RECLAMATION

Managing Water in the West

Drop Testing of Rope Access Backup Devices

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Special thanks to PMI, CAMP, Rhino Staging, and Andrew Blackstock!

U.S. Department of the Interior
Bureau of Reclamation

Tested Devices

- CAMP Goblin
- Heightec-PMI Vector
- Safe Tec Duck-R
- Petzl Rescucender
- Petzl Shunt
- Petzl ASAP with Absorbica
- Kong Backup
- ISC Red

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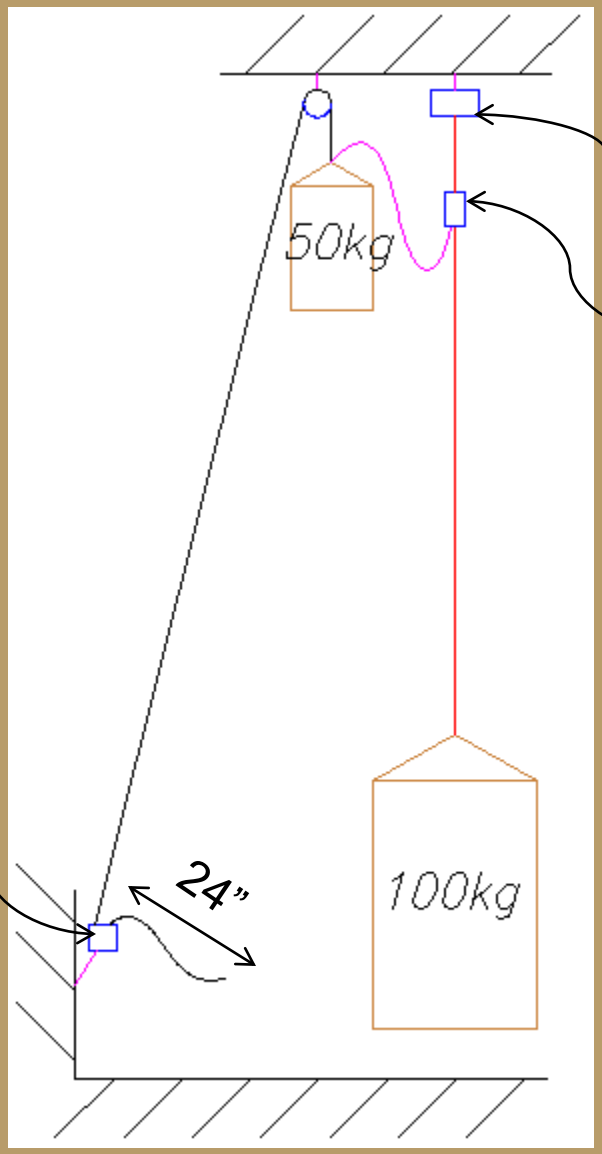
Test Setup 1

50kg Test Weight w/ 100kg Weighted Line



Load Cell

Backup Device

Lowering Device

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Rappel Simulation

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Test 2 – Goblin w/ Goblin Lanyard
50kg Test Weight w/ 100kg Weighted Line

Goblin Lanyard:
40 cm (~23 in. ‘biner to ‘biner)
FF (Fall Factor) 2

Peak Force: 1,303 lb

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Tests 5 and 6 – Goblin w/ PMI CT

50kg Test Weight w/ 100kg Weighted Line

WARNING: Test is not to manufacturer's recommendations

PMI CowsTail: 25 in. (31.5 in. 'biner to 'biner)

Note differences in test due to differences in rappel simulation

Test 6: FF2 – 1,263 lb

Test 5: FF2 – 1,081 lb

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Tests 8 and 9 – Vector w/ PMI CT
50kg Test Weight w/ 100kg Weighted Line

PMI CowsTail: 25 in. (31.5 in. ‘biner to ‘biner)

Note: Fall arrest in Test 8 may have been assisted by 100kg Weight. Vector appears to be “held” by test weight.

Test 38: FF2 – 1,254 lb

Test 8: FF2 – 1,186 lb

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Tests 11 and 12 – Duck w/ PMI CT
50kg Test Weight w/ 100kg Weighted Line

PMI CowsTail:
25 in. (31.5 in.
‘biner to ‘biner)

2 of 3 tests on Duck
FAILED

Note: Difference in
Fall Factors

Test 12:
FF0 –
832 lb

Test 11: FF1 – 844 lb

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Tests 15 and 16 – Rescucender w/ PMI CT

50kg Test Weight w/ 100kg Weighted Line

PMI CowsTail:
25 in. (31.5 in.
‘biner to ‘biner)

Note: Difference in
Fall Factors

Test 16:
FF2 –
992 lb

Test 15: FF0 - 633

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Tests 22 and 24 – Kong Backup

50kg Test Weight w/ 100kg Weighted Line

Note: Difference in lanyards

Test 24: Yates Long Lanyard 18 in. (‘b to ‘b) – 1,011 lb

Test 22: Yates Short Lanyard 13 in. (‘biner to ‘biner) – 841 lb

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Tests 25 and 26 – Red w/ PMI CT
50kg Test Weight w/ 100kg Weighted Line

PMI CowsTail: 25 in. (31.5 in. ‘biner to ‘biner)

Note: Repeated Tests

Test 26: FF0 – 887 lb

Test 25: FF0 – 1,178

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Tests 27 and 28 – Shunt w/ PMI CT

50kg Test Weight w/ 100kg Weighted Line

WARNING: Test is not to manufacturer's recommendations

PMI CowsTail: 25 in. (31.5 in. 'biner to 'biner)

Note: Repeated Tests

Test 28: FF0 – 761 lb

Test 27: FF0 – 826 lb

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Test Setup No. 1

Backup Device	Lanyard	~ FF	No. of Tests	Ave. Pk. Load (lb)	Ave. Slip (in.)	Comments
ASAP	Absorbica	2	1	820	0	Few stitches blew
Duck	Cows Tail	1	1	840	6	
Duck	Cows Tail	0	3	790/NA	16/∞	2 of 3 FAIL
Goblin	Gob. Lan.	2	2	1300	30.5	
Goblin	Cows Tail	2	5	1,060	6.5	
Goblin	Cows Tail	0	2	690	0	
Kong	Yates Short	2	1	NA	∞	FAIL
Kong	Yates Long	2	2	NA	∞	FAIL
Red	Cows Tail	0	2	NA	∞	FAIL
Rescucender	Cows Tail	0	4	860	1	
Rescucender	Cows Tail	2	1	992	2	
Shunt	Cows Tail	0	3	790	0	
Shunt	Cows Tail	1	2	890	3	
Vector	Cows Tail	2	3	1250	45	
Vector	Cows Tail	0	1	700	0	

Your Add Here!!!

Just Kidding ;^)

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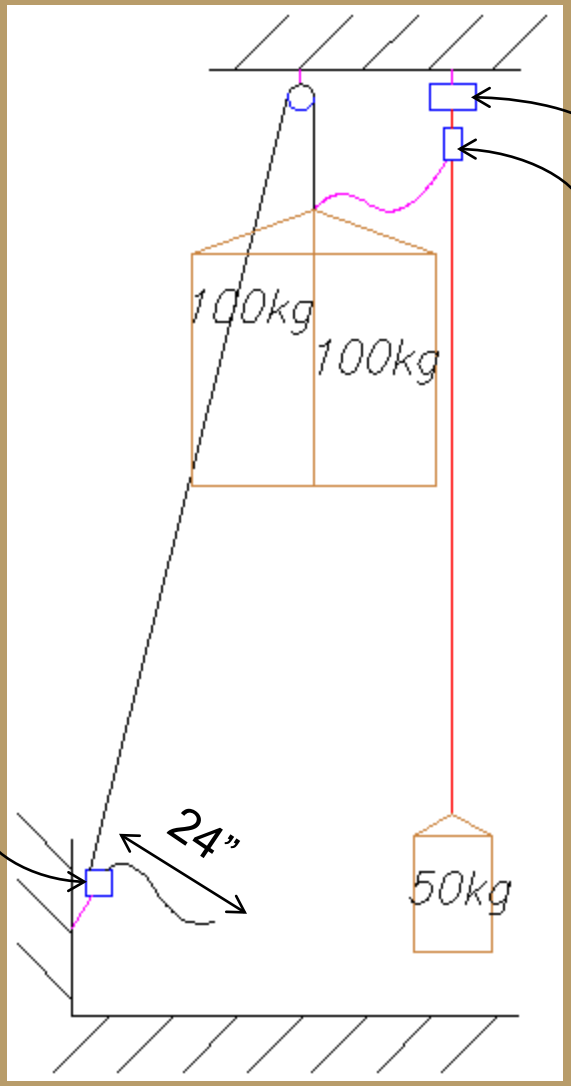
Test Setup 2 – Two Person Load

200kg Test Weight w/ 50kg Weighted Line



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Test 33 – Goblin w/ PMI CT

200kg Test Weight w/ 50kg Weighted Line

WARNING: Test is not to manufacturer's recommendations

Fall Factor: 1
Slippage: 35 in.
Peak Force: 1,316 lb

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Tests 34 and 43 – ASAP/Absorbica

200kg Test Weight w/ 50kg Weighted Line

Test 34: FF1

<u>Test 34</u>
Fall Factor: 1
Slippage: 6.5 in.
Deployment: 5.5 in.
Pk. Force: 1,423 lb

<u>Test 43</u>
Fall Factor: 2
Slippage: 15 in.
(includes trailing)
Deployment: 22.5 in.
Pk. Force: 1,481 lb

<u>Test 24 (not shown)</u>
Pk. Force: 1,445 lb
Ave. Pk. F.: 1,450 lb

Test 43: FF2

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Test 35 – Vector w/ PMI CT
200kg Test Weight w/ 50kg Weighted Line

WARNING: Test is not to manufacturer's recommendations

Fall Factor: 2
Pk. Force: 2,107 lb

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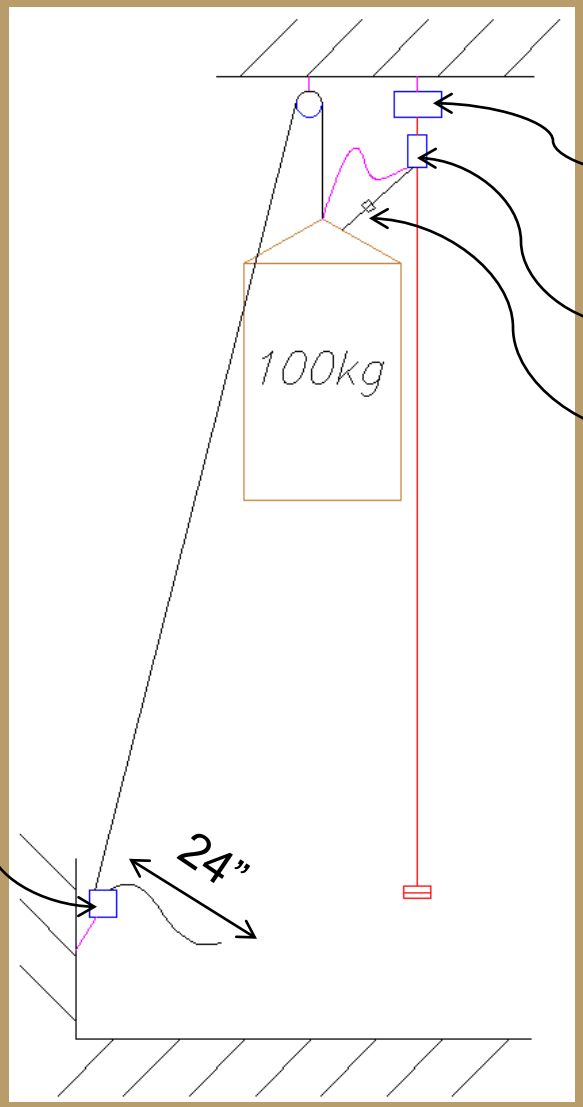
Test Setup No. 2

Backup Device	Lanyard	~ FF	No. of Tests	Ave. Pk. Load (lb)	Ave. Slip (in.)	Comments
ASAP	Absorbica	1	3	1,450	8	Ave. Deploy: 14 in.
Goblin	Cows Tail	1	1	1,320	11	Sheath glazed
Vector	Cows Tail	2	1	2,110	89	Sheath severed, core intact

Test Setup 3



Load Cell

Backup Device

13.5 lb Buckle

Lowering Device

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Breakaway Buckle

Measured buckle strength: 13.5 lb
Pinch Grip Strength: 20 lb (4mm cord – no knot)

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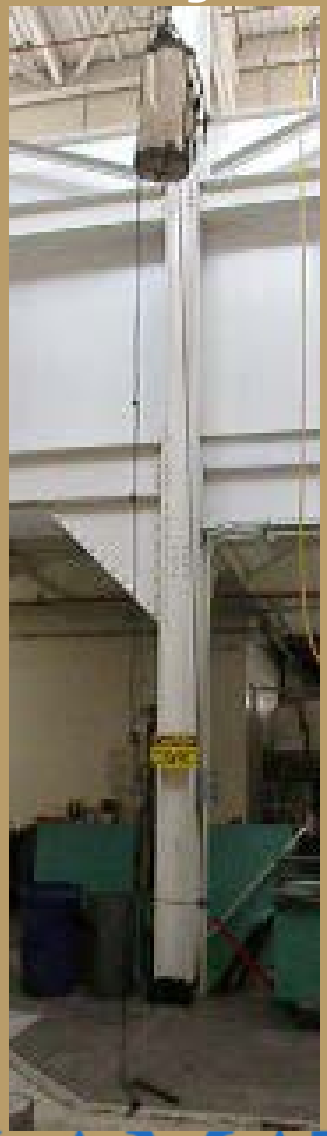
Test Setup 3 - w/ Tied Lanyard

Test A: Duck

Test B: Kong (Tow Mode)



Test C: Red

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THE END

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Appendix

				* = resuse lanyard		** All ropes: 7/16" PMI Access Pro Low Stretch				
	Test Scenario									
Test #	Test Weight (kg)	Rope Weight (kg)	Backup Device	**Rope	Lanyard	Fall Factor (approx.)	Peak Load (lb)	Backup Device Slip (inches)	Comments	Rope damage
21	50	100	ASAP #1	#6	Absorbica	2	816	-14	Rope length 65", Shockpack blew a couple stitches which was not completely obvious at first	
34	200	50	ASAP #2	#10	Absorbica	1	1423	6.5	Shock pack deployed 5.5"	
42	200	50	ASAP #3	#13	Absorbica	1	1445	1.5	93" Rope length	
43	200	50	ASAP #4	#14	Absorbica	1	1481	15	103" Rope length, Shock pack deployed 22.5"	
11	50	100	Duck #2	#5	31.5" lanyard	1	844	6	88" from knot to orange tape	
12	50	100	Duck #2	#5	31.5" lanyard*	0	832	Failure, Device rode down to bag	63" knot to orange tape	
13	50	100	Duck #3	#5	31.5" lanyard*	0	791	Bounced and slipped 16" before catching	63" knot to orange tape	
14	50	100	Duck #3	#5	31.5" lanyard*	0	844	Failure, Device rode down to bag	No visible damage to duck	Slight wear on rope
2	50	100	Goblin #1	#1	23" lanyard	2	1303	Not measured	Goblin tested in self trailing mode, not holding safety line off the bag	Very minor sheath abrasion visible, core feels compressed but not damaged.
3	50	100	Goblin #1	#1	23" lanyard*	2	1291	30.5	Goblin tested in self trailing mode, not holding safety line off the bag	Very minor sheath abrasion visible, core feels compressed but not damaged.
5	50	100	Goblin #1	#1	31.5" lanyard	2	1081	-10.5	Goblin tested in self trailing mode, not holding safety line off the bag	
6	50	100	Goblin #1	#1	31.5" lanyard*	2	1263	25	Goblin tested in self trailing mode, not holding safety line off the bag	
7	50	100	Goblin #2	#2	31.5" lanyard	2	1001	7.5	Goblin tested in self trailing mode, 88" measured from knot to orange tape	Very minor sheath abrasion visible, core feels compressed but not damaged.
10	50	100	Goblin #3	#4	31.5" lanyard	2	974	-6	92" measured from knot to orange tape	
17	50	100	Goblin #4	#5	31.5" lanyard*	0	710	< 1	Maybe had 6" of slack in safety	
18	50	100	Goblin #4	#5	31.5" lanyard*	0	675	< 1		
20	50	100	Goblin #5	#6	31.5" lanyard	2	984	-5	Rope length 78"	
33	200	50	Goblin #6	#9	31.5" lanyard	1	1316	11		Minor sheath abrasion
22	50	100	Kong #2	#7	13" lanyard with Kong biner	2	841	Failure, Device bounced a few times and rode down to bag		
23	50	100	Kong #2	#7	18" lanyard	2	508	Slid halfway down initially due to crossed biner, but as we lowered everything with crane, kong and 50 kg bag fell to the ground	Biner was cross loaded	
24	50	100	Kong #2	#7	18" lanyard*	2	1011	Failure, Device bounced a few times and rode down to bag		

				* = resuse lanyard		**All ropes: 7/16" PMI Access Pro Low Stretch				
	Test Scenario									
Test #	Test Weight (kg)	Rope Weight (kg)	Backup Device	**Rope	Lanyard	Fall Factor (approx.)	Peak Load (lb)	Backup Device Slip (inches)	Comments	Rope damage
1	Test Deleted									
4	Test Deleted									
19	Test Deleted									
32	Test Deleted									
36	Test Deleted									
25	50	100	Red #1	#7	31.5" lanyard	0	1178	Failure, Device rode almost all the way down to bag (15" away)		
26	50	100	Red #2	#7	31.5" lanyard*	0	887	Failure, Device rode all the way down to bag	59" from anchor to start	
15	50	100	Rescuecender #1	#5	31.5" lanyard*	0	633	2		
16	50	100	Rescuecender #1	#5	31.5" lanyard*	2	992	2	106" measured from knot to orange tape	Minor core compression on rope
39	50	100	Rescuecender #2	#12	31.5" lanyard*	0	1290	1.5	79" Anchor to orange tape	
40	50	100	Rescuecender #2	#12	31.5" lanyard*	0	751	<1	79" Anchor to orange tape	
41	50	100	Rescuecender #2	#12	31.5" lanyard*	0	753	1.5	79" Anchor to orange tape	
27	50	100	Shunt #1	#7	31.5" lanyard*	0	826	0		
28	50	100	Shunt #1	#7	31.5" lanyard*	0	761	0		
29	50	100	Shunt #2	#7	31.5" lanyard*	0	794	0		
30	50	100	Shunt #2	#7	31.5" lanyard*	1	923	2.25	91" Rope length	
31	50	100	Shunt #2	#7	31.5" lanyard*	1	865	4	91" Rope length	
8	50	100	Vector #1	#3	31.5" lanyard	2	1186	56, slid almost to lower bag	Not holding bag away, 89" measured from knot to orange tape	
9	50	100	Vector #1	#3	31.5" lanyard*	2	1254	42, slid almost to lower bag	Repeat test #8 holding bag away, 89" measured from knot to orange tape	
35	200	50	Vector #2	#11	31.5" lanyard	2	2107	89	94" Rope length	Rope was completely desheathed. Core still intact.
37	50	100	Vector #3	#12	31.5" lanyard*	0	699	0	Held the device up with tape to simulate a factor 0 fall, no video	
38	50	100	Vector #3	#12	31.5" lanyard*	2	1306	38	90" Rope length	

Note: Backup Device Slip is measured from 24-inches below backup device start position to incorporate 24-inch rappel simulation. Negative slip is taken as zero.

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