinner towards the front edge for various ski helmet models. In this case, a shock absorption test result can be either negative if the positioning 1 is used (the marked impact point is impacted correctly) or positive with positioning 2 (instead the marked target impact point a point displaced to the crown area is impacted).

EMPA recommendation
The correct alignment of the target impact point and the centre of the anvil should be prefered (procedure 1) because of the higher test precision. If the other method is used, the safety of certain helmet designs is not guaranteed over the whole frontal test area, because impact points in the lower part of the frontal test area will never be tested. The problem should be brought to the attention of the responsible CEN Working Group, so that the text of EN 1077 could be revised and clarified in this respect.

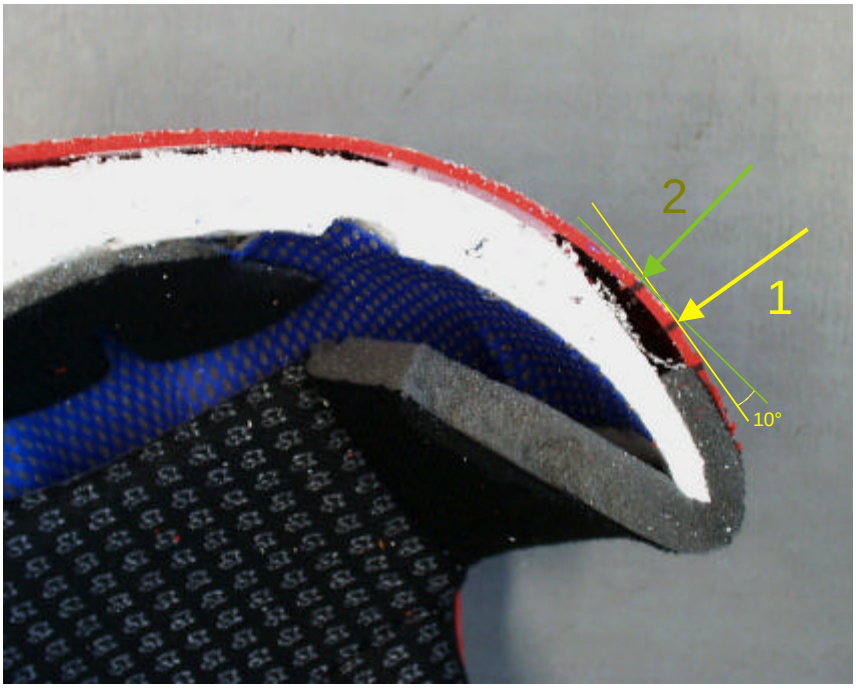


Photo 1: Liner damage observed after a shock absorption test using positioning procedure 1 (max. deceleration 264 g). The yellow arrow indicates the direction of the impact and the impact point 1 which coincides with the defined target impact point (see the corresponding black marking on the red shell). The yellow line indicates the anvil surface at the moment of the contact. The surface of the compressed liner runs parallel to this line. The lowest black marking on the red shell indicates the border of the frontal impact zone.

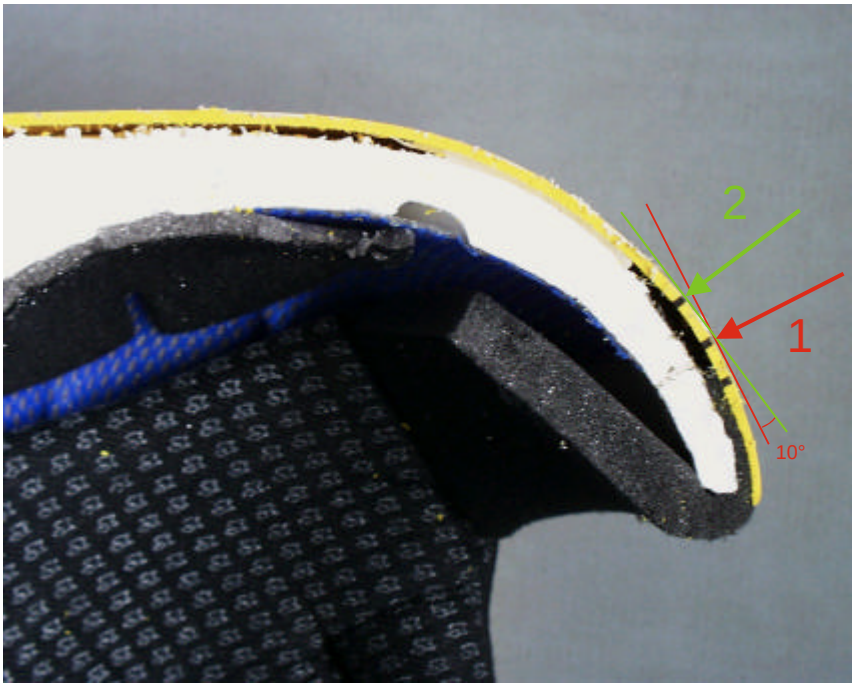


Photo 2: Liner damage observed after a shock absorption test using positioning procedure 2 (max. deceleration 190 g). The green arrow indicates the direction of the impact and the impact point 2 which does not coincide with the defined target impact point 1 (see the corresponding black markings on the red shell). The green line indicates the anvil surface at the moment of the contact. The surface of the compressed liner roughly runs parallel to this line and maximum compression occured below the impact point 2, i.e. at a point different from the marked target impact point. Because the helmet was tested at a point, where the liner is thicker, the observed compression of the liner material is smaller than that in Photo 1.