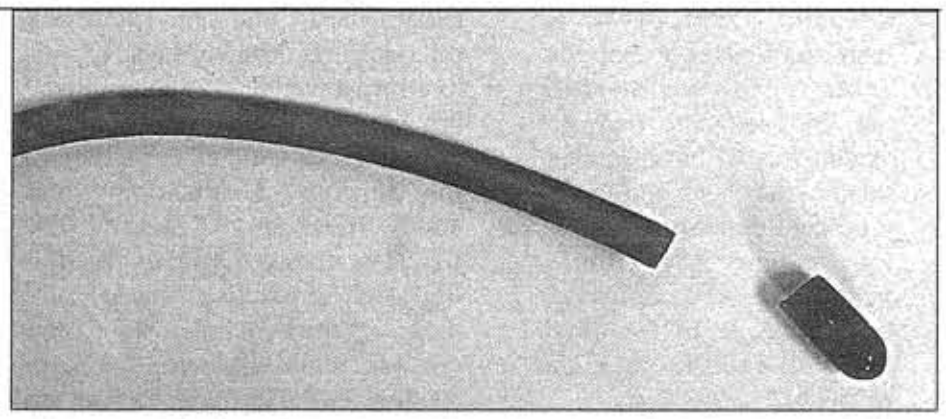
EDUCATION

Increasing Explosive Safety at Snowmass

By John Brennan



Avalanche hazard mitigation at ski areas throughout the world relies on the use of explosives. Even so, as a user group, our annual consumption of explosive products is very small compared to the mining industry. In recent years, explosive manufacturers' liability concerns have forced many in the United States snow safety industry to purchase initiating products from foreign suppliers. In addition, as recently as last Fall's meeting between the National Ski Areas Association's (NSAA) Explosive Committee and the International Society of Explosive Engineers (ISEE), disagreements regarding explosive protocols continue to plague our industry. Naturally, a proactive approach to safety serves our best interests. The following are my recommendations for increased safety with explosive systems as used at the Snowmass Ski area.

Examples of Static Generation[1] Typical Voltage Levels		
Means of Generation	10-25% RH	65-90% RH
Walking across carpet	35,000V	1,500V
Walking across vinyl tile	12,000V	250V
Worker at bench	6,000V	100V
Poly bag picked up from bench	20,000V	1,200V
Chair with urethane foam	18,000V	1,500V

Electrostatic Discharge

Electrostatic discharge (ESD), more loosely known as static electricity, has been a concern to explosive users since the 14th century[1]. Back then, black powder users strove to prevent ESD from causing pre-ignition at seaside forts. More recently, owing to at least one ESD accident, Canada mandated the use of static shunting staples on all cap/ fuse assemblies[2]. These shunting staples provide a preferential pathway to ground for the ESD. The fuse powder used at the time of the accident in Canada was conductive. They have since changed the type of powder to a non-conductive core. Although not mandated in the U.S., in part because United States fuse manufactures never used a conductive core, it is interesting to note that all the pre-assembled cap/ fuse assemblies being imported by Petro-Explo have these staples installed[3]. The core of their fuse trains is described as 'semi-conductive.' This may be a truer description of a core of fuse powder since it is made up of carbonaceous material and salts.

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As compared to other items in the table showing static generation, blowing snow can generate readings in excess of 20,000 volts[4]. Rotor wash during heli-bombing has its own inherent static concerns. As a reference, the ESD 'shock' on the human body needs to be around 3,000 volts before it can be felt[i]. Bottom line voltage values and sources necessary to cause pre-detonation are elusive as many factors can contribute to pre-ignition: relative humidity, the conductivity of the powder train, the fuse's outer coating, and the sensitivity of the detonator's initiating mixture[ii]. Many detonators use lead styphnate as part of the initiation mixture, and this compound is known to be extremely sensitive to ESD.

To keep static from entering the fuse train, traveling through a conductive black powder train and reaching the potentially ESD-sensitive detonator, Ron Thomas of Ensign-Bickford recommended simply taping over the exposed end of a cap/ fuse assembly[iii]. For operations that build a sizeable number of cap/ fuse units, this taping process is laborious and slow. A simple solution is to use a Poly Vinyl Chloride (PVC) nipple over the end of the cut fuse. The PVC nipple not only effectively eliminates the fuse's internal pathway for static, but it also keeps the moisture-absorbing black powder fuse train dry.

As Russ Johnson commented in the 2001Fall Issue of *The Avalanche Review*, stringent explosives use protocols "revealed a dramatic drop in the re-light and no-light dud statistics." Keeping the fuse train as dry as possible and crimping off a 4-inch section of fuse prior to placing the pull wire igniter surely leads toward these favorable statistics. For operations where a minimum fuse length or burn rate are mandated or desired, this crimp cut needs to be considered. A snug fit is achieved with a PVC nipple that has a .187 inch inner diameter by .5 inch inner length. These units sell for less than two cents each when purchased in quantity[iv].

The electronics industry has a long history of financial woes due to ESD. One of their simpler and least expensive deterrents to ESD damage is to package susceptible componetry into static shielding packages. For the avalanche community, this can be as simple as placing cap/ fuse or primed boosters into these sacks[v]. Conveniently, these bags can also accomplish the segregation of the primers from other equipment inside a route pack- a State regulation in Colorado[vi].

Thermalite Connectors

It should be noted that Petro-Explo imports pre-assembled cap and fuse units that may have a Thermalite igniter cord connector crimped to one end. This unit is painted red to differentiate it from the detonator. These igniters are so heat sensitive that simply holding a lit butane cigarette lighter under them for a few seconds can cause an initiation. For comparison, a freshly cut piece of Safety Fuse in the best condition needs to have the flame held against it for almost 10 seconds before initiating. Common sense certainly dictates removing any type of pre-installed igniter before arming your shots. Likewise, NSAA Explosive Guidelines and certain State Regulations mandate it. After the Thermalite igniter has been removed, the PVC nipple can be installed.

Double Capping

For those operations that are double capping without the benefit of using cast boosters manufactured with two cap wells, there is a temporary solution. One cap/fuse assembly may be inserted into the cast booster capwell and the fuse taped to the outside canister of the unit. The other cap/ fuse units can be installed in the "through tunnel" and the fuse taped to the outside. This procedure has been mentioned as a reliable method of detonating certain cast Pentolite charges[7]. Extreme care must be exercised when using this temporary procedure as there is potential for having the shock-sensitive detonator extending out the end of the primer. A small cork can be purchased and placed into the unarmed charge effectively sealing the through tunnel. Once properly placed, taping over the exposed end of the 'through-hole' or cork will prevent the possible entrance of foreign material during transport to the blast site. Before using this described method, it is wise to contact the manufacturer of the explosive to insure that their boosters will detonate in this manner. The best solution to arming with two detonators is the use of a cast booster that is designed to accommodate the two detonators.

I am very interested in ongoing research or opinions regarding these topics. Reach me at:
jbrennan@aspensnowmass.com

John Brennan is Snow Safety Director at Snowmass Ski Area and a consultant to Las Leñas Ski Area in Argentina. He is also a State licensed Blaster, a member of Colorado's Chapter of the ISEE, and a Professional Member of AAA. He began patrolling at Snowmass in 1992 and received the Dale Gallagher Memorial Scholarship to the National Avalanche School in 1993.

References:

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