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AVALANCHE TRANSCEIVER RECOVERY SKILLS

TIPS AND TRAPS

1. Range Awareness.

- a. Each day carry a visual image of the reception range applicable to your group.
- b. Pay attention during the transmit and receive tests conducted when your group first sets out in the morning. The range of the weakest transceiver in the group establishes the range margin for the day. If one transceiver has a particularly short transmission range during the morning test, replace its batteries or the unit itself. One weak transceiver compromises the entire group.
- c. Rely on the range margin when you are conducting a search. For example, if the weakest unit in the group has an effective transmit range of 30 feet (when out of orientation), apply this information in your search grid. Therefore:
 - i. Don't ski to the absolute perimeter of the slide path. Make your turn and reverse direction 20 feet or so short of the perimeter.
 - ii. Keep the base of your zig-zag triangle less than twice the range margin (e.g., with a range margin of 30 feet, make sure your traverse tracks stay within 60 feet of each other).
 - iii. When multiple rescuers are conducting straight fall line patterns, keep rescuer spacing to less than twice the range margin.

2. Reception Strength Setting.

- a. While in transmit mode, always ensure that your reception strength dial has been left at maximum strength. Get into the habit of confirming periodically the setting of your reception strength dial. This point is applicable especially to the Ortovox F-2, where the transmit/receive switch is independent of the reception strength dial.
- b. If an emergency occurs, and you switch hastily to receive to begin a search, don't handicap yourself by also having to remember to turn your reception strength dial to maximum range. Reflect on the consequences if you forget this point: your partner is buried; you switch to receive mode to locate her (remembering from your CPR class that you've got about 4 minutes); and when you get to the bottom of the slide path without picking up a signal, you realize that your reception strength dial has been set at minimum strength throughout the initial search.

3. Search Pattern.

- a. Pick the most efficient search pattern based upon what you observe at the slide path and what you know about the range margin for your buried partners.
- b. Considerations:
 - i. If the slide path is narrow (less than twice the range margin), do a fall line search in the center. Don't waste time with the zig-zag pattern.
 - ii. If you have a last seen point for the trapped skier, start your search at that point, and do a fall line pattern below this point. Don't waste time with the zig-zag pattern.
 - iii. If you have a surface clue (hat, pack, ski pole, etc.), do a fall line search above and below this clue. Don't rely on a ski as a clue. A detached ski may ski itself out of the fall line course of the victim.
 - iv. If you have multiple rescuers so that adjacent fall line patterns can be conducted simultaneously and cover the entire slide path, don't waste time with any zig-zag patterns.

4. Orientation.

- a. Learn how to orient your unit: rotate through two planes, 90° through horizontal plane, then 90° through vertical plane. 180° rotation is irrelevant; unit is in orientation at both 0° and 180°. When conducting the coarse search, assume that your unit and the buried unit are out of orientation. Your range margin assumption should be based upon this same assumption.
- b. Orient your unit shortly after picking up the first signal. Make a mental note of the orientation relative to the slope (not relative to your own body; your body will be changing direction).
- c. Continually reorient during your fine search. Reorientation may increase the received signal enough to allow you to reduce ("crank down") the signal strength dial.
- d. Remember, an oriented unit does not necessarily point directly to (or directly away from) the victim. The oriented unit is parallel to the tangent of the induction line of the emitted signal. (For accomplished users of transceivers, following the induction line tangent may enhance search efforts, but the traditional grid strategy should be learned first by new users).

5. Eliminate Territory - FAST, FAST, FAST.

- a. If you don't care about your buddy's survival, then take your time. If you want to save a life, though, then **MOVE, MOVE, MOVE!** You need to eliminate territory. Use the transceiver to tell you where you don't have to search. If you have a large slide path, you have a lot of territory to eliminate, and only about 3-4 minutes to do so.

- b. Next to moving fast, the best way to eliminate territory is to **crank down**. Consider the numbers: the Ortovox F-2 shows reception range of 15-35 meters at the highest setting, and 8-15 meters at the next lower setting. For a particular search, assume actual range of 80 feet (13 ski lengths) at the highest setting, and 35 feet (6 ski lengths) at the next lower setting (approximate averages of the specified range brackets). At the highest setting, the rescuer has 25,600 square feet of territory to cover $((80 \times 2) \times (80 \times 2))$; at the next lower setting, she has 4,900 square feet. She has reduced her search territory by 80% simply by cranking down the volume control one stop. Observations:
- i. Always crank down the volume at the earliest moment (as soon as you can do so without losing signal). Orient the unit to increase the chance of seizing a crank down opportunity.
 - ii. Beginners (persons new to transceivers) tend to delay their crank downs. They derive comfort from the strong signal, and try to avoid the ambiguity of a weak signal. Practice is the most effective way of overcoming this handicap. Use your transceiver; get comfortable with it; trust your equipment. Learn to relish the weak signal because it means you are going to be doing a lot less running around.
 - iii. Get used to cranking down while you are on the move. When you first get a signal, classic search strategy says to stop, orient your unit, try a crank down, then begin your fine grid. Don't be stuck in this rut. If you luck out, and your signal strength is increasing in the direction you are traveling (i.e., the buried unit is ahead of you; maybe up or down at an angle, but basically ahead), crank down as you move until you begin to fade. Don't waste time stopping and orienting when your line of travel is producing great results (the MOVE, MOVE, MOVE principle in action).
 - iv. When fishing for a fade point, MOVE, MOVE, MOVE. Beginners, uncertain of their detection of fade points, tend to slow down and degenerate into the "baby step pattern" when trying to perceive a fade. They will shuffle a few steps forward, stop, listen, shuffle a few steps back (skis were never designed to go backwards), stop, listen, then repeat this mistake all over again to try to confirm the subtle change in volume they hear. No! Avoid this pattern! If you think you detect fading, move aggressively, one or two ski lengths (6 - 12 feet). That kind of move will tell you for sure whether your signal is getting stronger or weaker in your present direction of travel.
 - v. Don't "ski backwards." Those things on your feet come with only one end turned up. Do a kick turn. If you don't know how, learn. Get good at it, so that you can do it without poles, and while you are holding a transceiver in one hand.

6. Speeding Things Up - Loudspeakers and Induction Line Tangent.

- a. The new single frequency (457 kHz) transceivers come with some changes that can make the first two phases of your search go much faster.

- i. Based upon range tests we conducted between the Ortovox F-2 (dual frequency) and F-1 (single frequency) transceivers, we estimate a 50% or so increase in the receiving range of the F-1 compared to the F-2. (We didn't notice any significant difference in the transmitting ranges of the two units.) This means you should pick up your first signal from the buried transceiver more quickly, and it should allow the rescuers to open up the search pattern (zig-zag or fall line) affording coverage of the same avalanche area with fewer passes.
 - ii. Most of the new transceivers come with a loudspeaker, eliminating the need for an ear phone. This avoids the frustrating interruptions frequently caused by having the ear phone drop out of your ear. Also, as mentioned below, it allows you to let the transceiver hang from your neck while you ski, freeing up both hands to grip poles and let you ski in a natural stance.
 - iii. It appears that the circuitry of the new transceivers has been modified to be more sensitive to the orientation between the search transceiver and the buried one. This makes it easier (along with the lights and "arrows" that have been added) to detect and determine the line of the tangent to the electro-magnetic induction line being emitted by the buried unit. This, in turn, makes it easier to learn and become competent in the induction line tangent search technique.
- b. During phase 1 of your search (executing your search pattern, listening for that first signal from the buried transceiver), you can leave the F-1 transceiver around your neck, either outside of your jacket or with your jacket open, so you can hear the loudspeaker. This keeps your hands free, allowing a more natural and speedy skiing stance, or to help you move rapidly through the rubble of avalanche debris. The loudspeaker and greater reception range of the F-1s contributes to a faster phase 1 search. It shouldn't have to be said, but we will anyway: make sure your reception strength dial is at maximum volume, and the speaker is aimed out, away from your body.
- c. Phase 2 begins when you get your first signal. The enhanced sensitivity of the new units to orientation with the induction lines means that you can scrap (at least at this stage of the search) the classic transecting-grid-in-search-of-fade-point method. Instead, follow the induction lines.
- i. When you get the first signal, orient your beacon (holding it in the horizontal plane). The signal strength (sound from loudspeaker, lights, arrow) will be strongest in two directions, 180° opposite of each other (this is the tangent of the induction line of the signal from the buried beacon). Head off in one of the directions (if you've done phase 1 properly, the preferred direction should be downhill). If the signal strength begins to fade, kick turn 180° and move in the opposite direction. The signal strength will increase as you move toward the buried transceiver.
 - ii. If the signal strength is increasing, keep moving, as fast as terrain and skiing skills permit. While moving, sweep your beacon in front of you, side to side, 45° to the left, then 45° to the right of your direction of travel. (Don't over sweep the beacon because there is another tangent and strong signal at your back (180°), and you don't want to be misled by picking it up.) The signal will fade to your left, and fade to your right, so keep on truck'n right down

the middle. With practice, it becomes automatic; the sound just sucks you along toward the buried transceiver. This part of the search can be conducted very rapidly.

- iii. Remember - you are following the tangent of a curving induction line, so don't expect to be moving constantly in a straight line. More likely, you'll be moving in an arc. (As always, however, there are exceptions: if the buried transceiver is vertical (perpendicular to the snow surface), your induction line tangents could be leading you straight to the victim, without any noticeable curvature to your line of travel. If that's the case, go with the flow. Don't waste any time being confused by it all.)
- iv. As signal strength increases, turn down the volume. The lower volume makes it easier for many to detect the fading to the left and right of the line of travel. The lower volume will also pay off when you complete phase 2 of the search, and switch into the fine grid pattern of phase 3.
- v. How long do you continue with the induction line method? Easy! For as long as it continues to produce results for you. As you move through phase 2, you will be rewarded constantly by an ever-stronger signal as you pursue your line of travel - until it stops!! At some point, the signal will drop off - not get stronger. This is the end of phase 2 and your induction line journey. Now make the transition:
 - (1) First, don't stop immediately. This could be a fade point, indicating that you have passed beyond the buried unit. But it could also be a null point. For example, if the buried unit is vertical, pointing perpendicular to the surface, you could be right in the null zone where there is no received signal. You could be directly over the victim. To eliminate the null possibly, "punch through" the fade point: continue beyond for another 2 or 3 feet to see if the signal returns. If it does, your fade was not a fade, but was instead a null.
 - (2) If the signal does not return, you have a true fade point. Now start phase 3 with the transecting lines grid. Mark (or remember) this fade point, turn 180°, and move across the slope to your other fade. This is your first bracket; move to the mid-point; orient the unit; and do the next bracket perpendicular to the first.
- d. A comment about the induction line method: In the past, there has been a reluctance to teach induction line technique to beginners. They could get irretrievably confused and blow the whole search.
 - i. Our experience has been the opposite. The beginners take very quickly to the induction line method. They simply move in the direction of the sound. It's natural. Their instincts, their adrenaline, everything is propelling them toward the sound.
 - ii. This is in contrast to the classic grid technique, where everything moves against the novice instinct. You get a strong sound, so you turn it down so you can hardly hear it. Instead of

moving toward the sound, you move away from it, looking always for another fade point. The induction line technique is natural; the grid system is not.

- iii. **BUT**, having said all that, never, never skimp on the classic grid drills. Simply getting close to the victim is not enough; you've got to find her. The induction line method will get you close, but it's the grid that will mark the location. Also, if you get confused, the grid is the only sure way to get unconfused. While the induction line technique is fast, it can frequently lead to confusion. The grid technique is what you need to get bailed out of your problem.

7. **Classic Fine Search Pattern.**

- a. This will be demonstrated by your instructor, but basically it's a series of perpendicular lines of travel (horizontal or across the slope; then vertical or up or down the fall line). Each line of travel is bracketed by a fade point, and the 90° direction change occurs at the midpoint between the two fade points. Reorientation and crank down occurs (or is attempted) at the midpoints, where signal strength is usually the strongest ("usually," because in some instances, the midpoint could be in a null zone, generating little or no signal).
- b. Grid tips:
 - i. Do the horizontal (across the slope) bracket first. It's simply a single traverse with a kick turn at the fade points at each end. Move fast. Don't revisit territory you've already covered. Perhaps you may wish to drop a ski pole or some other (nonessential) object at the fade points to provide a clear demarcation of the side perimeters of the search area. Generally, the horizontal bracket can be accomplished much more swiftly than the vertical bracket (which always requires some climbing up hill).
 - ii. Return to the midpoint of the horizontal bracket. Orient and try to crank down. If you can achieve a crank down, you will save yourself considerable effort (and your victim, considerable time) when you undertake the vertical grid line in search of top and bottom fade points.
 - iii. When starting your vertical grid, always climb up hill first. If the buried unit is above you, you don't want to discover that only after you have dropped down the slope and located the bottom fade point.

8. **Pin Point Search Pattern.**

- a. Usually, you should stay in your skis until you get to the lowest volume control setting. Obviously, there are exceptions. If the victim is buried deep, you may never get to the lowest setting at the snow surface. If the avalanche debris is solid enough to run on, and impossible to ski, you may gain speed by taking the skis off.

- b. When you get your skis off, throw your poles and skis clear of the site. Otherwise, they end up in your way, and the metal bindings (and other ferrous objects) may alter the perceived signal.
- c. Get down on your knees. Take the transceiver strap off your neck (or, if possible, extend the strap to its farthest reach) so that you can make your pin point grid passes with the transceiver right at the snow surface. Continue the same grid, passing the transceiver from hand to hand, both horizontally (across the slope) and vertically (up and down slope). Maintain the unit in a constant orientation as you move from fade point to fade point; avoid an arching sweep with your hand because the orientation will change. Use your free hand to trench out the perimeter boundaries identified by the fade points.
- d. You're trying to localize the midpoints of your brackets to a dig area of approximately 1 to 2 feet square. If the burial is deep (6 feet or more), your final brackets will be more than 2 feet because of the larger volume cone emitted by the buried unit. Punch your fist into the snow to mark the location when it's time to dig.
- e. Sometimes you will have trouble localizing a dig point because of confusing signals.
 - i. If the burial is shallow, and the signal seems strong everywhere, disorient the unit to find the weakest reception orientation. Then repeat the grid listening to the weaker signal.
 - ii. If the buried unit is transmitting dual frequency, when you are very close you may begin to hear the double beep of the two signals (2.275 kHz and 457 kHz). This occurs even with the new F-1 Ortovox single frequency transceivers. Don't be confused by the introduction of this second signal; it's good news, not bad.
 - iii. Be aware of the null zone phenomenon. Depending upon the relative orientation of the buried unit and receiving unit, you may get maximum signals on each side (though within the fade point bracket), and another fade point over the buried unit or near the midpoint of your bracket. Don't be confused. Use the null as your midpoint, either for digging or as the center of your next perpendicular bracket. The null does not mean necessarily that the buried unit is directly below.
 - iv. With the Ortovox F-2 (or other dual frequency transceiver), you may hear a clicking sound from your electronic quartz crystal watch. If you are familiar with this sound, and it doesn't distract you, then ignore it. Otherwise, take the watch off, and get it out of the way. (I stick mine on my head, under my hat).

9. The Schizophrenic F-1s.

- a. As mentioned previously, the Ortovox F-1 units seem more attuned to orientation than their F-2 forebears. That's great during phase two of your search because of the substantial assist it provides in learning and using the induction line tangent method. The orientation sensitivity sucks, however, when you're doing your pin point search.

- i. At this stage, you are on your hands and knees and doing a classic grid search, bracketing fade points with 90° transecting line passes with your transceiver. You would hope that your search unit is broadcasting proximity messages only: strong signal (speaker or lights) means close; weak signal means far. Unfortunately, that's only part of the picture: strong signal also means orientation with the buried unit; weak signal means less or no orientation. Moreover, when close to the buried unit, its electro-magnetic induction fields are curving sharply, so a small movement of the search unit can take you from exact orientation on an induction line tangent (strong signal) to zero orientation (90° out of phase) (weak signal); and the sharp signal discrepancy can occur even when your search unit is more or less equidistant from the buried unit at both the strong and weak signal locations. Title of this document: "*Tips and Traps.*" This is a **TRAP** of major proportions.
 - ii. Conclusion: The pin point search with the F-1 transceiver is a pain in the butt, but your buddy is still buried, so **Deal With It**. Here, hopefully, are some **Tips**.
- b. Travel with probe poles, either the ridiculously expensive collapsible kind, or the male-female mating (also expensive) ski poles. If you have multiple rescuers, keep one on the transceiver search, while the others probe. But, be cautious. Avoid excessive foot traffic in the pin point search area. If your buried buddy has been fortunate enough to achieve an air-pocket around her face, you don't want to be the one to collapse it. If you are the only rescuer, switch to the probe when the transceiver fails to produce a reliable pin point dig area.
 - c. Learn to judge burial depth. Based upon our experience with the Ortovox F-1 Focus: If on the lowest volume setting (2 - 0 meters), you can get a red light, the burial is shallow (not more than 2 feet), so just start digging. If on the lowest volume setting you can't get a red light, but you can get yellow, the burial is probably between 2 feet and 6 feet. The pin point grid and fade point brackets are likely to be fairly wide because of the depth of the buried unit and diameter of the signal volume cone at the surface. Probe poles are useful in this situation: they can still reach the victim and may be more efficient than the rescue transceiver if the transceiver is having problems in locating a precise dig location.
 - d. Lastly, no red light, no yellow ... no **Tips**.
 - e. During the pin point search, you must treat the signals of your F-1 like the words of your wacky, bipolar uncle: honor and respect, but verify, corroborate and confirm. Conceptually, the task is to neutralize the orientation signal of the rescue unit so that you are dealing only (or principally) with the proximity signal. Here are some ways we have discovered that work, sometimes:
 - i. Repeat your grid passes. Hold the rescue unit horizontally, pick an orientation, and make a pass in search of the fade points. Then repeat the same pass, but with the horizontal unit rotated 90°. If the midpoint of the two passes is at the same location (more or less), then use it. If results are ambiguous, repeat with the unit rotated 15° (or 30°, 45°, 60°, etc.). Try to find an orientation that is most consistently out of orientation with the buried unit throughout

the entire grid pass. For comparison, always focus on the midpoint of a grid pass. The midpoint is more important than the fade points when doing this type of corroborating test.

- ii. Vertical orientation. It may be that the most consistent out-of-orientation position of the rescue unit is to hold it vertically (perpendicular) to the snow surface. If that seems to be the case, then conduct all your pin point passes with the search unit held vertically.
- iii. Optimum disorientation. When a position of "optimum" disorientation is discovered, maintain the unit in that position throughout the full bracket sweep (from fade point to fade point) so that your midpoint can be determined more accurately. Then, when you shift your sweep 90° for the perpendicular bracket, again search for the position of "optimum" disorientation. Do not assume that the optimum disorientation position is the same for both the side-to-side sweep and the up/down-hill sweep.
- iv. Lights only. Sometimes the speaker tones of the F-1 rescue units are uniformly loud, making it difficult to isolate a midpoint or dig area. If this happens, ignore the speaker tone in the fine grid, and concentrate instead on the red or yellow light signal strength indicator. The light is less sensitive to the received tone than the speaker. If the speaker tone is distracting, cover it with your thumb or heel of your hand and muffle the sound. Also, inserting an old ear phone plug from an F-2 unit will turn off the speaker in the F-1 unit.
- v. Double beep. If the buried unit is dual frequency (*e.g.*, Ortovox F-2), another indicator of proximity is when the F-1 unit begins to pick up the double beep sound. The F-1 is supposed to receive only the international frequency of 457 kHz, but the sound associated with the old U.S. frequency (2.275 kHz) also becomes audible when the receiving and transmitting units are very close. This is a powerful proximity indicator (as opposed to orientation indicator), so use the fade points of the double beep sound to locate your bracket midpoints and eventual dig area.
- vi. Inductor behavior. The F-1 and F-2 units (and most other avalanche transceivers) are inductors; a ferrous core wrapped with wire, positioned along the long axis of the unit.
 - (1) When an inductor (the search unit) moves through an electro-magnetic field (the induction field generated by the buried unit), it gains energy which generates electric current (manifest by the signal we see and hear with the rescue unit). The inductor also stores some of the energy gained from the buried unit. The stored-energy phenomenon may affect your fade points.
 - (a) Consider the example when you are moving the search unit from the left end (fade point) of a horizontal search bracket through the strong electro-magnetic field directly over or nearby the buried unit, continuing out to the fade point on the right: your right fade point occurs when the rescue unit has too little energy to continue to generate a noticeable signal. If you pause at the end of the right bracket, then retrace the pass to the left side, you will notice

that the right fade point is closer in (closer to the midpoint) than indicated on your first pass from left to right.

- (b) This is because your first pass from left to right (passing over or near the buried unit) had energy to spare in carrying the bracket to the right fade point. When the rescue unit has an opportunity to "go cold" at the right end of the bracket (*i.e.*, lose the stored energy gained from passing over or near the buried unit), its right fade point moves closer to the buried unit as you retrace the pass because the transmitted signal is pure and not enhanced by any stored energy coming from the initial sweep. **Tip:** During a pin point search, pause briefly at the end of a bracket pass, and establish the fade point at the signal generated on the "return" trip. This will narrow the fade point bracket.

- (2) Inductors also respond to speed when moved through an electro-magnetic field. In other words, if you move the rescue transceiver faster over (nearby) the buried transceiver, it will accumulate more energy and carry it to a more distant fade point than if the pass were made more slowly. Therefore, in order to narrow your search brackets based upon transceiver fade points, make sure your transceiver passes are slow when passing over or close to the buried unit.

10. Confusion.

- a. It is no sin to get confused in the middle of your search - it happens to all of us. The **SIN** happens when you stop, pensively, **TRYING TO FIGURE OUT WHAT WENT WRONG. DON'T STOP!**
- b. If you still have a signal, immediately do your horizontal grid, right from the point where you were standing when illuminating cognition failed. Find fade points, return to midpoint, orient, crank down if you can, and continue your classic grid. This is the only efficient way **TO RECOVER FROM COGNITIVE LAPSE**. It is guaranteed to produce monumentally superior benefits for your buried buddy than standing around, scratching your head, trying to reconstruct the events that have led up to your present boggled state of mind. The **CONFUSION IS HISTORY, FORGET IT, GET ON WITH THE JOB!**
- c. If you have lost the signal, crank up until you find it, then do your classic grid, starting with the horizontal pass. If you still have no signal after cranking up to full volume, hustle back to a location where you last had a good signal, and then do your classic grid. This is likely to mean that you have to **CLIMB BACK UP THE HILL**. Don't let the repugnancy of the notion of climbing suck you into the notion that further cerebral effort and reflection might produce a rationalized alternative to the certain discomfort of ascending over "old terrain."

11. Digging.

- a. Dropping the transceiver. At this point, you are probably holding the transceiver in your hands, and passing it from hand to hand. When it's time to dig, you have to stow the transceiver. **DO NOT PUT THE TRANSCEIVER DOWN ON THE SNOW!** This is the natural urge, but resist it. Loop the strap around your neck and stuff the unit down your sleeve, or stuff the unit down the front of your pants, or stick it into a large jacket pocket, but don't let go of it. There are at least three good reasons for this cardinal rule:
 - i. Snow leads to moisture, and over time, excessive exposure to moisture can impair the unit's reliability. You're carrying this unit because it might save your life sometime; take very good care of it.
 - ii. Transceivers slide, especially when there is a slope angle. The last thing you want to witness is the acceleration rate of a loose transceiver off in search of the *alpha* angle at the bottom of the slide path.
 - iii. You are, by definition, located in avalanche terrain. If there is more snow to come down, or a different gully to release onto your location, you need to get to your transceiver fast in order to get it back to transmit mode. In those circumstances, you have no time to try to figure out which shovel full of snow buried the transceiver you set down nearby.
- b. **MOVE, MOVE, MOVE.** Now is the time to move snow fast. The clock is still ticking, and pin pointing the location of the victim's transceiver is still far short of the ultimate goal: clearing the victim's airway. Trench gingerly so that your shovel doesn't slice open the victim's skull, but clear the loose snow in huge volume.
 - i. Be alert to unit orientation. If orientation is in the vertical plane (and the victim is wearing the transceiver strapped to his chest), the victim may be head down or up. This means you'll need to be more precise in determining your dig location.
 - ii. Dig efficiently. If the snow is hard and needs to be slashed before it can be scooped, **slash, slash, slash**, then **scoop, scoop, scoop**. You'll get more done more quickly than if you **slash and scoop, slash and scoop, slash and scoop**.
 - iii. After you have moved a significant amount of snow, and want further guidance in directing your digging, recover your transceiver and get your head and transceiver down into the pit you've dug. Listen to the signal strength at each wall of the pit, and you will usually get clear guidance as to the direction of continued digging. Unfortunately, the F-1 units are less reliable down in the pit than the F-2s. Same old problem: the F-1's sensitivity to orientation may give you a stronger signal at one side of the pit because of better orientation with the buried unit, when actually that side is more distant from the buried unit than other locations in the pit with weaker signals.

- iv. If the slope is steep and burial deep, enlarge your hole to the up hill side. The shortest distance to the transceiver is a line perpendicular to the slope's surface, not a line directed toward the center of the earth. That means you should be digging into the hill (*i.e.*, towards the up hill side), instead of straight down. (See Attachment A, *Transceiver Trigonometry*.)
 - c. **Don't Break the *@#\$\$%! Shovel.** The only thing dumber than not carrying a shovel in avalanche terrain is breaking the only shovel you have. Being skiers and addicted to snow country, we all regard ourselves as experts at shoveling snow - **NOT!**
 - i. If you haven't spent solid time thinking about your snow-shoveling technique, you're not an expert.
 - ii. First, get the right equipment. Consider the frozen blocks of snow and ice from a slab avalanche that have set up after a 600 yard run. A rescuer needs a strong aluminum shovel to get through this crap. A plastic or Lexan shovel doesn't cut it, literally or figuratively. Lexan makes a good beach toy, but it ain't no avalanche tool!
 - iii. Secondly, slash with your shovel, don't try to lever with it. The avalanche debris has to be broken up before you can move it. Use the aluminum shovel as a pile driver, slamming straight down into the snow pack from over your head. When your pile driver has broken up enough debris, then throw the loose stuff aside. Don't, don't, don't, ever, use your shovel as a lever, sinking it into a chunk of debris, and then trying to break it loose by levering it out with the shovel handle. This is a good way (in fact, the best way) to break your tool, and your buried buddy isn't likely to take kindly to such stupidity.
 - iv. More and more shovels come with the added feature of extension handles. Again - same message. Don't break it. If you extend the handle, you place even greater force on the neck should you succumb to a leveraging impulse. A broken handle means scrapping for you buddy with your finger nails - don't do it - keep the handle short. Extension handles are a feature your buddy wishes you would ignore.
- 12. Practice, Practice, Practice.** That's the only way to get proficient with the skills of transceiver recovery. You need to be proficient (not just familiar) if you are going to be a reliable partner in avalanche terrain. A total search from start to finish in a moderate sized slide (200 feet by 200 feet) should take no more than 3 - 4 minutes. If you are carrying a transceiver, have the skill to save a life, not just participate in a body recovery.

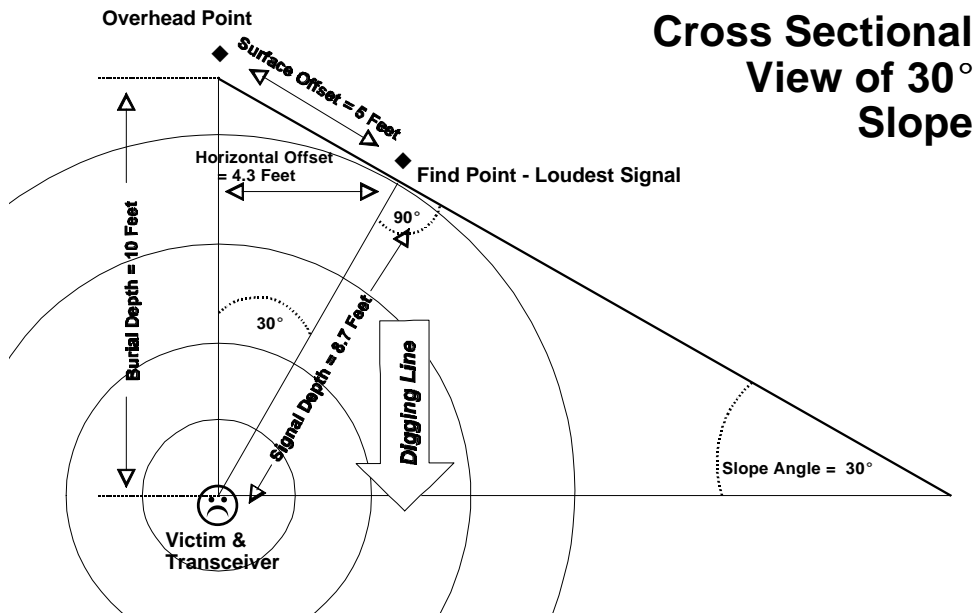
TIPS AND TRAPS

Attachment A

Transceiver Trigonometry Big Trap - Steep Slopes and Deep Burials

When using a transceiver on a steep slope to locate a deep burial, your classic grid technique may seem ineffective. Your fine grid search will lead to a "find point," the point of loudest signal. This is where you will start digging. Unfortunately, however, if you dig straight down from this point ("straight down" as in the line of gravity; toward the center of the earth), you are apt to miss the buried transceiver. It will be up the hill from you, and the distance uphill will depend upon two critical variables: the angle of the slope you are on, and the burial depth of the transceiver.

To understand why, refer to the nearby drawing labeled "Cross Sectional View of 30° Slope." It depicts a 30 degree slope with a transceiver buried 10 feet down. The shortest line (labeled "Signal Depth") between the buried transceiver and the snow surface intersects the slope at the point labeled "Find Point." While the burial depth is 10 feet (measured straight down from the "Overhead Point"), the Signal Depth is 8.7 feet (assuming a 30° slope), so the signal from the search transceiver will be stronger at the Find Point than at the Overhead Point. As a matter of simple trigonometry, the Signal Depth line (the shortest line to the surface) is the line that intersects the slope surface at a right angle (90°).



If you were to bore straight down from the Find Point, you would miss the buried transceiver by 4.3 feet (in theory), the distance labeled "Horizontal Offset." To locate the buried transceiver from the Find Point, you should tunnel into the hill along the Signal Depth line. Obviously, tunneling is not practical when the burial is deep and a lot of snow has to be moved quickly.

To locate the transceiver by digging straight down, you should dig from the Overhead Point, which in this instance is 5 feet up the slope from the Find Point. This distance is labeled the "Surface Offset."

These labeled points and distances are theoretical, based upon the trigonometric relationships of right triangles. The reason these relationships are pertinent is because the search transceiver is designed to locate a point on the snow surface that is closest to the buried transceiver. As previously stated, this is the point where the imaginary line from the buried transceiver intersects the surface at a right angle. If the surface were flat (slope angle

of 0 °), the Find Point and the Overhead Point would be one and the same. As the slope gets steeper, however, the Find Point shifts downhill from the Overhead Point, the amount of shift or offset depending upon both slope angle and burial depth.

The theoretical trig formula at work here is: Surface Offset = Burial Depth * sine (Slope Angle). The table nearby labeled "Sample Offset Distances" provides representative measurements of offset distances based upon various combinations of Slope Angle and Burial Depth. As illustrated, the steeper the slope, the greater the Surface Offsets. On a 15° slope, the Surface Offset will be 26% of the Burial Depth; 50% on a 30° slope, and 71% on a 45° slope. Also, the deeper the burial, the greater the Surface Offset. For example, on a 30° slope, a 2 foot burial produces a 1 foot Surface Offset, while a 10 foot burial extends the Surface Offset to 5 feet.

Slope Angle	Burial Depth	Signal Depth	Horizontal Offset	Surface Offset	SO as % of BD
15°	2.0 ft.	1.9 ft.	0.5 ft.	0.5 ft.	26%
15°	6.0 ft.	5.8 ft.	1.5 ft.	1.6 ft.	26%
15°	10.0 ft.	9.7 ft.	2.5 ft.	2.6 ft.	26%
30°	2.0 ft.	1.7 ft.	0.9 ft.	1.0 ft.	50%
30°	6.0 ft.	5.2 ft.	2.6 ft.	3.0 ft.	50%
30°	10.0 ft.	8.7 ft.	4.3 ft.	5.0 ft.	50%
45°	2.0 ft.	1.4 ft.	1.0 ft.	1.4 ft.	71%
45°	6.0 ft.	4.2 ft.	3.0 ft.	4.2 ft.	71%
45°	10.0 ft.	7.1 ft.	5.0 ft.	7.1 ft.	71%

How can a rescuer cope with these offset "errors?" First, by simply recognizing that they exist. If you are searching on a steep slope, remember that your transceiver's Find Point (loudest signal) will be down hill of the Overhead Point; the steeper the slope, the further downhill. Persons experienced in using transceivers and recognizing avalanche risk are able to make good estimates of slope angle. Just remember, if you're on a 30° slope, your Surface Offset will take your Find Point downhill by 50% of burial depth. If the slope is steeper, your Find Point is even further downhill.

It is also possible to estimate Burial Depth after you have practiced with your transceiver for awhile. For example, with the Ortovox F-1 Focus, if you are able to get a red light on the lowest volume setting at the Find Point, you know the burial is very shallow, probably less than 2 feet. On the other hand, if the lowest volume setting you can achieve at the Find Point is the next volume setting up (2 - 8 meter range), you know your burial is deep, probably 6 feet or more.

The second way to deal with these offset errors is to compensate when digging your hole. Always dig uphill of the Find Point. Use the Find Point to establish the down-slope perimeter of the hole, and as you widen the hole in the fall line, always widen in the uphill direction. The deeper you have to dig, the larger your hole will be, so when you enlarge uphill (into the slope), you will be getting closer to the buried transceiver.