



# Athletic Capacity Evaluations (ACE)

Modeling Alpine Ski  
Physical Capacity

[The ACE Model](#)

With an aim to provide Alpine ski coaches and athletes with a sport specific profiling tool, the British Ski Snowboard association (BSS) has created the Athletic Capacity Evaluations (ACE) to assess athletic prowess, and physical and movement literacy as it relates to a skiers development.

The development of world-class skiers requires every athlete to develop a well-rounded basis of physical literacy from multi-sport practice, which is why each of the ACE evaluations relates to: 1) the movement skill requirements of ski racing, and 2) global movement capacity across a range of athletic skills.

Each athletic capacity evaluation has been carefully selected based on the following criteria:

- Assess global physical movement patterns that relate to specific Alpine skiing activity.
- An evaluation must reflect the metabolic (energy systems), motor control (stability/ strength), and/or neural firing activity (coordination/ time and type of muscle contraction) and muscular (production of force) properties linked to ski racing.
- Must serve as valid measure of gross athletic capacity across environments.
- Requires minimal equipment and resource to run each evaluation.
- User friendly to both coaches and athletes.

Naturally, the quality and validity of any profiling tool is essential when grading physical literacy and athletic capacity of athletes, which is why the ACE evaluations have been selected with reference to over 2 decades of Alpine ski research to optimise the specificity of these measures to ski racing.

### **Evaluating ACE results:**

Upon measuring athletes' physical **literacy** an understanding of athletic profile is created and modelled using Excel software, which accompanies this package. See pages 10-11 for examples of: Data entry into a Table format, and Graphical illustration of results.

From this, further engagement and training recommendations with athletes' are based on continued development with reference to their performance in the ACE model.

Data points collected from each ACE camp are included within the athlete's individual profile, which is shared between athlete, coach and the physical practitioner. Up to 3 sets of data points will be collected on each athlete during a yearly training cycle.

### **The 7 ACE evaluations are:**

*Note: Evaluations must be filmed to ensure validity across environments.*

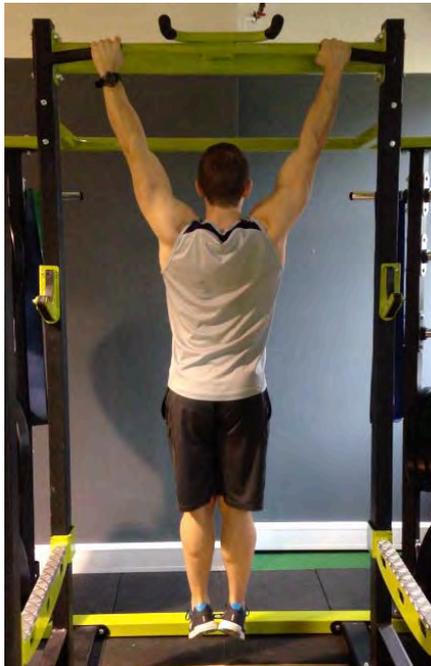
- 1) Over-hand grip Pull-up on a straight bar – click on the link - [Over-hand grip Pull-up](#)**

The Pull-up assessment measures the strength-endurance capacity of musculature and connective tissues acting at the arms, back, shoulder, trunk and pelvis.

A high level of strength throughout the body is essential to withstand high forces and eccentric loads imposed on the body during racing (Turnbull et al., 2009). Furthermore, a high level of strength at the shoulder girdle is shown to be an important factor to reduce the risk of injuries to the shoulder joint, and the head (concussions), which is the heaviest part of the body (Kocher and Feagin, 1996).

#### How to conduct the Pull-up evaluation:

- Place hands on the bar in an over-hand wider than shoulder width grip position, with the thumb wrapped around the index finger.
- Start in a hanging position and begin the pull-up until the chin arrives above the bar with the head in neutral, with the legs in a straightened position.
- Ensure a pause for a 3 second count is held at the top and bottom of the pull.
- Count total reps completed until either the athlete cannot maintain the 3-second hold, or a knee bend and breaking from the 'ramrod' posture is lost.
- No swinging, or use of a leg 'kick' is permitted.



Regression: If the athlete cannot complete any reps with the over-hand grip (Pull-up), an under-handgrip style (palms up) can be used to allow a score to be collected – this is known as the Chin-up. For the chin-up take a shoulder width grip on the bar.

Complete 2-3 attempts to achieve a best max rep score with a 3-minute rest between attempts. Highest number of reps completed should be taken as the final score. Please state which pulling method was used to collect the score: Pull-up or Chin-up.

#### 2) The Bear Crawl (+ water bottle) – click on the link – [The Bear Crawl](#)

Research has shown that a high level of activation and control of the trunk (torso) along with the ability to dissociate actions at the legs and secondly the arms, is vital during ski turning (Heikkinen, 2003). Therefore, this evaluation measures the ability to maintain dynamic control at the shoulder, trunk and hips, whilst completing forward and reverse crawling patterns.

To ensure validity is maintained across assessments a filled water bottle should be rested on top of the athletes' lumbar spine (low back) in a horizontal, across body position.

The water bottle serves as constant feedback to the athlete that crawling reps must be completed whilst maintaining a neutral spine and good pelvic positioning. If a neutral 'sound' posture is lost, the water bottle will drop to floor indicating distance travelled (marked at the hands) and the limit of dynamic control and capacity.



#### **How to conduct the Bear Crawl evaluation:**

First measure a 10m straight line marked with a single cone at the start and end points.

- Begin by setting up on all fours behind the start cone, have a friend place a 'full' water bottle across the low back region and crawl 10m to the next cone by simultaneously lifting opposing hand and foot, reach forward and place down on the floor ahead of the body, continue this motion with opposite hand and foot, and repeat.
- When both hands arrive at the end cone, crawl in reverse until your feet reach the 10m start cone.
- Dragging or sliding of hands and feet are not allowed.
- Crawling is performed continuously until the water bottle drops to the floor, or the athlete cannot complete further distance.

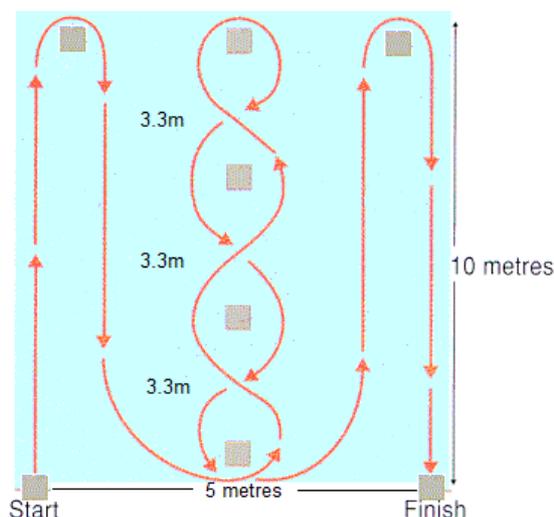
After practicing crawling technique a couple of times, the athlete is permitted 2 attempts to log a total score.

Total distance covered forwards and backwards is summed as the 'total score' this should be logged in metres (m).

### **3) The Illinois Agility – click on the link - [Illinois Agility](#)**

This evaluation measures the ability to express ballistic strength, power and speed in a highly functional context. The multiple sharp changes in direction of the drill replicates the muscular contraction profile imposed on the leg muscles during turning on ski's, and also requires the athlete to show a high degree of control and strength through high knee and hip flexion-extension postures as seen in Slalom skiing (Turnbull et al., 2009).

Build the course (pictured below) and hand time the 10m acceleration phase (being: start to first turn, breaking the line at 10m).



#### How to conduct the Illinois Agility evaluation:

The evaluation requires the athlete to run the red line route once (as in the diagram) as fast as possible.

- The athlete lies face down on the floor with their head behind the “Start” cone.
- The assistant gives the command “GO” and starts the stopwatch.
- The athlete jumps to his/her feet and negotiates the course around the cones following the red line route as quickly as possible through to the finish.
- The assistant stops the stopwatch and records the time when the athlete’s body passes the “Finish” cone.

Record the 10m time (acceleration) and also the total time taken to complete the course.

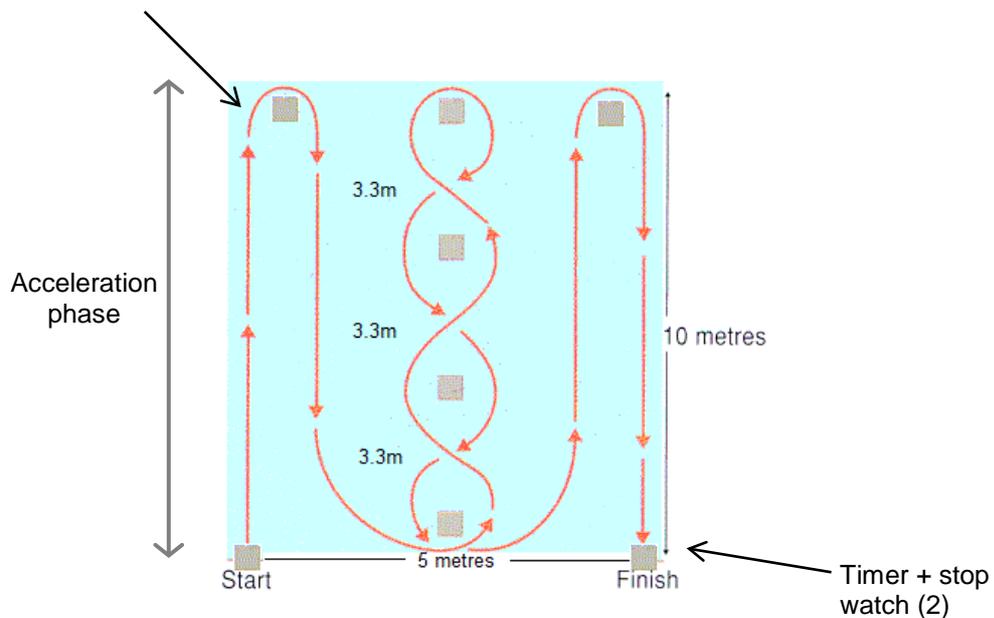
Complete up to x3 runs with 3-minutes rest between each running effort.

Record the best effort (quickest time) from the three runs.

#### 4) 10m Acceleration

This score is obtained by recording the first 10metres of The Agility Illinois evaluation (see page 5) and represents athletes’ absolute explosive speed and power. Muscular speed and power are considered to be important qualities of the elite Alpine ski racer (Turnbull et al., 2009).

The image below shows that the first 10metres from “start” cone to first cone is the acceleration phase and the timed distance to record.



### Recording the Acceleration evaluation:

- The 10m Acceleration time **MUST** be taken from the quickest total time achieved in the Agility Illinois evaluation.  
More specifically, the Acceleration score taken to log the athletes' performance in this evaluation is dictated by the quickest run scored in the Agility Illinois evaluation.
- If you have access to timing gates you may wish to use them instead of handheld stopwatches for ease of data collection.
- Timing gates should be set up at the "start" cone (1), and secondly, in-line with the first cone (2), see number reference in the diagram above.
- Up to x3 acceleration times should be collected along with the Agility Illinois timed runs.

Please indicate if a hand-held watch or timing gates have been used.  
The evaluation must be filmed.

### 5) X-Over Hop – click on the link - [X-Over Hop](#)

This evaluation indicates express eccentric, ballistic strength and change. The level of ability to complete this the high level of turning seen in Alpine 2009). What's more, a single leg hop scores programming for injury limbs. One of the single



the athlete's ability to isometric, and concentric power during a directional single leg control and task effectively relates to athleticism required during racing (Turnbull et al., large difference between can be used to influence prevention to the lower-most common reasons for

ACL and Back injuries is a discrepancy between limb performance. This is also a screening assessment conducted by many professional organisations.

The central line you mark should be 300mm (width) outside edge to outside edge distance between the lines marked in this image.

You must complete 4 separate hop efforts: 2 off the left foot, and 2 off the right foot. When jumping with the left foot you should set up on the right hand side of the central line to begin. When jumping with the right foot you should set up on the left hand side of the central line.

#### **How to conduct the X-Over Hop evaluation:**

Right foot hopping example:

- Starting on the left side of the central line stood on your right leg only
- Begin by hopping over the 2 lines to the right side,
- Then, quickly across to the left,
- Before finally hopping and landing (with control) over to the right side, and “sticking” the landing for a 2-second count to finish. That is 3 hops in total.
- Measure the total distance covered in metres.
- If you over balance or touch the floor with your foot/ hand it's a ‘no jump’. Also, touching the tape with your foot at any stage is a ‘no jump’.
- The athlete has 2 attempts after a warm up to produce a score.

The recorded score is the furthest distance recorded after 2 attempts on each leg.

This means there should be x2 scores, 1 for the left leg, and 1 for right leg.

Please log both scores in the Excel scoring document to indicate left to right side differences, this is the ‘combined’ score.

#### **6) 150m Decrement Run – click on the link - [the 150 Decrement Run](#)**

This evaluation measures the efficiency and capacity of the anaerobic and aerobic energy systems that are taxed during ski racing. Information collected shows the athletes ability to perform an all-out single race effort, and also the body's ability to recover from repeated race efforts, which are shown to be important for ski racing (Steilow, 2010, Turnbull et al., 2009).

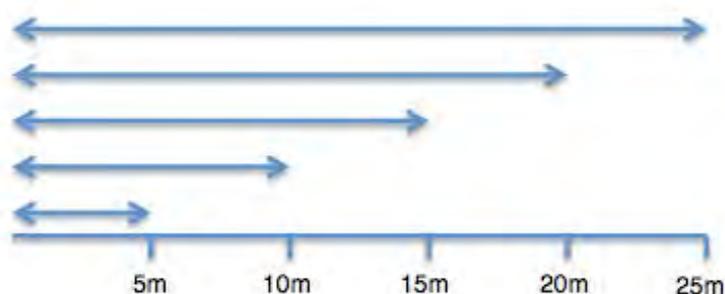
This is the most aerobically demanding of the evaluations therefore you must complete a thorough warm-up before you begin.

**Safety Note.** If you are carrying an injury or niggle DO NOT attempt this evaluation.

See diagram below for a blueprint of the Decrement run. The total distance should be set at 25 metres in length, with 5 x 5m interval points.

**How to conduct the 150m Decrement Run:** (The video link shows the protocol to use, but with the following changes as listed).

- Start on your front with your head behind the “start” line.
- On “GO” You have 30-seconds to shuttle 5m and back, 10m and back, 15m and back, 20m and back, and finally 25m and back.
- Your aim is to complete a maximum number of shuttles possible with 30 seconds of running. Then you have a 30 seconds rest and return back to the start position.
- You must complete 6 consecutive 30-second intervals, interspersed with 30-seconds rest = 6minutes of total work.
- At each 5m mark you must pick up a small object (e.g. bean bag) and carry it back to the previous 5m marks. Complete this pick up and put down at each 5m point throughout the 30 seconds (as seen in the video).
- Replace the beanbags to the 5m points after each 30-second trial and repeat the drill.



For each trial record the total distance completed to the nearest 5m mark. Only completed 5m marks can be counted.

At the end of the evaluation you should have scores for 6 individual trials, and therefore one overall score summed from the 6 trials.

Lastly, if you are completing this evaluation on your own and not at a supervised ACE event you must film this assessment. Scores will not be accepted without filmed evidence.

Make sure you remain hydrated with a drink of water during and after this evaluation as required.

## 7) The Hexagon Jump – click on the link - [Hexagon Jump](#)

This evaluation challenges the ability to complete jumping and landing at high speed, with several changes in direction, which reflects agility, coordination and foot speed.

This evaluation is shown to have high correlation to Alpine ski racing performance (Andersen et al., 1990) and also serves as a major ACL prevention screening evaluation. The ability of a skier to decelerate under control repeatedly is a major indicator of ACL susceptibility.

First, click on the video link [how to draw a Hexagon](#) to build the dimensions for the evaluation.



**How to conduct the Hexagon evaluation:**

- Start by standing in the middle of the hexagon.
- On “GO” jump over and back across every line around the hexagon in one direction with feet remaining close together (as in above image).
- Complete 3 full revolutions, finishing back in the middle of the hexagon, then stop the clock.
- Jumping direction is individual to the athletes' preference.
- There is a .5 second (1/2 a second) time deduction if you touch a line during any of the 3 revolutions.

Up to 2 efforts / trials are allowed before a 'best time' can be taken and used as a final score.

Again, the assessment must be filmed and submitted along with the score.

# Athlete Database Example – Table data entry view

U16 ATHLETIC CAPACITY EVALUATIONS																			Close Full Screen	
NAME	Selected/ Not Selected	Assessment Date	Venue	10m Acceleration	150m Decrement	X-Over Hop Combined (x1R / X1L)	Illinois Agility	Sergeant Jump	Chins	Marching Superman	10m Acceleration	150m Decrement	X-Over Hop Combined	Illinois Agility	Sergeant Jump	Chins	Marching Superman	No. of evaluations completed	OVERAL L POINTS	
Method				taken from best agility time		sum of x2 jumps	best of 3 runs	best of three	best of three	best of three										
	Not - Selected	April 28th 2013	Preston	2.22	6.40	6.62		42.50	4.00	1.00	3749	675	285	0	716	617	0		6042	
		Sept 7th 2013	LJMU	2.69		10.42	17.22	44.50	3.00	10.00	3550	0	511	602	757	357	108		5885	
				-17.47%	#DIV/0!	36.47%	100.00%	4.49%	-33.33%	90.00%	4842	#DIV/0!	#NUM!	3331	#NUM!	#NUM!	#NUM!		#DIV/0!	
											0	0	0	0	0	0	0		0	
											0	0	0	0	0	0	0		0	
	Not - Selected	April 28th 2013	Preston	3.03	6.05	0.00	0.00	31.50	1.00	19.00	3408	597	0	0	494	0	230		4729	
		Sept 7th 2013	LJMU	2.90	0.00	8.80	18.32	31.00	0.00	40.00	3462	0	414	494	484	0	530		5384	
											0	0	0	0	0	0	0		0	
				-4.48%	#DIV/0!	100.00%	100.00%	-1.61%	#DIV/0!	52.50%	4737	#DIV/0!	#NUM!	3331	#NUM!	#DIV/0!	#NUM!		#DIV/0!	
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	Not - Selected	April 28th 2013	Preston								0	0	0	0	0	0	0		0	
		Sept 7th 2013	LJMU	2.72	0.00	8.83	17.65	36.00	2.00	22.00	3537	0	416	558	584	140	271		5506	
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											0	0	0	0	0	0	0		0	
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	Not - Selected	April 28th 2013	Preston	2.94	4.45	9.66	0.00	35.00	0.00	0.00	3445	281	465	0	564	0	0		4755	
		Sept 7th 2013	LJMU	2.53	0.00	7.79	17.53	37.00	0.00	17.00	3617	0	354	570	604	0	202		5347	
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				16.21%	#DIV/0!	-24.01%	100.00%	5.41%	#DIV/0!	100.00%	4681	#DIV/0!	#NUM!	3331	#NUM!	#DIV/0!	0		#DIV/0!	
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	Not - Selected	April 28th 2013	Preston	3.19	5.45	11.33	0.00	49.00	0.00	0.00	3342	471	566	0	850	0	0		5229	
		Sept 7th 2013	LJMU	2.91	0.00	8.34	18.93	39.00	0.00	11.00	3458	0	386	439	644	0	121		5048	
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				9.62%	#DIV/0!	-35.85%	100.00%	-25.64%	#DIV/0!	100.00%	4712	#DIV/0!	#NUM!	3331	#NUM!	#DIV/0!	0		#DIV/0!	
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	Selected	April 28th 2013	Preston	2.38	6.45	14.78	0.00	45.60	6.00	3.00	3681	686	776	0	779	1231	21		7174	
		Sept 7th 2013	LJMU	0.00	0.00	11.10	0.00	53.00	7.00	5.00	0	0	552	0	933	1574	45		3104	
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				#DIV/0!	#DIV/0!	-33.15%	#DIV/0!	13.95%	14.29%	40.00%	#DIV/0!	#DIV/0!	#NUM!	#DIV/0!	#NUM!	#NUM!	#NUM!		#DIV/0!	
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											0	0	0	0	0	0	0		0	
	Selected	April 28th 2013	Preston								0	0	0	0	0	0	0		0	
		Sept 7th 2013	LJMU	0.00	0.00	9.26	0.00	40.00	2.00	14.00	0	0	441	0	665	140	161		1407	
											0	0	0	0	0	0	0		0	
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											0	0	0	0	0	0	0		0	

# Athlete Report Example – Graph view of results

Home	Layout	Tables	Charts	SmartArt	Formulas	Data	Review
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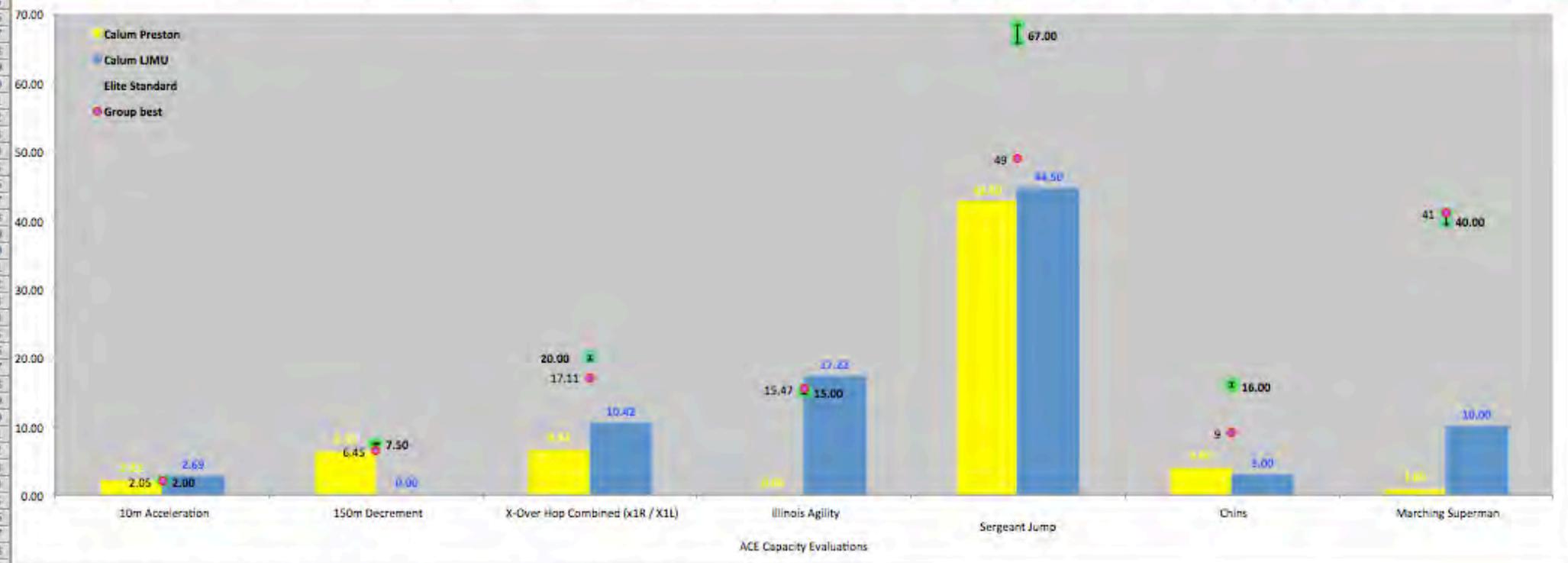
## U16 ATHLETIC CAPACITY EVALUATIONS

Close Full Screen

To be replaced with Hexagon Jump @ next ACE

To be replaced with Bear Crawl @ next ACE

NAME	Selected/ Not Selected	Assessment Date	Venue	10m Acceleration	150m Decrement	X-Over Hop Combined (x1R / X1L)	Illinois Agility	Sergeant Jump	Chins	Marching Superman	10m Acceleration	150m Decrement	X-Over Hop Combined	Illinois Agility	Sergeant Jump	Chins	Marching Superman	No. of evaluations completed	OVERALL POINTS
Method				taken from best agility time		sum of x2 jumps	best of 3 runs	best of three	best of three	best of three									
	Not - Selected	April 28th 2013	Preston	2.22	6.40	6.62	0.00	42.50	4.00	1.00	3749	675	285	0	716	617	0	7/8	6042
		Sept 7th 2013	LJMU	2.69	0.00	10.42	17.22	44.50	3.00	10.00	3550	0	511	602	757	357	108	7/8	5885
				% Change	-17.47%	#DIV/0!	36.47%	100.00%	8.49%	-33.33%	90.00%	4842	#DIV/0!	#NUM!	3331	#NUM!	#NUM!	#NUM!	#DIV/0!
											0	0	0	0	0	0	0	0	0



- The graph above includes scores taken from Preston ACE (yellow values) compared against scores obtained at Liverpool ACE (blue).
- The purple circular marker indicates the best score collected from ACE events to date within each physical evaluation.
- The green marker with T line book ends shows the 'Elite standard' result for each passessment - This score should be a long term goal when striving for physical performance. This set of benchmark values have been derived from athlete performance comparisons and research made in Soccer, Rugby Union and League.
- An improvement in ohysical performance is considered if each score is improved by a minimum of 2% change.

## **ACE References**

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