

the complete guide to

CIRCUIT TRAINING

A SPECIAL REPORT FROM



**PEAK
PERFORMANCE**

The research newsletter on
stamina, strength and fitness

the complete guide to

CIRCUIT TRAINING

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From the editor

Circuit training is one of the most commonly used sports training components and is used by sportsmen and sportswomen from many sports. However, perhaps because of its ubiquity it's often seen as a general method of developing sports condition and fitness. Although this is undoubtedly so, with thought and application circuits can be used throughout the training period to develop speed, agility and skill and even reduce injury potential.

In article 1, Phil Gardiner provides an introduction to circuit training setting the scene for the articles that follow. In articles 2,3 and 4 I provide you with ways in which circuits can be devised to replicate the demands of your sport and their specific physical requirements – in order, endurance, speed and skill. You will be able to use these articles to create a 'super circuit' specific to you and your sports needs. In article 5 Phil explains how to periodise (plan over the training year) circuit training for a sprinter. His article shows you just how vital circuits can be in an overall training plan. It's in this article that he also introduces the pre-habilitation aspect of circuits – that's their ability to strengthen the athlete's body so that injury risks can be minimised. In article 6 we take a look at boxing training – as an example of a sport where circuit training is particularly crucial, and finally in article 7, we provide examples of circuits that can be used for various sports. These workouts will act as valuable pointers for the construction of your own sports-specific circuits.

Although circuit training can be thought of in relatively non-advanced terms, as noted, it is actually far from that. Hopefully this Peak Performance special will enable you to throw these beliefs out of the window and enable you to see it in a new light and specifically understand how it can be a vital, specific and constant part of athlete preparation.



John Shepherd

What is circuit training?

By **Phil Gardiner**

In this article I describe the major reasons for including circuits in a sports training programme and provide the reader with examples of training sessions that have been successful for various athletes, including those I have worked with and the military.

Circuit training:

- is a series of exercises performed in rotation
- involves exercises that can be performed with or without external resistance (just bodyweight)
- can include rest periods between the exercises and/or at the end of each circuit, or there can be no recovery periods at all. It all depends on the fitness of the athlete/athletes doing the circuit and what their training requirements are. If the aim of the circuit is to improve endurance (*see article 2*), then the recoveries will ideally be short. However, should the aim be to increase power or speed (*see articles 3,4,5,6*), then recoveries will normally need to be longer to allow for quality of movement to be less/unaffected by fatigue.

Why include circuits in a training programme?

- Circuits can easily be managed in a group situation.
- Circuits can be tailored to the individual.
- Circuits – particularly if no extra resistance is involved – can be performed almost anywhere.
- Circuits can be designed to target various training goals.

Who uses circuit training?

Circuit training is perhaps the most versatile of all training options and potentially one of the most effective

For people from all walks of life, from the office worker who goes to the local gym, to the amateur to elite sportsman or sportswoman, whether a Sunday league footballer, an athletics club sprinter, or World or Olympic Champion rower or 400m runner – circuit training is perhaps the most versatile of all training options and potentially one of the most effective.

Circuit resistance

Circuit training using only bodyweight as resistance, such as press-ups or jump squats, can be as hard a workout as you want it to be. However, these workouts are of moderate intensity and can often be performed 2-3 times a week by fitness enthusiasts. It usually only takes 24 hours to recover from this type of workout. However, for sportsmen and sportswomen fitting circuits into their intense and full training plan it can be more problematic given their need to train at a high intensity, cover numerous elements of performance and compete on a regular basis.

I will often programme bodyweight circuit training workouts for lower intensity training days. They are often used in conjunction with tempo running (runs performed at 70-80% effort with the emphasis on technique) and medicine ball throwing. All these training options develop and maintain general fitness in my athletes and assist their recovery process, following high intensity sessions such as sprinting or heavy weights, which are performed on other days.

If for example, Sunday is a high intensity training or match day, then Monday and Tuesday should be recovery days and would be a good time to programme in a circuit training unit. They can be performed again later in the week, perhaps a day or two following a second high intensity session. In article 5 I provide further information on how to include circuits into an evolving training plan – with particular reference to sprint athletes – see page 39.

I believe that when using circuit training for general conditioning – and if including it with other elements of training in one session – it should be performed last, with the quality, speed, skill and agility work performed first.

Getting started

Types of circuit

Circuit style circuits are performed on the basis of each exercise being performed for a given number of reps, then the next and the next and so on, before returning to the first exercise to start the second circuit. Recovery between exercises and sets is determined according to the athlete's fitness, the number of reps, and the time in the training year.

Series style circuits require each set of the same exercise to be performed before moving onto the next – a rest can be taken at the end of each set or between all the exercises in the series

How many reps and sets?

The number of reps you perform each set will be determined by how fit you are, the time in the training year and more specifically the number of sets you decide upon. Most instructors/coaches base their circuit sessions on three sets. A good starting point for the beginner is three sets of 10 repetitions per exercise (the UK armed forces advocate this as a starting figure – of which more later).

However, you may wish to test yourself first and work at a percentage of the maximum repetitions you can perform to failure in 60 seconds – 50% of maximum would be a good starting point. Thus if you were able to perform 50 press-ups in a minute your starting number would be 25. However, if you are a total beginner, the test to maximum could well leave you stiff and sore for a few days, so it's best to be conservative and select a comfortable number of reps as your starting number. You will soon improve and be able to tackle more intense workouts. Starting circuit training conservatively will minimise residual muscle soreness, which will in itself be a motivating factor.

Having worked with most of my athletes for several years I know what they are capable of and tend to set a time limit of 20 seconds per exercise to begin with, working at three sets, increasing to 30 seconds over a period of weeks, with the number of sets remaining the same.

This means that I can vary the exercises as much as I feel necessary without having to test the athlete's maximums each time I introduce a different exercise to the circuit. They only perform as many reps they can manage within the time allocated – some exercises are much tougher than others. I have also discovered that different athletes excel at certain exercises that others will find difficult – all have differing strengths and weaknesses. Note: it is not advisable to introduce totally new exercises into a circuit, as a lack of specific technique could lead to injury.

Circuits with resistance

If using a circuit format for training with resistance – most commonly weights (although resistance bands and weighted jackets can also be used) – the same principles should be applied. In most cases I tend to programme weight training in a circuit format with intensities up to 75% of one repetition maximum. Any lifts at a higher intensity are performed in series format.

The same principles apply as with bodyweight circuits and I tend to couple these circuits with low intensity tempo. However, resistance based circuit training can be included in the athlete's training as units in their own right. They can be a tough workout option (see the rowing circuit in the endurance article on page 23). I will give examples of the type of circuit workouts I use with my athletes later in this article.

The physiological aspects of circuit training

Local muscular endurance (the most common reason for using circuit training)

The ability to perform repeated muscular actions is essential in sport, whether they are whole body actions or single joint actions. Many sportsmen and sportswomen are required to reproduce dynamic movements with a high power output. Conditioning the body to re-produce maximal efforts with little or no drop-off in quality of performance is the cornerstone of any effective and relevant conditioning programme.

To avoid muscle and joint imbalances the training programme should include movements for every joint/muscle group. It is a mistake to focus solely on the athlete's sport specific muscle groups and joints as this will lead to imbalances that could result in injury. A perfect example is that of the tennis player who only focuses on the 'hitting muscles' and not on the supportive stabilising ones, with the result that they develop shoulder problems.

Consequently, I believe that it is advisable whenever possible to include a pulling (flexion) exercise for every pushing (extension) exercise. This ensures that the joint/muscle group worked is being strengthened in both directions. Typical examples include combining leg extensions (for extension) and leg curls (for flexion) and biceps (for flexion) and triceps curls (for extension) into the same circuit.

As well as placing potential strain on the body's muscular-skeletal system, the lack of a balanced circuit (and other training) programme can result in poor posture. A typical example is the sportsman or sportswoman who has spent a lot of time developing their chest muscles, with exercises such as the bench press, but has neglected to develop the muscles of the rear shoulder and upper back. Consequentially they develop a 'round shouldered' look, which is often associated with poor posture of the upper back and potential for back pain.

And it is important to remember that although jumping and short acceleration running involves mainly a pushing actions from the legs, many generic sporting movements (including top speed sprinting) entail predominantly pulling movements. This should also be taken into account when planning a strength-training programme (of which circuit training will probably play a major role).

Circuit training for fitness

Recently the British Army has ventured into a 'war' of a different kind – against obesity. Its circuits are being advocated as a great way for the population to get fit.

With good reason, as circuit training is the cornerstone of

military fitness training. Fitness tests related to circuit training are used as part of the selection process for all disciplines and trades from infantry to catering. Every new recruit then undergoes a couple of months of basic training, of which fitness is a primary aspect. This initial training involves gruelling circuit training sessions.

Circuits – the British Army way

Military physical training instructors (PTIs) have an interesting method of organising circuit training workouts. They pair participants, sometimes with similar abilities, sometimes with opposite strengths and weaknesses, for example, a physically strong person working with a recruit with good endurance.

While one recruit in the pair runs five times around a sports hall, for example, the other performs a bodyweight exercise, for example a press up. When the laps are completed they both stop and immediately swap disciplines. The running laps determine the time spent on the exercises and this can be altered to work on either of the strengths or weaknesses of the pairings or emphasise a certain type of fitness development. Fewer laps would result in a greater strength development and more laps, increased endurance.

The participants can also be split into groups of three or four if using limited resources such as a gym bike or rower. Part of the team would work on the machine/s while the others would run around the sports hall for ‘x’ amount of laps.

Other types of circuits used by the British army

I have provided some interesting variations on the circuit themes used by the British Army when training their recruits. As with the example above, you may wish to include them in your training or in that of those you coach:

1. Gym based

Format: circuit

Develops: aerobic endurance

Warm up	Exercise bike 5 mins @ 50% effort	Row machine 5 mins @ 50% effort
Circuit and effort	Recovery	Record distances
Cycle 60 secs	60 secs	
Row 60 secs	60 secs	
Cycle 120 secs	120 secs	
Row 120 secs	120 secs	
Cycle 180 secs	180 secs	
Row 180 secs		
Recovery 5mins on bike/rower/treadmill plus light stretching		

The circuit is repeated and the recruits are encouraged to beat their distance scores from the first circuit.

For those fit enough, the effort times can be increased to four minutes!

2. Swimming pool and pool side

Format: circuit

Develops: aerobic endurance and local muscular endurance

Swim two widths of pool
Press ups x 20
Swim two widths of pool
Sit ups x 20
Swim two widths of pool
Squats x 20
Swim two widths of pool

Note: recruits must pull themselves out of the pool and not use the steps

The number of widths swum/exercises performed and repetitions completed depend on the fitness levels of the

recruits at the time. The circuit can be progressed by increasing the number of widths swum to three or even four.

The high levels of general fitness achieved by the Royal Marines enables them to carry out very strenuous and mentally complex tasks in their training while still being able to make effective decisions while under stress – this prepares them for combat situations where making the correct decisions under immense pressure is really a matter of life and death. This fact was recognised by the backroom staff of the 2003 England Rugby Union team who enrolled the services of the Royal Marines instructors to put the prospective World Cup squad through their paces.

If you want to experience a military style workout, search the web. You'll find numerous organisations and personal trainers running military style circuit workouts.

Circuit training offers a great deal to the sportsman and sportswoman and their coach. Hopefully the information provided in this article will act as a great starting point on basic circuit types, their specific design and the implementation of circuits into your sports or fitness training.

Constructing a sports-specific circuit: endurance

By John Shepherd

In this article further variations on ‘circuit styles’ are discussed and further thoughts provided on how to pull together a circuit that is specific to your sport (with an endurance emphasis) and explain why exercise selection is crucial

The ‘normal’ conditioning role of circuits

As indicated in article 1, circuits comprise of body weight and resistance exercises and normally combine high numbers of repetitions with short recoveries. This develops strength endurance – the ability of a muscle or muscle group to continue to contract under conditions of fatigue. This is a pre-requisite of many racquet, field and track events, for example, where endurance is to key to winning performance. Circuits can also develop a significant degree of aerobic fitness, if relevantly constructed, of which more later.

Adding a greater aerobic element to a circuit

In article 1 the basic formats of circuit were presented – circuit and series, body weight and resistance, to these may be added another variation that has a specific relevance for endurance athletes – ‘aerobic circuits’.

To design such a circuit, intervals of running, rowing and so on are incorporated into the circuit. These periods could be at the end of each circuit or between each exercise. This type of circuit would be highly relevant for middle and long distance track runners, field and racquet sports players and rowers, for example. The length of these efforts would normally be limited

to 1-4 minutes. They are similar to the British army circuits described on pages 15-18. Research indicates that these aerobic circuits can at least maintain aerobic fitness and $VO_2\text{max}$ (a measure of the body's ability to process oxygen) if performed regularly. This is because the athlete's heart rate will remain elevated throughout the circuit with the specific CV component contributing significantly to this. To achieve the designated aerobic effect heart rates should be around 70-85% of maximum across the circuit.

Making your circuit sports specific – an endurance emphasis

To make your circuit sports specific and create a greater likelihood of physiological transference into your sport you should, when selecting exercises, consider:

- the movement patterns involved in your sport;
- the energy systems used – whether they are more anaerobic or aerobic;
- the areas of the body that might need to be strengthened to reduce injury potential (*this is covered in more detail in article 6*);
- the speed of movement of the actions involved in your sport;
- the nature of the muscle actions involved – are they dynamic, multi-directional, or more constant?
- the length of your sport;
- what type of contact if any, is involved.

If you do this you will be able to develop a much more relevant circuit to your sport which will have a potentially greater transference into it and therefore a greater chance of improving your performance.

To provide a specific example you will find an endurance-based circuit (with comments) on page 23 specifically designed for rowing. You'll see that the majority of the exercises selected have a high relevance to the rowing action.

Power endurance

Power endurance is a phrase used by Tudor Bompa when

Selecting the most appropriate exercises

Returning to training

Athletes from numerous sports often discover that circuits will form a significant part of their training when they return to training after their end of season break. This is no bad thing as these workouts will develop general fitness and condition that can then be progressed into more specific sports fitness as the training period continues (article 6 outlines this developmental progression as applied to sprinters). However, particularly for power athletes, such as sprinters and football goalkeepers, it is advisable that coach and athlete always focus on the relevance of the exercises being selected. Failure to do so could condition a training response that could actually be detrimental to future specific sports performance. A sprinter, for example needs to be able to exert maximum force on the track for a very short period of time. They need powerful, explosive muscles. However, a circuit with multiple reps, that perhaps lasts 30 minutes or more and involves non-sprint specific exercises, could actually dull the responsiveness of their muscles (an example of a sprint specific circuit is provided in article 3).

referring to the type of endurance ability required of field sport players and rowers, for example. Bompa is one of the world's leading strength and conditioning experts and is the only coach to have produced an Olympic champion in a power event and World Champion in an endurance one.

He believes that power endurance is optimally developed by using 30-50% of one repetition maximum loads and 30-60 repetitions performed explosively. It should be noted that the athlete would progress to this intensity over a number of weeks starting with a much lower number of reps (12-15). Such workouts he says, '...require the athlete to exert maximum willpower to overcome fatigue and to reach optimum mental concentration before performing each set'. Basically, the athlete has to be in the zone and be ready and able to challenge pain!

Now, a major difference between Bompa's approach in this respect and that of other coaches is that he recommends far fewer exercises – 3-5 in the circuit – and that recovery between exercises needs to be as long as 3-5 minutes (in the

developmental phase of training) to enable the athlete to be able to summon enough energy to produce another set of high energy repetitions and develop specific, repeatable power. In terms of sets he believes that once conditioned, 3-6 should be possible. Consequently, he believes that if the athlete becomes unable to perform the exercise explosively during a set, then the set should be terminated, as power endurance will not be being developed – rather, a sub-standard physiological response will be patterned.

This type of training is recommended because it will develop the ability of both slow and, crucially, fast twitch muscle fibres to contribute to endurance performance. It will also increase the athlete's 'performance economy'. If an athlete becomes more specifically 'powerfully enduring', he or she will be able to generate more force when running, rowing, cycling and so on. This will mean that they are able to cruise along whilst applying less effort, thus conserving energy. Note that Bompa's approach to all aspects of sports specific strength training is very in-depth and he does also recommend much shorter recovery circuit workouts, using 60-90 second recoveries for example. He is so thorough that his programmes vary for the distance of the endurance activity that an athlete is training for, ie his programme for a 100m front crawl swimmer would be different for a 400 to 1500m specialist. Readers with a specific interest should consult his books – notably *The Periodisation of Strength Training for Sports* (see reference).

* *Periodisation of Strength Training for Sports* – page 212,
Bompa et al, Human Kinetics – 2nd edition 2005

Rowing specific circuit

This circuit was designed by Olympic rowing coach Terry O'Neill. It involves body weight and resistance exercises.

Circuit rationale

The circuit is based on the ultimate goal of the rower; to complete the 2k distance as fast as possible. The exercises are: 1) rowing specific, 2) they must be performed ultimately at a pace equivalent to actual stroke rate, 3) they create conditions that mirror the heart rate and lactate* levels sustained during a 2k race and 4) reflect the time it takes to complete the race distance.

O'Neill progresses his circuits across the training cycle through various pre-season phases, through to competition. Each one increases endurance, speed and power commensurately. As he says, 'In this mesocycle (medium-length, training phase) the weight is reduced. This is so that the athlete can complete 45 seconds of continuous rhythmic exercise at a given rate (speed) at each station; at the end of each station the athlete moves onto the next exercise without stopping (the stage format is followed Ed). This gives a total of 8 minutes of work, during which time heart rates will

rise to 85-95% of maximum. I get the athletes to rest for two minutes at the end of each complete circuit. The aim is for them to do 3 complete circuits during the first 3 weeks and 4 in weeks 4,5 and 6 of this mesocycle.'

The exercises:

- * High pull
- * Press behind neck
- * Biceps curl
- * Bent over rowing
- * Side bends (to right and left)
- * Squat
- * Bench press
- * Clean and press
- * Crunch
- * Bench pull
- * Hyper-extensions

Resistance:

For all exercises the weight on the bar (where appropriate) is kept to 15-30kg – such a loading will enable the speed component of the lift/exercise to remain high and closely match that actually required when rowing.

With thanks to Concept2 (www.concept2.co.uk) and Terry O'Neill for the circuit and comments

* Lactate is a body chemical involved in energy creation. Its rate of production in muscles increases with the intensity of the exercise. The fitter an athlete becomes the more effective their muscles will become at buffering and using lactate to produce energy

Circuit training for speed

By John Shepherd

Circuit training is not traditionally associated with the development of speed (or specific sports skills). As was indicated in article 2 they tend to be viewed as a great way to condition endurance or as a means to lay the foundations of sports readiness upon which more specific sport condition can be built as the playing/competition season approaches. However, this need not be the case and with thought, circuits can actually be designed and implemented in a way that will enhance speed specifically throughout the training cycle

Using circuits to build specific sport speed, skill and endurance

The key training variable that needs attention when it comes to using a circuit to develop speed is ‘quality’. Invariably, for a circuit this will boil down to the recovery between exercises and the number of reps/time spent on each exercise. Speed obviously requires fast movements to be executed, whether this be in the form of repeated tennis strokes for a tennis player or the number of strides made by a sprinter in a 100m race. Coach/athlete should therefore carefully consider the key speed aspects of their sport and the way that this speed is manifested, and select appropriate exercises accordingly. The ‘right’ speed circuit could enhance both the athlete’s actual speed and their resilience for remaining at speed – which will of course dramatically improve their chances of winning. To illustrate this an example of a sprint specific circuit that could be used in the ‘pre-competition training phase’ is provided.

Example of a sprint specific speed circuit

Exercises:

1) Sprint arm action from lunge position

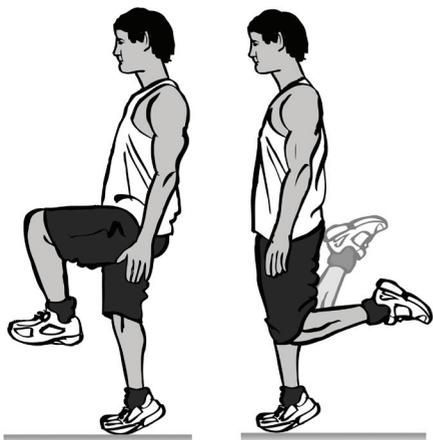
Rationale: driving the arms powerfully and at speed contributes to leg speed; this exercise will condition relevant shoulder power and endurance.

How to perform: assume a lunge position, then drive the arms backwards and forwards as if sprinting.

Key technique tips: focus on driving the elbows back, whilst keeping the shoulders down and relaxed. Hands should reach a position in line with the eyes to the front of the body.

2) Leg cycling (below)

Rationale: Sprinting requires quick transference from one stride to the next. Key to this is the folding up of the 'free leg' as it leaves the track surface and the heel travels a curvilinear path up toward the butt and is then pulled through from the hip into the next stride. This exercise will 'pattern' this cycling action. It will also specifically strengthen the hamstring muscles to withstand the forces involved in sprinting.



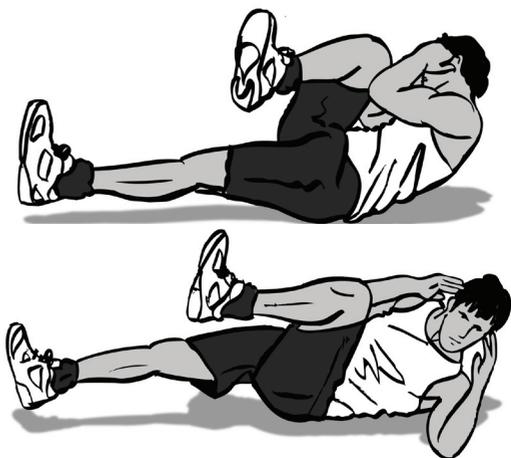
How to perform: Stand next to a wall or a suitable height railing that you can use for balance. Stand on your leg nearest to the wall/rail and lift the thigh of your outside leg to a parallel to the ground position (use your arm nearest the wall/railing for balance). Sweep this leg down and round under your body, pulling your heel up close to your butt as the leg travels behind your body. Extend your lower leg when the leg comes to the front of your body, before sweeping it down to begin the next cycle.

Key technique tip: Keep upright and don't twitch or twist through your trunk as you cycle your leg underneath your body.

3) Alternate knee to elbow crunch ('chinnies', below)

Rationale: develops the ability of the core (abs and back) to withstand the torque (twisting forces) it is subject to when sprinting. This will ensure that the power out-put of your limbs is channelled where you want it (through the track for sprinters) and is not dissipated through unnecessary sideways movement.

How to perform: lie on your back. Place your fingers by your ears and keep your elbows out. Bring your opposite elbow and knee together whilst bending at your waist. Extend your leg and elbow to straighten your body then repeat the movement to the other side.



Key technique tip: twist your trunk as you move forward and back.

4) Speed hops

Rationale: sprinting requires quick ground reactions – a top class sprinter's foot may only be in contact with the ground for only 0.089 sec. Performing this exercise will condition this reaction.

How to perform: hop with a low trajectory more or less up and down on the spot. Land on your forefoot and make the reaction and jump as fast as possible.

Key technique tip: keep your legs relatively straight whilst hopping, minimising knee bend on each hop – this will develop the 'leg stiffness' required for sprinting.

5) Seated sprint arm action

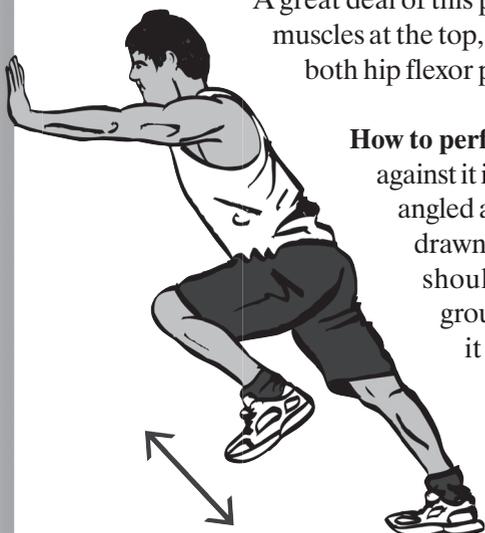
Rationale: to improve the performance of the sprint arm action and develop specific core strength. When sprinting the forces generated by the arms and legs can create a pulling/twisting effect on the torso. This exercise will strengthen this region to withstand these forces and in so doing will also enable the power generated to be optimally transferred through the track/running surface and not wasted in lateral movement.

How to perform: Sit on the ground with legs extended and trunk upright. Keep chest elevated and look straight ahead whilst pumping the arms backwards and forwards as if sprinting.

Key technique tips: Hands should reach a position level with the eyes to the front of the body, whilst upper arms should attain position parallel to the ground behind. Maintain a 90-degree bend at your elbows throughout the exercise.

6) Leg drives (left)

Rationale: In order to accelerate the body from a stationary start the sprinter's legs must push forcibly back against the track. A great deal of this power will come from the hip-flexors (the muscles at the top, front of the thighs). This drill will develop both hip flexor power and speed.



How to perform: stand facing a wall with your hands against it in line with your chest. Your body should be angled at approximately 45 degrees – if a line were drawn through your ankle to the outside of your shoulders. Drive your foot down toward the ground and then after your toes contact it, pull it up as quickly as possible to return your thigh to its parallel to the ground position.

Key technique tip: maintain the angled position of your body throughout the exercise.

7) The plank (below)

Rationale: This ‘held’ exercise is included in the circuit to
a) add recovery and
b) develop core condition.



How to perform: assume a type of press-up position and support your body through your elbows and toes – there should be a straight line through your ankles, outside of knees, hips and shoulders through to the back of your neck.

Key technique tip: remain relaxed throughout the hold.

8) Medicine ball chest pass against wall (right)

Rationale: Both arm speed and power are crucial to optimum sprinting – this exercise will develop plyometric (quick muscle reaction) power in the shoulders and chest.

How to perform: stand facing a wall. Hold a light medicine ball (2-5kg) with your hands on its sides. Push the ball away from you as powerfully as you can, using a chest pass action to throw it against the wall. Catch the rebound and repeat the throw.

Key technique tip: stand close to the wall and ‘move’ the ball as fast as possible through the ‘catch and throw’ cycle.

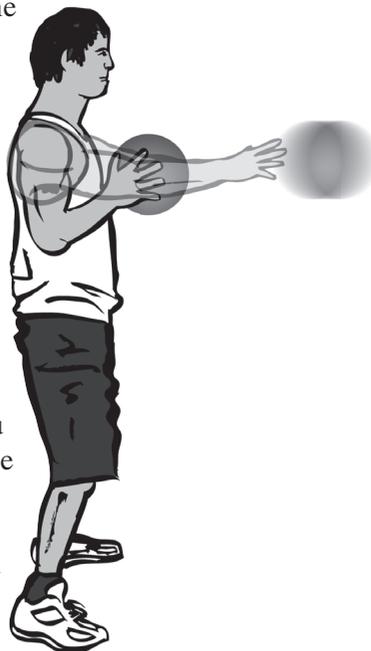


Table 1: Sample progression for a training mature sprinter

Circuit to performed 1 to 2 times a week								
Exercise/week	1	2	3	4	5	6	7	8
Sprint arm from lunge	2 x 10 secs	2 x 12 secs	2 x 15 secs	4 x 15 secs	3 x 14 secs	3 x 16 secs	3 x 18 secs	4 x 10 secs
Leg cycling	2 x 15 left and right	2 x 18	2 x 20	4 x 16	3 x 18	3 x 20	3 x 20	4 x 12
Chinnies	2 x 15	2 x 18	2 x 20	4 x 20	3 x 20	3 x 26	3 x 26	4 x 16
Hops	2 x 10 left and right	2 x12	2 x 15	4 x 14	3 x 14	3 x 16	3 x 16	4 x 12
Seated sprint arms	2 x 10 secs	2 x 12 secs	2 x 15 secs	4 x 18	3 x 18 secs	3 x 20 secs	3 x 20 secs	4 x 15 secs
Leg drives	2 x 10	2 x 12	2 x 15	4 x 16	3 x 14	3 x 16	3 x 18	4 x 12
Plank	2 x 20 secs	2 x 25 secs	2 x 28 secs	3 x 20 secs	3 x 25 secs	3 x 25 secs	3 x 25 secs	4 x 20 secs
Med ball chest pass	2 x 20	2 x 25	2 x 30	4 x 25	3 x 30	3 x 30	3 x 30	4 x 20

Sprint circuit format, circuits, repetitions, recoveries and suggested progression

Key to this circuit is the completion of the exercises at the fastest possible speeds (where relevant) without significant tail-off. This circuit uses time on an exercise as the repetition variable and it is performed in series. As with all circuits, the athlete should start with a manageable time (in this case) and then gradually increase the time spent on each station – however the key difference with this circuit when compared to more endurance orientated ones is the need to maintain the speed of the exercises. If this tails off, then the circuit is not going to meet its goals. Coach/athlete should be on the look out for noticeable deterioration – if this occurs then recovery should be increased, or the number of circuits. A sample progression has been provided in table 1 (*above*).

Recovery between exercises: as indicated this must be long enough to allow the athlete to perform the exercises as fast as possible without significant fatigue.

Consider the progressions carefully – you’ll note that some exercises are not progressed as much as others in terms of repetition duration. This is because they are ‘tougher’ and create greater fatigue. By week 8 the sprinter should have sufficient speed endurance to complete all the exercises with lightening speed.

The specific speed endurance developed in this workout should transfer directly into improved sprinting. An added value of the circuit will be its ability to strengthen body parts in a way specific to sprinting which will minimise injury risk.

Note: the sprint circuit would be suitable for field and racquet sports players as well as sprinters.

Circuit training for skill

By John Shepherd

Skill is a crucial element of all sports – being able to perform a top spin forehand with optimum ability as a tennis player or strike a ball cleanly between the posts every time as a rugby kicker will provide every opportunity of building a winning performance. Under conditions of fatigue skill can break down – a relevantly constructed circuit can contribute to minimising this deterioration

Skill is often trained in isolation to other sports conditioning elements. Many football players will, for example, do their skills work and weights and running work in separate workouts. Although this is both practical and a necessary part of sports training this need not always be the case. Incorporating specific sports skill into a circuit offers huge potential and the skills based sports circuit affords the coach a unique conditioning opportunity.

The skills based sports circuit affords the coach a unique conditioning opportunity

Most field and racquet sports require their respective athletes to perform skills under conditions of fatigue. One piece of research estimated, for example, that elite footballers made 7,000 turns and 3,900 jumps in competitive play and training. To make all those turns and jumps as effective as possible the player needs to have both skill and specific endurance. Superior endurance will also reduce injury potential, as further research indicates that the fittest players are less likely to sustain injuries, particularly in the last quarter of a match.

How to construct circuits that develop skill and specific endurance

1) Analyse the time requirements of your sport

Consider: what is the typical length of plays within your sport or the average running distances achieved and their velocities? OK, a football match lasts 90 minutes, but much of that time will be spent – depending on playing position – jogging, sprinting, running backwards and sideways and so on. Thinking about this will put you in the best position to construct a relevant skill based circuit.

2) Analyse the energy system used in your sport

Field and racquet sports, for example, rely on the anaerobic (without oxygen) energy systems, with the aerobic (with oxygen) energy system providing a base for the former. A base which allows the athlete to recover more quickly between on pitch/court efforts. Positioning relevant recoveries between equally pre-determined periods of effort could produce a sports performance circuit highly transferable to your sport.

Rugby research indicates that players spend about 47% of the match walking and jogging, 6% running and sprinting, 9% tackling or competing for the ball and 38% standing. Armed with this information it would be possible to construct a highly relevant circuit for this sport

3) Analyse the movement patterns required of your sport

Following on from point 2, coach/athlete should select exercises that reflect the movements involved in their sport. Consider how turns and jumps and other sport specific movements are performed and implement them into your circuit. Example of football skill circuit found on pages 35-38. Study its contents and you will appreciate how you can really get specific when constructing a circuit that will directly contribute toward improved performance.

4) Analyse the body parts and muscle groups that need to be specifically conditioned

Concern yourself with where you (or the athletes you coach)

need power and how your muscles work to provide this. For example, for most sports the thigh muscles are key. Single leg resistance and body weight exercises could be vital circuit ingredients in this respect, as in most sports, the legs work independently to generate this power. Single leg squats and hops would therefore be relevant exercises.

5) Analyse the body parts and muscle groups that need to be specifically pre-conditioned to avoid injury

Following on from point 4, it is equally important to consider the exercises that will reduce the chances of sustaining an injury. Those involved in sports that require sprints should, therefore, include exercises that bolster the hamstrings and Achilles tendons, for example.

Skill based circuit: an example

Sport: football

Develops: specific skill and endurance

Many of the exercises in this specific skill and endurance developing circuit involve the use of a ball. This simple addition will maximise physiological transference from the circuit into playing performance.

Format: series

All exercises are performed for 30 seconds (unless otherwise indicated), players then move straight onto the next exercise. At the end of each circuit 2 minutes' recovery is allowed. Start with two circuits. The circuit will last approximately 18 minutes. The circuit could be performed on a pitch or in a gym. Players work in pairs, performing exercises side by side – or as in the case of the sit-up with header exercise (exercise 2), alternating with each other

1) Side to side passes over 5m – to develop precision passing under fatigue

How to perform: players stand 5m apart and perform a series of alternate left to right side-foot passes between each other for the designated time span.

Technique tip: remain on the balls of your feet throughout the drill, quickly adjusting your stance to make the passes.

2) Sit-up with header – develops abdominal strength and heading skill and power

How to perform: work in pairs. One player assumes a sit-up position with feet flat on the floor and knees bent to 90 degrees. The other player stands slightly over and to the front of the sitting player. This player should time their throw of the ball so that the player performing the exercise is able to head it back to them at the top of each sit-up.

Technique tip: brace the core when making the header and use the neck muscles to add power and direction to the header.

3) Press-ups and stand up drill – develops shoulder and all over body power (conditions the ‘fall down-get up quickly’ reactivity required of football players)

How to perform: start from standing and drop into a press-up position by bending at the knees and reaching forwards with the torso and arms. Perform a press-up and then stand back up to complete one repetition.

Technique tip: when performing the press-up, lift and lower your body under control maintaining a straight line from the top of the heels through to the back of the head.

4) Crunches – develops core strength

How to perform: lie on the floor and bring your knees into your chest so that your thighs are at right angles to the ground and your lower legs parallel to it. Keeping your fingers by your ears and elbows outstretched, ‘crunch’ to lift your torso 15-20cm from the floor, lower under control and repeat.

Technique tip: concentrate on the lowering phase as much as the lifting phase.

5) Straight leg jumps – to develop heading take-off power

How to perform: stand straight and jump into the air primarily by using your calf muscles and ankles for propulsion. Use your arms to assist your jump by swinging them back and then past your hips at the point of take-off.

Technique tip: maintain a slight bend at the knees throughout the exercise –really concentrate on using the ankles and calf muscles to make quick dynamic jumps.

6) Backwards, sideways and forwards shuttle running over 15m – develops football agility

How to perform: position two cones 15m apart. Run forwards to the first cone, then backwards to the ‘start cone’, then sideways to the right and sideways to the left, between the cones. Continue this pattern for the required duration.

Technique tip: initiate the movements from the balls of your feet.

7) 30 seconds’ walking – to simulate match recovery

How to perform: simply walk!

Technique tip: take deep breathes to slow your breathing – can be replaced with a more demanding exercise as fitness improves.

8) Simulated heading movement – specific heading transferability

How to perform: take a large step forward and then leap into the air off of one leg to perform a simulated heading action.

Technique tip: jumps should be made from both left and right legs. Drive the non take-off leg up powerfully at take-off to maximise vertical impulse.

9) Hamstring bridge – serves a pre-conditioning role, strengthening the hamstrings (a muscle prone to injury among footballers)

How to perform: lie on your back and place your hands by your hips on the floor. Press your heels into the ground and lift your hips 10-20cm from the floor. Hold for 10 seconds, lower under control and repeat.

Technique tip: relax whilst performing the exercise.

10) Plank – strengthens the core

How to perform: assume a sort of press-up position, with your weight supported on your toes and elbows. Hold for 10 seconds and take 5 seconds' recovery between reps (*see illustration on page 29*).

Technique tip: keep a straight line through your body from the back of your heels to the back of your head.

11) Seated position 'get up and sprint' 15m drill –

develops the crucial 'get up and go' requirement of football

How to perform: sit on the ground with your hands by your sides. Get up and turn through 180 degrees to sprint 15m. Jog back to start position and repeat, this time turning in the other direction.

Technique tip: practise turning in both directions. Maintain a forward lean across the body whilst accelerating, push the ground behind you with your legs and drive your arms as fast as possible.

12) Sprint dribble – develops great dribbling ability

How to perform: start by a cone, then dribble a ball at speed to a cone placed 15m away, stop and position the ball next to the cone. Sprint back to the first cone and jog back to the cone with the ball. Retrieve it and sprint dribble back to the other cone. Leave the ball there. Repeat this pattern for the duration of the exercise.

Technique tips: keep your head up when dribbling. Use turns in both directions throughout the drill.

Circuit training for sprinting and explosive movement

By **Phil Gardiner**

Sprinting relies on huge power outputs and is an activity that might not seem ideally suited to circuit training – however a relevant and periodised (planned) training programme that includes this training ingredient can optimise sprint performance

I mainly use this circuit in the early stages of the sprinters' winter training – the 'general preparation phase'. This lasts 6-8 weeks in the autumn. It provides a foundation of general fitness for the athlete with the emphasis on local muscular endurance. This develops the ability of a muscle group/muscle to repeat a movement for a high number of repetitions with reduced fatigue. However, as you will see from the exercises included, squats, lunges, press-ups and chin-ups, for example all major muscle groups (shoulders, legs and core) are targeted to avoid imbalances. If any of my training group has had any injury problems then the exercises are adjusted personally for them to safeguard against aggravating these – of which more later. This is a great circuit for virtually all sportsmen and sportswomen regardless of sport. It will work for footballers, rugby players and even cyclists and distance runners, as it targets the key muscles that are involved in these sports and will lay down a highly relevant base of specific foundation.

Note: this type of circuit is also ideal for the non-competitive person who wants to achieve/maintain general fitness.

Circuit 1:

Preliminary training (beginning of training year) sprinter's circuit – also suitable for general fitness

Format: circuit

30 seconds on 30 seconds off with 3 minutes' recovery between circuits

1) Press-ups

How to perform: support your body on your toes and your hands, which should be placed under your shoulders. Extend your arms to lift your body and bend them to lower.

Technique tip: maintain a straight line from your heels, through your back to the top of your head.

2) Sit ups

How to perform: sit with your feet hip-width apart and flat on the floor. Crunch your abdominal muscles to lift your torso. Lower under control.

Technique tip: place hands by head – don't hold onto it.

3) Lunges

How to perform: take a large step forward to place one foot flat on the floor. Keep your trunk upright and look forward, your weight should be supported on the toes of your rear foot. Bend your front leg so that its thigh reaches a position near to parallel to the ground and push back up. Lunge with alternate lead legs.

Technique tip: coordinate your arms with your legs – that's opposite arms to legs.

4) Triceps dips

How to perform: place your palms on a bench behind you with your legs outstretched in front of you and hip-width apart. Extend your arms to lift your body and bend them to lower.

Technique tip: look straight ahead of you and keep your back in close to the bench.

5) Chinnies

How to perform: lie on your back and place your fingers by your ears with your elbows back. Simultaneously bring your opposite knee to your elbow, whilst crunching and rotating your torsos. Extend your leg away from you and lower your torso to the ground. Repeat to other side (*see illustrations on page 27*).

Technique tip: keep the movement rhythmic and fluid. Consciously rotate as you move forward and back.

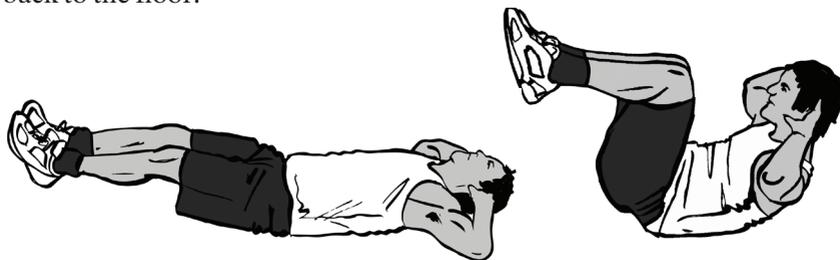
6) Squats

How to perform: stand with your feet hip-width apart and heels on the floor. Bend your thighs to lower to a near thighs parallel to the ground position and push back up.

Technique tip: maintain the natural curves of the spine and look straight ahead.

7) Double crunch (below)

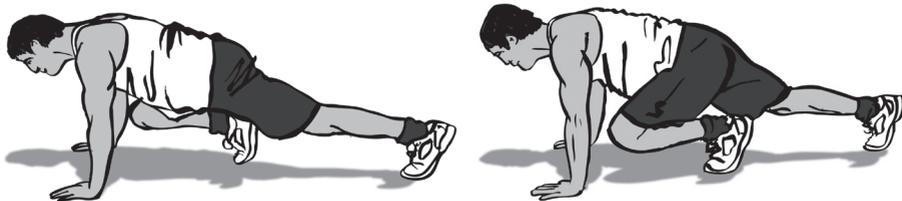
How to perform: lie on your back and place your fingers by your ears, with your elbows back. Bring both your thighs toward your chest whilst bringing your chest toward your thighs so that you perform a sort of pike. Extend your legs and take your torso back to the floor.



Technique tip: maintain control over the movement and lower your torso back to the ground slowly.

8) Treadmills (overleaf)

How to perform: attain a sort of press-up position and then bring one leg into toward your chest, push it back away and then bring the other leg in and repeat.



Technique tip: keep your back flat as you drive your legs alternately backwards and forwards.

Comment:

I mainly use this circuit in the early stages of the sprinters' winter training – the 'general preparation phase'. This lasts 6-8 weeks. It provides a foundation of general fitness for the athlete with the emphasis on local muscular endurance. However, as you will see from the exercises included, all major muscle groups (shoulders, legs and core) are targeted to avoid imbalances. If any of my training group has had any injury problems then the exercises are adjusted personally for them to safeguard against aggravating these – of which more later.

Adding resistance to the circuit

Adding resistance ups the intensity of the circuit; when I implement these circuits I therefore reduce the number of repetitions. For speed and power athletes the development of endurance is much less of a concern than having the ability to overcome resistance. However, for an endurance runner the emphasis could be placed on greater repetitions with lower resistance. Note for 'power endurance' athletes, such as rowers, circuits are very tough and some incorporate heavy weights and a relatively high number of reps (see article 2).

**Circuit 2:
incorporated into the training plan from
November**

Format: series

Resistance: 50% of 1 repetition maximum – unless otherwise stated

Repetitions: 12 – unless otherwise stated

Recovery: minimal between exercises, 3 minute between sets

Note: it is beyond the scope of this Peak Performance special to provide detailed explanations for the majority of the following weights exercises. Most are widely used by athletes and coaches.

Exercises:

1) Hang clean

2) Bench press

3) Squats

4) Lat pull downs

5) Step up

6) Dumbbell sprint arm action – 25 each arm with 2-5kg dumbbells

7) Treadmills – 25 each leg

8) High pulls

9) Reverse leg extensions*

* **Reverse leg extension** – this exercise can be performed with a physio band tied around the ankle with the other end tied to the bottom rung of a gymnasium wall bar or another fixed object. It can also be performed on a multi gym cable/low pulley machine with the ankle strap attachment. For the purposes of this description I will describe the physio band version.

How to perform: the athlete stands facing the wall bars and holds the bar at shoulder level. The athlete should maintain an upright posture. One end of the band should be hooked behind the heel of one leg and the slack should be taken up. Without bending their knee, the athlete should extend the leg behind their body as far as the resistance of the band will allow. They should then allow the leg to return to the starting position with control. The exercise is repeated for the prescribed number of times. Repeat with other leg.

Technique tip: good posture must be maintained throughout, as altering the upper body angle at any time would reduce the

workload placed on the gluteal muscles (the muscles targeted by the exercise) and it would serve little purpose.

Comment:

You will notice there are no abdominal exercises in the circuit. At this stage in the training year we sometimes tag them onto the end of the training session. Four to five exercises are selected, ensuring that all of the abdominal muscle group area is targeted. These exercises are performed without rest, with each work interval lasting usually 30 seconds. Not including them in the circuit reduces the recovery between the muscle groups used in the other exercises, which can increase the intensity. Try it and see.

Note: it is particularly crucial that correct exercise technique is maintained throughout all circuits, but this importance is enhanced when the circuit includes resistance exercises, such as hang cleans and high pulls with Olympic bars. These have a high technical component. Failure to maintain the required skill could result in injury.

Keeping things varied

A key challenge with circuit training is to maintain the physical progression of the athlete without them becoming bored. To achieve this I often use different types of resistance (other than weights) to add variety and extra stimulus to workouts. I've provided an example of a session that I often implement in mid-winter – circuit 3. It commences in December and is employed until February. For the 'different' resistance, medicine balls and low intensity plyometrics (jumps and throwing type exercises) are used. I'll often get my athletes to do active mobility exercises during the recovery between sets.

**Circuit 3:
Varied resistance circuit**

Format: stage

Sets and recovery: 3 x 8 repetitions with 30 seconds' recovery between exercises and 3-4 minutes between sets

Resistance: 4-5kg medicine ball

Exercises:

- 1) Squats**
- 2) Press-ups**
- 3) Squat jumps**
- 4) Medicine ball drop and push throw***
- 5) Side lunge**
- 6) Side to side jumps**
- 7) Sit up and medicine ball throw**
- 8) Walking lunge**
- 9) Close hand placement press-ups**
- 10) Split jumps**

*** Medicine ball drop and push throw**

How to perform: the athlete lies face up on a bench. The coach stands over the athlete (sometimes on a box) behind their head. The medicine ball is dropped by the coach, the athlete catches the ball and immediately pushes it back up to the waiting coach's hands. The drop, catch, drop pattern is repeated quickly.

Technique tip: ensure that the athlete does not catch the ball over their face.

Comment

This circuit is much more dynamic than the previous two. It can be used in conjunction with the resistance circuit (circuit 2) or a similar one. I advocate that it is performed once in a weekly training cycle. A word of caution regarding recovery – this type of circuit is much more intensive than circuits that don't use added resistance and will take the athlete longer to recover from.

As the sprinters' training progresses towards the summer months, the number of exercises is reduced and the recovery between exercises increased.

Upping circuit power even more

I have devised an even more dynamic circuit, which I use in April prior to the start of the outdoor track season – see circuit 4. It emphasises quality of movement and fatigue is kept to a minimum to permit this. Consequently the repetitions are kept

low and the recoveries long. On paper it looks like an easy circuit – but similar to other high intensity workouts, such as sprinting. It is actually very demanding, particularly on the central nervous system* (CNS). It may take the athlete 48-72 hours to recover fully from this type of workout.

Coach and athlete should consider that hurdle jumps and other similar plyometric drills are very demanding on ligaments and tendons around joints, particularly the ankles and knees, so these types of workouts should only be performed by athletes with months of progressive prior conditioning. I progress through circuits 1-3 as indicated to achieve this state of readiness.

* The CNS is comprises of the brain and spinal cord. Traditional interpretations of it believe that it responds consciously to external factors. However, it is highly plausible that a great deal of its function actually goes on at the unconscious level.

Circuit 4: Power circuit

Format: stage.

Number of circuits: 2-3

Recovery: 60 seconds between exercises, 5-10 minutes after each circuit

Resistance: body weight and medicine ball

Exercises:

- 1) Medicine ball chest pass** – 5 throws
- 2) Hurdle jumps** – over 5 hurdles
- 3) Reverse overhead throws** – 5 throws
- 4) Box jumps** – 5 jumps up onto box

The competition period

It is important to maintain general fitness/conditioning during the competition season, to ensure that the sprinter does not lose condition and to reduce the risk of injury – circuits are good for prehabilitation in this respect (of which more later). These circuits can be done by athletes at home, as they involve no special kit.

Circuit 5: **Competition period circuit**

Format: circuit

Number of circuits: normally 3

Work interval: 30 seconds

Recovery: 30 seconds, 3 minutes after each circuit

Resistance: body weight

Exercises:

1) Press-ups

2) Sit ups

3) Squats

4) Bench triceps dips

5) Chinnies

6) Treadmills

Many top class athletes will perform circuits similar to this one 'in season', particularly whilst travelling between competitions. Their beauty is that they can be performed even in the most cramped hotel room.

Circuit 6: **Competition period circuit**

I also include exercises (usually upper body) within a tempo running session on grass. The workout is performed as follows: 2 x 10 x 100m 'turnarounds' with 10 press-ups or 10 sit ups performed after each 100m.

Five minutes' walk recovery between sets.

This type of workout is of low intensity and acts a recovery session. It is placed between high intensity training days.

Circuits for specific requirements

A World Record holder and Olympic Champion's circuit

I have provided an example of a circuit workout that was actually performed by world triple jump record holder Jonathon Edwards from 1989-1996. Edwards completed the

workout once a week and it would take between 30-40 minutes to finish. It was part of his preparation programme and would cease to be used at the commencement of each outdoor competition season. This session was published as part of a presentation at the European Athletics Congress in 1996 by Edwards' coach Carl Johnson.

It is quite different in format and content to many other circuits that I and countless other coaches and fitness professionals advocate, but remember that it was designed for a specific type of athlete who already had a sound general conditioning base.

As you can see, there are exercises in the circuit that have a jump component, befitting that of a triple jumper, who requires great ankle and knee joint strength – it therefore serves a strengthening, injury reducing role (this, as previously indicated, is known in training terms as pre-rehabilitation or pre-conditioning).

Circuit 7: **Jonathan Edwards' specific circuit**

Format: stage

Number of sets: 3 based on 50% of Edwards' 45 second test scores (maximums tested every fourth week).

Recovery: none between exercises or sets

Resistance: body weight

Exercises (brief descriptions given for the more unusual):

1) Press ups;

2) Hip lifts – feet and shoulder blades in contact with the floor, lift hips off floor;

3) Octagonal jumps – on the spot fast two-footed jumps, moving in an octagonal pattern;

4) Medicine ball twist and throw – standing side on to a wall, turn upper body and throw ball against wall, catching the rebound and repeat;

5) Reverse to front support – start in a press up position, lift one arm in the air and turn the body so that it is at right angle to the ground. Then lower the arm down to end in a press-up position. Then raise the opposite arm and repeat the process. The two movements = 1 rep;

6) Dorsal raise – lie in prone position on floor, raise chest off floor and return to original position;

7) Calf raise;

8) Bench triceps dips;

9) Wobble board – stand on wobble board without lowering either foot to the floor;

10) Jump squat – lower the hips into squat position – jump vertically from that position and repeat.

Core stability and rehabilitation

As indicated, I believe that circuit training can be useful for injury prevention and for rehabilitating post injury. However, I do not believe that adequate core stability can be developed within a regular circuit format when fatigue is prevalent.

I have witnessed athletes being wrongly (in my humble opinion) directed to perform core stability exercises (many of them quite advanced) as part of a general fitness circuit and even immediately following heavy weight training. Exercises such as the plank and the ‘superman’ require the athlete to maintain correct posture throughout the time allocated for the exercise – if posture diminishes then the exercise needs to be terminated. This runs contrary to what often happens in a circuit when the athlete struggles to hold a less than perfect technique to meet the circuit’s rep durations.

I believe that core stability exercises should be targeted at developing strength in the deep-seated abdominal muscles, such as the transversus abdominis and internal obliques in order to maximise core strength and stability. As soon as these muscles become fatigued then the larger dominating abdominal muscles (the rectus abdominis and obliques) take over the movement. The exercise then loses its status as a true core stability movement.

I prefer core stability work to be carried out at the beginning of a session following a short warm up. No sprint drills are included in this warm up as they require input from the core muscles and will create some level of fatigue prior to the core stability exercise unit being performed – as indicated, this

would diminish the athlete's ability to achieve control in the stability exercises.

Rehabilitation

As mentioned earlier, I use general conditioning bodyweight circuits at the commencement of the training year. However, I also use this type of training as part of a rehabilitation programme for athletes post injury. After stability and mobility in the injured area has been established, I prescribe exercises to strengthen the muscles and tendons in the area that has been injured.

As an example, if the hamstrings have been injured we include exercises to strengthen the gluteus muscles as they are the stabiliser muscles for the hamstrings and need to be sufficiently strong. When the athlete is sufficiently strong enough and the non-resistance exercises have fulfilled their task, then a controlled exercise using a physiotherapy stretch-band could be included to further develop the athlete's hip extension strength and hip flexion strength. This can be achieved as part of a short circuit, including upper body exercises, which can develop the post injured area without fatiguing the athlete too much so that he/she loses control of muscle movement.

The exercises that work the previously injured area would use low resistance to begin with. Coach and athlete would determine the number of repetitions used in regard to how much control and range of movement the latter has whilst performing the exercise, so as not to cause re-injury.

We then build up strength endurance across the whole body as well as the injured part. This prepares the athlete to return to normal training whilst maintaining a degree of relevant condition.

Circuit training as a key constituent of boxing training

By John Shepherd

Boxing is one of the toughest sports around at both amateur and professional level and boxers are renowned for being among the fittest athletes. The sport requires agility, speed, power, upper body and lower body muscle and a great core to 'hold everything together'. Plus, of course, you've got to be able to take a battering. Not surprisingly sportsmen and sportswomen often include boxing type training into their general conditioning. And circuit training is a key feature of this training workload

Real world boxing training – how a professional boxer trains

Boxer: Lenny Daws professional light welter-weight boxer (10 stone)

Record: Lost 1, drawn 1, won 18

Trainer: Ian Burbedge

Daws is a former British number 1 and is currently ranked 5th (he fights at the same weight as Ricky Hatton).

Ian trains Lenny 5 days a week, twice a day. Preparation for a fight depends on the number of rounds. The trainer explained that the minimum preparation phase would be 6 weeks for a 6 round fight, but that if the fight were longer, for example 10-12 rounds, then another 3–4 weeks would be added.

Running

Ian noted that the amount of running that boxers do is exaggerated and run durations typically reflect the length of the fight – for example, a 36 minute run for a 12 x 3 minute round contest. The trainer specifically believes that there is no real need to run more than three miles as the sport is an explosive one, rather than a slow steady one (more on its energy system needs later). Lenny often performs fartlek* runs – with the boxer upping the intensity with sprints and faster paced running during his runs, for example between lamp-posts. This was seen to be more reflective of what actually happens in the ring, where there will be flurries of activity, rather than a single steady effort. Ian advises Lenny to run every day when preparing for a fight and this activity would be the first workout of the two or three that the boxer will do each training day.

* method of training that was developed in Sweden and means ‘speed play’. The athlete decides what speeds to run at and what recoveries to take whilst running

Circuit training the foundation of Lenny’s conditioning

Circuit training provides the foundations for Lenny’s conditioning. When preparing for a fight these workouts form the mainstay of the second day’s workout (after the run) with the more technical components of boxing following (the third part), such as pad work. Four to 6 weeks out from a fight this process is reversed and specific boxing preparation work takes precedence and the circuit follows the run.

In terms of exercises a typical circuit includes, for example, chin ups, diamond, normal and plyometric press-ups, crunches, the plank and squat thrusts. Weights exercises are also included in the circuit, for example dumbbell flys and lateral raises, but loadings are kept relatively light. These workouts are designed to increase the boxer’s ability to handle his own weight, develop power and resilience under conditions of fatigue and not build muscle. The latter also reflects the

need with Lenny, as a light welter-weight, to maintain weight - a significant increase in muscle mass caused by heavier weight training could take him over the 10 stone (63Kg) limit. Typically 8 exercises feature in the circuit and these would be performed in 5 minute bursts. All boxing specific training would involve 3 minutes of effort with 1 minute's recovery, to reflect fight conditions.

3-4 weeks out from the fight

Ian explained that although Lenny will still run, the work done in the gym will be much more specific nearer the fight. Typically the boxer will do a couple of rounds of shadow boxing and often bag work and then go straight into sparring. In terms of the numbers of rounds Lenny will start with 3 x 3 minutes and then build up to 6 x 6 to reflect the fight's specific requirements. For amateurs Ian recommends following the same planning format, gradually building up from 2 x 2 minutes to 4 x 2 minutes of sparring over time.

After the specific boxing work Lenny will still perform a circuit. However, Ian explained that he would constantly be assessing Lenny's condition and adapting and progressing training accordingly to develop ring readiness and avoid over-training – thus the circuit's intensity could be reduced.

Training to take punishment

Ian explained that learning to trade and take blows comes from sparring. The former amateur commented: *'It sounds quite odd but the body becomes conditioned to being hit. You find that over the first couple of days of sparring that you tend to get a few lumps and bumps, especially if you get caught, but after a while your body hardens up.'*

So what's it actually like being in the ring?

Ian explained that as the fight approaches nerves increase, but once the bell goes as he put it: *'you're focused on your job'*. He thought that anyone who said that they weren't nervous was lying.

‘After the specific boxing work Lenny will still perform a circuit’

'I've been knocked out. I can remember doing my boots up back in the changing room and asking, "What time am I on?" And I continued doing my boots up and my coach said, "You've been hit", and I said, "Shut up!"... You know you don't realise it. Occasionally a shot will hurt, but more often than not you won't feel it because you are thinking about your own plan ... the only thing I can ever liken it to is if you don't head a football right, you get that black feeling come over you and there is a bit of a wobble, but it goes quickly and you get on with it.'

However, Ian went onto explain that it was only after the fight when you realise how much you have been hit that the pain starts as the adrenaline ebbs away.

Boxing speed

The 'greatest', Muhammad Ali, claimed that he was so fast that he could be in bed before it went dark after he flicked off a light switch! Speed of hand and speed of foot are vital commodities for a boxer.

Speed of hand

Ian believes that the best way to develop hand speed is through pad work. This requires the trainer to be in the ring holding pads and moving the fighter around as he throws various punches to the pads. He explained: 'It's very difficult to do this when sparring because you are constantly looking for openings and you're not thinking directly about improving hand speed (and) on a bag it's amazing the amount of times you will throw the same combination, you get into a habit... but because you're working with someone on the pads that alters the dynamics.'

Speed of foot

The trainer adapts agility and quickness drills from other sports and employs them in Lenny's training, often in circuit format

Skipping is still used by boxers as a way to develop foot speed and agility, but Ian explained that perhaps some modern practices are more beneficial. The trainer adapts agility and quickness drills

from other sports and employs them in Lenny's training, often in circuit format. These are introduced about 3 weeks out before the fight, when the boxer's legs are strong. This out and out speed work is completed with fuller recoveries. Specifically, he uses a very short speed ladder of only 4 rungs with most of the work aimed at developing change of direction speed: 'It's surprising how much he (Lenny) has improved on that. Because where he boxed orthodox (with a left leg lead Ed) anything going to the left he was perfect at, but if he had to go to the other side he wasn't comfortable at all'. Daws is now able to take the fight to his opponent with equal speed in either direction due to his trainer's adaptation of contemporary agility and quickness training.

The physiological requirements of boxing

Due to ethical issues boxing research is far from plentiful compared to other sports. However, there are a number of studies that have looked, at for example, the energy demands of the sport.

Boxing and boxing training requires both aerobic (with oxygen) and anaerobic (without oxygen) energy. The demands on these energy systems vary in regard to the duration of the fight, as they would for example, with different track races. A heavyweight who goes toe to toe for 15 rounds relies on a different spread of energy system usage compared to an amateur who fights for 4 x 2 minute rounds. Looking specifically at the change from 3 x 3, to 4 x 2 minute rounds in the amateur game research indicates that this has made the sport even more anaerobic ⁽¹⁾. Indian researchers discovered that lactate (a chemical present in the body that increases with escalating activity) levels reach a higher peak during 4 x 2 minute rounds compared to a match of 3 x 3 minute rounds. Average heart rate was also seen to increase to 192 beats per minute (bpm) from 176 bpm respectively. The higher heart rate levels indicate a greater anaerobic energy system contribution and fight intensity and percentage of VO_2max (a measure of oxygen consumption) being worked at – although the intensity is maintained for less time during the shorter rounds.

Table 1 displays the VO_2max of amateur boxers of various nationalities for 3 x 3 minute rounds (as indicated it would be expected that these would be higher for 4x 2 minute rounds).

Boxing, lactate levels and other selected sports

Lactate is a powerful indicator of a sports' anaerobic element.

Wrestling (a contact sports of short duration similar to boxing)

Research examples: post contest lactate levels – US collegiate wrestlers – 19mmol/litre⁽²⁾ and at 1998 World Wrestling Championships – 14.8mmol/litre⁽³⁾ and a recorded VO_2max of 52.63ml/kg/min

Rowing (a sport traditionally associated with high lactate levels)

Research examples: 13.4 mmol/litre – collegiate rowers performing a flat out 6 minute ergo (rowing machine) test⁽⁴⁾ Note in rowing there is a surge in lactate particularly in the last 500m as the finish line nears. Olympic rowing is about 60-70% aerobic and 30-40% anaerobic in terms of energy system spread. Amateur boxing with its 2 minute rounds would primarily tax the short-term anaerobic system (up to 90 second duration) and hike lactate levels, with a reduction in the aerobic content. I would argue that the demands of 4x2 minute round boxing would be 60-70% anaerobic and 30-40 aerobic.

Table 1: VO_2max and amateur boxers of various nationalities for 3 x 3 minute rounds contests

Boxer's nationality	VO_2max in ml/kg/min
Greek national	55.8
Hungarian national	56.6
French national	64.7
Indian elite juniors	54.6
Indian elite seniors	61.7

Adapted from www.medic.usm.my/mssu/ARTICLES/article-2.htm

Tennis (a non contact sport, but played with a work to rest basis like boxing)

20 Austrian ranked tennis players showed only an average lactate build up of 2.07mmol/litre during games⁽⁵⁾. Tennis rallies are very short normally lasting a matter of seconds and there's plenty of rest relatively speaking – although matches can last hours. The lower intensity results in lower lactate levels.

Football

Danish division 4 players – first half 6.0mmol/litre, second half 5.0mmol/litre⁽⁶⁾

The above snapshot of other sports and their 'lactate component' shows that boxing ranks right at the top as a test of the short-term anaerobic energy system as measured by lactate accumulation. Circuit training with its high intensity, stop start nature can do much to develop the necessary condition to fight optimally in the ring.

Boxing fitness

Many of you reading this will have done boxing based workouts as part of your sports training/fitness routine or might be thinking of doing so. In the first part of this section we look at some of the sports science and assess the physiological outputs of these workouts, with particular reference to calorie burning. And in the second part Ian Burbidge talks about his work with footballers and rugby players and just what the sport specific benefits of boxing training can be.

Boxing circuits generally take 45-60min and involve skipping, all body parts circuit exercises (such as press-ups and crunches) and occasionally (for the more advanced) bag or pad work and shadow boxing. Recoveries are kept to a minimum and the workouts can be very tough.

Researchers compared boxing based workouts to treadmill running to determine energy expenditure⁽⁷⁾. Eight adult males with boxing based class workout experience took part in the study. There were three conditions:

- 1) an hour's boxing based workout in a laboratory;

- 2) an hour's boxing based workout in a gym;
- 3) an incremental run on a treadmill.

In the lab the men burned 671Kcal and 599 Kcal in the gym. Interestingly these figures compared with the energy expenditure of the hour's treadmill run (the runner's covered about 9km in this time).

These are high-energy expenditure figures for all the test protocols. More significantly they display the significant effect that boxing based circuit workouts can have on calorific expenditure. As the workouts are predominately anaerobic and require greater all body power than the treadmill running, the research confirms assumptions that boxing workouts are indeed a great way to develop general fitness, power and local muscular endurance under conditions of fatigue.

Boxing training for general fitness and sport

Ian believes that boxing training offers much to the fitness enthusiast and sportsman and sportswoman. He works with rugby and football players and introduces boxing training into the players' conditioning. 'If you are looking at developing fast twitch (speed and power producing) muscle fibre, it's all good work. I think it's got a place in a lot of sports. Rugby players will probably take to it better (than footballers) because they are used to doing a lot of work with their hands.'

Ian provided the analogy of the rugby hand-off as being like a punching movement, as a specific area where boxing training can offer a real performance benefit to the player. Footballers, however, only use their upper bodies really for balance and do not need to carry as much muscle. In his experience he finds that players of the 11 aside game have better endurance when performing boxing workouts compared to their 15-aside counterparts, which he attributes to their lower muscle mass and the greater running demands of their sport.

Ian Burbedge's boxing fitness circuit exercises

1. Bench press x 10
2. Fast chest press using resistance bands x 15
3. Squat, jump and medicine ball throw x 15
4. Cycling action sit-ups x 25
5. Chin-ups x 10
6. Upright row using resistance bands x 20
7. Side plank with rotation x 10 each side
8. Lateral raise and shoulder raise combination x 10
9. Squat thrusts x 15
10. Diamond press-up and biceps curl combination x 10 each

The circuit would be completed with no rest between exercises (series style) and one minute's recovery would then be taken before going again. The number of circuits completed would depend on the athlete's fitness and the time in the training year.

Boxing is a demanding sport and training for it needs to reflect this. Changes in the amateur game in terms of length and numbers of rounds and in the professional sport in terms of the number of rounds the fight will be scheduled for should be taken into account when conditioning the fighter. The high anaerobic content of the sport should be the primary conditioning requirement.

Boxing training – which is largely based on circuit training – for the sportsman and sportswoman particularly involved in stop/start dynamic anaerobic sports, can act as a useful conditioner, and for the fitness enthusiast can contribute significantly to calorie burning and all body strength and tone.

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Sample circuits

In this article Peak Performance's experts present examples of circuits for various sports that you can adapt, use and take inspiration from

Rugby – pre-season

Rugby Union and Rugby League are two of the toughest field sports played at both amateur and professional level.

The physical demands of both codes place a great emphasis on physical power and muscular strength endurance. Speed is also crucial, as is the capacity to repeat that speed many times in a game, albeit mostly over very short distances. And of course there is the physical contact, the tackles, rucks and mauls, and in this respect rugby has been called a 'collision sport'.

The percentages of the various playing components do vary between the playing positions but every player will require all of them to some extent.

Examples: Rugby Union forwards require the ability to accelerate over very short distances – 2-10 metres, but will need to be able to repeat this many times in a match.

In the backs, a Union winger will need good acceleration, but also greater top speed over 10-50m. They must be able to repeat these efforts many times during a match, but in most cases will only be called upon to sprint flat out occasionally and as a result will have more recovery time than for example, a flanker (No 6/7), who will be involved in play much more frequently.

The rugby circuit

When working with an amateur Rugby Union team I devised a circuit that would address the physical demands of every position so that all the players could work together.

This was scheduled into pre-season and would form part of a workout that commenced with agility work using sprint ladders, mini hurdles and marker cones – this was followed by the circuit, then game play (usually touch rugby).

The circuit is progressed by increasing the number of repetitions when players are ready and able to cope. When the season drew closer the emphasis on game play increased and this in itself became more physical as contact elements were introduced, the circuit quantity was reduced accordingly.

Format: stage

Recovery: between exercises minimal, recovery between each circuit three minutes

Performed: outdoors on grass

Exercise	Distance/time/number	Selected comments
Acceleration Run	10m	Sprint 10m walk back and repeat
Press-ups	30secs	
Floor ladder drill + sprint	20 rung ladder + 5m	Take short fast steps between rungs
Rip it out	15secs each	Player a lies on ground holding rugby ball. Player b attempts to prise ball out of player's hands
Tackle bag shuttle	4 x 5m each	Run hit bag held by partner, run backwards to start and repeat.
Tricep dips	30	Use chair – heels on ground
Squat jumps	30secs	
Reverse to front support	30secs	See Jonathon Edwards' circuit – (see page 48)
Tackle pad hit and drive	x 4 each	From crouch position drive up into pad held by partner pump legs to drive him/her back
Tyre runs x 3	10m-15m with 7kg tyre	Sprint from a 3 point start, pulling tyre by way of rope tied round weights belt and tyre

Racquet sports – pre-season

Tennis, squash and badminton require fleet of foot and great hand and eye coordination. Circuits can develop these qualities and the stamina needed to endure the stop-start action. Although the sports are of different durations, with tennis

matches lasting the longest, all rely on anaerobic power – an energy system that can easily be trained with the right circuit methodology.

Format: series

Recovery: 20 secs on, 30 secs off. Three mins between each circuit

Performed: indoors or out (on court, in sportshall, or even dry flat grass)

Exercise	Distance/variation	Selected comments
Run forward and backwards	10m	Make the transitions dynamic
Jump and simulated smash		Racquet can be held
Floor ladder drill – lateral steps	1 x standard 20 rung ladder	Short fast lateral steps between rungs
Crunch		
Triangle hops	Left and right leg	Player hops a triangle pattern using low trajectory hops
Compass runs	5m each direction	Player sprints 5m forward ('north') and then back to centre, to sprint 5m 'east', back to the centre and on to the other points of the compass
Split jumps		Consecutive jumps from a lunge position, alternating leg position in air
Side plank	Left and right side	
Press-ups		
Sprint to net or wall for squash players and perform ghosted shot and sprint back to service line/box and repeat		Ghost shot can be called out by coach or varied by the player

This circuit reflects the needs of racquet sport players and will develop relevant condition

Basketball – in-season

Basketball players have to perform explosive bursts of energy while on court and their skill levels must remain high if they are to make those 'three-pointers' and blocks. This circuit will maintain this fitness.

Format: series

Recovery: 20 secs on, 20 secs off. Two minutes between each circuit

Performed: indoors or out on court

Exercise	Distance/ variation	Selected comments
Run forwards and backwards dribbling ball	20m	Make the transitions dynamic
Jumps to touch backboard or rim		
Floor ladder drill – lateral steps	1 x 10 rung ladder	Short fast lateral steps between rungs, left and right
60% effort run up and down court or half court		
Triangle hops	10 secs each leg	Player hops a triangle pattern using low trajectory hops
Rebound jumps		Stand in front of strong low box – approx. 50cm high. Jump onto box and immediately back down and then back onto the box, continue this quick-fire pattern
Bench triceps dips		
Plank with rotation	To left and right	Assume a side plank position. Reach top arm up (so at 90 degrees to ground), then reach arm round and under body, rotating torso at same time and then rotate back to start position
Back pedal and 5m sprint		From standing, back pedal 5m and then sprint forward 5m
Straight leg jumps		Keep legs virtually straight while using the calf and ankles to jump dynamically up and down on the spot

As with the previous circuit the exercises selected are game specific and will pre-condition and develop/maintain match condition.

Speed and power circuit – (suitable for most athletes) in pre-season and early conditioning phases

Format: series

Recovery: 20 secs on, 20 secs off. Two minutes between each circuit

Performed: on running track or dry flat grass, or in sports hall

Exercise	Distance/ variation	Selected comments
Speed bounds	10m	Push the ground back dynamically as possible, all work is done behind the body, walk back between efforts
Chinnies		
Floor ladder drill	1 x standard 20 rung ladder	Short fast steps between rungs
Prone position sprint and walk back		Get up from prone position and sprint 10m, walk back and repeat
Hops on spot	Each leg	Player hops using low trajectory hops
Rebound jumps		Stand in front of strong low box. Jump onto box and immediately back down and then back onto the box, continue this quick-fire action
Sprint arm action		From lunge athlete sprints using their arms only
Plank		
Line bounce		From standing, feet shoulder-width apart position, athlete jumps a short distance over a line using a low trajectory and then bounces back to repeat continuously. Movements made from the balls of the feet
Straight leg jumps		Keep legs virtually straight while using the calf and ankles to jump dynamically up and down on the spot
Medicine ball, wall chest pass		Throw and catch a medicine ball against a wall as fast as possible

This circuit should only be completed by well-conditioned athletes with relevant training behind them. Although quality of exercise performance will suffer due to fatigue, this should not deteriorate so much that the athlete is not developing relevant power and movement speed that will transfer into their sport.

Notes

