

Bicycle Helmet Protection: Is the Standard Sufficient?

Bicycle helmets were first used in the 1880's, however those early designs were quite different from the vast spectrum of products currently on the market. While the early designs were of the kind that allowed one to fold up the helmet and put it in his back pocket, the modern helmets are much more sophisticated in their design and performance. Although the designs have changed significantly, there has been little change in the bicycle helmet standards used to evaluate the performance of helmets.

Applicable Standards

In order to evaluate the various standards and the criteria that they apply to bicycle helmets, one must first understand the functions sought to be performed in the design of a helmet. Bicycle helmets are designed to perform three functions:

- Reduce the deceleration of the skull and brain by managing the impact. This is achieved by crushing the soft material incorporated into the liner of the helmet;
- Spread the area over which the forces of the impact reach the skull to prevent forces from being concentrated on small areas of the skull; and
- Prevent direct contact between the skull and the impacting object.

There are basically three standards that are recognized as appropriate procedures for evaluating a helmet's performance in relation to these design objectives. These standards are:

CPSC (Consumer Product Safety Commission) Standard – this standard covers all helmets produced for sell in the U.S. after March 10, 1999;

ASTM F1447 Standard (American Society for Testing and Materials) – the most used standard prior to implementation of the CPSC standard; and

Snell Memorial Foundation B-95 Standard – criteria established by a non-profit foundation founded in 1957 to promote safer helmets.

Only the CPSC standard is a required standard for helmets sold in the U.S. This standard sets out “minimum” criteria which a helmet must meet prior to sale. The ASTM standard is virtually identical to CPSC standard, and it has seen little use since the implementation of the CPSC standard. The Snell B-95 standard is a voluntary standard which many consumer advocates feel is a more stringent standard than the CPSC standard. Snell B-95 testing is conducted by Snell Memorial Foundation staff, whereas the CPSC has a “self-certification” program where manufacturers test helmets and certify their compliance. Helmets which meet Snell B-95 criteria carry a Snell certification sticker to indicate its compliance.

All three of the standards involve three basic tests: drop, roll-off and retention system strength tests. The differences in the standards lies in the criteria of the tests. (See Table 1). The key difference is that the Snell B-95 standard requires slightly more head coverage and slightly higher drop heights. Another major advantage of the Snell B-95 standard is that Snell conducts “random sample testing” of helmets purchased from retail stores. The other standards merely require pre-production certification. Random sample testing allows for the opportunity to discover defects which may have occurred

during the manufacturing process to be discovered and the need for a recall to be assessed.

For many years, most manufacturers certified to Snell standards, and many retailers would not sell non-Snell certified helmets. However, with the enactment of the CPSC standard in 1999 many manufacturers have opted to test to only the CPSC criteria.

Effects on Helmet Design

Helmet design in recent years has largely been driven by manufacturers desire to produce a helmet that is “marketable”. Helmets may be designed to get the “look” the marketing department seeks, and then the engineering department has the task of ensuring that the design meets the minimum requirements of the CPSC standard. This is in effect “reverse engineering”.

The marketing of helmets is driven by one key design concept: vents. Vents are the holes in the helmet. The vents in helmets have increased dramatically in number and size over the past ten years. The vents create an aerodynamic appearance and also allow air ventilation to the cyclist’s head. The vents also make the helmet look “cool” based upon marketing studies conducted by manufacturers. Manufacturers know that the vents provide no aerodynamic advantage to individuals other than professional cyclists. Manufacturers also know that the thinner the helmet is and the more vent space there is – the more dense the foam has to be to manage any energy from an impact.

As material in between the vents gets smaller, engineers have to increase the density to provide the impact protection required by the CPSC standard. This results in harder foam and smaller surface contact areas with the head which cause unmanaged energy to be transferred to the head. This goes directly against the stated design purposes for a bicycle helmet.

This “impact attenuation” criteria is measured in drop tests. Impact testing is defined by a “test reference line” which varies from helmet to helmet based upon the shape of the helmet. Manufacturers are quick to place warning labels on helmets that indicate the “helmet can only protect what it covers”. However, they do not tell the consumer that no testing of the helmet is required *below* the test line, even though those portions of the helmet may be covering critical portions of the head (e.g. temporal area). Manufacturers are aware of the potential for injury in these areas because studies have reported that over half of all helmet impacts in real world situations occur below the test line.

Result to the Consumer

Unfortunately, the majority of bicycle helmet manufacturers have chosen to focus on marketing strategies as opposed to engineering analysis. This has resulted in bicycle helmets being “designed down” to meet the CPSC minimum standard. CPSC statistics show that since 1991 the number of head injuries in bicycle accidents has increased 10 percent, even though helmet use has risen significantly. Safety experts concur that while helmets do not always prevent injury, they are very effective at reducing head injury severity when accidents do occur. Therefore, this data is puzzling to many safety

engineers. Numerous explanations have been posed, but a solution to the problem can only result from the implementation of more stringent safety standards which require manufacturers to place more focus on safety design with little room for marketing driven concepts.

	ASTM F1447	SNELL B-95	CPSC
Anvil used	Flat, 48 mm hemispherical and kerbstone	Flat, 48 mm hemispherical and kerbstone	Flat, 48 mm hemispherical and kerbstone
Impact velocity, energy or drop height flat anvil	2.0 m (6.2 m/s)	110 J (2.2 m) for certification; 100 J (2.0 m) for follow-up testing	6.2 m/s
Drop height other anvils	1.2 m (4.8 m/s)	72 J (1.5 m) for certification; 65 J (1.3 m) for follow-up testing	4.8 m/s
Impact Energy	<300 g	<300 g	<300 g

TABLE 1

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