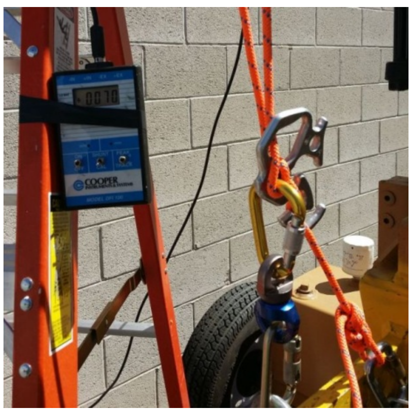
SQWUREL Testing Diary

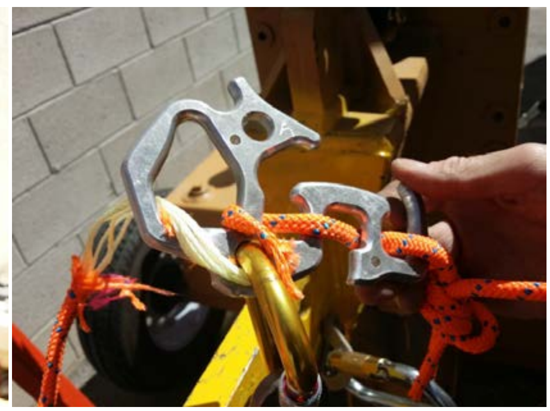
This document will contain the results of testing and quality control measures taken and any conclusions drawn from the tests.

If you would like to read about thoughts on testing, certification, quality control and find definitions of BG Gear test methods, please take a look at the SQWUREL Testing, Certification and Quality Control Page. Of note on that document also contains a section describing the forces the Sqwurel is subjected to when rigged properly, showing that the Sqwurel does not see a tensile load when rigged and used properly.

2014, May 01 - Prototype Testing

One of the prototypes rigged ready for rappel with BlueWater 8mm static rope with the break strand of rope woven through all three tail holes. The break strand of rope was secured to an anchor point. The carabiner in the Sqwurel was also secured to an anchor point. The anchor strand of rope was then tensioned (anchor strand pulled away from break strand and Sqwurel) until failure which occurred at over 3700 pounds. The point of failure was the rope itself as it passed around the carabiner.   Thank you to Todd Rentchler of Canyon Werks for allowing use of his equipment for this test.





2015, May 25 - Thoughts on Retirement Due to Rope Grooves

The Sqwurel is just about ready for release and a standard for retirement due to rope grooves needs to be set. Unfortunately this cannot be done with real world testing, since there are no fully worn out Sqwurels running around. Prototypes with a design very close to the final Sqwurel design have been used and worn down well beyond the 50% point and have continued to function safely. Physical testing will be performed in the future with the intent of updating the recommendation. With safety being a primary concern, BG-Gear will initially set a conservative standard for Sqwurel retirement as a result of rope grooves. Retire your Sqwurel when any part of the device is worn 33% (one third) of the way through with 66% (two thirds) remaining intact.

Future testing to update the retirement recommendations will be performed when some well worn Sqwurels are obtained.

2015, May 21 - SQWUREL Release Date

The SQWUREL is made available for sale on the BG Gear web store. The first litter of 500 Sqwurels are released. Now that new production Sqwurels are available, testing will begin shortly.

Prior to public release of the Sqwurel prototypes were rigged for rappel and pull tested to failure which occurred at over 3700 pounds of force (the failure point was the rope itself where it wrapped under the carabiner, not the Sqwurel).   The Sqwurel was designed with a larger cross sectional area around the throat than the two most common competing devices (the ATS and Pirana) to ensure the Sqwurel had sufficient strength. Also prior to public release 12 prototypes were given to members in the canyoneering community who used the prototypes extensively over the course of a year. Some of the prototypes were rope grooved from use to well beyond the 50% worn through point and continued to perform well. With this in mind BG gear felt it was safe to release the Sqwurel to the public. After obtaining the first batch of Sqwurels for public release BG Gear will continue to test the Sqwurel to ensure quality and safety.

2015, June 10 – SQWUREL Physical Testing.

What to do with 6 SQWURELS, new dynamic rope, new static rope, one sacrificial carabiner and some extra time? SQWUREL Testing!!!!!!

Where:

Testing was conducted at Silver State Wire Rope and Rigging in Las Vegas, NV using their hydraulic pull testing equipment.

Items Used:

BG Gear supplied:

6 ea. Sqwurel rappel devices (new and unused), 1 ea. Petzl Attache carabiner (new and unused),

BlueWater 8mm Zion Pro static rope (new and unused), Mammut 8mm Phoenix Dry dynamic rope (new and unused)

Silver State Wire Rope and Rigging supplied:

Hydraulic pull testing equipment and a few steel carabiners for use during testing (previously used frequently at the facility)

Goals, Test Highlights and Conclusions of Today's Testing:

This section will define the goals of today's testing session, note highlights of the tests and draw some conclusions from the testing. To see the other details of the testing scroll down to the Testing Results section below.

Goal 1.

Tests #1, #2, #3 and #4 of today's testing session were performed to see if the Sqwurel can hold up to the UIAA 129 testing. The BG-301A test was used, which is run the same way as the static test portion of the UIAA 129 test. Dynamic rope was used to match requirements of the UIAA 129 tests.

Full UIAA testing and certification is not the goal for today's testing. UIAA testing requires each and every friction setting to be tested. Instead of testing every setting, the Sqwurel was tested in settings that would be more likely to show a weakness in the Sqwurel.

Test Highlights 1.

The BG-301A tests were run on the Sqwurel using a new single strand of Mammut Phoenix 8mm dynamic half rope with each pull. The same Sqwurel was pull tested in the settings Simple-3, Simple-2, Jumbo-3 and then Behomoth-3. These setting were chosen to stress the tail, which is the portion of the Sqwurel that has the largest potential for weakness. After each test the rope, carabiner and Sqwurel were undamaged and continue to function properly. Unfortunately the BG-301A tests were run at 6kN and should have been run at 7kN. Future testing will be conducted to test at 7kN.

Conclusion 1.

This series of tests subjected the Sqwurel to 6kN in normal rigging for rappel resulting in no damage to the rope, carabiner or Sqwurel indicating the Sqwurel is strong enough for use in the field.

Goal 2.

Tests #5, #6, #7 and #14 of today's testing session were performed to see how the Sqwurel would hold up if the BG-301A tests were run and pulled to failure instead of stopping at a specified force. The BG-302A test was used, which is performed just like the BG-301A test but the rope is instead pulled to failure. Static rope was used in tests #5, #6 and #7 since canyoneering in the United States primarily uses static rope. Dynamic rope was used in test #14 to see how dynamic rope would hold up when pulled to failure.

Test Highlights 2.

First the BG-302A test was run with static rope and the Sqwurel set to Friction Level Simple-0 to see how the throat of the Sqwurel would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 3510 lbf. After the test the test the carabiner and Sqwurel were undamaged and continue to function properly.

Next the same Sqwurel was tested using the BG-302A test with static rope and the Sqwurel set to Friction Level Simple-3 to see how the tail of the Sqwurel would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 3540 lbf. After the test the carabiner was undamaged and continued to function properly. After the test the end segment of the tail was bent about 8 degrees.

Next a new Sqwurel was tested using the BG-302A test with static rope and the Sqwurel set to Friction Level Jumbo-3 to see how the tail of the Sqwurel would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 3260 lbf. After the test the carabiner was undamaged and continued to function properly. After the test the end segment of the tail was bent about 5 degrees.

Later another Sqwurel was tested using the BG-302A test with dynamic rope and the Sqwurel set to Friction Level Simple-3 to see how dynamic rope would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 2675 lbf.

Conclusion 2.

These tests subjected the Sqwurel, rigged properly set to rappel in various settings, to forces sufficient to cause system failure. In all cases the rope was the failure point in the system indicating the Sqwurel will not be the weak point when the system is subjected to high forces.

Note:

When all 3 tail holes are utilized and the system is pulled to failure the end segment of the tail may be slightly bent but does not break and continues to perform its function. If the system is subjected to significantly high forces, ALL pieces of equipment should be considered for retirement rather visibly damaged or not.

Goal 3.

Tests #8, #12 and #13 of today's testing session were performed to determine the performance of the Soft Lock-off, Hard Lock-off 1 and Hard Lock-off 2 methods. The BG-303A, 303B and 303C tests were used. Static rope was used since canyoneering in the United States primarily uses static rope.

Test Highlights 3.

First a the BG-303A test was run with static rope and the Sqwurel set to Hard Lock-off method 1 to see how the Sqwurel would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 3260 lbf. After the test the tail of the Sqwurel was warped and compressed like and accordion with no visible signs of cracking or breakage.

Next a Sqwurel was tested with static rope and the Sqwurel set to the Soft Lock-off method to see how the Sqwurel would perform under sufficient force to cause the system to fail. The system did not fail but at about 1350 lbf the rope begins to slip slowly through the lock off. The test was stopped after the rope was allowed to slip a few inches.

Next a new Sqwurel was tested with static rope and the Sqwurel set to the Hard Lock-off method 2 to see how the Sqwurel would perform under sufficient force to cause the system to fail. The failure point in the system was the rope at 3155 lbf. The sheath of the rope failed and the entire assembly began to slide over the still intact core of the rope. After the test the tail of the Sqwurel was warped and compressed like and accordion with no visible signs of cracking or breakage.

Conclusion 3.

These tests subjected the Sqwurel rigged in the various lock-off modes. In the field a significant fall may create high forces on a Sqwurel set in one of the lock off modes. The Soft Lock-off mode may slip a very small amount if a fall subjects the system to about 1300 lbf but will still continue to provide the lock-off function. Both the Hard Lock-off method 1 and the Hard Lock-off method 2 will continue to provide the lock-off function up to over 3100 lbf when the rope itself becomes the weak point in the system.

Goal 4.

Test #9 of today's testing session was performed to determine how the tail responds to high rope tension forces. The BG-306 test was used to determine the range of rope tension required to flex deflect the tail temporarily and determine the rope tension required to flex the tail leaving permanent flex / deflection. Static rope was used since canyoneering in the United States primarily uses static rope.

Test Highlights 4.

The Sqwurel was rigged ready to rappel in Friction Level Simple-3 and the rope was tensioned repeatedly starting at low forces and ramping up the force by about 100 lbf with each tensioning. Each time the rope was tensioned a straight edge was used to see if the tail was being flexed / deflected during tension. When the forces were high enough to flex / deflect the tail, the rope was released and the tail was re-measured to determine if tail returned to flat or not to note if the flex / deflection of the tail was temporary or permanent.

At about 1600 lbf the tail began to flex / deflect a small amount under tension and returned to flat after tension was released. The same was true at forces up to about 2630 lbf.

At about 2745 lbf a flex / deflection of less than 1/64th of an inch over the length of the tail remained after tension was released. At forces up to about 2940 lbf the permanent tail deflection remained at less than 1/64th of an inch over the length of the tail.

Conclusion 4.

When rigged properly the tail of the Sqwurel will not be bent when subjected to forces below 1600 lbf. Forces between 1600 lbf through 2630 lbf may flex the tail slightly and the tail will return to flat after unloading. Forces above 2745 lbf may leave a permanent flex in the tail of the Sqwurel. During use in the field it should not be possible to generate forces sufficient to permanently flex the tail of the Sqwurel unless a catastrophic event occurs, in which case all components of the system should be considered for retirement.

Goal 5.

Test #10 of today's testing session was performed to see what happens when the Sqwurel is accidentally rigged improperly with the Sqwurel located on the spine of the carabiner. The BG-304 test was used. Static rope was used since canyoneering in the United States primarily uses static rope.

Test Highlights 5.

First the Sqwurel was placed on the spine of the carabiner a short distance below the curved portion of the carabiner. When the system was tensioned to about 1650 lbf the carabiner righted itself into the proper orientation with the force being applied at the ends along the spine. The shape of the carabiner allowed the rigging to slip into proper alignment when sufficient force was applied.

A second test was run with the Sqwurel set about half way down the spine of the carabiner and the opposing pull force on the carabiner was set up near the bottom of the gate to ensure the carabiner did not slip into a proper orientation. The failure point in the system was the rope at about 2500 lbf. The Sqwurel and Carabiner appeared undamaged and continue to work properly (the carabiner will be retired by the way).

Conclusion 5.

The shape of some carabiners will make it difficult to fully load the system if the Sqwurel is rigged on the spine of the carabiner. If however the system does become fully loaded with the Sqwurel set on the spine of the carabiner, the weak point in the system is still the rope failing.

Goal 6.

Test #11 of today's testing session was performed to see how see how strong the Sqwurel is when subjected to tensional forces applied between the carabiner hole and the throat.

Test Highlights 6.
Two pull tests were performed on the same Sqwurel with a steel carabiner in the carabiner hole and another steel carabiner in the throat and tensioned. The first pull test resulted in one of the steel carabiners breaking / failing at 9550 lbf (42.48kN). The second pull test resulted in another carabiner breaking / failing at 10,950 lbf (48.5kN). The Sqwurel remained in good shape but did have minor deformation at top of throat and bottom of carabiner hole where the carabiners left a slight indention of their shape.

Conclusion 6.
The test was stopped after two carabiners were broke and the Sqwurel was still holding strong. The Sqwurel is strong under a tensile load however in the field the Sqwurel should never experience a tensile load if used properly. This test offers little information about strength or safety under normal use.

Goal 7.

Test #15 of today's testing session was performed to see if the dynamic rope had high enough tensional strength to be used in tests to failure. Dynamic ropes are not rated in tensile strength but instead are rated in impact force indicating the forces a load see when dropped from a specified height on the rope.

Test Highlights 7.
A length of the Mammut Phoenix dynamic rope was tied with a figure 8 knot in each end then tensioned to failure. The rope failed at one of the figure 8 knots at about 2370 lbf. The rope stretched a lot before breaking.

Conclusion 7.
The dynamic rope does have sufficient tensile strength to conduct some test to failure but will not be as strong as static rope and offer less insight as a result. Also of not the amount of rope stretch is extreme and may complicate testing as equipment with long throws may be required.

Final Overall Thoughts
The Sqwurel was released without formal testing. It was deemed ok to do so due to several prototypes being in use for over a year and going strong, the cross sectional area of the throat sides were designed larger than other devices and preliminary pull testing on prototypes showed favorable results. Today's testing was aimed at getting a first look at the strength / safety of the final version of the Sqwurel V1 rappel device. Each test was run with a new segment of rope.

A set of tests were done with the Sqwurel and 8mm dynamic rope which mimic the UIAA 129 which is an internationally recognized testing standard. The tests were mistakenly done at 6kN rather than the required 7kN. With the UIAA type testing done at 6kN the Sqwurel was still subjected to high forces and passed these tests with no damage and continue to function properly. Keep in mind that the UIAA 129 testing does not stress a device to failure so it gives limited insight about the actual strength of the device. Future testing may be done to redo these tests at the required 7kN. Testing to failure in subsequent testing will help provide insights about the overall strength and safety of the Sqwurel.

Another set of tests were done with the Sqwurel set to standard rigging ready to rappel with 8mm static rope then the rope tensioned to failure. Each test in this series set the Sqwurel in a different Friction Level setting. The majority of Friction Level settings chosen were those that would be most likely to expose a weakness in the tail of the Sqwurel, which is the weakest portion of the device. In all tests the rope was the failure point at rope tensions ranging from 3260 lbf to 3540 lbf when static rope was used and around 2675 lbf when one test was run with 8mm dynamic rope. When all 3 Tail Holes are rigged and the rope tensioned to over 3000 lbf the tail was left bent by about 5 to 8 degrees, showed no visible signs of cracking or breakage and continued to provide the designed function. If the system is subjected to significantly high forces, ALL pieces of equipment should be considered for retirement rather visibly damaged or not.

Another set of tests were run with 8mm static rope to test the lock-off modes, Soft Lock-off, Hard Lock-off method 1 and Hard Lock-off method 2. The Soft Lock-off method may slip a very small amount if a fall subjects the system to about 1300 lbf but will still continue to provide the lock-off function. Both the Hard Lock-off method 1 and the Hard Lock-off method 2 will continue to provide the lock-off function up to over 3100 lbf when the rope itself becomes the weak point in the system. Also of note when the Hard Lock-off method 1 and Hard Lock-off method 2 were tensioned to rope failure the Tail was compressed like an accordion but showed no visible signs of cracking or breakage.

Another test was run to test tail flex / deflection. Using 8mm static rope the Sqwurel was set in Friction Level Simple-3 to utilize the full length of the tail. The rope was tensioned repeatedly starting at low forces and ramping up the force by about 100 lbf with each tensioning. Each time the rope was tensioned a straight edge was used to see if the tail was being flexed / deflected during tension. When the forces were high enough to flex / deflect the tail, the rope was released and the tail was re-measured to determine if the tail returned to flat or not to note if the flex / deflection of the tail was temporary or permanent. At about 1600 lbf the tail began to flex / deflect while under tension but returned to true flat after tension was released. At about 2745 lbf the tail was first noted to experience a small permanent deflection of less than 1/64th of an inch over the full length of the tail. The test was run up to about 2940 lbf with the permanent deflection still less than 1/64th of an inch over the full length of the tail.

Another test was run using 8mm static rope and the Sqwurel rigged incorrectly on the spine of the carabiner. The test showed that the shape of some carabiners will cause the carabiner to right itself to proper orientation when force is applied. If however the system does become fully loaded with the Sqwurel set on the spine of the carabiner, the weak point in the system is still the rope failing.

Just to see how strong the Sqwurel is when tensioned between the Throat and the Carabiner Hole a test was run using steel carabiners to pull apart the Sqwurel. Two tests ended when the steel carabiners failed at 9550 lbf (42.48kN) and 10,950 lbf (48.5kN). The Sqwurel is strong under a tensile load however in the field the Sqwurel should never experience a tensile load if used properly. This test offers little information about strength or safety under normal use.

A final test was run not aimed at testing the Sqwurel. Static ropes are rated with a tensile strength indicating how strong the rope may be. Dynamic rope on the other hand is rated in impact force indicating the forces seen by the load when dropped a specified distanced when tied to the rope. Curiosity set in wondering if the 8mm dynamic rope was up to the task of testing to failure. The dynamic rope does have sufficient tensile strength to conduct some test to failure but will not be as strong as static rope and offer less insight as a result. Also of note the amount of rope stretch is extreme and may complicate testing as equipment with long throws may be required.

Test Results:

Test #1 of session **BG-301A** test

SQWUREL V1 (set to Simple-3),	New
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm dynamic half rope (Mammut, Phoenix),	New single strand segment

The rope was tensioned to 1350 lbf (6kN) and held for approximately 1 minute. The rope, carabiner and Sqwurel were undamaged and continue to function properly. BG-301A was supposed to be ran at 1573 lbf (7kN) but a lower value was mistakenly used.

Test #2 of session **BG-301A** test

SQWUREL V1 (set to Simple-2),	Used previously in test #1
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm dynamic half rope (Mammut, Phoenix),	New single strand segment

The rope was tensioned to 1360 lbf (6.05kN) and held for approximately 1 minute. The rope, carabiner and Sqwurel were undamaged and continue to function properly. BG-301A was supposed to be ran at 1573 lbf (7kN) but a lower value was mistakenly used.

Test #3 of session **BG-301A** test

SQWUREL V1 (set to Jumbo-3),	Used previously in tests #1 and #2
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm dynamic half rope (Mammut, Phoenix),	New single strand segment

The rope was tensioned to 1330 lbf (5.9kN) and held for approximately 1 minute. The rope, carabiner and Sqwurel were undamaged and continue to function properly. BG-301A was supposed to be ran at 1573 lbf (7kN) but a lower value was mistakenly used.

Test #4 of session **BG-301A** test

SQWUREL V1 (set to Behemoth-3),	Used previously in tests #1, #2 and #3
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm dynamic half rope (Mammut, Phoenix),	New single strand segment

The rope was tensioned to 1380 lbf (6.1kN) and held for approximately 1 minute. The rope, carabiner and Sqwurel were undamaged and continue to function properly. BG-301A was supposed to be ran at 1573 lbf (7kN) but a lower value was mistakenly used.

Test #5 of session **BG-302A** test

SQWUREL V1 (set to Simple-0),	Used previously in tests #1, #2, #3 and #4
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At 2700 lbf small popping sounds were heard from the rope and the sheath begins to tear with the core of the rope holding strong. At 3510 lbf the rope completely fails. The failure point was the rope breaking where it wrapped under the carabiner. The tail was not affected in this test as the device was rigged in Simple-0 not utilizing the tail.

Test #6 of session **BG-302A** test

SQWUREL V1 (set to Simple-3),	Used previously in tests #1, #2, #3, #4 and #5
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At 2400 lbf small popping sounds were heard from the rope and the sheath begins to tear with the core of the rope holding strong. At 3540 lbf the rope completely fails. The failure point was the rope breaking where it wrapped under the carabiner. The end segment of the tail was permanently bent about 8 degrees. It was noted that the round shape of the carabiner made a small indention in the top of the Carabiner Hole. This Sqwurel was used in Tests #1 through #6 and it is unclear when this indentation occurred.

Test #7 of session **BG-302A** test

SQWUREL V1 (set to Jumbo-3),	New
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At 2700 lbf small popping sounds were heard from the rope and the sheath begins to tear with the core of the rope holding strong. At 3260 lbf the rope completely fails. The failure point was the rope breaking where it wrapped under the carabiner. The end segment of the tail was permanently bent about 5 degrees. A small indentation at the top of the carabiner hole is noted.

Test #8 of session **BG-303A** test

SQWUREL V1 (set to Hard Lock-off 1),	New
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At 2540 lbf the sheath begins to tear where the rope wraps under the carabiner with the core of the rope holding strong. At 3260 lbf the rope completely fails but this time breaks where the rope exits the top figure 8 anchoring knot. The tail was permanently bent and compressed like an accordion with no visible signs of cracking or breakage.

Test #9 of session **BG-306** test

SQWUREL V1 (set to Simple-3),	New
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned repeatedly starting at low forces and ramping up the force by about 100 lbf with each tensioning. Each time the rope was tensioned a straight edge was used to see if the tail was being flexed / deflected during tension. When the forces were high enough to flex / deflect the tail, the rope was released and the tail was re-measured to determine if tail returned to flat or not to note if the flex / deflection of the tail was temporary or permanent.

1600 lbf was the minimum force noted to flex / deflect the tail a small amount. The load on the rope was released and the tail returned to being flat indicating the flex / deflection of the tail was temporary as the tail remained flat after the load was released. The tail was also tested at rope tension forces of 1730, 1810, 1905, 2010, 2105, 2310, 2445, 2575 and 2630 lbf. In all cases the tail returned to being flat after the load on was released.

2745 lbf was the minimum force noted to leave a permanent flex / deflection of the tail after the load was released. The deflection was less than 1/64th of an inch over the length of the tail. The tail was then loaded to 2830 and 2940 lbf both leaving a permanent flex / deflection in the tail of less than 1/64th of an inch over the length of the tail. The test was stopped after 2940 lbf.

Test #10 of session **BG-304** test

SQWUREL V1 (set to Simple-3),	New
Carabiner (Petzl, Attache),	New
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The Sqwurel was placed on the spine of the carabiner a short distance below the curved portion of the carabiner. The rope was locked off by simply weaving the rope up and down the tail and did not use one of the standard lock-off methods. The rope was tensioned and at about 1650 lbf the carabiner righted itself into the proper orientation with the force being applied at the ends along the spine. The shape of the carabiner allowed the rigging to slip into proper alignment when sufficient force was applied.

A second test was run but was set up with the Sqwurel set about half way down the spine of the carabiner and the pulling force on the carabiner was set up near the bottom of the gate. This configuration places the load perpendicular to the spine and was used to ensure the carabiner did not slip into proper orientation when force was applied. The rope began to creek just before complete failure at about 2500 lbf. The Sqwurel and Carabiner appeared undamaged and continue to work properly (the carabiner will be retired by the way). The rope broke / failed where it wrapped under the carabiner similar to other tests ran to failure. In this configuration the rope was still the weak point.

Test #11 of session **BG-307** test

SQWUREL V1,	Used previously in test #10
2 ea. Carabiners (steel shop carabiner),	Used previously around the facility in various ways

The Sqwurel was rigged with a steel carabiner in the carabiner hole and another steel carabiner in the throat. The carabiners were tensioned to test tensile strength of the device. The first pull test resulted in one of the steel carabiners breaking / failing at 9550 lbf (42.48kN). The second pull test resulted in another carabiner breaking / failing at 10,950 lbf (48.5kN). The Sqwurel remained in good shape but did have minor deformation at top of throat and bottom of carabiner hole where the carabiners left a slight indention of their shape.

Test #12 of session **BG-303B** test

SQWUREL V1 (Soft Lock-off),	Used previously in tests #10 and #11
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At about 1350 lbf the soft lock begins to slip very slightly. Test was stopped after rope was allowed to slide a few inches.

Test #13 of session **BG-303C** test

SQWUREL V1 (Hard Lock-off 2),	New
Carabiner (steel shop carabiner),	Used previously around the facility in various ways
8mm static rope (BlueWater, Zion Pro),	New single strand segment

The rope was tensioned until failure occurred. At about 2200 lbf rope begins making popping sounds. At about 3155 lbf the sheath of the rope failed where it wraps under the carabiner and the sheath began to slip along the core. The tail was left warped and compressed like and accordion with no visible signs of cracking or breakage. It was not noted at what force the tail began to deform.

Test #14 of session **BG-302A** test

SQWUREL V1 (set to Simple-3),	Used previously in tests #10, #11 and #12
Carabiner (steel shop carabiner),	Used Previously around the facility in various ways
8mm dynamic half rope (Mammut, Phoenix),	New single strand segment

The rope was tensioned until failure occurred. At about 700 lbf rope begins making creaking and popping sounds. The rope exhibits an extreme amount of stretching / elongation as tensional force continues to ramp up. At about 2675 lbf the rope fails and breaks where it wraps under the carabiner.

Test #15 of session (tensile test of the Mammut, Phoenix rope)

Dynamic ropes are rated in impact force the load experiences when dropped while tied to the rope. This test was done to see if the dynamic rope used in these tests had a sufficient tensile strength to be used in pull to failure tests similar to how the static rope was used.

Rope was tied off with a figure 8 knot on each end then tensioned until failure occurred. At about 2370 lbf the rope failed and broke where the rope exited the top figure 8 knot.