



Field Testing Avalanche Airbags in Slovakia

Marek Biskupič, Filip Kyzek, Milan Lizuch, Jozef Richnavský, Igor Žiak
Avalanche Prevention Centre of Mountain Rescue Service, Slovakia

Pawel Chrustek
Anna Pasek Foundation, Poland

Photos by Gabriel Liptak

ON APRIL 3, 2012 AT 9:36 IN JASNA, SLOVAKIA, 50KG OF PLASTIC EXPLOSIVES CREATED A ROARING AVALANCHE THAT TOOK OUT EVERYTHING IN ITS WAY. WHEN IT SLOWED, IT REVEALED THREE BODIES, THOUGH NONE WERE HUMAN—DUMMIES WERE PLACED IN AN AVALANCHE PATH IN ORDER TO TEST THE FIELD PERFORMANCE OF AVALANCHE AIRBAGS.

AIMS

An avalanche airbag's purpose is to prevent complete burial. There are currently three different shapes of avalanche balloons on the market. One system uses a dual bag (ABS), while the other two systems are mono bag (Mammut/Snowpulse and Backcountry Access (BCA)). The three brands differ in shape and location from which they inflate. The aim of the field test was to observe how the differently shaped avalanche airbags behave in avalanche. Specific attention was paid to the grade of burial. Previous field trials used: (i) ABS mono airbags (Tschirky and Schweizer, 1996); (ii) ABS mono airbags, ABS double airbags and Avagear collar mono type airbag vest (Kern et al., 2002); and (iii) ABS dual airbags and Snowpulse collar type mono airbags (Meier and Harvey, 2010).

TEST SITE INSTRUMENTATION AND METHODS

The following packs were chosen because of their differences in shape. The Mammut Lifebag is a collar-type mono balloon backpack. When the pack is inflated, it creates a balloon around the backside of the neck and shoulders. The aim of this system is to prevent burial and simultaneously provide trauma protection to the head and neck. The BCA Float is also a mono-balloon pack with the balloon positioned behind the head. Besides preventing burial, it provides some trauma protection for the head and neck. Both mono bag systems have a 150L volume. The dual airbag system tested was the ABS

Vario, which consists of two balloons located at the sides of the backpack for a combined volume of 170L. Both of the balloons are independent; if one fails to inflate, the other still can.

The field test took part in Jasna, Slovakia, where numerous easy, approachable gullies and couloirs can be found. The test site was instrumented with three crash test dummies each weighing 80kg. The joints were adjusted to simulate the flexibility of real humans.

The dummies were placed on a northeast-oriented slope 40m below a snow cornice with the help of a ropeway system. Each dummy was instrumented with an avalanche balloon pack, and they were placed side by side in a line. One dummy was wearing the Mammut Lifebag Guide 30L pack, while the other two were equipped with BCA Float 18L or ABS Vario 25L, respectively. All three backpacks were deployed 60 seconds prior to the avalanche release.

The upper part of the avalanche path was 37 degrees. The release areas consisted of snow cornice, with height ranging from 0.5m to 3m. The track was 37 degrees, and the run-out was smooth with no depressions or terrain traps.

The position of the dummies was measured with sub-meter GPS accuracy before and after the avalanche. Several cameras and point-of-view cameras were placed either in the field or across the field to shoot the movement of the dummies. Photographers took their positions prior to the accident to document the field test.

RESULTS

The pyrotechnician-triggered explosion blew the large cornice into pieces which then sped down the steep slope; additional snow masses were loaded in the main flow and formed a sizeable avalanche. The turbulent front hit the dummies with decent speed four seconds from initiation. The first dummy to be hit was wearing the BCA Float backpack; in the following 0.25 second, all other dummies were hit. Immediately, all the dummies disappeared into the snow mass and were rotated and twisted before falling over a lower cliff. All dummies were then almost immediately visible, and floated on the avalanche surface. The BCA Float dummy was the first to stop, and within the few seconds ABS and Mammut Lifebag dummies stopped in the runout area. Immediately after the avalanche stopped moving, the position of the dummies was measured with GPS and a grade of burial and position was assessed. The movement of the dummies was also video analyzed. The grade of burial was classified according to Observational Guidelines for Avalanche Programs in the United States (Greene et al, 2010).

The dummy wearing the Mammut Lifebag was dragged for 132m in 20 seconds by the avalanche. The average speed was 6.6ms^{-1} (23.76kmh^{-1}), and it reached a maximum speed of 17.8ms^{-1} (64.08kmh^{-1}). The dummy accelerated on the track for 89m, reaching its maximum acceleration of 3.56ms^{-2} . When the avalanche stopped moving, this dummy was buried from the hips down. The lower part of the body was anchored in the snow deposit and whole body was partially buried in a tilted position. The partial burial was not critical. Airways were not obstructed and the head was not impaired by snow. The Mammut Lifebag balloon pack was clearly visible on the avalanche surface.

The dummy equipped with ABS Vario system was carried 123m in 18 seconds. The maximum velocity reached by this dummy was 18.6ms^{-1} (66.96kmh^{-1}) while the average speed was 6.9ms^{-1} (24.84kmh^{-1}). The avalanche hit its maximum speed nine seconds in. The dummy accelerated for a distance of 93m, reaching acceleration of 3.36ms^{-2} . The avalanche left the dummy in a horizontal, face-up position with its head pointing downslope. The dummy had piece of snow approximately 70cm in diameter on its abdomen and some snow surrounding it. The grade of burial was between partially buried and not buried. It is questionable whether a human would be capable of freeing him or herself from this position without additional help. It is important to note that the airways were not obstructed and the head was not impaired with snow. One leg was visible and the balloons were clearly visible.

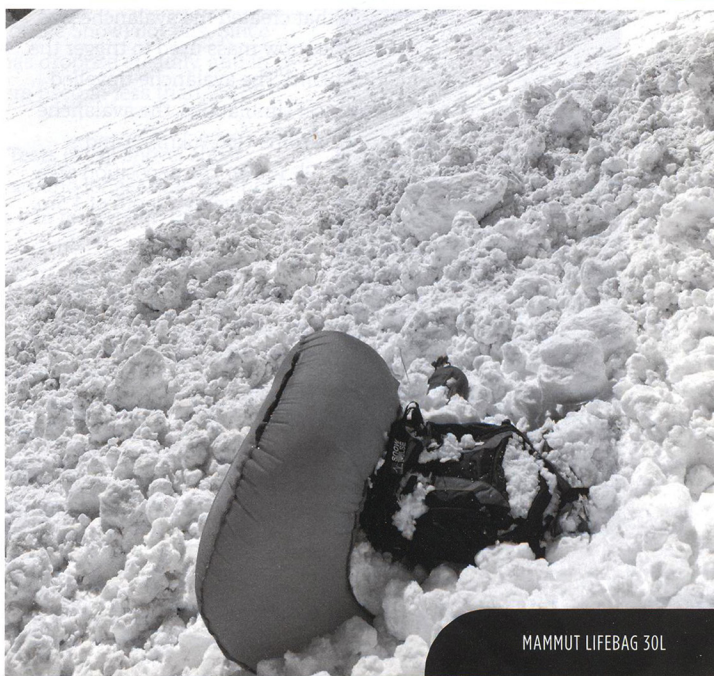
The dummy wearing the BCA Float balloon pack was carried 114m, the shortest distance, at an average speed of 8.1ms^{-1} (29.16kmh^{-1}). It reached its maximum speed of 16.8ms^{-1} (60.48kmh^{-1}) after 84m, with an acceleration of 3.72ms^{-2} . From this moment the avalanche started to decelerate



ABS VARIO 25L



BCA FLOAT 18L



MAMMUT LIFE BAG 30L

until it stopped and the dummy was lying on its back. The head and the airways were free of snow except for a few small pieces of snow around the dummy. The least amount of snow was deposited on this dummy, and it is likely that a human could free him or herself with no additional help. The burial was classified as not buried. The airways were unobstructed and the head was not impaired by snow. Both legs and one arm were sticking out from the snow deposit. The balloon was clearly visible on the snow surface.

Prior to the snow deposition, all three dummies were segregated from main flow and floated on top of the avalanche. When snow deposition started and the avalanche slowed, the dummies were segregated on the side of the avalanche path. The grade of burial differed. The dummy that travelled farthest was the most seriously buried; the dummy that travelled the shortest distance had the least serious grade of burial. The dummy with the Mammut Lifebag was closest to the main flow, and was therefore transported further to the front of the deposition zone. The BCA Float dummy stopped 116m from the front of the deposition, the ABS Vario 96m and Mammut Lifebag 88m.

It is important to note that none of the dummies' airways were obstructed, and their heads were free of snow. The extremities of the dummies were twisted and positioned unnaturally; humans would likely suffer serious injuries. However, dummies are not able to replicate human behaviour in an avalanche, who would likely be trying to actively escape the main flow.

ABOUT THE AVALANCHE

The avalanche was triggered by a falling cornice that loaded underlying snow. The cornice was 40m long with a height of 0.5m to 3m. The maximum width of the avalanche was 60m, and its width was restricted to 25m in a confined area of the path. The predominant snow that created the avalanche was moist. The initial volume of the snow mass used to trigger the avalanche was estimated to 280m³. The avalanche travelled for 250m. According to numerical simulations, the avalanche reached a maximum speed of 18.6ms⁻¹ (66.96kmh⁻¹) and maximum impact pressure of 125.13kPa. The deposition area was 30m wide and 130m long, with an average depth of 1.5m.

CONCLUSION

The field testing consisted of only one trial, and a reference dummy without an airbag was not used. It is probable that the reference dummy would be buried, but we cannot be sure. The results of the test are only applicable for this particular avalanche (and terrain and avalanche conditions). An important, positive note is none of the dummies were completely buried. In all cases the airways were not obstructed and balloons were clearly visible on the surface of avalanche. In

this particular trial, the grade of burial became more serious the farther downslope the dummy was. This can vary in other cases and real life situations. In this field test, none of the dummies were completely or partially critically buried. Even when wearing an avalanche airbag backpack, one can be completely buried. It is therefore necessary to regularly review the effectiveness of avalanche airbags by conducting retrospective studies on real avalanche situations. A short video of the test can be found at youtube.com/watch?v=xRd-tDos5Vg.

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