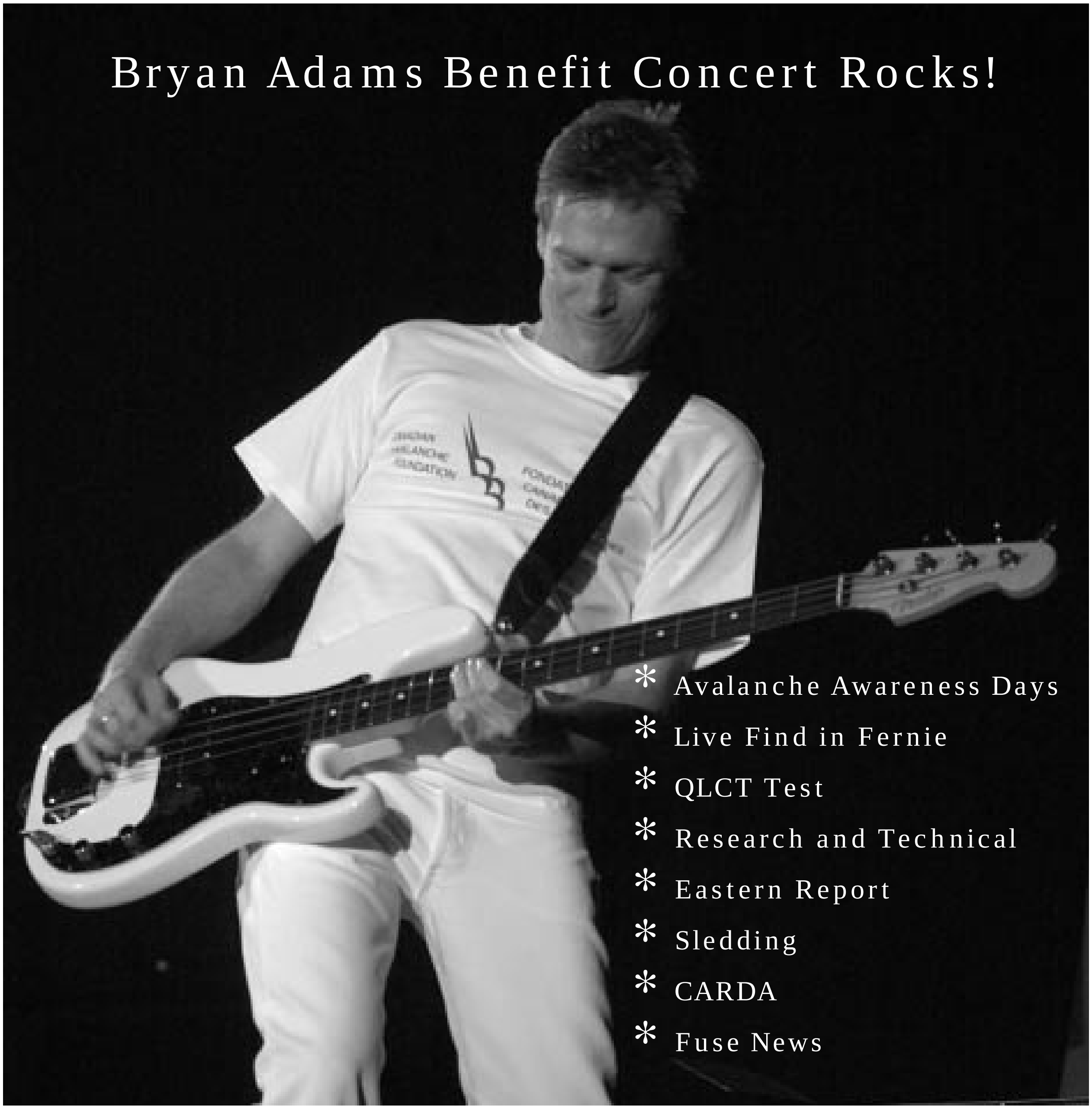
AVALANCHE NEWS

Winter 2000-2001 Volume 61

Bryan Adams Benefit Concert Rocks!



* Avalanche Awareness Days
* Live Find in Fernie
* QLCT Test
* Research and Technical
* Eastern Report
* Sledding
* CARDA
* Fuse News

Photo courtesy of the *National Post*

CANADIAN AVALANCHE ASSOCIATION

AVALANCHE NEWS

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PRESIDENT'S MESSAGE

Greetings,

I hope everyone is managing to get through one of the driest winters we've had for some time. It certainly has been a challenging year operationally, due to lack of snow and the poor snowpack that has developed.

The CAA Board of Directors continues to work toward implementing better procedures and policies to make the Association function better for you, the members, as well as for other organizations we interact with. One initiative is the CAA Committees, and defining their roles so that the hardworking volunteer members have better definition as to what their role is. Thanks to all of those that have worked on these policies so far.

We continue to look at ways to improve communication within the organization. The members only supplement is the first step. We are also exploring other options that include electronic media, such as a secure members only website. We are also working to improve communication between committees and the Board of Directors (BOD) by circulating BOD minutes to all Committee Chairs. This should keep everyone in the loop.

Avalanche Awareness Days were a success, with a good presence on Media Day in Whistler, and with participation by members across Western Canada on January 12th and 13th. There was coverage on television, in newspapers and on the radio.

Thanks to the all the volunteers on the Board and Committees, as well as the staff at the CAC for their ongoing work in support of the Association. If you have any ideas or suggestions, please do not hesitate to contact the Canadian Avalanche Centre, BOD or any of the Committees.

Have a safe winter.

Regards,

Bill Mark

CAA President

NOTE FROM THE FOLKS AT THE CAC

Hello,

Well, let me start by introducing myself. My name is Brent Strand and I'm the new guy at the Canadian Avalanche Centre. I recently moved back to B.C. after living in northern Alberta for the last 10 years, where I experienced major mountain withdrawals. I'm an avid backcountry/downhill skier and a mountain biker, not to mention just an all around outdoor enthusiast. My experience with the backcountry and avalanches in the past have been “big balls and no brains” due to a lack of education. Heck, I think 10 years ago I probably hiked straight up every slide path behind Glacier Park Lodge! Duh! Since then I have taken my Ski Operations Level I, which has shown me the way. Great course and great people.

I was introduced to the CAA when I was approached to help them with the Avalanche News publication, Infoex on Thursday and Friday nights as well as other various computer needs. Since then I have acquired a more permanent position with the Centre and have been bestowed the duty of the Avalanche News, as well as many front office duties and general correspondence. I'm very pleased to be working in an industry that is closely related to my personal desires. Myself and my fiancé Corinna will be a permanent fixture in the mountains which we truly love. Hope to meet you all some day, and enjoy life to the fullest because nobody will do it for you!

Checking out this years conditions.

Brent Strand
Infoex Dude and Client Relations

The tentative schedule of the CAA 2001 AGM spring meeting

(subject to change).

Monday, May 7	(evening)	Education Committee/CAATS Course Leaders
Tuesday, May 8	1pm-5pm	CAATS Instructors Meeting
Wednesday, May 9	8am-9pm	Public & Technical (various evening meetings)
Thursday, May 10	8am-5pm	Public & Technical, AGM
Friday, May 11	8am-5pm	Continuing Professional Development Seminar

Location: Ramada Courtyard Inn, Penticton, B.C.

Bulk room rates have been negotiated:

Ramada Courtyard Inn (250) 770-3272	$70.00 per night
Sandman Inn 1-800-726-3626	$65.00 per night

AVALANCHE AWARENESS DAYS 2001

The Canadian Avalanche Association (CAA) has developed Avalanche Awareness Days as an annual promotion to profile the contributions of the avalanche safety industries to the safety and enjoyment of life in Western Canada, to promote the avalanche awareness of backcountry recreation enthusiasts, and to act as a fund raising vehicle for the CAA's Public Avalanche Bulletin. The primary public and media events were held on January 12th and 13th, 2001 at Whistler, B.C. Friday was Media Day, providing publicity for Avalanche Awareness Day on Saturday. Smaller events were held concurrently in several other communities across Western Canada where winter sports are a significant part of the local culture and lifestyle.

Media Day Events

At the ungodly time of 6:30 in the morning approximately 25 television, radio, magazine and newspaper reporters were shivering in the dark at the bottom of Blackcomb's Solar Coaster lift, waiting to begin their coverage of a full day of avalanche safety demonstrations and events.

Against a sunrise backdrop, the Blackcomb patrol cranked a cornice with enough powder to wake up Herb Bleuer in Pemberton. When it comes to impressing media folks, bigger is better!! Tony Sittlinger had an opportunity to explain the "behind the scenes" activities of the avalanche safety program at the ski area. Ski patrollers demonstrated avalanche rescue responses, avalanche beacon use, probing and avalanche first aid. Local Canadian Avalanche Rescue Dog Association (CARDA) folks were on hand to show off their canine partners, and explain the benefits of having trained avalanche dogs "on staff" at ski areas. A mock helicopter sling rescue showing the state-of-the-art patient transport capabilities at Whistler Blackcomb concluded the outdoors events.

The media contingent were awed by blue skies and a 270-degree panorama of the Coast Range as they lunched at Christine's, an upscale eatery located at treeline on Blackcomb Mountain. At a press conference following lunch, Paul Smith of Columbia Brewing presented a cheque for $10,000 to the Managing Director of the CAA to support the Public Avalanche Bulletin. Clair Israelson thanked Columbia Brewing for their years of support to the CAA and avalanche accident prevention, described the origins of the CAA, the services to Canadians that are delivered by the CAA, and the CAA's goal for improved Public Avalanche Bulletins. He then introduced an impressive line-up of ski industry celebrities who presented avalanche awareness messages.

Brian Savard and Eric Pehota of the Whistler Freeride Team talked about responsible adventure, training and preparation, and the avalanche gear that backcountry enthusiasts need to carry. Cathy Podborski recounted her burial in an avalanche, her feelings as the event occurred, how she was recovered alive because of the training, safety equipment and pre-planning of those she was with, and her continuing love of winter mountain adventure. Robin Siggers, accompanied by search dog Keno, talked of his recent live recovery of a skier buried in an avalanche near Fernie. Justin Trudeau concluded the press conference by talking of the value of mountain adventure, avalanche awareness training and current avalanche information as essential tools for safe winter recreation, and his personal support for the CAA's public service initiatives.

Avalanche Awareness Day Events

Numerous groups and organizations contributed to make the public outreach events of Avalanche Awareness Day a success.

Whistler Blackcomb provided prime space for the event at the base of the main ski lifts out of Whistler Village, with access to the thousands of people who were riding those lifts. They also contributed several senior ski patrollers to assist with event logistics and to represent the patrol to the public. On the mountain the patrol demonstrated avalanche rescues, use of avalanche transceivers, and avalanche rescue dog searches. The B.C. Ministry of Transportation and Highways was out in force, with a 105 recoilless rifle on site to attract visitors to a display describing how the Snow Avalanche Program keeps B.C.'s highways safe in winter.

Doug Kashuba and staff from Survival On Snow were on hand, exhibiting their excellent beacons, shovels, probes and packs. Whistler Search and Rescue volunteers demonstrated their winter rescue and patient care skills and handed out accident prevention literature, while CARDA dogmasters showed their dogs and explained their contributions to winter safety. Appearances by Peter Schaerer and Justin Trudeau brought ambience to the CAA booth, where pamphlets, danger cards, books, snow science posters and banners attracted people to ask questions and purchase materials for avalanche safety.

All in all, the day was an excellent showing of the science and technology of avalanche safety in Canada, and the community of people who work together to make our winter activities safer.

<u>CAF Fund Raiser</u>

Avalanche Awareness Day concluded with a fund raiser on Saturday night at the Garibaldi Lift Company pub, organized by Jack Bennetto of the Canadian Avalanche Foundation. A CAF presentation on avalanches inspired Kokanee consumption, and then a couple of great comedians kept the crowd laughing as they lined up for great bargains at the silent auction. Due to the generosity of the companies and individuals who contributed items for the silent auction, this fund raiser was both a financial and social success.

The following companies and individuals contributed items for the fund raiser. We encourage you to remember these friends of the mountain community when you purchase products or services. The CAA and the CAF extend a sincere “Thank You” to each of these companies for their generous support.

Columbia Brewing
Marmot Gear Canada
Survival On Snow
Whistler Blackcomb
Arc’Teryx Equipment Inc.
Kapristo Lodge
Jacques Morel
Canadian Mountain Holidays
Mike Wiegele Heliskiing
Whistler Heliskiing
Garibaldi Lift Company
Scott Flavelle
Dave Murray Ski Camps
HYAK Wilderness Adventures

A special thanks is to CAA stalwarts Brian Leighton, Marc Schoenrank, Bernie Protsch, Tony Sittlinger, Anton Horvath and the numerous other ski patrollers and support staff who teamed up with Stuart Rempel and the Whistler Blackcomb Public Relations Department to coordinate and deliver these Avalanche Awareness Days events. Many thanks to Whistler Blackcomb and Intrawest for acting as the primary events host, and helping to make Avalanche Awareness Days 2001 bigger and better than ever.

Two other people deserve special recognition for their personal contributions to Avalanche Awareness Day 2001. Jake Bogoch, for his work for the CAA, planning and coordinating Avalanche Awareness Day events at Whistler and the other venues in both Alberta and B.C. Jake’s enthusiastic leadership and determination were key to the success of these events. The CAA also thanks Justin Trudeau for his willingness to support avalanche accident prevention, and to contribute his time and energy to work with the CAA in this common cause. Justin’s involvement ensured extensive media coverage of Avalanche Awareness Days, and improved national awareness of snow avalanches as one of Canada’s fascinating and sometimes deadly natural phenomena.

AVALANCHE AWARENESS DAYS 2001

Justin Trudeau, speaking on avalanche education

Brian Savard, Whistler Freeride Team

Paul Smith
Director of Public Affairs, Columbia Brewery

Media action

European Law and Standards Affecting Avalanche Beacons

Felix Meier, Consultant, CH – 8193 Eglisau, Switzerland

ABSTRACT: In the past two years, new directives issued by the European Government have led to a change in the legal status of avalanche beacons and to an overhaul of the European standard EN 300 718 for avalanche beacons. The standard will be harmonized throughout Europe and also provide some technical improvements.

1. Harmonization

European standards that have been adopted by all member countries following the procedures as laid down in Directive 98/34/EC ("laying down a procedure for the provision of information in the field of technical standards and regulations") are called "harmonized" standards. Once a harmonized standard exists, all national standards regarding the same product must be withdrawn.

Standard requirements that are compulsory are termed "technical regulations". Products that do conform to these technical regulations may be distributed freely within the European Community, and no member country may restrict their sale or use.

The decision on whether to accept a product, which does not meet some of the non-compulsory requirements as set down in a standard, is left to the consumer.

2. The RTTE Directive

In March of 1999, the EC has issued a new directive 1999/5/EC "on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity" (the "RTTE Directive"). This directive states that any equipment falling under its scope (and avalanche beacons definitely do!) must fulfill some "essential requirements" in order to be allowed to be put on the market and freely circulate within the EC. These essential requirements are the ones affecting:

- Health and safety of the user — Art. 3.1 a
- Electromagnetic compatibility — Art. 3.1 b
- Effective use of the radio spectrum — Art. 3.2

The essential requirements are compulsory for any equipment (Art. 3.2 for radio equipment only). In addition, article 3.3 of the directive states that, for certain types of equipment, requirements covering other domains such as interoperability, privacy, access to emergency services etc. may be declared to be essential. Such extension of the essential requirement areas requires an explicit decision by the EC Commission.

Requirements that are not covered by one of the articles 3.1, 3.2 and possibly 3.3 of the RTTE directive cannot be compulsory. They may be part of a standard, but they do not constitute part of a technical regulation.

3. Application of Art. 3.3 of the RTTE Directive to Avalanche Beacons

In March of 2000, ICAR, the International Commission for Alpine Rescue, has issued a recommendation requesting that avalanche beacons be subject to article 3.3 e (devices providing access to rescue services) of the RTTE directive and that the relevant parts of the avalanche beacon standard ETS 300 718 be compulsory for application. ICAR considered requirements regarding compatibility and interoperability and a minimum performance in terms of range, reliability and robustness to be essential for access to rescue services.

The European Commission has charged its Committee for "Telecommunications, Conformity and Market Surveillance" (TCAM) with investigating individual classes of devices for the applicability of extended requirements. The findings of TCAM form the base of an eventual EC decision. The secretary of TCAM, after a hearing with interested parties in Vienna on June 20, 2000, has come to the conclusion that:

- Avalanche beacons do provide access to rescue services.
- The essential requirements should be extended to requirements affecting compatibility, robustness and reliability.

ICAR then asked all of its member organizations from countries that are represented in TCAM to contact the head of their national delegation and inform him about the importance of this matter to the members of their organization. As a result, on Sept. 25, TCAM has adopted a draft Commission Decision that states that

- Avalanche beacons shall be designed so as to be able to interwork, within their capabilities, with new beacons as well as with the installed base of beacons, which was approved under national approval regulations based on ETS 300 718.
- Avalanche beacons shall be so constructed as to ensure correct functioning after having been exposed to an avalanche and continue to function when being submerged for a longer period in snow following the avalanche.

This draft will now be forwarded to the European Commission for formal approval.

4. Impact on EN 300 718

The European Telecommunications Standards Institute (ETSI) has been put in charge by the European Commission to re-edit all of its standards in order to comply with the RTTE directive. Re-edit in practice means structuring the requirements into three groups:

- Requirements that are compulsory by Art. 3.1 and 3.2 of the RTTE directive.
- Requirements that are compulsory by Art. 3.3 of the RTTE directive.
- Other, non-compulsory requirements.

The deadline for drafting a new EN 300 718 was set for the end of September 2000. A working group was established in June, representing user associations, manufacturers and other interested parties. Since there was little time, the working group decided concentrate on adapting the standard to the new formal requirements. The technical contents were not modified except for items that were not disputed or that were obviously wrong. As a result, there is a new draft EN 300 718 which must now go through all the formal approval procedures as per directive 98/34/EC in order to be "harmonized" (have you ever read *Atlas Shrugged* by Ayn Rand?). The document is structured into three parts:

Part 1 Contains all the requirements, compulsory and non-compulsory.
Part 2 Itemizes the requirements that are compulsory under Art. 3.1 and 3.2 of the RTTE directive.

Part 3 Itemizes the requirements that are compulsory under Art. 3.3 e of the RTTE directive.

The important technical modifications are:

- The weight limit has been removed. This was considered a feature that the market will take care of anyway.
- All references to beacons operating at 2.275 kHz have been removed. Such beacons are not standardized any more. 15 years ago, the DIN standard provided the base for the transition to single frequency 457 kHz beacons. This transition is now considered to be complete.
- The receiver requirements have been adapted to also accommodate beacons with an optical user interface. Otherwise, beacons with an optical display only would not be able to meet the requirements as per Art. 3.3 e.
- The requirement for the operating time on one set of batteries has been set to 200 hours of transmission at +10° C and one hour of receiving at -10° C. This is more demanding than in the original version of EN 300 718, but it better reflects the user requirements.
- The extreme operating temperatures have been set to -20° C / +45° C. Operation down to -30° C was considered too demanding.
- The period of the carrier keying has been changed from 900 ms ± 400 ms to 1000 ms ± 300 ms. Shorter periods make it more difficult to detect multiple burials since they would increase the probability of overlapping signals. Most beacons today operate with a period of about 1000 ms.
- The transmitter frequency tolerance was reduced from ±100 Hz to ±80 Hz. This improves the compatibility among beacons from different manufacturers and allows for receivers with better performance. Today's technology permits implementation without an additional cost penalty.

5. Formalities

The old European standard EN 282 (1991) as well as the corresponding German national standard DIN EN 282 (1991) have now been formally withdrawn by resolution CEN/TC 126 (Paris 3 2000-04). They should not be referenced any more.

> The abbreviation in the standard name has officially been changed from ETS (European Telecommunications Standard) to EN (European Norm). So the correct reference to the standard for avalanche beacons is now EN 300 718.

6. Conclusion

Standardization work is quite a demanding task. Working group members must be technically well qualified and they do spend a lot of time for the task, even if email has eliminated much traveling. We do hope that the current revision will serve all interested parties well for some years to come.

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BRYAN ADAMS CONCERT

Bryan Adams Rocks to Benefit the Canadian Avalanche Foundation

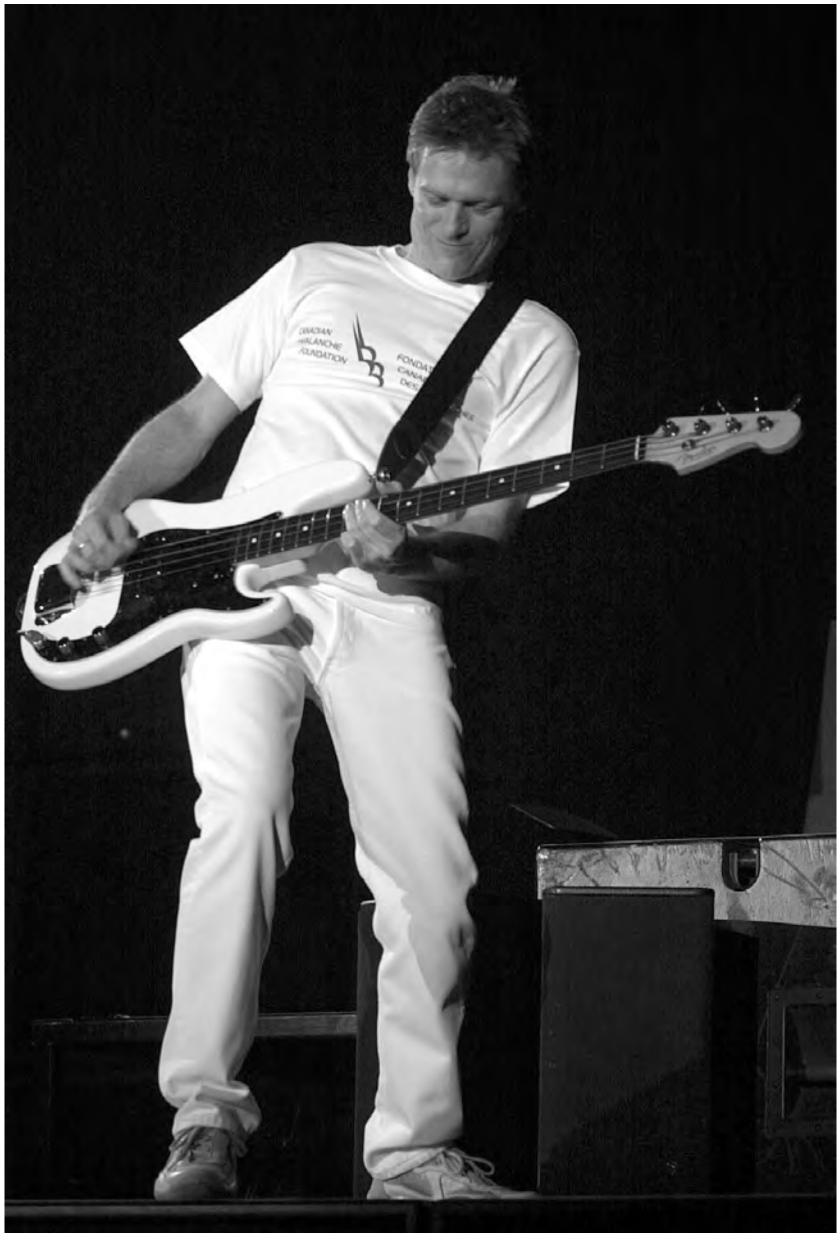

Photo courtesy of the *National Post*

Sporting a Canadian Avalanche Foundation (CAF) T-shirt, Bryan Adams rocked the multi-purpose recreation facility in Cranbrook on December 5th, 2000 in a benefit concert for the CAF. Joined on stage by Margaret Trudeau, mother of avalanche victim Michel Trudeau, and Chris Stethem, president of the CAF, Mr. Adams announced his generous donation of $50,000 to the CAF in front of 5,000 enthusiastic concert goers.

Adams, a skier himself and friend of Margaret Trudeau, invited the CAF to tour along with him on his Western Canada tour to promote public avalanche awareness. The CAF's information booth provided concert goers with information about avalanche awareness and raised funds through donations and merchandise sales. Traveling to Kelowna, Prince George, Grand Prairie, Cranbrook, Lethbridge, Regina, Saskatoon and Red Deer the CAF was well received. Even at the prairie venues a number of skiers, boarders and snowmobilers expressed their interest in avalanche safety programs.

The immediate mandate of the CAF is to update the current Public Avalanche Bulletin from a bi-weekly publication to a daily publication. Donations to the CAF can be made by the following methods:

- <www.avalanchefoundation.ca> - CAF website for donation forms and all CAF news
- By mail to the CAF, P.O. Box 290, Revelstoke, BC V0E 2S0
- By telephone to the CAF office in Revelstoke at (250) 837-2418
- Mountain Equipment Co-op (MEC) – donate at the till at any MEC store

All donations of $25 or more will merit a tax receipt.

Mary Jane Pedersen, CAF

BIGGER MAY BE BETTER...

Determining the Equivalent Explosive Effect for Different Explosives

Jerome B. Johnson
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P. O. Box 35170
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ABSTRACT

Explosives with different amounts of available chemical energy per unit mass (specific energy) have the same explosive effect when the total available chemical energy (detonation energy) for the explosives are equivalent:

$$e_{m1}\, m_1 = e_{m2}\, m_2 = E_t$$

where e_{m1}, e_{m2} are the specific energies and m_1 and m_2 are the masses for two different explosives and E_t is the total detonation energy. The mass of explosive 2 needed to produce the same explosive effect as explosive 1 is :

$$m_2 = e_{m1}\, m_1 / e_{m2}$$

The specific energy can be estimated from $e_m = e_v/\rho_0$ where

$$e_v = -4.7613 + 1.6923\, D$$

is the amount of available chemical energy per unit volume, D is the unconfined detonation speed (km/s), and ρ_0 is the explosive initial density (Mg/m^3). The effectiveness of a low detonation speed explosive will be similar to that of a high detonation speed explosive when their total detonation energies are the same. The perception that high detonation speed explosives are more effective than low detonation speed explosives at causing snow avalanche failure is a result of comparing explosives with equivalent mass rather that equivalent total energy and the fact that the Chapman-Jouguet pressure of an explosive is strongly dependent on detonation speed.

INTRODUCTION

Avalanche control professionals may select an explosive based on its effectiveness at initiating snow avalanches, releasing cornices or creating fractures and settlement in snow. Concerns about safety, ease of handling, cost, or the need to perform a specialized task may also play a role in selecting an explosive. This selection process can be hampered by the lack of an accurate method to determine the equivalent explosive effect between different explosives. The effect that an explosive has on its surroundings depends on the impulse (integrated pressure over time) and maximum pressure that is generated upon detonation. These are generally determined by the total available chemical energy (detonation energy), detonation speed, and the level of confinement of the explosive. This paper presents a discussion of the explosive detonation process and describes a method for determining the equivalent explosive effect between different explosives. The perception that high detonation speed explosives are more effective at causing snow avalanche failure than are low detonation speed explosives is also discussed.

EXPLOSIVE DETONATION

In an idealized detonation, the detonation wave consists of four regions. The leading shock front of the detonation wave compacts the chemically unreacted explosive to a state on its Hugoniot curve (the locus of pressure-density states attained by shock loading from a single initial state) with a discontinuous high pressure. The reaction zone follows the shock front and releases most of the detonation energy producing extreme pressures, densities and temperatures. Subsequent chemical reactions cause the pressure and density to decrease, over a period of several hundred nanoseconds, to the equilibrium Chapman-Jouguet (C-J) state located at the rear of the reaction zone. The expansion of gases following the C-J state produces a rarefaction wave, the Taylor wave (Dobratz and Crawford, 1985;

Tarver, 1992). The detonation products are at the C-J state which is assumed to be at thermodynamic equilibrium. The C-J pressure (Pcj, detonation pressure) is slightly lower than the pressure at the detonation shock front (Dobratz and Crawford, 1985) and is the maximum bulk pressure that an explosive can achieve. The actual explosive pressure depends on its state of confinement and is generally less than Pcj.

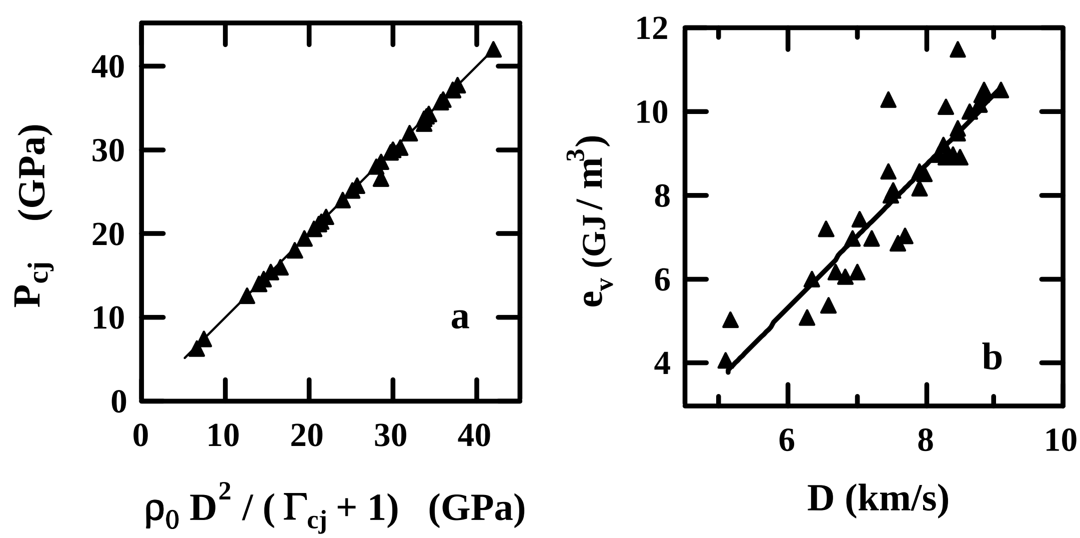
Explosives are typically characterized by their Pcj, the C-J GrŸneisen parameter (Γcj, the ratio of the thermal pressure to the thermal energy at the equilibrium C- J state), detonation speed, initial density, and energy per unit mass (specific energy) or energy per unit volume (energy density) (Table I in the Appendix). Explosive volume and energy density determine the total detonation energy that is available to be transferred as kinetic energy into the surrounding medium. The mass of an explosive and its specific energy are often used in place of volume and energy density. The detonation speed, density and Γcj determines the C-J pressure (Pcj, the pressure at the equilibrium C-J state). Detonation pressure is a function of explosive initial density (ρo, Mg/m^3) and the unconfined detonation speed (D, km/s), and can be calculated from:

$$Pcj\ (GPa) = \rho o D^2/(\Gamma cj + 1) \qquad (1)$$

where Γcj Å 2.75 can be used to obtain reasonable estimates when Γcj is unknown (Lee et al., 1968) [Fig. 1a]. The detonation speed of an explosive depends on its energy density; however, our interest is to estimate the energy density using detonation speed:

$$ev = -4.7613 + 1.6923\ D \qquad R = 0.92 \qquad (2)$$

where ev (GJ/m^3) is the energy density (Fig. 1b). The specific energy does not correlate well with detonation speed since explosives often include an inert filler that decreases the energy density. Consequently, the value of the specific energy may increase or decrease depending on the density of the inert filler compared to the densities of the reactive materials.



(a) (b)

Fig. 1. (a) The C-J pressure as a function of explosive initial density, unconfined detonation speed and C-J GrŸneisen parameter, and (b) the energy density as a function of unconfined detonation speed. Data from Dobratz and Crawford (1985).

EXPLOSIVE EFFECT

The effectiveness of an explosive is, in general, determined by its ability to fracture and/or move the surrounding material. For a given explosive this is determined from its Pcj and impulse. The Pcj is an indicator of the explosive pressure (the actual pressure depends on both the Pcj and strength or compressibility of the surrounding material), and the impulse is a measure of the momentum that is transferred into the material. For an explosive to be effective its pressure must exceed the fracture or yield strength of the surrounding material, otherwise the pressure pulse will propagate through the material without significant effect. This is why explosives specialists use high detonation speed/high Pcj explosives in hard competent rock. When the explosive pressure exceeds the material's fracture or yield strength the extent of fracturing and permanent deformation in the material will be determined by the impulse. For low strength materials or materials with pre-existing fractures low detonation speed/low Pcj explosives are adequate, although high Pcj explosives will also work.

In snow, which has relatively low strength, most explosives will produce pressures sufficient to cause fracturing and deformation. As a result, the effectiveness of an explosive in snow will be primarily controlled by the impulse. For spherical explosive charges, the impulse at a given radial distance is:

$$I = \frac{(2\,M\,E_t)^{1/2}}{4\,\pi\,R^2} \qquad (3)$$

where I is the impulse, Et is the total detonation energy, R is the radius from the center of the explosive to the pressure shock front and M is the mass of material engulfed by the shock wave. The ratio of impulses, at the same radius, for two different explosives is a measure of their relative explosive effect:

$$\frac{I_1}{I_2} = \frac{E_{t1}^{1/2}}{E_{t2}^{1/2}} \qquad (4)$$

The explosive effect of the two explosives is equal when their impulses are equivalent. Consequently their total detonation energies are also equal:

$$Et1 = em1\ m1 = Et2\ = em2\ m2 \qquad (5)$$

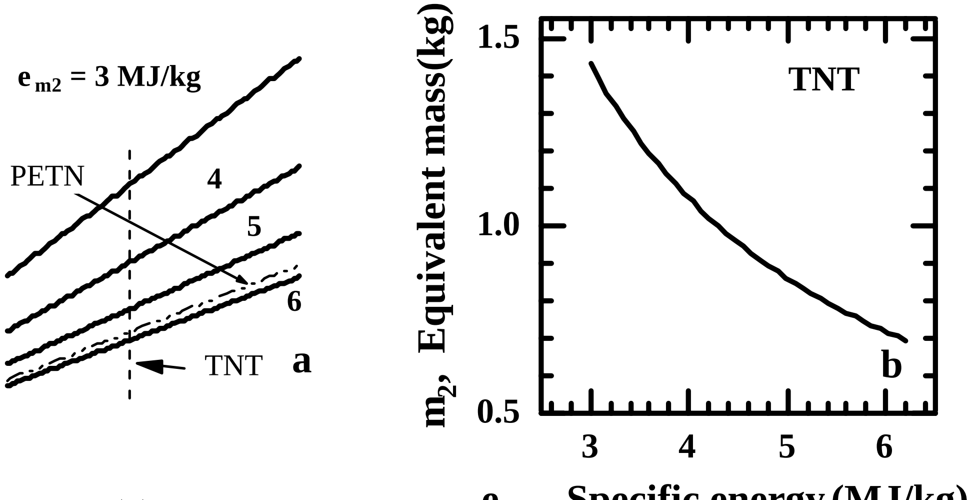
where em is the specific energy and m is the mass of the explosive. The mass of explosive 2 needed to produce the same impulse as that of explosive 1 can be determined from:

$$m2 = \alpha m\ m1 \qquad (6)$$

where αm = em1/em2. The specific energy can be determined from Table I (in the Appendix) or estimated using equation 2 and:

$$em = ev/\rho 0 \qquad (7)$$

Fig. 2 provides a graphic method for determining αm when the specific energies of the two explosives are known. As an example of usage consider the problem of determining the mass of PETN ($\rho 0$ = 1.77 Mg/m3) explosive that has the equivalent impulse of 1 kg of TNT. The specific energies of PETN and TNT are 5.7 MJ/kg and 4.3 MJ/kg, respectively. From Fig. 2a, αm Å 0.75 or 0.75 kg of PETN provides the same explosive effect as 1 kg of TNT. Fig 1b can be used to determine the mass of an explosive with specific energy em2 that has the same explosive effect as 1 kg of TNT (the relationship of this curve to Fig. 2a is shown as a dashed line in Fig. 2a).



(a)

(b)

Fig. 2. (a) The mass ratio (α_m) required to produce an equivalent explosive effect for two different explosives where e_{m1} and e_{m2} are, respectively, the specific energy of the reference explosive and explosive of interest. (b) The equivalent explosive mass of an explosive with specific energy e_{m2} to that of a 1 kg TNT charge (shown as a dashed line in Fig. 2a).

Eq. 4 can be used to determine the amount of additional explosive mass needed to increase the impulse by a given amount where:

$$\frac{I_1}{I_2} = \frac{m_1^{1/2}}{m_2^{1/2}} \tag{8}$$

is the impulse ratio between explosives with different mass but the same specific energy. Calculations using Eq. 8 indicate that doubling the impulse of an explosive requires that the explosive mass be increased by a factor of four while increasing the impulse by a factor of three requires nine times more explosive mass (Fig. 3).

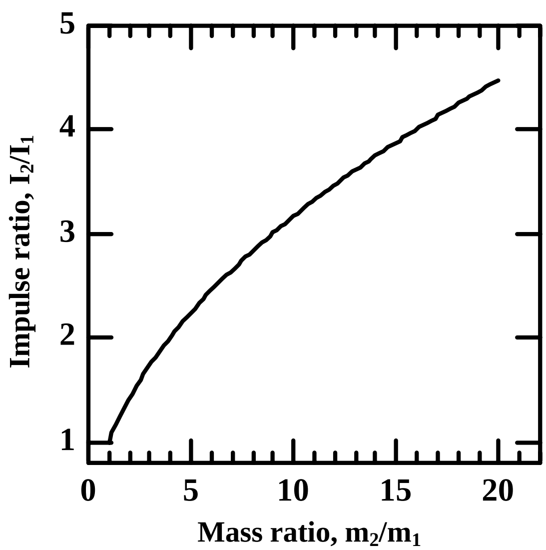
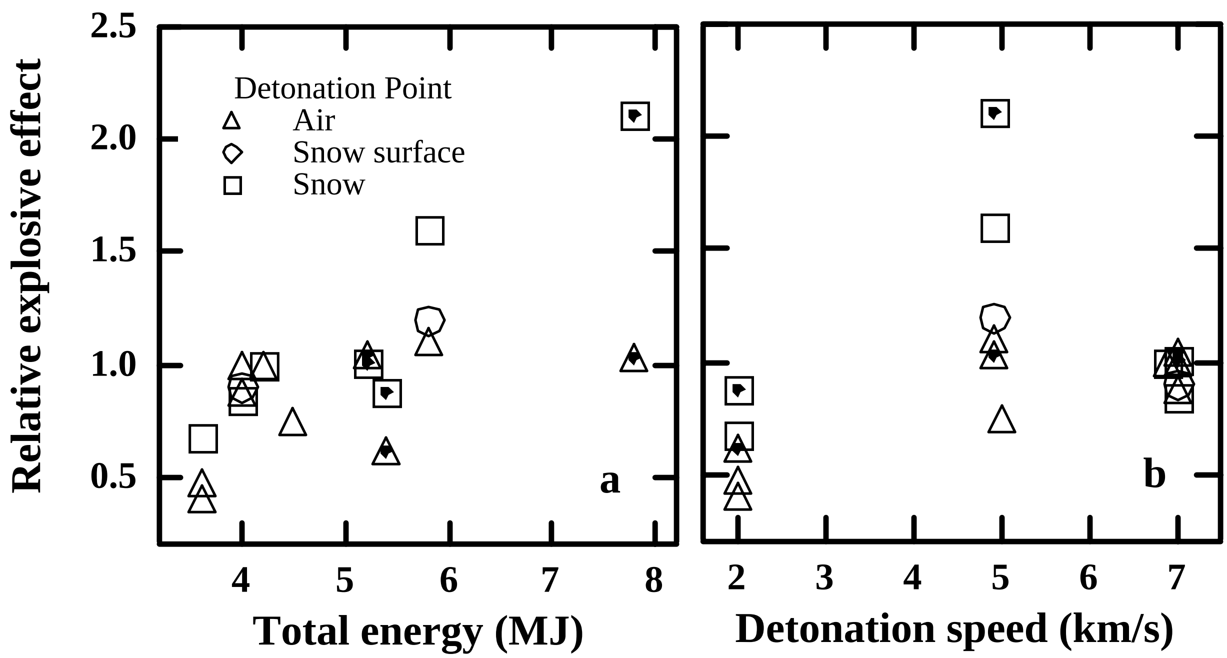


Fig. 3. The relative increase in explosive effect (Impulse ratio) achieved by increasing the relative mass (Mass ratio) of a spherical explosive charge.

DISCUSSION AND CONCLUSIONS

The effectiveness of an explosive in fracturing and deforming a material depends on the maximum pressure and total impulse generated upon detonation. High detonation pressure explosives, which also have high detonation speeds, are used in high strength brittle materials to maximize fracturing. Detonations that produce pressures less than the strength of the surrounding material may have little or no effect. For low strength ductile materials, like snow, any explosive (either high or low detonation pressure) should produce adequate results. High pressure explosives may be somewhat less effective as they lose energy to the production of excessive fractures that are unnecessary to cause bulk failure in a material. Most explosives produce sufficient pressure to produce fracturing and deformation in snow. Consequently, the primary factor determining explosive effectiveness in snow is explosive impulse which is controlled by the specific energy and mass of the explosive, not its detonation speed. This is counter to the perception among many avalanche control personnel that high detonation speed explosives are more effective at causing snow avalanche failure than are low detonation speed explosives.

Gubler (1976, 1977, 1978) conducted a study on explosive effect in snow, where the relative explosive effect was defined as a ratio of pressure or snow particle velocity produced by a given explosive as compared to Plastit explosive. The results of his study can be used to examine explosive effectiveness as a function of total detonation energy and detonation speed for the same explosive (Fig. 4). Although the data show significant scatter, Gubler's results indicate that relative explosive effect increases with increasing total detonation energy (Fig. 4a). No simple relationship exists between relative explosive effect and detonation speed (Fig. 4b).



(a) (b)

Fig. 4. (a) Relative explosive effect for various explosives as compared to plastit explosive as a function of the total detonation energy and (b) as a function of the explosive detonation speed (data from Gubler 1976, 1977, 1978). The explosives were detonated 1 to 1.5 m above the snow surface (Air), on the snow surface (Snow surface), and buried in the snow (Snow). All data symbols represent results for 1 kg explosives except for those marked with a center dot which where either 1.3 or 1.5 kg charges.

The findings of this study are consistent with observations that increased charge mass produces a greater effect (Livingood et al., 1990), but at a diminishing efficiency as the mass is further increased (due to the nonlinear relationship between the impulse and charge mass). Explosives with high specific energy will be the most effective for a given mass. Explosives with the same total detonation energy should have approximately the same effect at causing avalanche failure and snow deformation. The detonation speed of an explosive does not, in general, influence the effectiveness of an explosive in snow unless the particular application requires unusually high pressure.

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APPENDIX and Table I continued on next page.

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APPENDIX

Table I. Parameters for characterizing common explosives (compiled from Dobratz and Crawford 1985)

C-J parameters

Explosive	**Density** P0 (Mg/m3)	**Pcj** (GPa)	**Detonation speed** (km/s)	**ev** (GJ /m3)	**em** (MJ /kg)	Γ_{cj} (GJ /Mg)
BTF	1.859	30	8.48	11.5	6.2	2.717
COMP A-3	1.65	30	8.3	8.9	5.2	2.79
COMPB, GRADE A	1.717	29.5	7.98	8.5	4.95	2.706
COMP C-4	1.601	28	8.193	9	5.6	2.838
CYCLOTOL 77/23	1.754	32	8.25	9.2	5.2	2.731
DIPAM	1.550	18	6.7	6.2	4	2.842
EL-506A	1.480	20.5	7.2	7.0	4.7	2.752
EL-506C	1.480	19.5	7	6.2	4.2	2.719
EXPLOSIVE D	1.42	16	6.6	5.4	3.8	2.75
FEFO	1.590	25	7.5	8.0	5.03	2.578
H-6		1.76	24	7.47	10.3	5.9
3.092						
HMX	1.891	42	9.11	10.5	5.55	2.740
HNS	1.0	7.5	5.1	4.1	4.1	2.468
HNS	1.40	14.5	6.34	6	4.3	2.881
HNS	1.65	21.5	7.03	7.45	4.5	2.804
LX-01	1.23	15.5	6.84	6.1	4.96	2.711
LX-04-1	1.865	34	8.47	9.5	5.1	2.935
LX-07	1.865	35.5	8.64	10	5.4	2.922
LX-09-01	1.84	37.5	8.84	10.5	5.7	2.834
LX-10-1	1.865	37.5	8.82	10.4	5.6	2.868
LX-11	1.875	33	8.32	9	4.8	2.868
LX-14-0	1.835	37	8.8	10.2	5.56	2.841
LX-17-0	1.90	30	7.6	6.9	3.6	2.658
NM	1.128	12.5	6.28	5.1	4.5	2.559
OCTOL 78/22	1.821	34.2	8.48	9.6	5.3	2.830
PBX-9010	1.787	34	8.39	9	5.03	2.700
PBX-9011	1.777	34	8.50	8.9	5.01	2.776
PBX-9404-3	1.840	37	8.80	10.2	5.5	2.851
PBX-9407	1.6	26.5	7.91	8.6	5.4	2.513
PBX-9501	1.84	37	8.80	10.2	5.5	2.851
PBX-9502	1.895	30.2	7.71	7.07	3.7	2.648
PENTOLITE 50/50	1.7	25.5	7.53	8.1	4.8	2.78
PETN	0.880	6.2	5.17	5.02	5.7	2.668
PETN	1.26	14	6.54	7.19	5.7	2.831
PETN	1.50	22	7.45	8.56	5.7	2.788
PETN	1.770	33.5	8.30	10.1	5.7	2.640
TETRYL	1.730	28.5	7.91	8.2	4.7	2.798
TNT	1.630	21	6.93	7	4.3	2.727

KOKANEE GLACIER CAMPAIGN

CAA and the Kokanee Glacier Alpine Campaign

In the spring of 2001, the CAA committed to supporting the Kokanee Glacier Alpine Campaign, a collaborative effort by B.C. Parks and the Trudeau family to raise funding to build a new hut in Kokanee Glacier Provincial Park, commemorating Michel Trudeau and others who have died in avalanches in the Park, and to raise public awareness of avalanche safety in backcountry recreation. At the suggestion of CAA member Dave Smith, the CAA initiated dialogue with B.C. Parks regarding the use of the new hut as a training facility, and an agreement was reached for CAA support to the campaign.

The CAA has agreed to lend our name, credibility and support to the campaign, and will assist in developing appropriate avalanche safety messages for use in Kokanee Glacier Provincial Park. In return, the CAA Training Schools will have the use of the new hut facility, at cost, during the pre-Christmas season each year. This is a tremendous benefit to the CAA, as we have been unable to find an ideal location for CAATS courses in the Kootenays. In addition, B.C. Parks has agreed that if the campaign target of $900,000 is exceeded, the CAA will receive the first $40,000 of all excess funds to support the Public Avalanche Bulletin.

The public portion of the campaign was originally scheduled for early November in Nelson, B.C., to coincide with the date of Michel Trudeau's death. However, when Pierre Elliot Trudeau passed away, the Trudeau family requested that the campaign be postponed to allow them time to deal with their loss. As a result, the event was rescheduled for February 2nd and 3rd, 2001.

Diny Harrison and Clair Israelson represented the CAA and staffed a booth at the Kokanee Glacier Alpine Campaign celebrations in Nelson. Other CAA members working the event included Laura Adams, Rob Whelan, John Tweedy and Kevin Giles. Due to the rescheduling of the event, several other CAA members who had planned to assist in November were at work in the mountains, and unable to participate. Clair gave a presentation outlining the CAA's history and role in Canadian avalanche safety, and how the CAA supports the campaign's vision and values. Other speakers included Justin Trudeau, Roberta Bondar (Canada's only female astronaut), Nancy Greene Raine, and Wayne Stetski, regional manager for B.C. Parks. The highlight of the day was a presentation of a cheque for $100,000 to Justin Trudeau from B.C. Premier Ujjal Dosanjh, towards the campaign's financial goal.

Dave Smith, a long serving member of the CAA's Education Committee with strong connections to B.C. Parks, has agreed to act as the local point of contact between the CAA and B.C. Parks, and will work with B.C. Parks staff to help ensure that the new hut will be an effective facility for avalanche safety training in the Kootenays, and serve as a lasting tribute to all mountain adventurers who have died in avalanches in Kokanee Glacier Provincial Park. The CAA is proud to be a part of the mountain community supporting the Kokanee Glacier Alpine Campaign initiative.

“WHUMPFING”

Field Data and Theory for Human-Triggered “Whumpfs” and Remote Avalanches

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Remotely triggered avalanches and whumpfs (sometimes called “settlements”) are common occurrences in many mountains ranges, but have received little research attention in the past. These events are generally associated with persistent weak snowpack layers, consisting of surface hoar, depth hoar and facets.

Over the past four years, snowpack data have been collected at the sites of forty skier-triggered whumpfs and thirteen remotely skier triggered avalanches in the Columbia and Rocky Mountains of British Columbia. These data are compared to data for skier-triggered avalanches that were not remotely triggered. Whumpfs and remotely triggered avalanches showed significant differences in the weak layer and slab properties. Additional measurements at five whumpf sites indicated a collapse of the weak layer and downward displacement of the snow surface. At one site during the winter of 1999-2000, the speed of the propagating fracture through a weak layer under a soft slab was measured at 19.9 m/s using geophysical equipment.

A theory is presented that explains propagation of a fracture in a weak layer on level terrain. This theory also explains the large difference in speeds observed for whumpfs.

KEYWORDS: Avalanche Release, Persistent Weak Layers, Fracture Propagation

1. INTRODUCTION

Whumpfs and remotely triggered avalanches have received very little attention by researchers, although they are frequently responsible for avalanche involvements. The lack of attention probably stems from the fact that they are difficult to study due to their infrequent and unexpected nature. In a recent survey by Jamieson and Geldsetzer (1999), when 153 avalanche professionals were each questioned about one unexpected avalanche that they recalled, a surprising 41 per cent recalled a remotely triggered avalanche. This number seems high considering how infrequently they occur. One possible explanation is that often the propagation distances are great or the fracture travels through level terrain, both of which are unexpected and therefore remembered quite well. Whumpfs can be thought of as a remotely triggered avalanche in which the propagating weak layer fracture did not reach an avalanche start zone.

2. PREVIOUS WORK

Information about whumpfs and remotely triggered avalanches that do exist in the literature are mostly observational comments. One of the first references to remotely triggered avalanches was by Seligman (1936) who stated that an over snow traveler could trigger an avalanche some distance from a slope. Bader and others (1939) noted that an explosion detonated in one valley was able to trigger multiple avalanches some distance away from the location of the explosion. Carl Benson (1960) documented the collapse of softer snow layers and the propagation of these collapses in Greenland. He estimated that the softer layers of snow collapsed approximately 2.5 cm. In 1973, Truman reported the observation of several whumpfs that occurred outside of his Midwest home in an isothermal snowpack. He observed a wave like pattern on the surface of the snow. The surface of the snow was displacement downward approximately 1-2 cm after the wave had passed. He visually estimated the speed of these waves to be around 6 m/s. He concluded that based on the speed of the wave, it could not have been a compression or shear wave. DenHartog (1982) documented an event triggered by a large explosion in Antarctica. Again, a layer in the snowpack compressed with the fracture traveling at least five miles. The collapse of a softer layer in the snowpack caused the surface to be displaced downward. This downward displacement traveled slightly slower than the speed of sound in air.

The reports of downward displacement of the snow surface and wave like behavior of the surface leads us to the following hypothesis.

3. HYPOTHESIS

One accepted theory for skier-triggered avalanche release is that a skier first triggers a shear fracture in a weak layer of the snowpack (e.g. Föhn, 1987). This fracture propagates outwards from the trigger point. Fracture of the weak layer is followed by fracture of the crown, flanks and stauchwall, releasing an avalanche (e.g. McClung, 1987 and Schweizer 1999). The fact that whumpfs and remotely triggered avalanches can propagate across horizontal terrain questions whether this propagation is strictly a shear fracture of the weak layer. Schweizer (1999) states that collapse of the weak layer (compressive failure) seems quite plausible as the initial failure in an avalanche. While fracture mechanics texts (e.g. Broeck, 1984) indicate that a component of shear is necessary for fracture propagation in the weak layer we hypothesize that propagating fractures on level terrain *require* a compressive component. This collapse of the weak layer should be associated with whumpfs and remotely-triggered avalanches, most of which involve propagation on low-angled terrain. The downward displacement of the slab provides the energy to propagate these fractures.

4. METHODS

Our first step was to compare remotely triggered avalanches with avalanches that were not remotely triggered. Data were collected at the sites of whumpfs and remotely triggered avalanches and at avalanche sites that were not remotely triggered. To date we have collected data from forty whumpfs and thirteen remotely triggered avalanches. These data were then compared to data collected at fifty-one skier triggered avalanches that were not remotely triggered. All whumpfs and remote avalanches were triggered by either by a person on skis or snowshoes.

The second step was to develop and implement an experiment to measure the speed at which these failures traveled. This has never been measured and allowed us to compare the measured value to published theoretical values for shear fracture through the weak layer. If the speed was much greater than or less then the expected values for a shear fracture then it would support our hypothesis that it might not be strictly a shear fracture propagating through the weak layer.

5. COMPARISON OF REMOTE AND NON-REMOTELY TRIGGERED AVALANCHES

One of the most important pieces of information collected at investigated avalanche sites was the crystal type of the failure layer. (Figure 1) shows the crystal types for remotely triggered avalanches and for the non-remotely triggered avalanches that we have investigated.

Whumpfs and remotely triggered avalanches involved persistent weak layers in all but two events investigated in the Columbia and Rocky Mountains of Western Canada. The two cases where the weak layer was reported as non-persistent, field notes show that a persistent weak layer at the base of the snowpack could have contributed to the failure. This distribution of crystal types for remote avalanches is notably different than the weak layer crystal type for non-remotely triggered avalanches, which consisted of decomposed and fragmented crystals in forty eight percent of the cases. If we could have investigated all non-remote, skier triggered avalanches we would expect a larger percentage of failures occurring in decomposed and fragmented crystal layers; our research focuses on avalanches that have occurred on persistent weak layers. Although the data are biased towards persistent weak layers, it still clearly indicates that whumpfs and remotely triggered avalanches tend to only involve persistent weak layers.

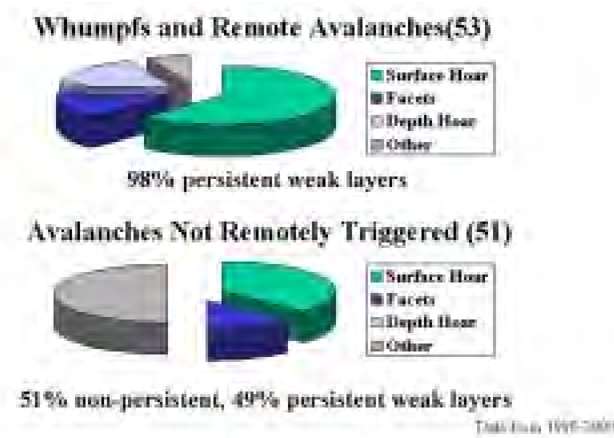

Figure 1. Comparison of weak layer crystal types.

One characteristic of persistent weak layers is that the layer has a measurable thickness usually between 2 and 30 mm, although some facet and depth hoar layers can be much thicker. Because these layers have thicknesses greater than their grain size there is potential for collapse of the layer. During the winter of '99-'00 at five sites where a whumpf occurred, the thickness of the weak layer was measured in an area where the weak layer had fractured, then again in an area where the weak layer had not fractured. Often a perimeter crack appears on the surface indicating where the fracture stopped (Figure 2). One whumpf showed a remarkable 10 mm of collapse between the un-fractured and fractured regions. The four other measurements showed a collapse of 3-7 mm, 3 mm, 2 mm and 1 mm respectively. We were only able to make these measurements at five sites where the extent of propagation could be determined from perimeter cracks.

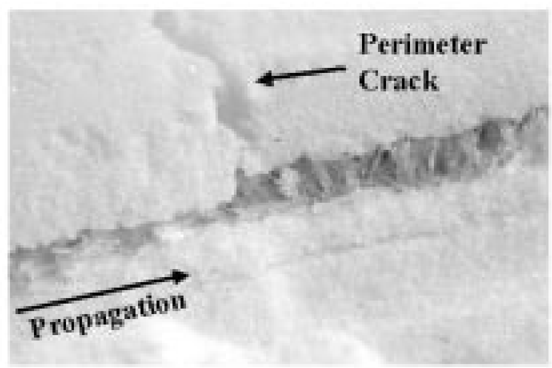

Figure 2. Collapse of a surface hoar layer, taken at the site of a whumpf. The vertical crack extends to the surface and indicates the perimeter of the failed area. This fracture was triggered 8 meters to the left of the area photographed.

While we did try to determine why propagation stopped, it was difficult to draw any specific conclusions about the stopping condition. In most cases, the perimeter fracture was at an abrupt change in slope incline or in an area where vegetation was protruding through the surface of the snow.

In addition to comparing the weak layer crystal types we have also compared the following measured variables: age of the weak layer, shear strength of the weak layer, thickness of the weak layer, maximum crystal size of the weak layer, thickness of the overlying slab, density of the overlying slab and average compression test score. Table 1 shows the comparison of these characteristics. Out of these seven characteristics of the slab and the weak layer, five have statistically different means. The two variables that did not prove significantly different ($p<0.05$) were the shear strength and compression test scores.

	Remotely Triggered and Whumpfs		Not-Remotely Triggered		t test	
	N	Mean	N	Mean	t	p value
Age of weak layer (days)	44	19.4	22	10.9	-2.66	0.001
Weak layer thickness (cm)	45	3.6	40	0.9	-2.59	0.01
Shear strength of weak layer (kPa)	38	0.76	39	0.62	-1.48	0.14
Maximum crystal size of weak layer (mm)	49	10.1	46	4.3	-4.44	$< 10^{5}$
Density of slab (kg/m^3)	48	148	41	127	-2.54	0.01
Thickness of overlying slab (cm)	55	63	51	43	-3.83	0.0002
Compression test score	40	15.8	38	15.3	-0.241	0.81

Table 1: Comparison of remotely triggered avalanches with non-remotely triggered avalanches. Shaded values show statistically significant differences in the mean values.

Comparison of these remotely triggered avalanches with non-remotely triggered avalanches shows significant differences in both the weak layer and the overlying slab. Remotely triggered avalanches tend to have thicker, more dense slabs, and the weak layers for remotely triggered avalanches are much thicker and have larger crystals.

6. MEASUREMENT OF PROPAGATION SPEED

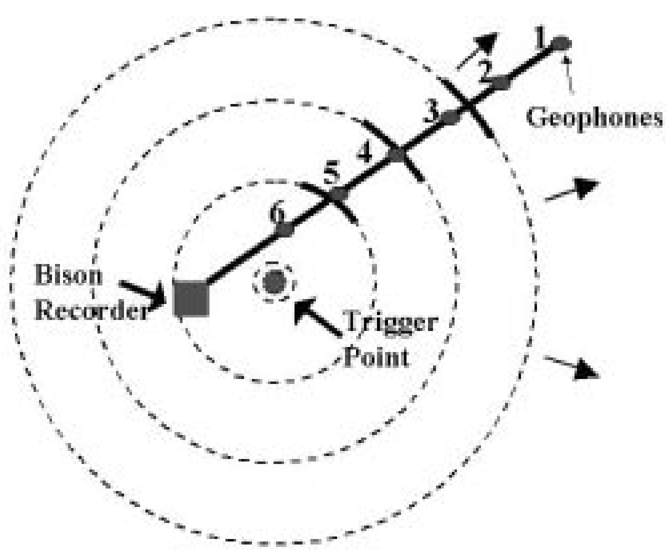

Figure 3. Schematic of the experimental setup used to measure the propagation speed of a whumpf. Concentric circles indicate propagation of the weak layer failure.

On February 19th of 2000, we set out to measure the propagation speed of a whumpf in Banff National Park, Alberta. (Whumpfs had been reported in this area several days prior to February 19th.) We used six geophones connected to a Bison 12-channel recorder. The weak layer consisted of a surface hoar layer that had formed Jan 1st. The layer was approximately 14 mm thick and at a depth of 39 cm. The overlying slab was dry snow with an average density of 189 kg/m^3. The six geophones were placed in a line on the snow's surface and then a whumpf was triggered near one end of the geophone string (Figure 3). Sampling at 2000 Hz, we recorded the downward displacement of the snow surface as the failure traveled through the weak layer below each geophone. The weak layer collapsed approximately 1 mm in one snow profile. After measuring the geometry of the geophones in relationship to the trigger point we calculated the propagation speed of the whumpf at 19.9 m/s. Theoretical values for the propagation speed of shear fracture through weak layers was thought to be on the order of 100 to 1000 m/s (Bader and Salm, 1990). McClung (1979) states that a shear fracture propagating through a weak layer would travel at roughly one half of the shear wave velocity of the snow layer directly above the weak layer. The density of the snow layer directly above the weak layer was 240 kg/m^3, the fracture should have traveled at approximately 170 m/s. Our measured speed was an order of magnitude slower than expected.

7. DISCUSSION

In 1989, Lackinger proposed that the failure of a weak layer in compression with an area of bending in the overlying slab widening outward could be one mechanism of avalanche initiation and fracture propagation. Our measurements of compression of the weak layer and the fact that geophones on the surface of the snow were able to record this collapse supports the argument that when a whumpf occurs the weak layer fractures and this includes a component of compression. As first noted by Bohren and Beschta in 1973, we believe that the overlying slab does exhibit a wave like behavior that is different from normal compression or shear waves. We believe that a flexural wave propagates in the overlying slab. Flexural waves are quite common in sheets of ice. Wilson (1955) states that any disturbance of a floating ice sheet generates flexural waves in the ice. As the flexural rigidity of the ice sheet increases so to does the flexural wave velocity. The length of theses waves in ice sheets range from 30 m to 300 m.

Our proposed theory is that a compressive fracture occurs in a persistent weak layer, which creates a flexural wave in the overlying slab (Figure 4). Energy is transferred through the overlying slab to progressively fracture the weak layer. This coupled process then spreads outward with the stiffness of the overlying slab controlling the speed of propagation. The speed of fracture propagation measured on February 19th helps to support this theory.

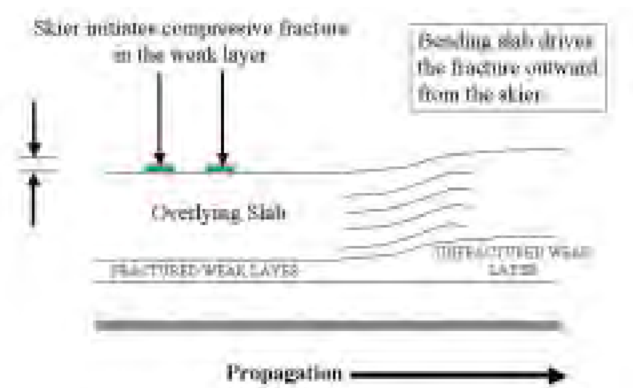

Figure 4. Diagram showing initial collapse of the weak layer. The overlying slab is bent, providing the downward force to progressively fracture the weak layer.

This flexural theory would also account for much greater speeds observed by researchers in Greenland and Antarctica. The weak layers in those cases, were 2-3 m deep indicating a much stiffer overlying slab. This would result in flexural waves propagating much faster than the speed we measured on February 19th. Conversely, in an isothermal snowpack, slower speeds would be expected where the overlying slab has lost stiffness due to warming and free water content.

8. CONCLUSIONS

Data from whumpfs and remotely triggered avalanches were compared to data collected from avalanches that were not remotely triggered. Several important snow pack characteristics were found to be different. In addition to this, the speed of a propagating fracture was measured and found significantly slower than previous estimates for the propagation speed of shear fracture through a weak layer. These two important pieces of information help to support our hypothesis that the failure mechanism for whumpfs and remotely triggered avalanches might be different than for many avalanches that are not remotely triggered. A theory was proposed that accounts for both the compression of the weak layer, and the large difference in observed speeds ranging from 6 m/s to over 300 m/s.

The theory presented here is for whumpfs and remotely triggered avalanches. It is the first theory to explain fracture propagation in weak layers through horizontal terrain.

9. WHAT DOES IT MEAN?

For the avalanche practitioner the most important piece of information in this paper is that whumpfs and remotely triggered avalanches are associated with weak layers consisting of surface hoar, depth hoar or facets. If a persistent weak layer exists in the snowpack, we must keep the danger of a remotely triggered avalanche in mind. While skier-triggered avalanches can occur shortly after a weak layer is buried, our data indicate that whumpfs and remotely triggered avalanches are delayed for some time after a persistent weak layer is buried. The average weak layer age from our data set is 19 days old, with the earliest event occurred 7 days after burial. The timing of this delay is most likely related to the overlying slab properties.

This paper has offered a theory for these events, but more importantly creates more questions that could be answered with careful experimentation. If the failure mechanism were correctly understood, then forecasting for these types of events would improve.

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SLEDHEADS

Educating Snowmobilers

It became apparent during the International Snow Science Workshop (ISSW) in Big Sky in October that some of the participants had problems with snowmobilers, or as I prefer to call them sledheads. I have been to the past three ISSWs and have never felt that I didn't belong, until the first session on Monday morning this year. I have been a sledder for 30 plus years, mountain riding for 14 years and teaching avalanche awareness to other sledders for eight years.

This article will not answer everyone's questions, but hopefully it will create a little insight to how I address backcountry sledders.

Some educators have a tough time with this group, mainly because they don't understand the sport. What is your political motivation towards these people? If it's negative do you think they won't pick up on that? Act as a professional and you will gain their trust and respect through your respect for them. These people will take what they are taught at a course and adapt it to their sport. Be sure that what you teach them can be adapted.

Humans tend to be reactive to problems instead of proactive.
People have been riding sleds for more than 40 years, but it's been in the past 15 years that a trend has started to appear with avalanche involvements. Why the change? All we have to look at is the machine: older sleds had poor traction, poor suspension and overall poor reliability. We used to have a hard time even on flat land! The manufactures have come a long way. Long travel suspension, long tracks with two-inch paddles are as reliable as most cars. We use to sit on top of plateaus and dream of going into certain areas (no mans land) that were inaccessible because of our sleds. Today if you want to go, the possibilities are endless, as is the potential for problems.

We already know that the sled will take us were we want to go, never asking if we should be there. If you take a few seasoned mountain riders and put them on the newer sleds, the places they can go are truly astounding. And for some of us, downright scary. Some might think what they are doing is careless and they shouldn't be doing it. Most of the time, we only need to explain that with a slight modification to their riding style they can be a lot safer. Even when they're doing five things wrong, if we can help them make it only four, we've decreased their risk.

Risk Management

Many groups will have lunch in a terrain trap while watching friends highmark a wind loaded slope two or three or four at a time right after a storm. Makes the hair on your neck stand up, right? Here's the kicker: no matter what we say they will continue to do this.

#1) Get the people at the bottom of the hill or in the terrain trap into a safer area. Explain why and always use a worst case scenario.

#2) Highmarking is part of the deal, so don't tell them not to do it, but to do it in a smarter and safer way. Go one at a time so only one person is exposed to danger while all other eyes of the group are watching. If someone gets stuck on the slope, they are on their own. This happens too often. They should have their own gear. So get out the shovel and start digging.

#3) Windward, leeward, wherever the most snow is, that is where you will find them. Trees, rocks and convex rolls are nothing more than targets to get up and around.

These are the risky spots that people need to be made aware of.

#4) Wait after a storm? *NEVER!* Someone else will get all the fresh snow and you'll be riding on someone else's tracks. Review the dangers of storm snow.

Keep at least one person in the group in visual contact at all times. The person in the front is responsible for keeping pace so the person behind doesn't fall back. No exceptions, that person behind you will save your butt if things break loose. Most are afraid of burial but what if there is an injury? Are they prepared to handle emergencies? Very few carry first aid and survival gear.

Have the group check their gear before they leave home or the hotel. I knew a person that forgot his transceiver in the hotel, and later in the day he was buried under less than two feet of snow, alive and uninjured. His body was recovered the next day. In another instance, a woman with a transceiver was buried, but the person left on the surface forgot his. The clock was ticking, and luckily there was a well-equipped group close by. They did a quick search and had a live recovery.

Always park beside, never in front or behind, another sled. If you need to get away quickly you don't want a traffic jam. And when you're stopped, always turn the key on and have the kill switch up so with one pull you're ready to go. In a panic situation you may forget to do this, so always do it when you shut it off.

The safest routes are a tough call on a sled. If there seems to be only one choice and it's dangerous, make it as safe as possible and go one at a time.

I urge anyone dealing with sledders to get a copy of *Sledding in Avalanche Terrain* by Bruce Jamieson and myself (available from the Canadian Avalanche Centre (250) 837-2435).

Special thanks to Faerthen Felix AAA, for without her encouragement this would not have been written.

Darcy Svederus/ SnowTec Services
Email: snowtec@telusplanet.net

Highmarking incident…
are you ready?

Photo courtesy of
Dusty Veideman, Photo House

SNOWMOBILING

Catching air near Valemount. Yeeha!

Photo courtesy of Tony Parisi

It used to be that sledders were ignorant of snow conditions and instability. As you probably know, many never even wore beacons. Those days are long gone!

Groups of independent long-time sledders now hire guides, not only to discover new areas and to learn how to safely do 'tricks' with their sleds, but to learn about snow and avalanche awareness.

We know of one case where two sledders were buried in the early instability, and we know of a dozen or more very close calls with sleds early this season. Some of these guys have horseshoes up their butts!

If it wasn't for the power and floatation properties of a snowmobile, burials in recreational snowmobiling might be even more alarming.

There are three fundamental safety practices (habits) that sledders need to remind themselves of in order to prevent multiple burials:

1 - *Make observations and be aware!*

2 - *Be able to identify aspect and terrain. Never park in an area exposed to avalanche danger, and especially not in a terrain trap!*

3 - *When instability exists, or when facing the unknown, only one sled on the slope at a time. Be certain that the sled on the slope is clear of danger before the next sled goes!*

Submitted by:
Tony Parisi
Snowfarmers Guide
Valemount, B.C.

Sledders doing a mock probe search during a RAC course in Westcastle, Alta.

Photo courtesy of Lori Zacaruk

CARDA

The Canadian Avalanche Rescue Dog Association (CARDA) held its annual General Training and Validation course on Whistler mountain. during the second week in January 2001. In attendance were 25 teams from B.C., Alberta, the Yukon, Washington, and Utah. There were also two observers from California, and a prospective handler from the Interior who was there to audit the course. The teams were at a variety of levels of training, ranging from beginners to advanced. The beginner teams had all been recommended to advance to our winter program after being assessed at the spring training session held in Knutsford, B.C. last May. The intermediates had either successfully completed the beginner phase of training last year and were at this course to continue with more advanced training and to make a validation attempt, or they were relatively new to the program and were there to continue training and to revalidate. The advanced teams, all seasoned handlers, here in attendance to revalidate and be challenged in more complex searches and multi-dog search scenarios. There were also a few seasoned handlers retraining with new dogs.

The calibre of new teams in the program was observed to be higher than ever. This was partially due to the success of our summer program in Knutsford. The dry land search training there has not only served to weed out any canines that were 60 per centers, but it has also enabled the teams to benefit more from their first on-snow training course. We have also enjoyed considerable success in attracting new handlers (with a high level of ski mountaineering skills) to the program.

We now have a total of 32 operational teams and an additional eight teams in training.

The first live recovery that Robin Siggers and his dog had in Fernie in December certainly generated considerable excitement within our organization, as well as a renewed level of enthusiasm. Through the years we had come oh-so-close on a number of occasions, and finally the moment arrived. Emotions were certainly running high for quite a few of us who have stuck with this profile for a number of years and endured the emotional highs and lows that are inevitably encountered while working in it. The motivation to continue with ongoing training and make the personal sacrifices that come with being a volunteer search and rescue doghandler will likely be easier for many of us to find now that we have overcome this hurdle.

From the executive and from the general membership of CARDA, our hats are off to Robin and Keno, and here's to number two!!

Anton Horvath
President, CARDA

CARDA teams at Whistler

FIRST LIVE FIND!

CARDA DOG SAVES A LIFE

It started out like any other day at the office, skiing powder, checking things out. It was the day before opening day at Fernie Alpine Resort. Traditionally, all of the staff skis this day to allow a warm up and shake down of the mountain systems before the mad rush of opening day.

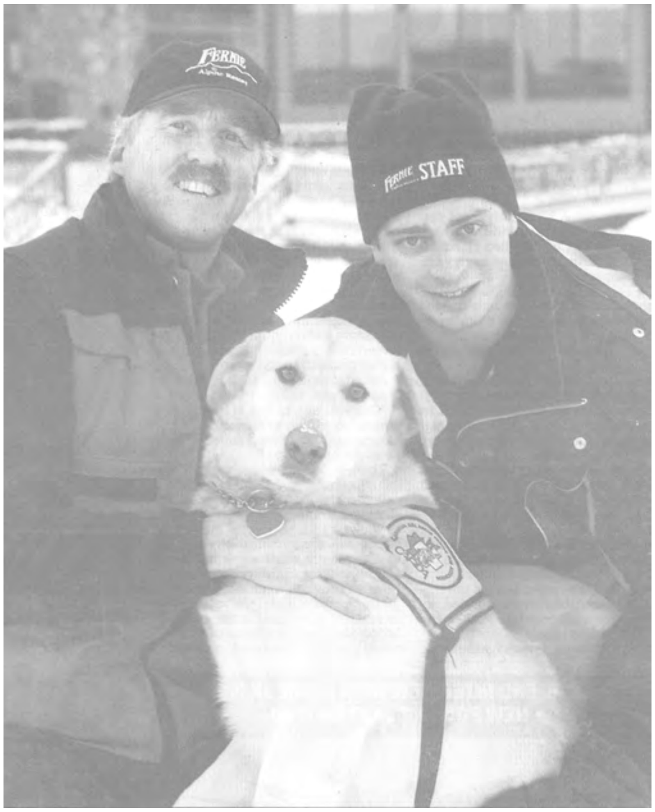
This is not a normal year or a normal snowpack. We were going to open with less than a metre of snow, which is unheard of. Due to these confounding conditions only one side of the mountain was open to staff. The Timber Side was left for the patrol to continue erecting closures for much of the area due to avalanche conditions that were not responding to normal blasting techniques. Lift operators were taken up to tour the designated safe route for use while working in the area because closure signage was still being placed.

At 12:24 there was a chilling radio call: “Avalanche, Avalanche Gun Bowl confirmed burial no transceiver bring the dogs.” My blood ran cold. I was below the accident site; Keno my CARDA dog was in the base area. I knew I was at least 15 minutes away from the site and one of our staff was dying in an avalanche. The ski area avalanche rescue plan was immediately put into effect. Keno was picked up in the base area and rushed to the scene by snowmobile while I boarded the chairlift that would take me back up to the site. It was the longest chair ride of my life as we rode directly over the burial site. I could see where the last seen point was and talked to the two patrollers who had witnessed the event and were frantically probing the relatively small deposit. It is frightening when you see how small a person under the snow becomes in an area of about 50m X 50m.

By 12:39 I’m on site with about 12 patrollers and Sue Boyd with her dog Jasper. Keno arrives shortly after. Sue and I split the deposit in two and put the dogs to work. Keno systematically sniffs everyone on the site then goes to work.

It’s a chaotic scene, people are probing like mad, a false strike then the shovels are out and the snow is flying everywhere. I’m watching my dog but also the shovellers. I look back at Keno and he is ragging a glove. Whose glove is it? No one knows. I dig down where Keno pulled out the glove. I find a limp hand about 30 centimetres below the surface. My God, it’s been at least 20 minutes. I use my hands to dig down. Shovellers crowd around and the snow is flying. We follow the arm down to his face. Breaking through the ice lense around his face, I pull the snow away and get to say the words I’ve been waiting to say for 10 years as a dog handler. He’s alive! He’s alive!

Robin Siggers



Robin Siggers, Keno and Ryan Radchenko
Photo courtesy *Calgary Sun*

MEC Display

This display was set up at the Vancouver Mountain Equipment Co-op. Just another step in the promotion of Avalanche Awareness. It was up for a three-month period and received positive feedback from the staff and the public.

Thank you MEC for your continuing support!

Mountain Equipment Co-op display Photo courtesy of Marie Kennedy

RECREATIONAL AVALANCHE COURSE (RAC) IN

GASPE PROVINCIAL PARK, QUEBEC

Ste-Anne-des-Monts, Québec, January 9, 2001 - The Centre d'avalanche de la Haute-Gaspésie (CAHG), together with Destination Chic-Chocs (DCC) and the Société des établissement de plein air du Québec (Sépaq), held Recreational Avalanche Courses on January 4 - 5 and 6 - 7, 2001 in Gaspe Provincial Park, Quebec.

A total of 16 people took part in these courses. They are CAHG and DCC staff involved in operations in mountainous terrain for avalanche study, guided activities, ski patrol and baggage transportation for hut-to-hut ski expeditions. For this event, the CAHG hired an avalanche professionnal who has worked for 20 years as a park warden in Banff National Park. The choice of Marc Ledwidge as the intructor for this course was justified by his fluency in French and his professionnal qualifications as member of the Canadian Avalanche Association (CAA), the Association of Canadian Mountain Guides (ACMG) and the International Federation of Mountain Guides Associations (UIAGM).

In order to follow the CAATS training program, a RAC course is an essential starting point prior to embarking on professionnal training. In March of this year, the CAHG will also have a person attend a CAATS Level 1 at Lake Louise. Furthermore, in the coming years, the CAHG and DCC aim to have four to six Level 1 graduates among their guides and ski patrollers working in Gaspe Provincial Park.

For the MRC Haute-Gaspésie, which is in charge of the Haute-Gaspésie Avalanche Centre Project since September 1999, this RAC course is the first step in order to reach the objectives of reducing snow avalanche impacts on human activities in Quebec by improving public safety and training avalanche experts in the province.

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QLCT TEST

A Quantified Loaded Column Test Method

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(The following article has been excerpted from the paper presented by Landry, Borkowski and Brown at the International Snow Science Workshop held at Big Sky, Montana, in October 2000. I have added explanatory comments [in brackets] where needed. The complete article, including discussions of the QLCT's mechanics, and side-by-side trials of the QLCT and shear frame conducted at Rogers Pass in March, 2000, will be published in the *Proceedings of the ISSW 2000* later this winter.)

Introduction

Development of this "quantified loaded column test" (QLCT) method began with the assumption that, for avalanche forecasting purposes, stability tests of snowpacks under the influence of down-slope creep forces are superior to tests of snowpacks subject only to vertical settlement. The challenge has been to develop a test apparatus for use on sloping study sites and capable of testing weak layers at any depth.

Accordingly, the QLCT measures the rapid, vertical load required to induce brittle shear fracture at the weakest slab/weak layer boundary within an isolated column of snow. The surface area tested has been calibrated to provide insight to the observer about the magnitude of precipitation loading required for shear fracture. [The QLCT utilizes 25 mm of snow water equivalent (SWE) as a form of standard unit for calculations, as explained below.]

Föhn (1987) conducted studies of the size effect [resulting from using different-sized shear frames] when determining snow strength [at the equivalent scale of a slab of "infinite" area]. A least squares fit [to his data set] would yield the equation:

$$C = 15.95A^3 - 13.25A^2 + 4.029A + 0.526 \qquad (1)$$

where C is the correction factor, and A is the cross-sectional area of the test apparatus. [Size-corrected] QLCT test results (in N/m^2) are used to compute a stability index ratio [comparing the strength of the weak layer to the shear stress produced by the "in-situ" overlying slab].

Test Design and Equipment

One of two nominal column surface areas are used, based on the snowpack strength: 0.08 m^2 (where 25 mm of H_2O over 0.08 m^2 = 2.0 kg) and 0.04 m^2 (25 mm of H_2O over 0.04 m^2 = 1.0 kg). Plywood 'load plates', 9 mm thick, with a tapered shape (toward the back of the column, to prevent binding at the column sides), and a recessed "dimple" at the areal center, are used to define the sides of a vertical column. The 0.08 m^2 load plate weighs 0.50 kg and the 0.04 m^2 load plate weighs 0.25 kg.

Compact Wagner-brand model FDK-10 and FDK-40 mechanical force gauges, with ranges of 0.5 to 5 kg and 2.0 to 20 kg respectively, are used to measure the vertical loads applied to the isolated snow columns at the areal center of the load plates. This combination of gauges and load plates provides adequate overlap to cover most test conditions.

The Life-Link brand snow saw is preferred for its thin kerf, resulting in the least disturbance.

Candidate weak layers are identified in the course of normal snowpit procedures. Then, one or two preliminary QLCTs are conducted to confirm the weakest weak layer and the appropriate mode, plate, and gauge configuration for subsequent tests. These preliminary test results are not used to compute final results.

Surface Mode Test Procedure

Surface mode is used for tests of weak layers within ≈30 cm of the snowpack surface. A load plate is placed on the snowpack surface and to prevent it from sliding down slope, the plate is tethered with a roller bearing assembly [shower door bearings on a split d-ring, attached to a swivel snap hook] to an MSR-brand 90 cm mountaineering 'snow picket', installed vertically, immediately uphill of the load plate. The load plate itself

QLCT "surface mode", showing the 0.04 m^2 load plate tethered to the snow picket and the force gauge positioned at the areal center of the load plate, ready for vertical load application.

provides a template for the vertical saw cuts used to isolate the snow column. First the column sides are cut, then the front face, and the back-cut is made last. [A second cut outside the "contained" side of the column, releasing a wedge-shaped column of snow, may also be made so long as the column is not intersected or disturbed.] With practice, a skilled observer can assure that the surface area of the slab/weak layer boundary being tested within the column is equal to the surface area of the load plate. Generally, the 0.08 m^2 load plate is employed in surface mode.

In surface mode the observer uses the appropriate force gauge to manually apply vertical force at the areal center of the load plate. During the test the load plate compresses low-density snow near the surface but is held over the column by its roller-bearing tether to the snow picket behind the column. Load-time to shear fracture is, nominally, 1-2 seconds. Although observer skill may be significant in surface mode tests, consistent results are possible. [The "skill factors" involve learning to maintain a true vertical load and learning to stop the load as soon as the shear fracture occurs. The development of a more sophisticated surface mode test apparatus could, potentially, reduce the variability introduced by different observers.]

Bench Mode Test Procedure

"Bench mode" is utilized for more deeply buried and/or stronger weak layers [when disintegration of the top of the snow column makes surface mode ineffective].

QLCT "bench mode" test following shear fracture in buried surface hoar. The 0.04 m^2 load plate is shown.

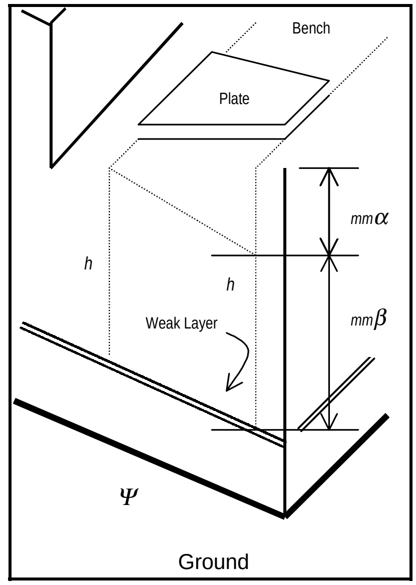
A 50-cm wide horizontal shelf is prepared removing surface, lower-density snow, the load plate is placed on this level surface, and the sequence of vertical saw-cuts are made to isolate the column.

In bench mode the surface area of the weak layer boundary being tested is larger than the load plate surface area. That difference in surface areas is a function of slope angle and is accounted for in the calculation of the test result. The height of the bench above the weak layer, measured on the vertical pit face, is held constant in each test, as is the position of the load plate behind the front edge of the bench. [A flat and plumb pit face is essential during bench mode.]

In bench mode, the force gauge is installed in a PVC bracket that slides freely along the round tubing handle of a specially designed flat-bladed "shovel". With the tool handle parallel to the snow bench, and the force gauge placed vertically above the areal center of the load plate, the flat blade is inserted into the snow wall behind the bench. With the tool blade thus "anchored", the tool handle provides the observer with extra control and leverage during loading. If all "4-finger" or softer snow is removed above the bench, minimal column distortion or destruction occurs. Load-time to shear fracture is, nominally, 1-2 seconds.

Calculating bench mode test results requires measuring H_2O_{Col}, the water equivalence of the column remaining between the weak layer and the load plate, as shown in the figure to the right. This is performed in a two-step procedure using a Snowmetrics-brand snow sampling tube.

First, a [smooth and plumb] "work chimney" is prepared at the left end of the bench [and perpendicular to the pit face]. The load plate is placed on the bench, slightly overhanging the chimney, at a fixed "setback" distance of 5-10 cm from the front edge of the bench. The vertical distance from the back edge of the load plate down to the weak layer is used to measure up vertically from the weak layer at the front edge of the load plate to locate the third vertex of a triangular wedge of snow immediately below the load plate. A crystal card is inserted horizontally at this third vertex. The plate is moved aside and a vertical sample core is taken down to the card, centered on the plumb line marking the front edge of the load plate. The slight error introduced by the non-perpendicular intersection of the sample tube with the stratigraphy at the bottom of the sample core is accepted. The water content of this sample $mm\alpha$ is divided by 2 since this represents exactly one-half of a parallelogram-shaped volume of snow bisected by the bench surface.



Components of bench mode H_2O_{Col} *measurements,* $mm\alpha$ *and* $mm\beta$.

Then, with a horizontal crystal card inserted where the plumb line drawn down from the front edge of the load plate intersects the weak layer, a second vertical sample is taken directly below the first. This measurement $mm\beta$ represents a "whole" volume of snow in the column, and is used at face value. The adjusted value for the first sample is added to the second measurement $mm\beta$ yielding a total water equivalence [in mm] of the column, as:

$$H_2O_{Col} = \frac{mm\alpha}{2} + mm\beta \qquad (2)$$

Sample Number and Quality

Currently, for routine sessions, 10 QLCTs are performed in a grid of two cross-slope rows of five tests each. A 4-m cord is used to mark, perpendicular to the slope's fall-line, the location of the pit face on the snow surface before excavation. Within each row, tests are spaced 50 cm from column-center to column-center, and the center-line of the second row of tests is set 100 cm (as measured horizontally) directly uphill of the center-line of the first row. Thus, the sixth test is performed directly uphill of the first test.

Tests resulting in "Q1" (unusually clean and smooth shear) or "Q2" ("average" shear, mostly smooth) planar shears are deemed valid. Non-planar "Q3" (uneven, irregular, or rough) results are typically

logged as “no shear” (Johnson & Birkeland, 1998). In cases of very low-density “slabs” over a weak layer (such as a density change within a new layer, or a slab over depth hoar), “collapse” results are common and, if consistent in location, are considered valid tests.
[A second QLCT paper containing a more comprehensive discussion of sampling, and the number of samples required to achieve some desired level of precision, is now in review with *Cold Regions Science & Technology*.]

Stability Index Calculations

QLCT result calculation procedures differ according to the test mode employed. However, both procedures generate the same end-product, expressed as the stability index:

$$S_{QLCT} = \frac{\tau_\infty}{\tau_{Slab}} \qquad (3)$$

where τ_∞ is the C [size] adjusted total shear stress at shear fracture (equation 1) and τ_{Slab} is the shear stress at the boundary between the in-situ slab and weak layer.

Surface Mode τ_∞ Calculations

Calculating τ_∞ for surface mode tests begins by converting the sum of the mean maximum vertical force applied through the force gauge and the load plate weight W_p into its water equivalent. For example, using the 0.08 m^2 load plate, where 2.0 kg of vertical force is equivalent to 25 mm of H_2O, and the load plate weighs 0.5 kg:

$$\text{Ex: } H_2O_{Test} = \left(\left(\overline{P} + 0.5\right) \div 2.0\right) \times 0.025 \qquad (4)$$

The vertical measurement H_2O_{Test} [in metres], with a density of 1,000 kg m^{-3}, is used to determine the increment of shear stress, τ_{Test}, producing shear fracture:

$$\tau_{Test} = \left(1000 \times H_2O_{Test}\right) g\, Sin\Psi\, Cos\Psi \qquad (5)$$

Next, the in-situ shear stress created by the slab itself is added to obtain total shear stress τ_{Total}:

$$\tau_{Total} = \tau_{Test} + \tau_{Slab} \qquad (6)$$

In surface mode the weak layer surface area being tested is the same as the load plate area. Applying area correction factors (C = 0.667 and C = 0.771 for the 0.04 m^2 and 0.08 m^2 load plates respectively) to τ_{Total}, yields τ_∞, as follows:

$$\tau_\infty = C\left(\tau_{Total}\right) \qquad (7)$$

The S_{QLCT} index can now be calculated using equation (3).

Bench Mode τ_∞ Calculations

Because the horizontal load plate’s shape is projected vertically onto a sloping stratigraphy, the surface area of the slab/weak layer boundary being tested is larger than the surface area of the load plate and loading is diffused in proportion to slope angle. QLCT reference tables [see References] provide “angle factor” ($\angle_{Factor}$) multipliers for the ratio of mm H_2O per kilogram force P at a given slope angle. The mean vertical force measured at shear fracture, plus the weight of the load plate W_p, are converted to mm H_2O by this factor. Then, H_2O_{Col}, the measured water equivalence in the snow in the column, is added, and their total is converted to meters to find H_2O_{Test} as follows:

$$H_2O_{Test} = \frac{\left(\left(\overline{P} + W_p\right) \times \angle_{Factor}\right) + H_2O_{Col}}{1000} \qquad (8)$$

The vertical measurement, H_2O_{Test}, with a density of 1,000 kg m^{-3}, is used in equation (5) to determine the increment of shear stress τ_{Test} producing shear fracture. Because the computation of τ_{Test} for bench mode incorporates the shear stress produced by the snow within the column under the load plate:

$$\tau_{Test} = \tau_{Total} \qquad \text{(bench mode only)}$$

No further adjustment is needed.

Slope-adjusted correction factors C are listed by plate size A and test site slope angle ψ in the QLCT reference tables [see References]. To find τ_{∞}, τ_{Total} is adjusted using equation (7) with the appropriate, slope/ plate-specific value for C.
The S_{QLCT} index can then be calculated using equation (3).

Closing Thoughts on the QLCT

The QLCT remains an experimental stability test and can certainly benefit from continued analysis of the method and development of the apparatus. For instance, the variability introduced by observer skill is an obvious target for further evaluation, pending the training of additional users. The correlation between QLCT results and Rutschblock, compression test, and stuffblock scores also warrants study, along with continued trials comparing the QLCT to shear frames (as performed during 1999/2000 and discussed in the ISSW 2000 paper). Pending additional funding, concepts for further development of the apparatus could be built and tested to determine whether the variability is reduced or, instead, the "human touch" is sufficiently reliable in surface mode.

At present, our application of the QLCT focuses on measurements of stability at carefully selected study plots. We hope to evaluate the variability of stability within study plots (of 30m by 30m size) and the strength of correlation in stability between study plots spread throughout an "avalanche region" and having the same elevation, aspect, and "position", relative to adjoining avalanche terrain. Our intent is to present those findings at ISSW 2002, in Penticton.

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QLCT Reference Tables. Because of their length, these are not reproduced here. Please e-mail or write to Chris Landry for copies of these reference tables and for other QLCT worksheets at clandry@imt.net, or 1611 W. Koch #19, Bozeman, MT, USA 59715.

Acknowledgements

Thanks to my Montana State University advisors John Borkowski and Bob Brown for co-authoring the original QLCT paper for ISSW 2000 from which this article was extracted. Also, special thanks to the Canadian Avalanche Association and the American Avalanche Association for their generous financial support of the most recent development of the QLCT and the larger research effort using the QLCT to investigate the objective extrapolation of study plot stability to avalanche starting zones.

NOTICE OF PROCEEDINGS:

AVALANCHES AND RELATED SUBJECTS

II INTERNATIONAL CONFERENCE
Sept 3—Sept 7, 2001

Kirovsk, Murmansk Region, Russia

"The contribution of theory and practice to avalanche safety"

Centre of avalanche safety of "APATIT" JSC

33a 50 Years of October, St
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Tel: 00 7 81531 96230
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Email: p.chernous@apatit.com

We encourage members to submit articles, pictures or announcements for future issues of *Avalanche News*

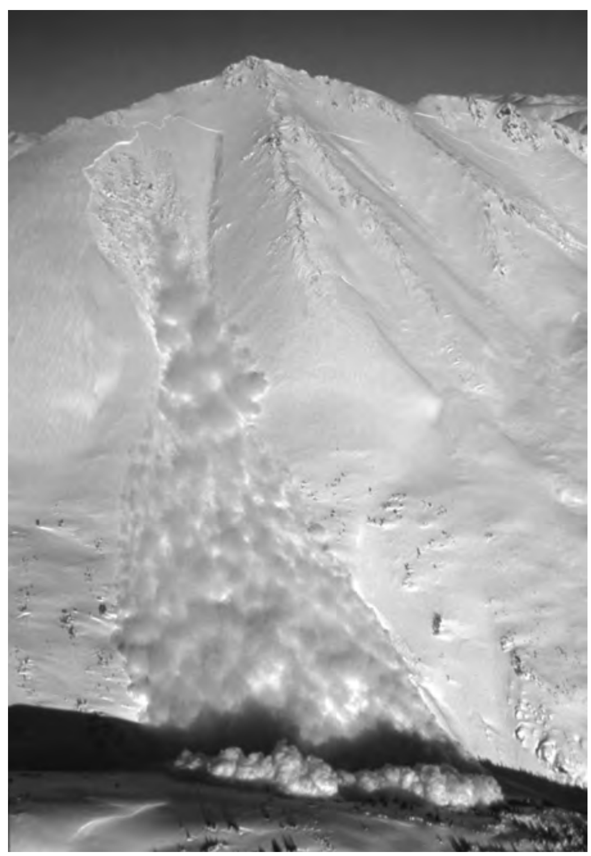

Photo from CAA archive

January 10, 2001

Clair Israelson
Managing Director
Canadian Avalanche Association
P.O. Box 2759
Revelstoke, B.C.
V0E 2S0

Dear Clair:

We at Columbia Brewery are delighted once again to show our support for the Canadian Avalanche Society with our donation of $10,000.00 for the 2001 fiscal year.

We would like to take this opportunity to commend you on the invaluable work your organization has been doing to educate the public about avalanches and help save lives, and to wish you all the best in your upcoming endeavours.

Sincerely,

Paul Smith
Director of Public Affairs

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EXPLOSIVE COMMITTEE REPORT

STAR Safety Fuse Assemblies

There have been several reports of fuse failures with old stock Star Safety Fuse Assemblies since the winter began. Apparently, some fuses have stopped burning just before the detonator, and some fuses have gone out after burning for several seconds. There have even been reports of duds with shots that have been double fused. Everett Clausen of CIL – Orion has been made aware of these problems as they have occurred. Although it is difficult to determine exactly why the fuses failed, it is speculated that it is the result of temperature cycling, or moisture intrusion. So far, all of the failures have occurred in older stock fuse. **There have been no reported problems with the most current version of Star Fuse Assemblies which come packaged in the tri-laminate heat sealed bags**.

As a preventive measure against fuse problems, CIL-Orion has suggested that agencies purchase seasonal amounts of fuse assemblies only. This will ensure fresh stock from one season to the next.

For agencies who have experienced problems, CIL-Orion has offered to replace any old fuse stock with those most recently manufactured, which come packaged in the heat sealed bags.

Fuse Cutters versus Fuse Crimpers

Over the years, I have heard from several individuals that the cutting device on a fuse crimper was never intended to be used to cut fuse assembly. The reasons varied, but the one which appeared to make the most sense came from George “Bitumen” Hafke (Federal Explosives Inspector). George argued that a dull cutting surface could actually drag the outer jacket of the fuse (including bitumen of course) over the powder train and prevent the igniter from lighting the fuse. As I had always used crimpers to cut fuse, and wasn’t even aware that anything else existed specifically for that task, I never took the recommendations too seriously.

The time has come to take this recommendation seriously. Apparently, there are in fact tools designed specifically for cutting fuse. They are lightweight, compact, and very sharp. Henkel (the Knife Company) makes a fuse cutting tool that resembles a pair of garden shears. It has a pointed (powder punch) handle similar to the crimper tool so that a cavity can be made in stick powder for a detonator.

CIL-Orion has recommended that these new cutting tools be purchased rather than crimpers. The Henkel fuse cutter is less expensive than a pair of crimpers and can be obtained by calling Everett at (450) 566-0655.

WCB Avalanche Blasting Exam

Candidates who wish to write the exam should meet the requirements for certification as per WCB Regulation 21.8 (book 3). The letter of recommendation is a vital part of this process and must factually reflect the candidate’s character, knowledge, qualifications and experiences.

Although we have yet to receive confirmation from WCB, it may also be a requirement for anyone who wishes to write an avalanche blasting exam that they have a minimum certification of a CAA Level 1 course (in addition to qualifications as cited in reg 21.8).

WCB avalanche blasting exams are multiple choice with an option of four answers (A,B,C or D), or a selection of ALL or NONE, or TRUE or FALSE.

The format of the exam is as follows:

- There are approximately 80 questions to test for knowledge of WCB and Federal Explosives Regulations that deal with Transportation, Storage and Handling of Explosives

- There are approximately 20 questions to test for knowledge of snow and avalanche phenomenon

Both of these sections must be written by the candidate.

Depending on the type of endorsement desired, the following options are available (each of the following sections has about 15 – 20 questions):

- Helicopter Bombing
- Avalauncher
- Hand Charging
- Cornice Control
- Case Charging

Anyone who writes the new exam and wishes to provide feedback, please contact me, or anyone from the Explosive Committee. There has been a considerable amount of effort made to improving the wording and format of the exam. Although it is likely a more challenging exam, all who have been involved in this process believe it is a step in the right direction. My thanks to all who participated in the process!

Avalanche Control Procedures

One of the primary initiatives of the Explosive Committee is to draft up procedures for various types of control. A draft version is being prepared and will hopefully be ready for presentation and discussion by the spring meeting.

If anyone has any comments or question about any of these issues, feel free to contact me at (250) 387-7514 (wk) or (250) 478-1076 (evenings).

Mike Boissonneault, Chair

Committee Members
Bernie Protsch
Colani Bezzola
Brian Johnson

Photo from CAA archive

Advanced Avalanche Hazard Mapping Course

The Canadian Avalanche Association, the National Search and Rescue Secretariat (NSS), and sponsor Parks Canada have initiated a project to develop or retire standards for snow avalanche hazard mapping (AHM). The project is part of the NSS New Initiatives Fund, which is intended to improve accident prevention and response. Avalanche hazard mapping standards are an incident prevention initiative.

The objectives of the project include:

- A Technical Guidebook for Avalanche Hazard Mapping in Canada, with recommended standards for identification and delineation of hazardous zones
- A non-technical Guide to Managing Avalanche Hazards in Canada, to assist land managers, land use planners and developers in identifying where a hazard may exist and recommendations for how to proceed with a professional assessment
- Development and staging of training course for professionals in Avalanche Hazard Mapping

The AHM project began during fall 2000 and will continue until summer 2002. The project team includes Peter Schaerer, David McClung, Bruce Jamieson, Chris Stethem, Janice Johnson, Larry Turner and Art Mears.

The Avalanche Hazard Mapping Course will be held in June 2002. The course pre-requisites include:

A. Successful completion of:

- Level 1 CAA Avalanche Safety Course (Operations or Transportation & Industry) or equivalent.
- CAA Introductory Avalanche Mapping Course or equivalent training in map and air photo interpretation in mountainous terrain.
- University or university transfer level introductory courses in:
  - Probability & Statistics
  - Calculus
  - Physics

  (Prior learning assessments of equivalent learning may be possible).

And

B. Four years of work experience in **either**:

- Avalanche safety operations **or**
- Planning, engineering, forestry, geoscience, geography or related fields, for the winter mountain environment.

Chris Stethem
Project Manager

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