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Endurance in the 400 metres Hurdles

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Starting from the premise that success or failure in the 400 metres Hurdles is largely determined in the final 100-150m of the race, the author states that endurance training, aimed at minimizing the effects of lactic acid accumulation, is of paramount importance. Using a series of tables he identifies the endurance structure of the 400 metres Hurdles and gives various types of endurance-based training units. He also gives an overview of the main training objectives in each phase of a periodized plan, and detailed examples of microcycles, including their component units and sessions, for each phase.

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1 Introduction

In terms of technique and endurance, the 400 metres Hurdles is without doubt one of the most difficult and demanding of all athletic events. In this discipline success or failure is largely determined over the final 100-150m of the race, at which point the anaerobic generation of energy has caused a high level of lactic acid to accumulate in the body. It is evident, therefore, that an athlete's training should be aimed at minimizing the detrimental effect of this lactic acid accumulation upon performance, ensuring that optimum rhythm and maximum possible speed be maintained towards the end of a race.

In the training of a 400m hurdler endurance work is therefore of paramount importance. Training should concentrate on stimulating the anaerobic lactic processes which generate a large share of the energy required for the event. Care must be taken, however, to incorporate alactic sessions into the schedule in order to avoid exhaustion.

The following study gives an overall view of the place of endurance work within an annual training plan for a 400m hurdler. It offers detailed examples of the various types of endurance work which can be included, and differentiates between methods of training which aim at increasing capacity - or an athlete's potential energy

Table 1a: Endurance structure in the 400 metres Hurdles
Energy level: anaerobic alactic capacity

Type of endurance	Specific type of flat endurance	Specific type of rhythm endurance	Example sessions	
			Flat endurance	Rhythm endurance
Speed endurance	Short alactic speed endurance		■ 5×4×30 92% [1'30" & 5'] or ■ 5×5×60 92% [2' & 7'] or ■ 3×6×50 92% [2' & 6'] ■ 4×5×40 98% [2' & 8'] or ■ 5×3×60 98% [2' & 10'] or ■ 4×4×50 98% [2' & 8']	

Note: The numbers/letters in square brackets indicate the length and type of recovery.
' = minutes and " = seconds
H = number of hurdles
h = hurdles put at race distance

Table 1b: Endurance structure in the 400 metres Hurdles
Energy level: anaerobic alactic power

Type of endurance	Specific type of flat endurance	Specific type of rhythm endurance	Example sessions	
			Flat endurance	Rhythm endurance
Speed endurance	Short speed endurance		■ 5×2×60 92% [1' & 4'] or ■ 3×4×40 92% [1' & 3'] or ■ 5×4×50 98% [1' & 4'] ■ 4×5×40 98% or [1' & 4']	
	Proper speed endurance	Short rhythm	■ 5×80 92% [4'] or ■ 3×120 92% [6'] or ■ 4×200 92% [6'] or ■ 4×200 98% [10'] or ■ 3×150 98% [8']	■ 2×1H/2×3H/2×5H or ■ 1/2/3/4/3/2H or ■ 4×2H/2×4H or
Special endurance	Special endurance 1	Medium rhythm	■ 2×300 92% [12'] or ■ 2×350 98% [20'] or ■ 2×450 92% [18'] or ■ 1×500 98%	■ 6/7/8H or ■ 5×(3−10h)/300m
	Special endurance 2	Long rhythm	■ 4×600 92% [20'] or ■ 1×800 98% or ■ 1×1000 92%	■ 2×10h [25'] or ■ 1×9h/2×(3h−finish) [15'] or ■ 2×400 Hurdles [25']

resources - and that which concentrates upon power, or the speed and efficiency of expenditure of those energy resources.

2 Endurance structure in the 400 metres Hurdles

Tables 1A to 1D show the types of endurance which make up the endurance structure of the 400 metres Hurdles, both on the flat and over barriers ('rhythm' endurance). They also give examples of training sessions or units for each specific type of endurance. Flat and rhythm work will often be included in the same training session or unit, the amount and the degree of intensity of each varying according to the level of skill of the athlete and the time of year at which training is taking place.

Table 1c: Endurance structure in the 400 metres Hurdles
Energy level: anaerobic lactic capacity

Type of endurance	Specific type of flat endurance	Specific type of rhythm endurance	Example sessions	
			Flat endurance	Rhythm endurance
Interval tempo endurance	Stress training	Rhythm stress	■ 3×250 [3'] 90-95% or ■ 200/250/300 [3'] 90-95% or ■ 400/450/500 [3'] 90-95% or ■ 1000/800/600 [3'] 90-95%	■ 200h/200/150h [3'] or ■ 7/6/5/4H [3' & 4']
	Intensive interval	Rhythm interval	■ 2×6×100 [2' & 4'] 88-90% or ■ 5×2×200 [1'30" & 3'] 80-85% ■ 3×3×450 [2' & 3'] 82-88% or ■ 3×2×500 [2' & 3'] 82-88% ■ 2×6×100 [2' & 10'] 88% or ■ 3×3×300 [2' & 10'] 80%	■ 4×3H/5H (7 strides) [2' & 6'] or ■ 4×4×3H (4 strides) [2' & 6'] or ■ 3(150/150h) [1' & 6'] 85%
Tempo endurance	Tempo	Rhythm tempo	■ 12×100 [5'] 90% or ■ 10×150 [5'] 90% ■ 10×150 [2'] 80% or ■ 8×200 [3'] 80%	■ 2×3H/4×5H [5'] 80% or ■ 4×6H (techniques) [6'] 80% or ■ 5×6H (7 strides) [5'] 85%
Strength endurance	Strength endurance		■ 5×200 acceleration 5×100 bounding	
	Interval strength endurance		■ 5×(100 acceleration/ 100 bounding/ 100 bunny hop/ 100 acceleration) [5']	

Table 1d: Endurance structure in the 400 metres Hurdles
Energy level: aerobic/anaerobic lactic capacity and power

Type of endurance	Specific type of flat endurance	Specific type of rhythm endurance	Example sessions	
			Flat endurance	Rhythm endurance
Mixed endurance	Extensive interval	Elements of rhythm endurance	■ 5×4×150 70-75% [45" & 1'30"] or ■ 6×5×200 70-75% [45" & 1'30"] or ■ 6×4×250 70-75% [45" & 1'30"] or ■ 5×4×300 70-75% [45" & 1'30"] or ■ 5×3×350 70-75% [45" & 1'30"] ■ 8×400 65% [1' & 5'] or ■ 5×3×500 80% [30" & 1'] ■ 3×2×1000 70% [1'30" & 3'] or ■ 2×2×1200 70% [1'30" & 3']	■ 4×3×100 (2H) 70% [30" & 3'] ■ 5×2×300 (5H) 80% [30" & 3']
	Continuous run		■ 3×12' Continuous run or ■ 2×20' Continuous run or ■ Cross country running or ■ Running games or ■ Hill run	

3 Types of endurance training in the weekly microcycle

Table 2 is an example of an annual plan which divides both flat and rhythm endurance training into weekly microcycles. These vary according to whether the athlete is in the introduction, general preparation, specific preparation, precompetition or competition phase in the year.

The following explanation describes briefly the characteristics of each microcycle.

3.1 Introduction phase

For most athletes this will take place in November. Endurance is developed mainly through aerobic alactic preparation work involving extensive interval training and various forms of continuous runs. This phase involves little work over hurdles and does not generally include sessions aimed at improving anaerobic power. It does, however, emphasize the development of strength endurance.

3.2 General preparation phase

This phase usually consists of the three winter months of December, January and February. The number of sessions in the week increases from 8 to 12, whilst the total number of endurance units in these sessions increases from 10 to 14. Work improving anaerobic lactic capacity - i.e. tempo runs, intensive interval training and

Table 2: Schedule of types of endurance in the weekly microcycle

Type of endurance	Introduction phase		General preparation phase		Specific preparation phase		Precompetition phase		Competition phase	
	Flat	Rhythm	Flat	Rhythm	Flat	Rhythm	Flat	Rhythm	Flat	Rhythm
Short alactic speed endurance –	—	—	—	—	1	—	1	—	1	—
Short speed endurance –	—	—	—	—	1	—	—	—	—	—
Proper speed endurance: Short rhythm –	—	—	—	—	—	1	1	1	—	1
Special endurance: Medium rhythm, Long rhythm –	—	—	—	—	1	—	1	2	1 or	3
Stress: Rhythm stress –	—	—	1	—	—	1	—	—	—	—
Intensive interval: Rhythm interval –	1	—	2	—	—	1	—	—	—	—
Tempo: Rhythm tempo –	1	1	1 or	1	1	—	—	—	—	—
Strength endurance –	1	—	1	1	1	—	—	—	—	—
Interval strength endurance –	1	—	2	—	—	—	—	—	—	—
Extensive interval: Elements of rhythm endurance –	3	—	2 or	1	—	—	—	—	1	—
Continuous run –	2	—	3	—	1	—	1	—	1	—
SUMMARY	9	1	12	2	6	3	5	3	3	4
*Number of units of endurance in a week –	10		14		9		8		7	
*Number of training sessions in a week –	8		12		8		8		7	

*In one training session, more than one unit which places emphasis upon endurance can be included. Therefore, during the introduction phase, out of the total 18 sessions per week, there will be 10 endurance units.

Table 3: Annual plan of endurance training

Type of endurance	Introduction phase (November)	General preparation phase (Dec-Feb)	Specific preparation phase (Mar-April)	Precompetition phase (May-June)	Competition phase (June-Aug)
Short alactic speed endurance			■ 4×4×60 92% [2′ & 6′]	■ 5×4×50 95% [2′ & 8′]	■ 5×4×40 98% [2′ & 8′]
Short speed endurance			■ 3×5×40 95% [1′ & 4′]		
Proper speed endurance: Short rhythm			■ 4×2H/2×4H	■ 3×200 98% [10′] or ■ 3×2H/2×4H/2×6H	■ 2×2H/2×5H/2×200 [15′]
Special endurance: Medium rhythm, Long rhythm			■ 2×600 98% [15′]	■ 350/450 98% [15′] or ■ 2×9H/300 98% adequate	■ 2×300 98% [20′] or ■ 2×10H [20′] or ■ Competition
Stress training: Rhythm stress		■ 300/350/200 95% [4′]	■ 350/200h/300 95% [4′]		
Intensive interval: Rhythm interval	■ 2×2×350 80% [2′ & 5′]	■ 4×(500/250) 80% [2′ & 6′]	■ 3×(250/150h) [1′30″ & 8′]	■ 2×6×100 90% [2′ & 10′]	■ 2×3×120 95% [2′ & 12′]
Tempo: Rhythm tempo	■ 2×(800/600/400) 85% [6′] or ■ 5×6H [5′]	■ 6×500 85% [6′ & 8′] or ■ 4×200h (alternate) [7′]	■ 450/400/350/300 85% [8′]		
Strength endurance	■ 5×200 acceleration & 5×150 bounding	■ 3×200 acceleration & 3×100 bounding or ■ 3×50 bounding uphill & 3×100 acceleration	■ 4×(80 acceleration/ 80 relaxed run/ 80 uphill) [jog]		
Interval strength endurance	■ 5×(2×200 acceleration/ 150 uphill bounding/ 100 bunny-hops) [jog & 5′]	■ 5×(100 bounding/ 3×100 bunny-hops/ 100 bounding) [jog & 5′]			
Extensive interval: elements of rhythm endurance	■ 5×5×100 75% [1′ & 5′] or ■ 2×5×300 60% [30″ & 1′30″] or ■ 5×2×500 65% [30″ & 1′30″]	■ 2×10×150 75% [jog & 4′]			■ 3×4×100 70% [30″ & 2′]
Continuous run	■ 3×12′ or ■ 2×25′	■ 2×25′ ■ 5×4′	■ 2×20′	■ 2×15′	■ 2×20′

Table 4: Schedule of microcycles in annual plan of training

Day of week	Introduction phase	General preparation phase	Specific preparation phase	Precompetition phase	Competition phase
MONDAY	■ Continuous run + stretch	■ Continuous run + technique work	■ Speed + short alactic speed endurance ■ Short rhythm + dynamic strength	■ Short alactic speed endurance ■ Short rhythm	■ Speed + short rhythm
TUESDAY	■ Intensive interval + strength endurance	■ Strength endurance ■ Intensive interval + jump	■ Special endurance + jump	■ Proper speed endurance + jump	■ Medium + long rhythm
WEDNESDAY	■ Continuous run + extensive intervals + technique work ■ Rhythm tempo + basketball	■ Continuous run + stretch	■ Rhythm interval + throwing exercises	■ Medium + long rhythm	■ Intensive interval or short alactic speed endurance or special endurance
THURSDAY	■ Interval strength endurance + extensive interval	■ Extensive interval + technique work ■ Interval strength endurance + intensive interval	■ Short speed endurance ■ Strength endurance + continuous run	■ Continuous run ■ Special endurance	■ Long rhythm
FRIDAY	■ Extensive interval + general stretch + basketball + stretch	■ Elements of rhythm endurance or rhythm tempo ■ General stretch + extensive interval	■ Rhythm stress	■ Speed + intensive interval	■ Extensive interval
SATURDAY	■ Tempo	■ Tempo + jump	■ Tempo + jump	■ Medium + long rhythm	■ Competition
SUNDAY		■ Continuous run + interval strength endurance			■ Continuous run

strength endurance - prevails. The amount of aerobic work does not alter but training over hurdles increases. There is still little emphasis upon work developing anaerobic lactic power.

3.3 Specific preparation phase

This is the most important and at the same time the most demanding training phase, usually taking place over March and April. Improvement in the climate makes it possible for athletes to leave sports halls in favour of outdoor tracks. The number of sessions decreases, but intensity is increased. Hurdle work now constitutes 30% of the training; aerobic endurance work functions only as a subsidiary; anaerobic capacity work is gradually phased out.

3.4 Precompetition phase

This takes place in May and the beginning of June. The major share of the work aims at 'shaping' power, i.e. at converting the work done up until this point into race preparation. From now on, repetitions of varying length and intensity over hurdles become the main focus of each microcycle.

3.5 Competition phase

The competition phase is usually the second half of June, July and August. In training the number of units decreases and those which remain are restricted to hurdle units performed with maximum intensity. Regenerative sessions taken from aerobic endurance microcyles can be incorporated to relieve the intensity of the hurdle training. Training is obviously adapted to take into account such variables as competition timetables and fatigue.

4 Annual plan of endurance training

Having organized each type of endurance work into defined microcycles, it is possible to prepare detailed schedules. These should take into consideration all those elements which are typical of endurance training, i.e. length and intensity of repetition; number of sets; time and type of intervals.

Table 3 (see page 48) gives detailed examples of sessions which could be included in a microcycle in order to improve the various types of endurance required by a 400m hurdler.

5 Schedule of microcycles in the annual training plan

Whilst the improvement of endurance is undoubtedly the most important aim in mind when drawing up a training plan for a 400m hurdler, other elements - i.e. strength, elasticity, speed, technique over hurdles - must not be neglected. The level of technical skill and the strength of the individual athlete must be considered, and work modified accordingly. Practical realities, such as the availability of appropriate equipment, must also be taken into account. Only when all these factors have been incorporated can we acquire a complete picture of an effective annual training plan for the 400 metres Hurdles. Table 4 (on page 49) is an example of such a plan.