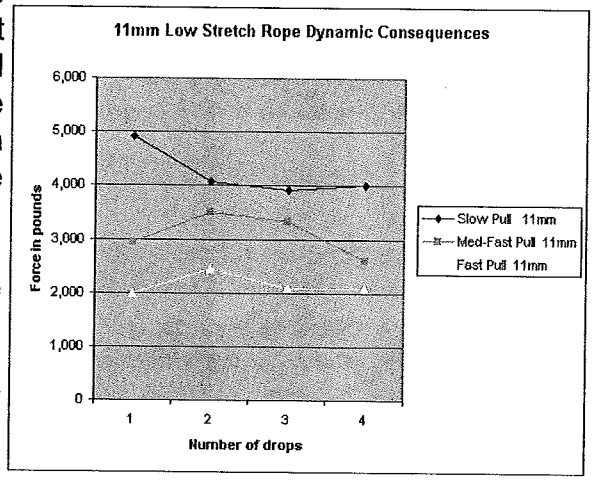
WHAT IS YOUR REAL SAFETY MARGIN

Recent Test Results suggest that our safety margin may "not" be as wide as we used to think. Test results presented at the International Technical Rescue Symposium 2004, in Albuquerque, New Mexico demonstrated that nylon ropes break more easily when the load is applied quickly, such as in a fall, than when a rope is slowly pulled to the breaking point. Dynamic tests, done by the High Angle Technologies team, revealed that the speed at which a load is applied to a static (low stretch) rope can greatly reduce the breaking strength. For example: An 11mm (7/16") static rope has a tensile breaking strength of about *28.5 kN (6,407 lbf). Prior to these tests, we (Climbing/Rescue Industry in General) figured a bowline knot would cause a rope to break at about **65% to close to 80% of the ropes strength or anywhere from: 18.5 kN (4,165 lbs.) to 23 kN (5,170 lbf). Up until Douglas Hansen's High Angle Technologies, Inc. took it a few steps further, this is all we knew. Now with the aid of our specialize testing gear, that literally samples the forces 2,000 times a second, we can get a much better picture of what happens in close-to real life situations, like a fall, or a main line failure. We measured the force it would take to break an 11mm (7/16") rope when we dropped a mass (load) of 204 kg (450 lbs.) approximately 3 meters (10 feet). The weight was tied to a piece of rope that was 20 feet long and we had tied four knots in it in an effort to quickly determine which knot was the weakest, sort-of the weakest link idea. That way we could avoid the weakest knot(s) and only use the one(s) that proved to be the strongest. Also, we use knots when we do a rescue, climb, work at height, etc, so we figured we should test it with knots tied in it. Actually having four knots tied in the rope, rather than one, probably increased the strength the rope would have broken at, due to the fact that knots can actually have a shock absorbing affect. We could try breaking a few ropes with no knots, but that seemed like it would be something the rope manufacturer may want in their R & D department, but otherwise we didn't feel like it would benefit us much, because we almost always use a rope(s) with knots tied in them. Another thought was, if we choose to simulate manufacturer's type rope tests. We could do this by wrapping the rope around a 10 cm (4") bollard, or in our case it would have to be a cylinder of steel, with a modification so it would connect to the load cell. We would have to do that at each end. Then, instead of the slow pull (almost so slow you can hardly see it move), we would drop a heavy load on the rope to break it. We decided that since we don't use ropes without a knots tied in them, that we would not test them that way. The first drop was amazing, WOW, were we surprised. The 28.5 kN (6,407 lbf) rope broke at 8.8 kN (1,980 lbf)! We did it four more times to be sure it was not a fluke.



Next we wanted to make sure it was NOT, just the Knot's weakening effect, but rather the speed at which the load was applied to the rope. We used the same configurations

and made 10 more tests. This time 5 were done at about 2.4 m/s (8 fps), then the second set at about 0.5 m/s (1.5 fps). The first five were around 12.5 kN (2,900 lbs.) and the second set were around 18.5 kN (4,200 lbs). It was for fact now, "The speed at which a load is applied to knotted nylon rope, DEFINITELY reduces the strength of the rope considerably. We theorize that the heat does not have time to dissipate, and consequently it causes the rope to fail at a lower breaking strength. For a rough outline of the test results click here. We are planning to due the follow-up presentation at ITRS 2005, after which we will possibly be able to give this Power Point Presentation to your Group: (Part 1, and/or Part 2: A Look at Knots and Ropes in a Dynamic Situation.)

*Blue Water Ropes

**Microys, Helmut, "Climbing Ropes, "American Alpine Journal 51 (1977): 140
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About the Presenter

In 1969 **Douglas S. Hansen** became actively involved in the vertical environment. Since then his life has essentially been High Angle Work, Engineering, Rescue, Emergency Response, and Equipment sales. Experience and training include: Military 1972, he enlisted in the 19th Special Forces Group. He graduated as an Army Medic (91B20) from the Army Medical Training Center in Fort Sam Houston, TX. In 1975, he was hired by the National Park Service to work as a Park Ranger. His duties included training park personnel in climbing and rescue procedures, and organizing and directing rescues within the Park. Due to a busy schedule Hansen transferred for the 19th S.F. Group to the117th Engineers Corps. At this same time he established International Mountaineering, a Professional Organization that focused on teaching climbing, rescue, high angle skills, doing work in high places, and selling high angle equipment. In 1976, Hansen was invited to join the Utah County Sheriffs Mountain Rescue Team and eventually became captain and operational leader of the Rescue Unit. Work experience includes for U.S. Steel Corporation, Safety Department, and Professional Fireman/EMT. 1984 he opened a full time High Angle Business: Hansen Mountaineering, Inc., which he sold in 2000. In 1992 he organized and lead an Expedition to the North Face of Everest. In the early 90's he formed a business called High Angle Technologies, Inc. that focused on high angle work, teaching and equipment sales. He has produced several videos that deal with the vertical environment, including: "Vertical Rope Skills", recipient of the Telley Award. He has served as an instructor for a number of different universities and schools, governmental organizations (U.S. Forest Service, National Park Service, Bureau of Reclamation, National Guard, U.S. Army), many sheriffs department rescue teams, etc. He is a noted author with nearly 100 published articles, several videos, and a DVD dealing with the vertical rope work, rescue, and safety. He currently works full time in his high angle business writing, teaching, doing specialty high angle projects, lectures at various conferences and seminars. AND most of all he loves to learn, and he keeps his cup only part way full.

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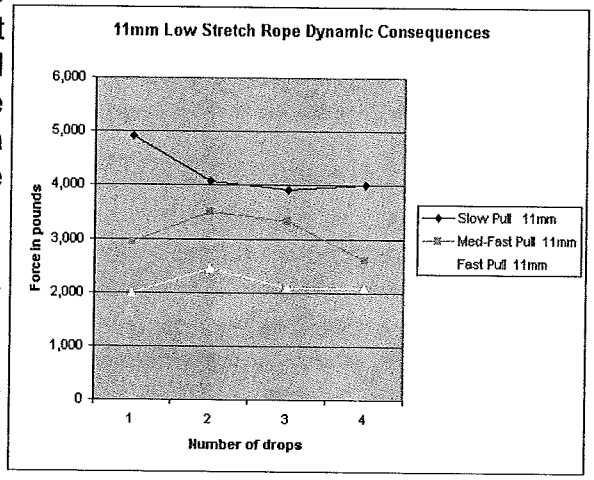

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Company Name _____ Date _____

Contact Name _____ Phone # _____

Please feel free to use this *Safe Operations Evaluation and Safe Procedure Form to assist improving safety and performance.*
Prepared by:

Douglas Hansen's
High Angle Technologies, Inc.
72 West 500 North, Orem, Utah 84057 U.S.A.
Office (801) 221-0398 Assistance(801) 376-5200

Pre-Operations Appraisal and Safe Operational Procedures

Date:_____

Name of Operation and Location:_____

Team Total [ ]: _____
Team Leader H.A.Specialist #1 H.A.Specialist #2 H.A.Specialist #3 H.A.Specialist #4 (list others on Back)

Clients Team (On-Site):_____
Team Leader Member #1 Member #2 Member #3 Member #4 (list others on Back)

Objective and details of Operation:_____
Main or Primary Objective

_____

_____
Others Goals:

_____

_____

_____

Hazard Analysis:

Hazards	Risk Potential	x	Risk Factor	=	**Risk Exposure

Average Risk Exposure: Total R.E._____ / # of Hazards_____ = A.R.E._____ Ideal number is 25 or below. **Any Risk Exposure above 50 "MUST" be Reduced! Either by lowering the R.P. or R.F., preferably both! **Please prepare an emergency plan for hazards that require one. (page #3)**

Details of How "Your" Team will Accomplish this Operation:

(Use back of sheet for Diagrams, Etc.)

List of the Equipment, Parts, and tools Required:

(Use Back of Sheet if Needed)

Emergency Plans, Fall Recovery/Rescue (Post in Obvious Place):

Emergency #1:(_____)

Explain how you will handle it, Priorities, Emergency Phone #s, Required equipment, Where the equipment is located, etc.:_____

(use the back for diagrams, and other hazards)

Emergency #1:(_____)

Explain how you will handle it, Priorities, Emergency Phone #s, Required equipment, where it will be located, etc.:_____

(use the back for diagrams, and other hazards)

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