

Functions and Benefits of a Foam Impact Liner in a Firefighting Helmet

The use of a foam impact liner in a firefighter's helmet serves two basic protective functions: one is structural; the other is thermal.

Structurally, the function of the impact liner is to control the rate of deceleration forces in an impact in order to prevent head injury. This is the prime function of any helmet when impacted. To understand why this function is important and how it works, think of the analogy of a speeding car approaching a brick wall. In this case, the brakes of the car represent the structural impact-absorbing system in the helmet. If the brakes are applied too gently, the car will slow down but not stop; it will strike the wall. On the other hand, if the brakes are applied too aggressively, the car will stop so abruptly (short stopping distance) that the occupants may still be injured, despite the car having stopped short of the wall. To prevent head injury, it is necessary to decelerate an object as uniformly as possible within the allotted stopping distance.

Foam has an ideal structure for this purpose. The foam materials used in helmet liners are typically about 10% polymer and 90% air. In addition to making the structure very light in weight, this means that the material can be crushed to 10% of its original thickness. This is a very efficient arrangement for decelerating a moving object - the air bubbles or cells collapse and thereby absorb energy.

There are other mechanisms by which impact energy can be absorbed and dissipated but none as effective and efficient as using foam or sacrificial ribs. This is why there is no motorcycle, bicycle, football or climbing helmet made that does not contain a compressible liner as the primary mechanism for impact energy absorption.

While other means of structural control, such as stretchable overhead crown straps, can be effective at managing the energy of an impact, they do not share another useful characteristic possessed by closed cell foam; its ability to prevent the transmission of heat. Air is one of the most efficient thermal insulation materials available, particularly if it is contained in a structure that prevents it from flowing freely and setting up convection currents to pass heat from one location to another. This is the principle behind a wool blanket, a down jacket, fiberglass house insulation and the foam or ribs in a helmet shock liner.

With foam, each cell that the heat passes is filled with a relatively large amount of air (nine times the volume of the heat-carrying polymer), which absorbs heat from the cell walls and cools the polymer. The net result is that after five (5) minutes in a 500°F oven under the NFPA 1971 heat resistance test, the top of the headform rises only 28°F. In helmets without insulating liners this temperature can be over 150°F and the top of the headform is not safe to touch.

We believe that foam impact liners add an extra level of protection and comfort to Bullard Fire and Rescue Helmets, and this added protection is important to consider when evaluating helmets.



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