Elite Youth Player Development Workshop

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THE VAMEVAL TEST AND USE OF THE RESULTS IN FOOTBALL TRAINING

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Research Committee FFF-DTN

CONTENTS

1 – Definitions

2 – How to choose a test

3 – Comparison of the main tests: VAMEVAL protocols

4 – In-depth analysis of VAMEVAL

5 – How to use VAMEVAL test results

6 – How to use maximum aerobic speed (MAS) in training

SOME INITIAL DEFINITIONS

Maximal rate of oxygen consumption

% of VO2max, MAP (maximum aerobic power) or MAS which can be used for long periods

AEROBIC CAPACITY

MAX OXYGEN CONSUMPTION:
$\dot{V}O_2$ max
(Genetic factors + training)

AEROBIC ENDURANCE:
% of $\dot{V}O_2$ max
(Training)

ECONOMY OF MOVEMENT
(Training + drills
+ specific strength exercises)

MAXIMUM AEROBIC SPEED (MAS)

MAS is the lowest speed at which VO2 max is attained. It is the result of the interaction between VO2max and economy of movement, and is an important measure for managing training intensity

Smallest amount of energy needed to move over a given distance at a given speed

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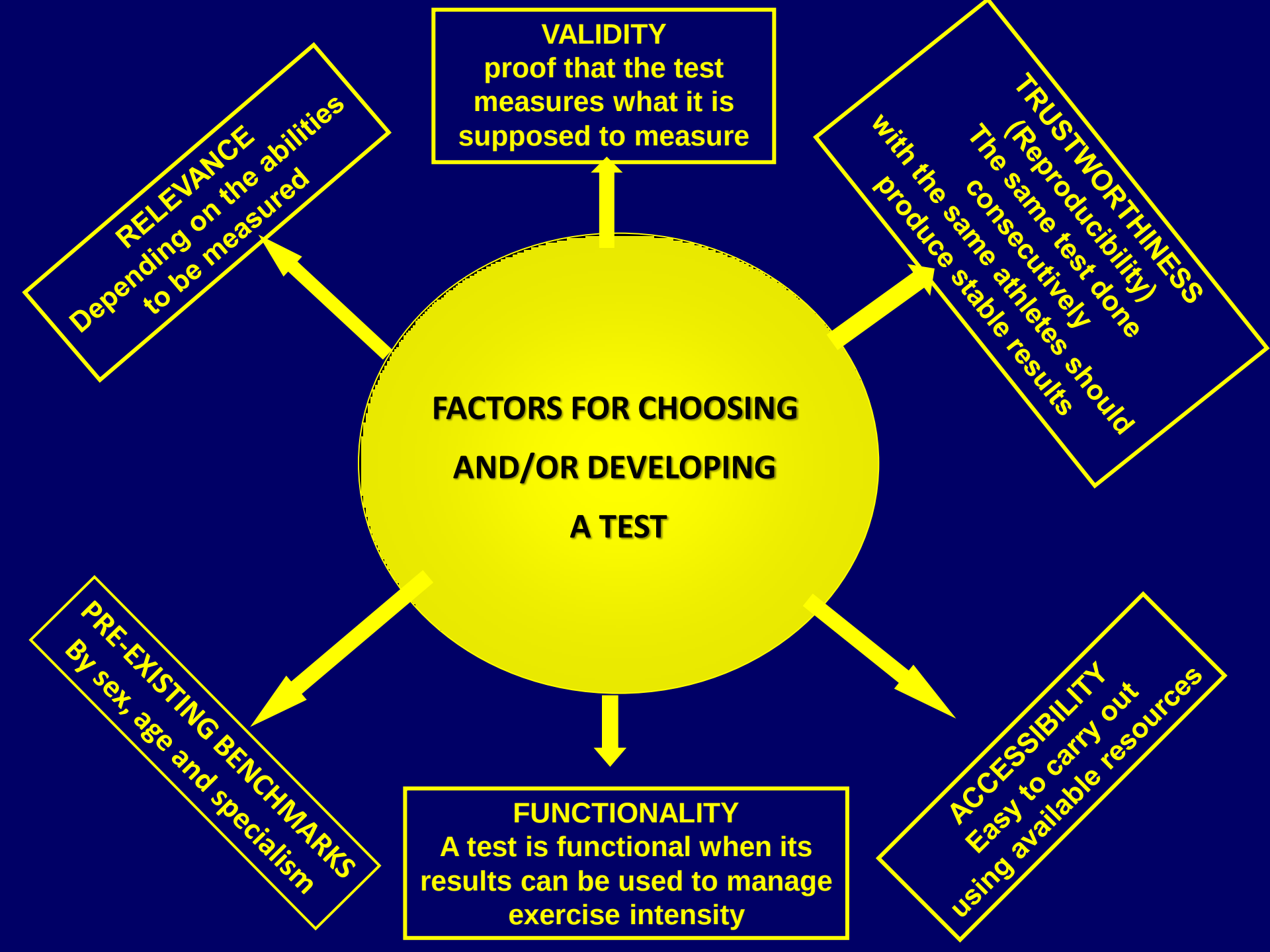
Numerous tests are currently used in football to evaluate aerobic capacity.

However the majority of them have never been scientifically validated.

When a coach or physical trainer uses one of these tests, the following questions arise:

- Is this test useful?
- What do I want to achieve with this test?
- Why use this test instead of another one?
- How can I use the results I get from this test?


VALIDITY
proof that the test measures what it is supposed to measure
RELEVANCE
Depending on the abilities to be measured
TRUSTWORTHINESS
(Reproducibility)
The same test done consecutively with the same athletes should produce stable results
FACTORS FOR CHOOSING AND/OR DEVELOPING A TEST
PRE-EXISTING BENCHMARKS
BY sex, age and specialism
FUNCTIONALITY
A test is functional when its results can be used to manage exercise intensity
ACCESSIBILITY
Easy to carry out using available resources

RELEVANCE

WHY TEST AND DEVELOP AEROBIC CAPACITY IN FOOTBALL?

High aerobic capacity allows an athlete:

1- to be more active without becoming overly fatigued during a match lasting 2 × 45 minutes

2- to recover better between two or more intensive efforts

3- to increase training capacity (in both intensity and duration)

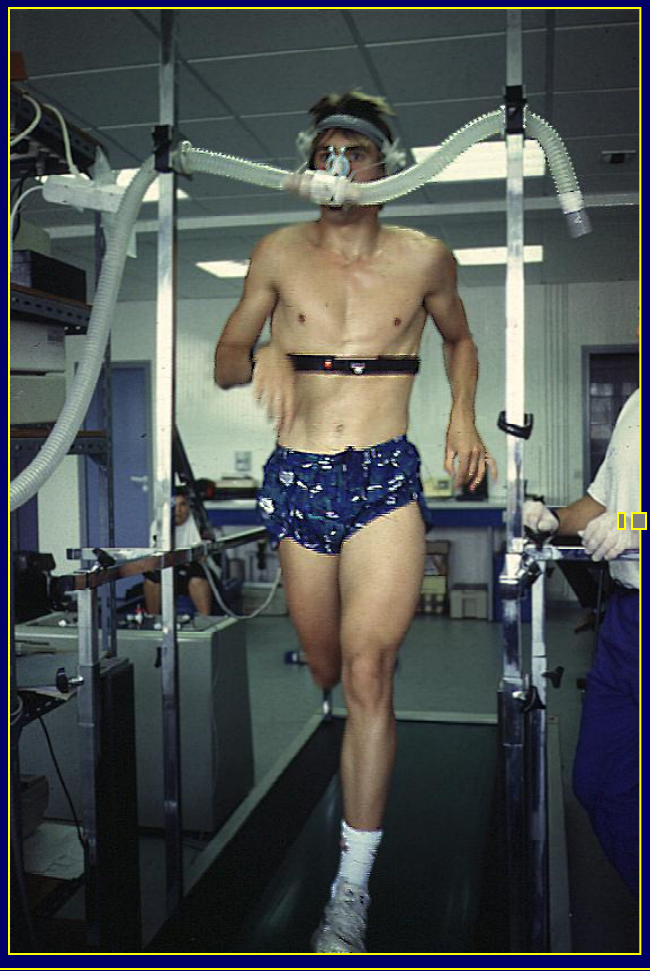
VALIDITY

FROM DIRECT TESTING…

TO TRAINING GROUND TESTS

ACCESSIBLE TO LARGER NUMBERS

RUNNING TESTS



DIRECTLY MEASURING VO2 MAX ON THE TREADMILL

FROM THE LAB…TO THE PITCH

MEASURING AEROBIC RUNNING SPEED ON THE PITCH

FUNCTIONALITY

A test is said to be functional when the result(s) can be used to guide and control coaching or training and to make modifications to training sessions

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CLASSIFYING THE DIFFERENT TESTS FOR EVALUATING AEROBIC CAPACITY: AEROBIC ENDURANCE (AE), MAXIMUM AEROBIC POWER (MAP) OR MAXIMIM AEROBIC SPEED (MAS)

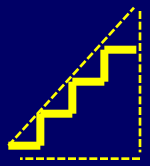
CONTINUOUS TESTS

PROGRESSIVE TESTS

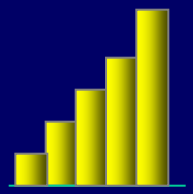
TESTS

- **CONTINUOUS**

- **PROGRESSIVE**



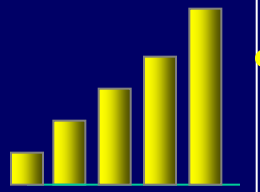
CONTINUOUS



SPRINT RACE

SHUTTLE RUNS

INTERVALS



SPRINT RACE

SHUTTLE RUNS

Tests by K. COOPER (1968) **: endurance?**

Time limit: % MAS **(endurance)**

Test by Léger and Boucher (1980): **MAS**

Test VAM-EVAL (1993): **MAS**

Shuttle run test (Léger and Lambert 1982)**: MAP**

Test by University of Bordeaux 2 (1990): **MAS** + HR - Lactate

Yoyo Test (Bangsbo 2008) : **> MAS + RVA**

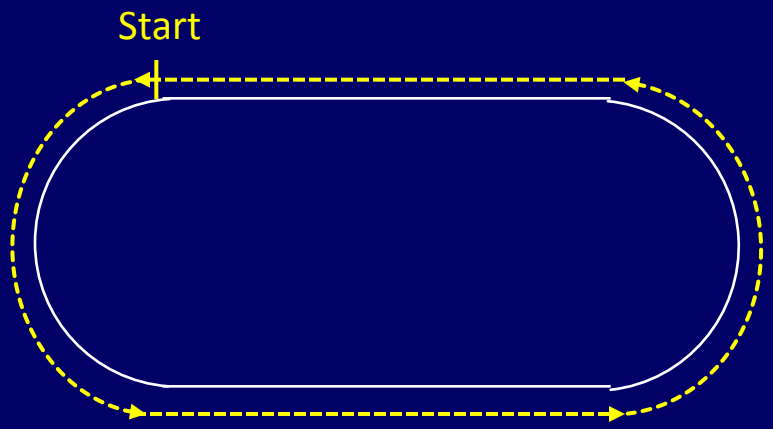
30-15s Intermittent Recovery Test (Buchheit 2008) : **> MAS + RVA**

1 – CONTINUOUS TESTS

TRACK SPRINTS

CONTINUOUS TESTS

Test of either 1) 12 min or 2) 2400m (K. COOPER 1965)



There are two variations of the Cooper test. The aim of the 12 minute test is to run as far as possible while in the 2400m test it is to run as fast as possible. The result indicates the level of physical fitness of the participant.

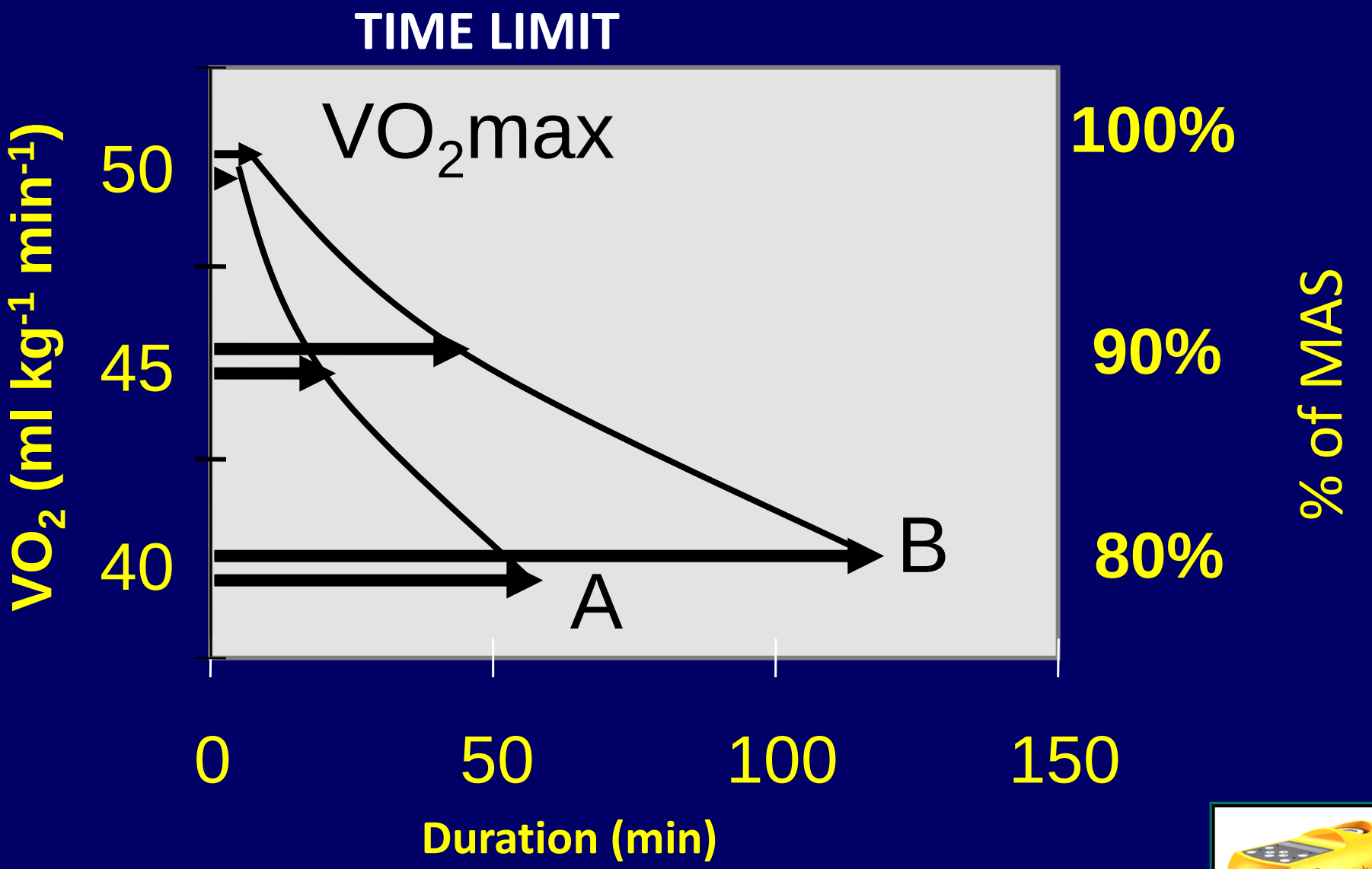
ADVANTAGES :

- Very accessible, only an athletics track and a stopwatch (or watch) required
- Benchmarks available set by sex and age (children, teenagers, adults, seniors)

DISADVANTAGES :

- No warm-up: danger for at-risk individuals
- Need to know how to run at a regular speed as fast as possible
- Varying correlation with VO2max depending on the group
- Does not give maximum aerobic speed (MAS)

CONTINUOUS TESTS (continued)

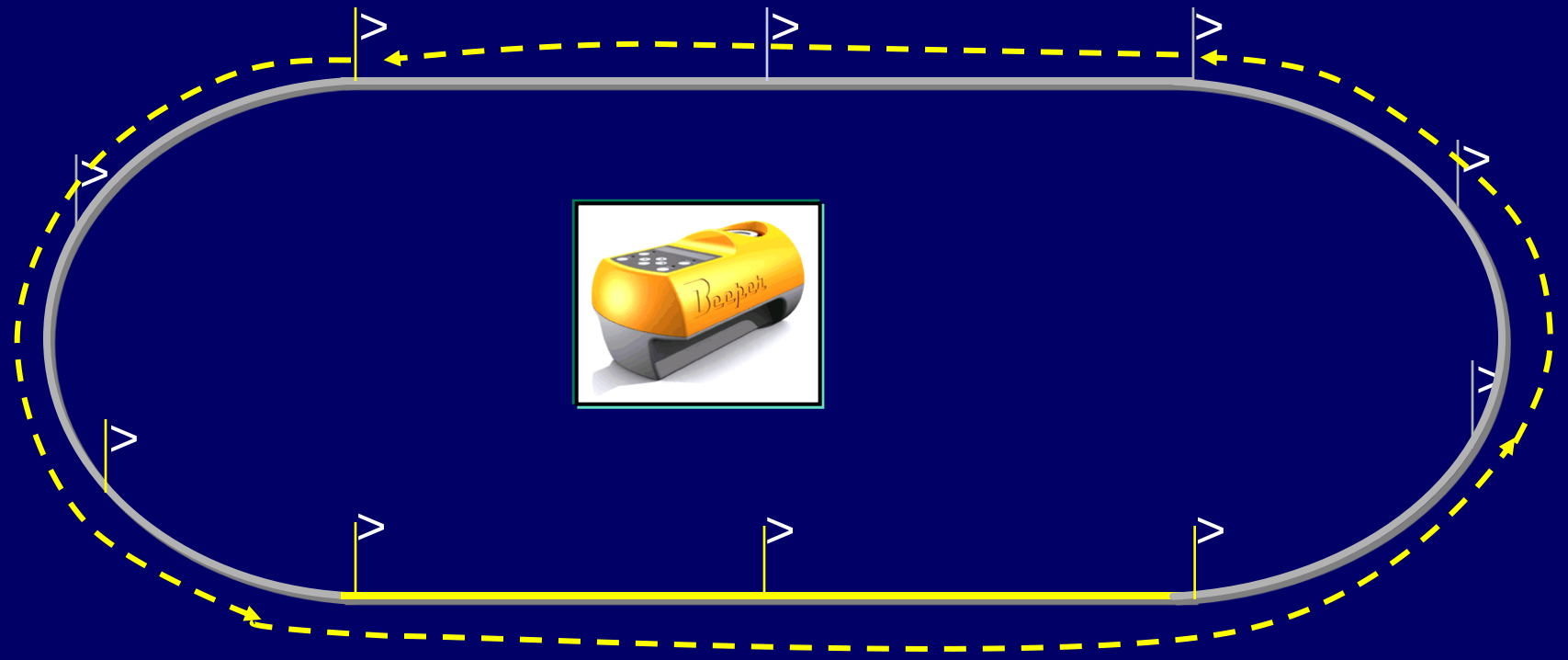


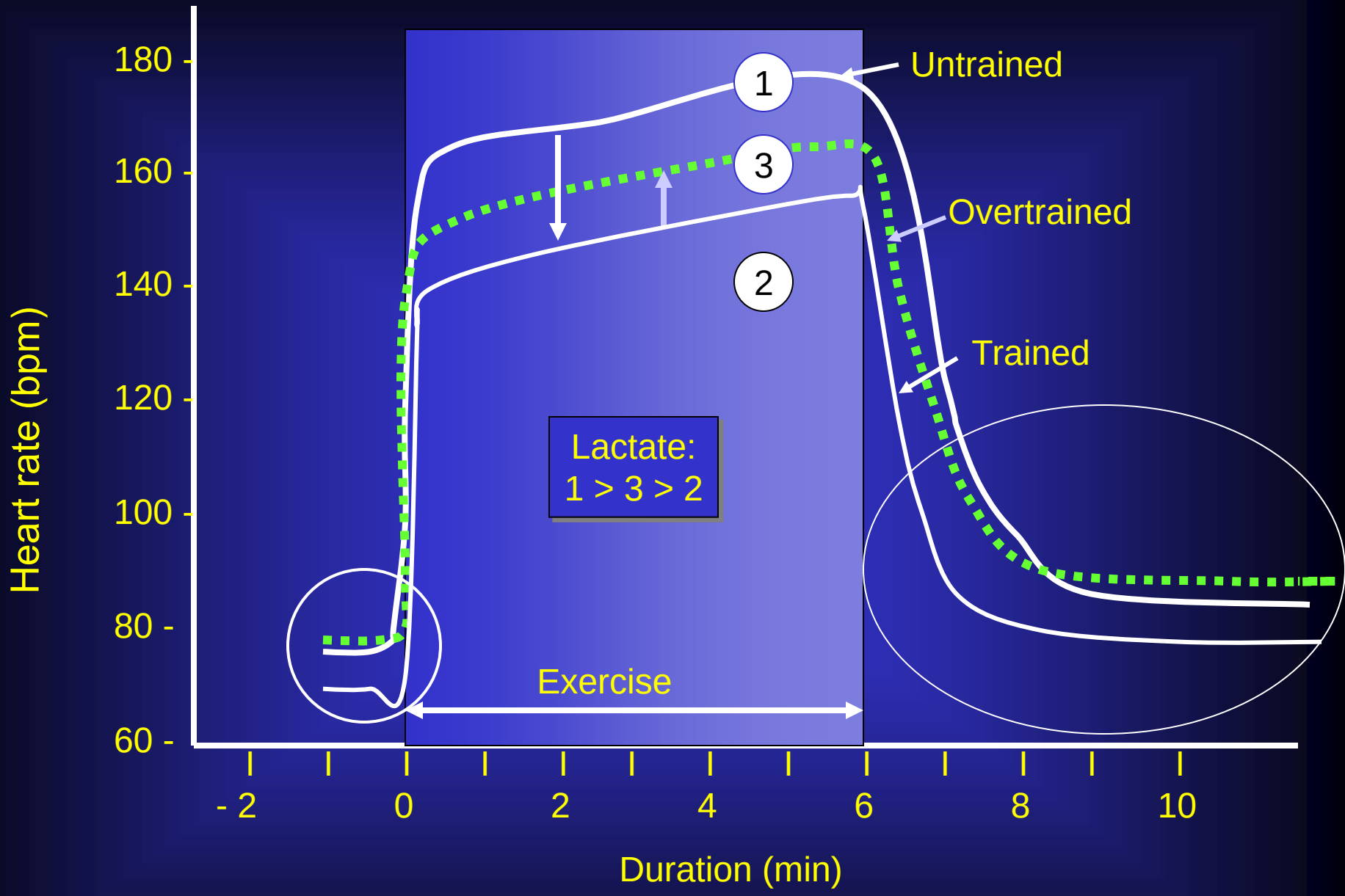
Must know MAS and how to use a beep test machine

ESTABLISHING A TIME LIMIT

Decide the percentage of MAS (90, 95, 100, 105 or 110 % of MAS), regulate the beeper and measure the time set for each speed

For percentages lower than MAS monitoring HR throughout the test and for 3 minutes afterwards can be an excellent way to establish a physiological profile throughout the season.





Evolution of the HR curve during and after a 6 minute run maintained at 90% MAS

II - PROGRESSIVE TESTS

SHUTTLE RUNS

- LEGER AND BOUCHER (1980)
- VAMEVAL (Cazorla and Léger; 1993)

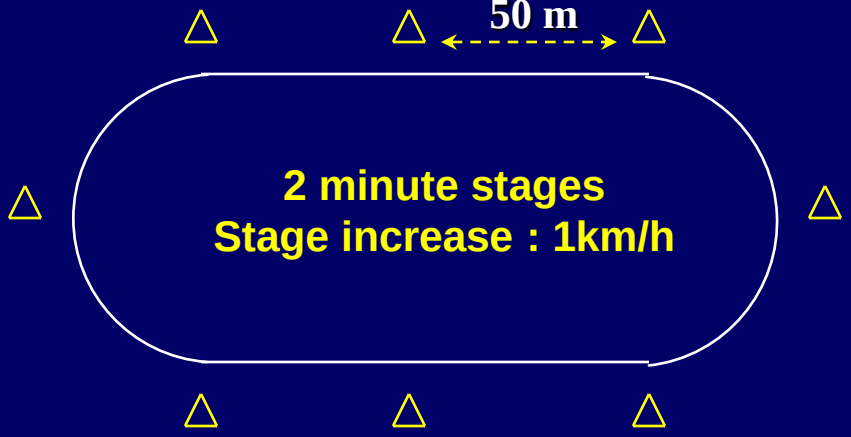
II - PROGRESSIVE TESTS IN A LINE

Materials needed and principles of the three following tests:

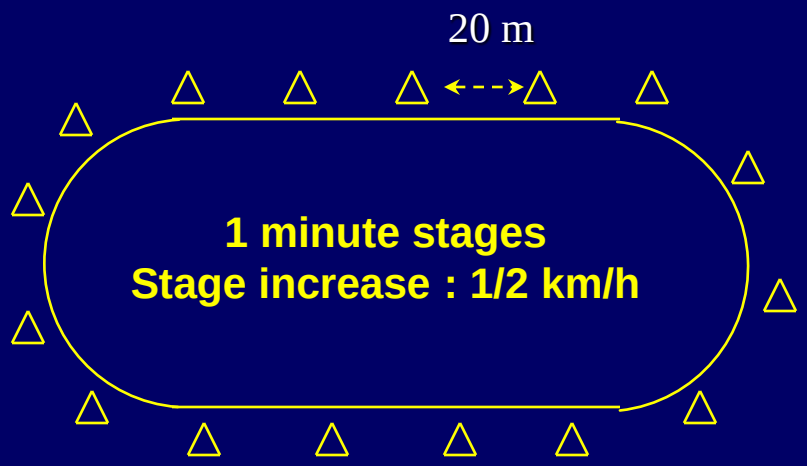
- *Multiple 20m or 50m sections of track*
- *Markers placed every 20m or 50m*
- *1 CD (supplied by UEFA?) with timed beeps or a beeper*

« Move to the next marker at each beep.

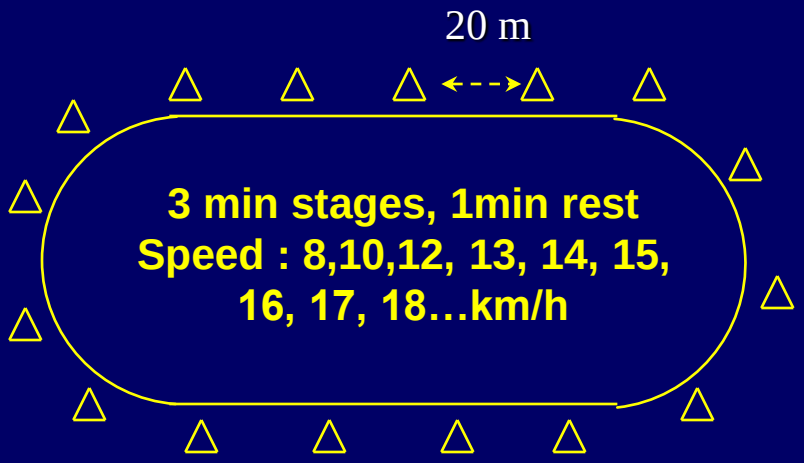
The interval between beeps reduces, increasing the speed as the test protocol progresses. »



Léger and Boucher test, 1980



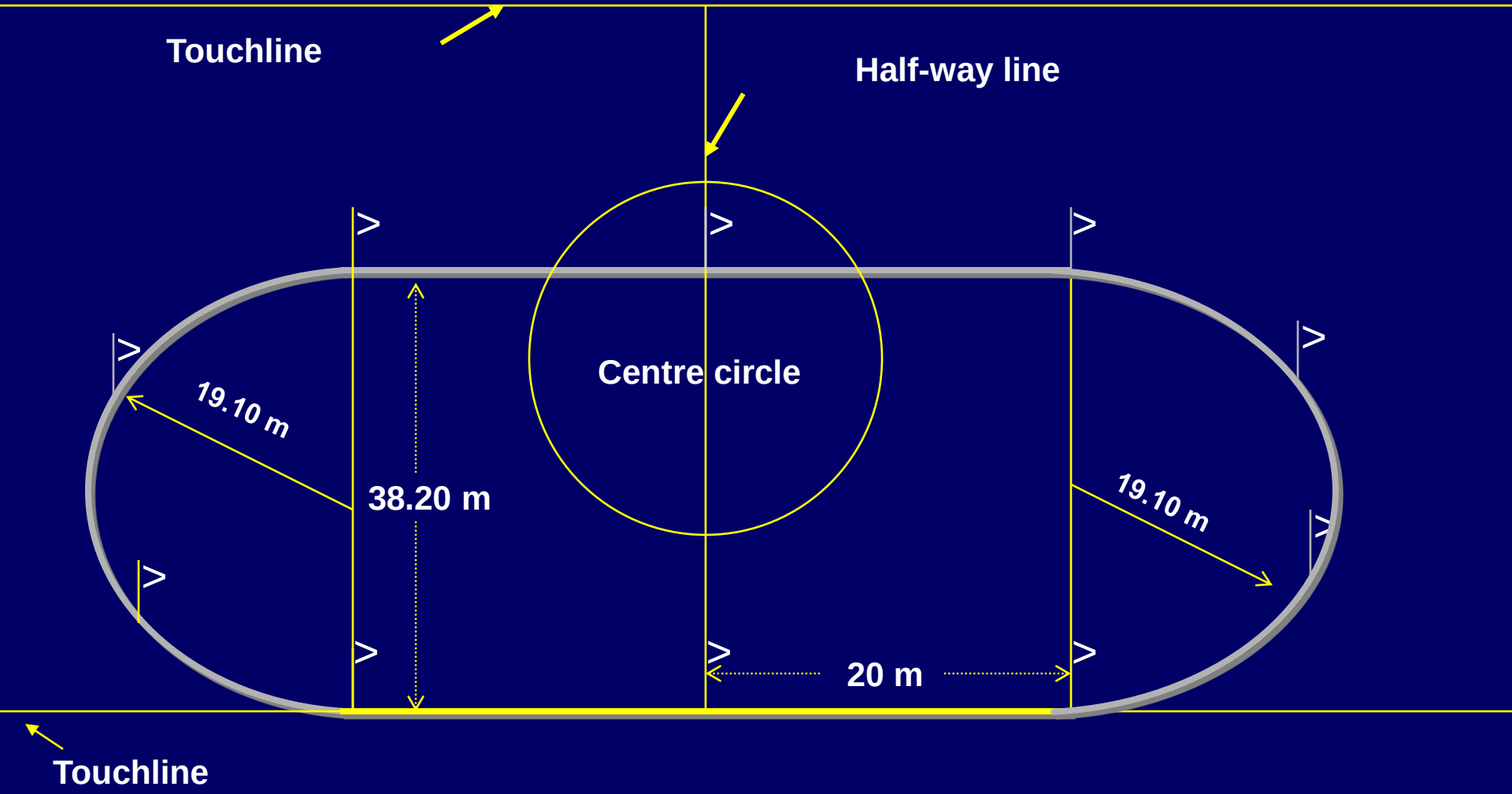
VAM-EVAL Tests (Cazorla and Léger, 1993)



University of Bordeaux 2 test, Cazorla (1992)

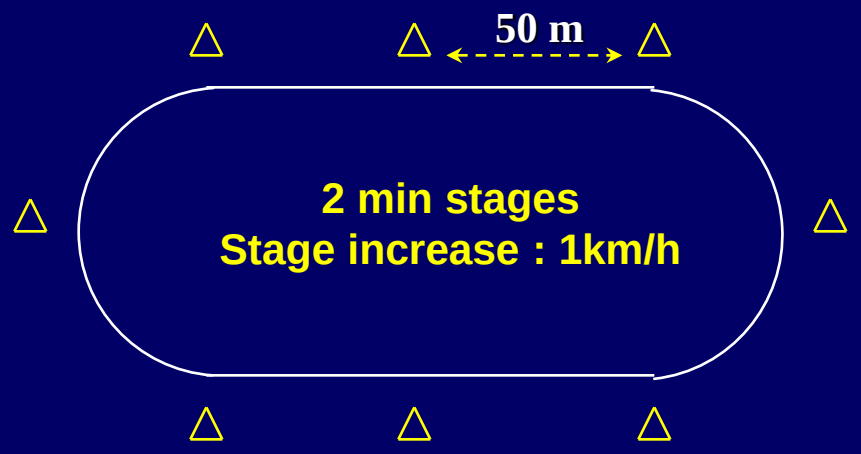
With and without HR monitors

How to measure out a 200m track on a football pitch



UNIVERSITY OF MONTREAL TEST

Léger L. and Boucher R. An indirect continuous running Multistage field test: Université de Montréal Track Test. Can J Appl Sport Sci. 5: 77-84, 1980



ADVANTAGES

- Benchmark test/trials
- Valid (Léger et Boucher 1980; Lacour et al.1991) for measuring VO2max and MAS

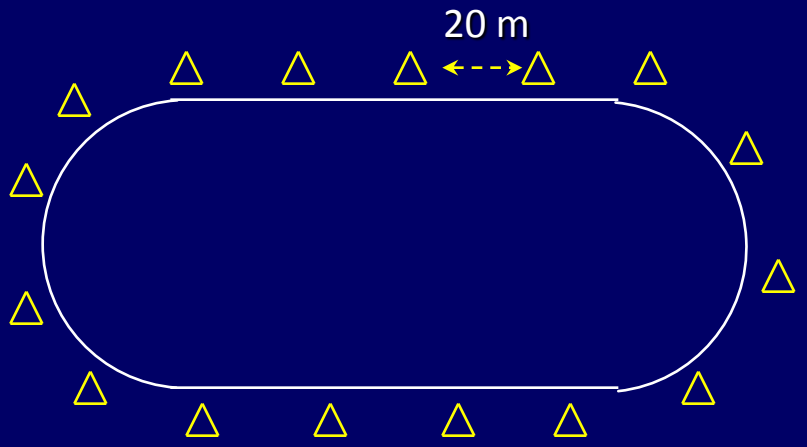
DISADVANTAGES

- 50m intervals too long to run at a regular pace
- 1km/hr increase per stage is too much

As a result it scores averagely for precision and accessibility

VAMEVAL TEST

Cazorla G. and Léger L. 1993.



ADVANTAGES

- Indirect validity using the Léger and Boucher test,
- Precise calculation of MAS
- Possible extrapolation of VO2max
- Benchmark results are available for footballers

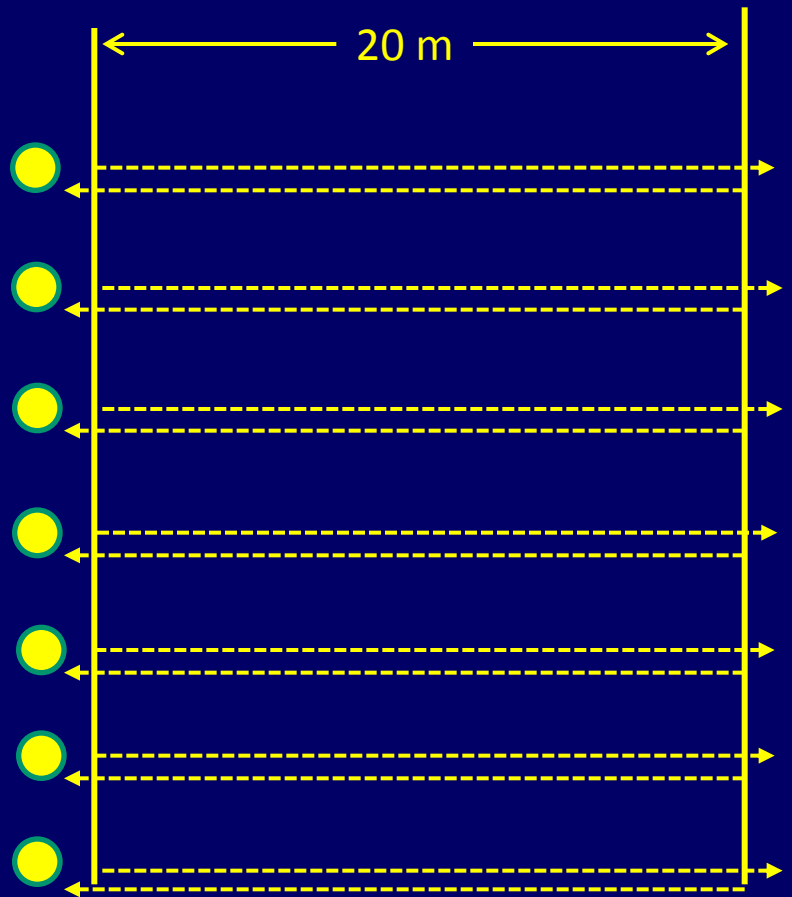
II - PROGRESSIVE TESTS (continued)

2-2 CONTINUOUS SHUTTLE RUNS TEST

(Léger et al. 1981)

SHUTTLE-RUN TEST 20m

Léger L. and Lambert J. 1982. Eur. J. Appl. Physiol. 49



Extremely popular in France and around the world in over 60 countries
Used in schools in France but also part of aerboic fitness tests for firefighters, navy and police..

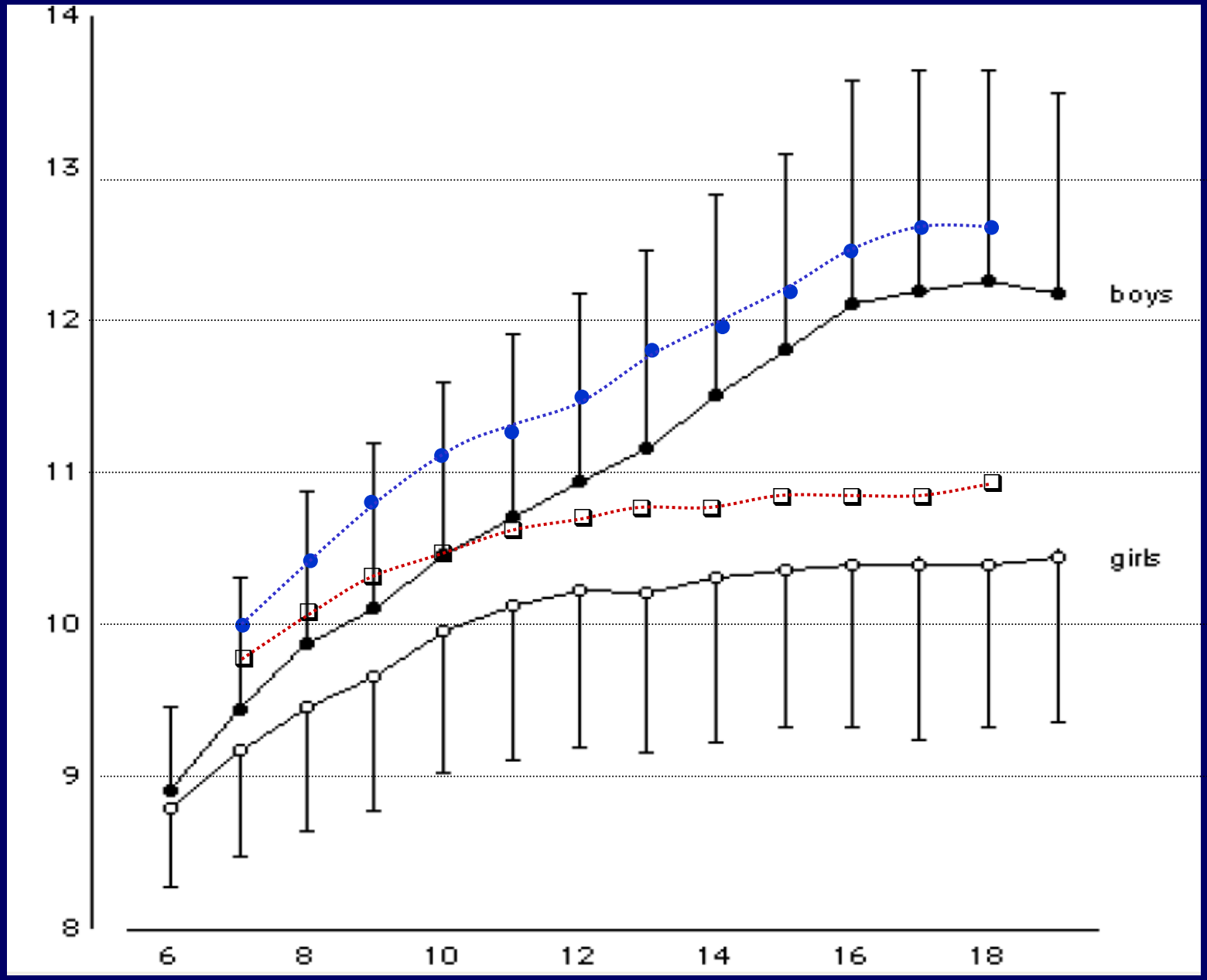
Standards calculated based on results collected from 37 countries

Olds T. Tomkinson G. Léger L. Cazorla G. 2006. *Journal of Sports Sciences 24(10): 1025-1038*

	boys			girls		
age	n	mean	SD	n	mean	SD
years		$km.h^{-1}$	$km.h^{-1}$		$km.h^{-1}$	$km.h^{-1}$
6	5685	8.917	0.545	5606	8.804	0.513
7	10138	9.454	0.871	10168	9.188	0.700
8	9526	9.882	1.000	10868	9.461	0.812
9	12935	10.120	1.085	12700	9.671	0.882
10	13859	10.459	1.142	13751	9.965	0.930
11	15480	10.716	1.202	15446	10.135	1.011
12	24544	10.951	1.237	24255	10.241	1.041
13	27535	11.166	1.303	27110	10.220	1.061
14	27106	11.517	1.323	24924	10.311	1.086
15	22465	11.812	1.283	20197	10.366	1.031
16	13311	12.122	1.462	13547	10.396	1.055
17	15108	12.192	1.450	14884	10.408	1.159
18	8580	12.263	1.395	8913	10.393	1.053
19	4917	12.182	1.315	4468	10.442	1.068
total	**211189**			**206837**		

n = sample size; SD = standard deviation.

How do French adolescents rank?



Olds T. Tomkinson G. Léger L. Cazorla G. 2006. *Journal of Sports Sciences 24(10): 1025-1038*

Based on the stage reached and the age of the participant an equation and/or a correlation table can be used to extrapolate VO_2max.

Equation : $VO_2max = 31.025 + 3.238$ speed (km/h) $- 3.248$ age (years) $+ 0.1536$ speed (km/h) x age (years) (as per Léger et al. 1983- 84)

Table : Example of part of a correlation table

Stage	Predicted VO_2max (ml.min^{-1}.kg^{-1}) by age												
(min)	6	7	8	9	10	11	**12**	13	14	15	16	17	18 +
…													
10	65.5	64.4	63	62	60.6	59.5	58.1	56.7	55.7	54.3	53.2	51.8	50.8
11	67.6	66.5	65.5	64.1	63	62	**60.6**	59.5	58.5	57.1	56	54.6	53.6
12	69.7	68.6	67.6	66.5	65.5	64.4	63.4	62	60.9	59.9	58.8	57.8	56.7
…													

But this test also depends on agility when changing direction and does not directly give maximum aerobic speed (MAS) in a straight line.

Prediction of maximum aerobic speed during “normal” running based on knowledge of maximum aerobic speed during shuttle runs

Shuttle run (km/h)	Regular running (km/h)	Shuttle run (km/h)	Regular running (km/h)
8.5	8.8	13.5	16.3
9.0	9.5	14.0	17.0
9.5	10.3	14.5	17.8
10.0	11.0	15.0	18.5
10.5	11.8	15.5	19.3
11.0	12.3	16.0	20.0
11.5	13.3	16.5	20.8
12.0	14.0	17.0	21.5
12.5	14.8	17.5	22.3
13.0	15.5	18.0	23.0

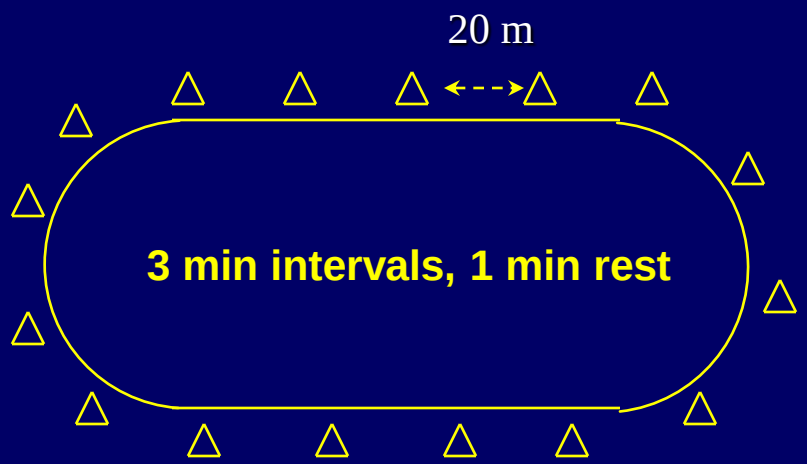
Cazorla , Léger ,1993.

II - PROGRESSIVE TEST

2-3 INTERMITTENT SPRINTS

- UNIVERSITY OF BORDEAUX 2 TEST *(Cazorla G., 1993)*

This test should only be used if the players have heart rate monitors to measure their cardiac adaptation and if their lactate levels can be measured during the test



University of Bordeaux 2 Test, (TUB2, Cazorla, 1992)

Sports co et al version: Speed: 8,10,12, 13, 14, 15, 16, 17, 18…km/h

Long sprint version: Speed: 12, 14, 16, 17, 18, 19, 20, 21, 22, 23…km/h

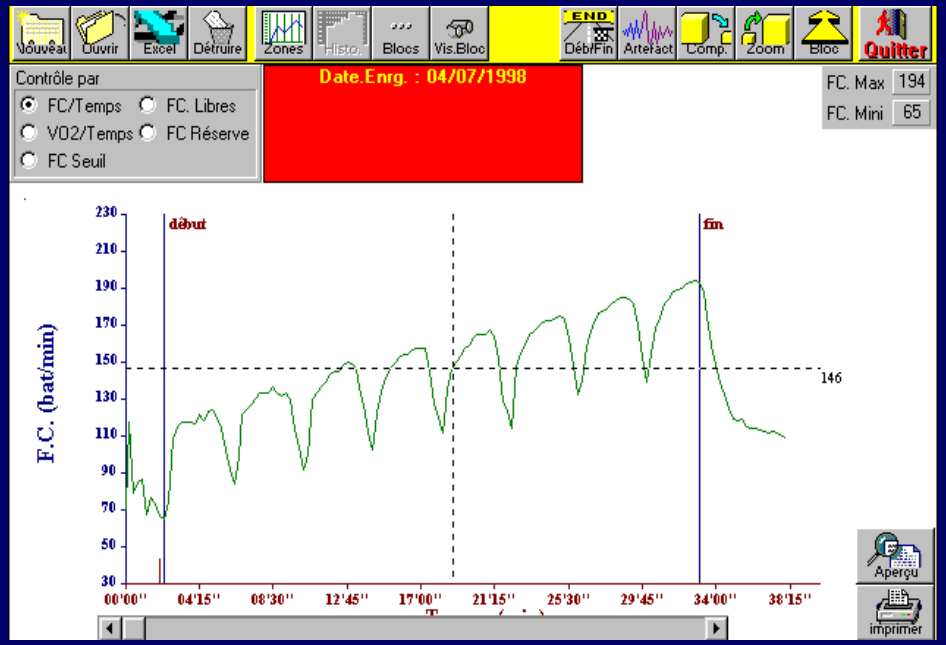
University of Bordeaux 2 test

TUB2 *(Cazorla G, 1992)*

-3 minute intervals.

- Increase the speed after each interval = 8, 10, 12, 13, 14, 15, 16, 17, 18 km/h....

- 1 minute rest between each interval (Calculations, record HR and note HR recovery rates between each interval).



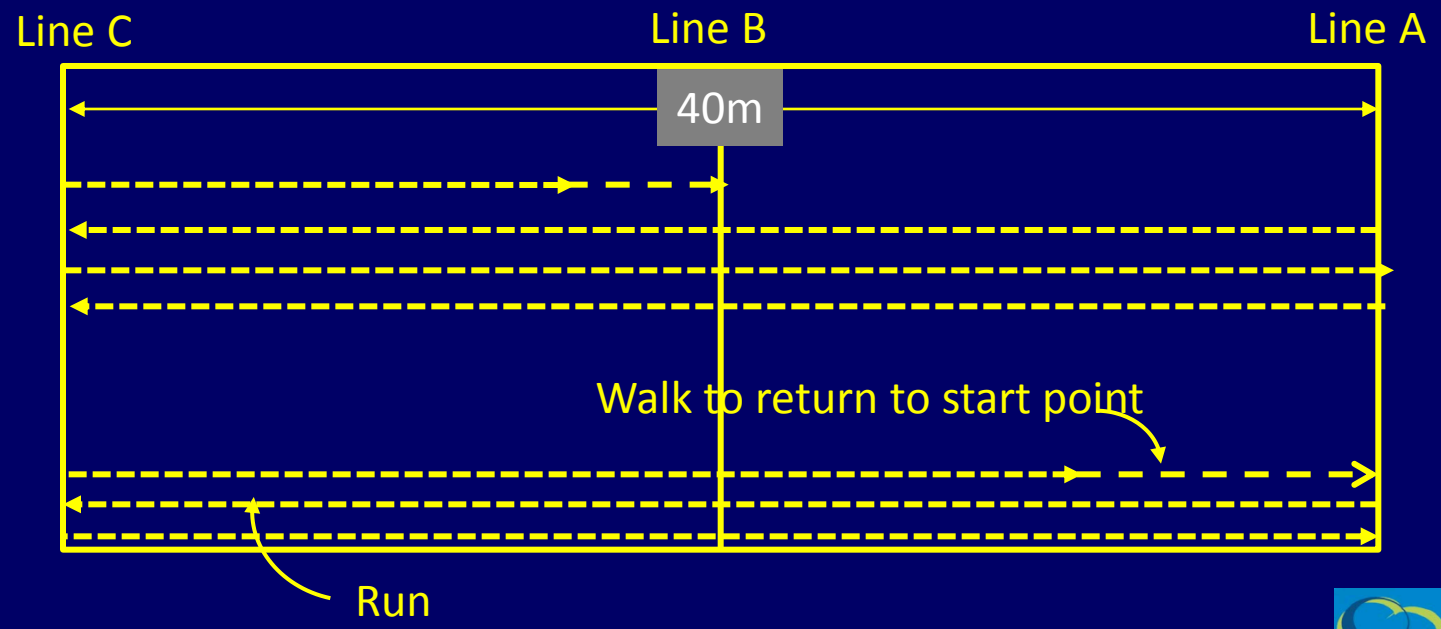
II – PROGRESSIVE TESTS

2-4 INTERMITTENT SHUTTLE RUNS

- **TEST 30-15 Intermittent Fitness Test** ***Buchheit M.*** *2008*
- **Yo-Yo Intermittent Recovery Test** ***Bansgsbo J. et al.*** *2008.*

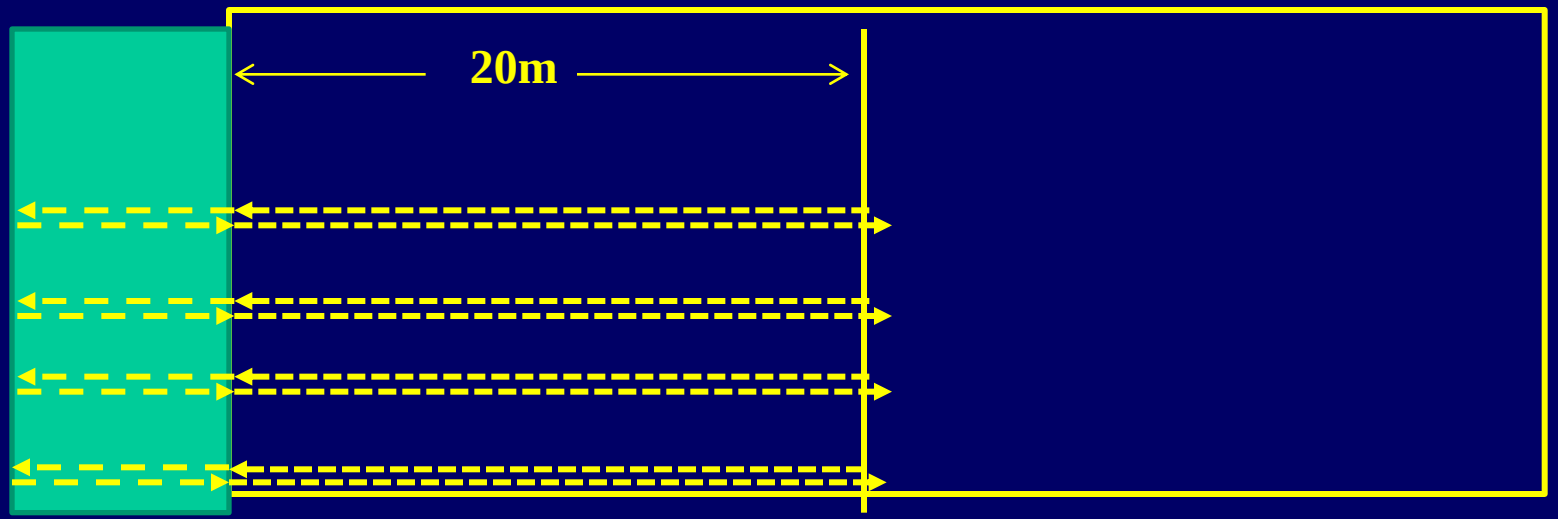
TEST 30-15
Intermittent Fitness Test

Buchheit M. *Science & Sports 23: 2008*



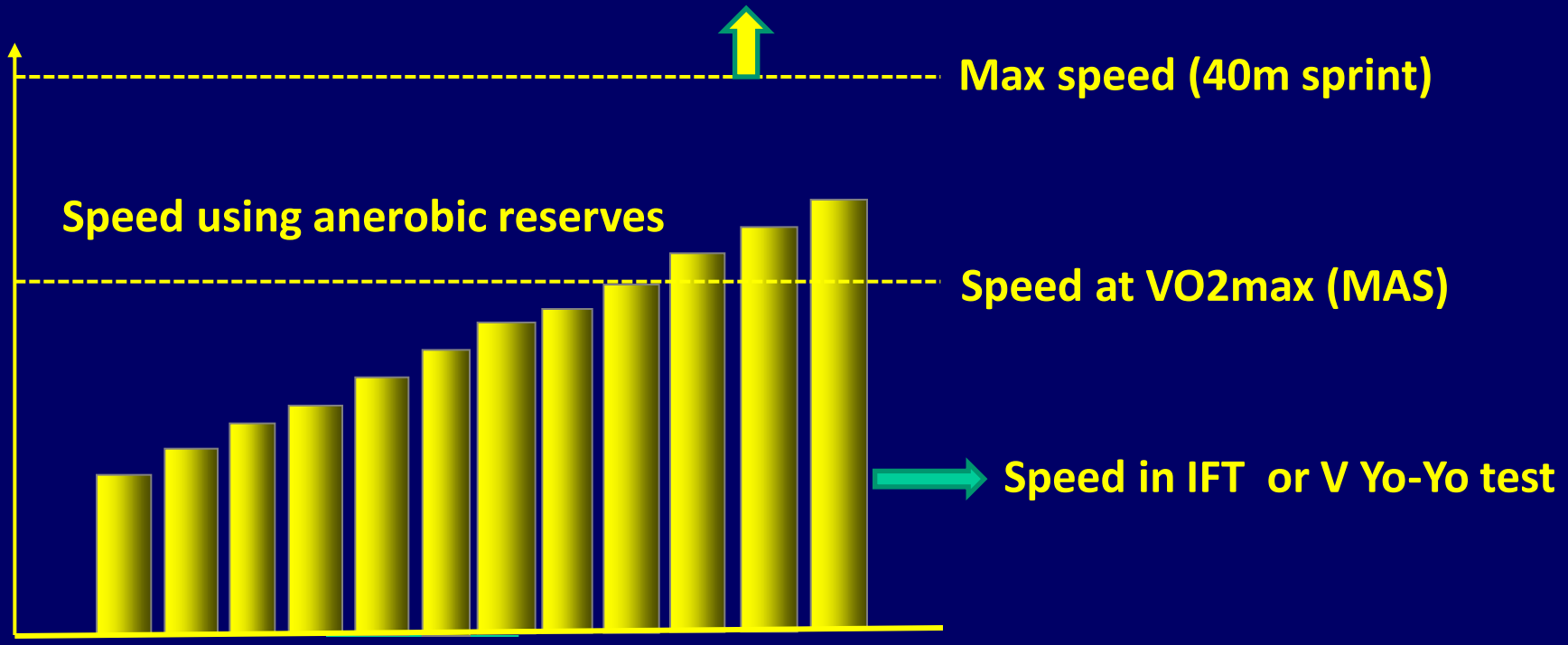
Yo-Yo Intermittent Recovery Test

Bansgsbo J., Laia M., Krustrup P. 2008. Sport Med 38(1)



COMPARISON OF THE FIVE TESTS

n = 10	VO2 (L.min^{-1})	VO2 ml.min^{-1}.kg^{-1}		Δ Sp. L.Bou.	HR (b.min^{-1})	Δ Lactate (mMol/L)		Δ CRP (mg/L)	
30-15s BUCHHEIT	4,91	64,20	20,10*	+ 3,75	192,7	10,82 *	465%	0,700 *	82%
	0,40	5,59	1,13		10,06	2,21	95%	0,080	9%
YO-YO Test	4,90	63,50	18,31*	+ 1,96	193	10,50 *	426%	0,686*	82%
	0,44	4,01	0,77		9,64	2,27	92%	0,130	15%
			Vit km.h^{-1}						
LEGER BOUCHER	4,87	62,78	16,35	Réf.	192,2	8,13	347%	0,268	33%
REFERENCE TEST	0,80	5,12	1,47		8,12	1,92	82%	0,065	8%
VAMEVAL	4,84	62,20	16,65	+ 0.3	192,5	8,20	324%	0,254	30%
	0,60	5,22	2,68		8,34	1,62	64%	0,059	7%
SHUTTLE RUNS L. LEGER	4,91	63,40	13,36*	- 2,99	193,4	8,14	332%	0,335	39%
	0,64	7,62	1,11		10,19	1,32	54%	0,043	5%



According to Buchheit 2010

Interval shuttle run tests at increasing speeds claim to be the most specific .
They evaluate several parameters at the same time:

- MAS + anaerobic speed reserves (ASR),
  + Recovery quality between intervals,
  + Acceleration ability after a stop,
  + Agility in changing direction

Even if **each one of these parameters** can be of relevancein team sports, the two tests above do not allow for any individualisation to show development of any given factor
Isn't practising the sport under consideration the best way of establishing the specificity of a test?

CONCLUSION AND THOUGHTS

1- Whatever the progressive test used on the pitch, **max HR and VO2max can be reached.**

2- Maximum aerobic speed (MAS) can be calculated using the three tests studied: **Léger and Boucher, VAM-EVAL and TUB2** (*thesis, Josselin Laffond*). These tests are recommended for use in managing training intensity, along with knowledge of athletes' MAS.

3- The shuttle-run test can be used to test VO2max in children, teenagers and adults but not MAS. This test is only recommended to estimate aerobic ability.

4- Interval shuttle run tests (Bangsbo, Buchheit) overestimate MAS because they use anaerobic components much higher than the anaerobic speed reserves are. Based on the fact that they are more practical (or specific), these tests are mostly used in team sports but **their functionality is questionable**.

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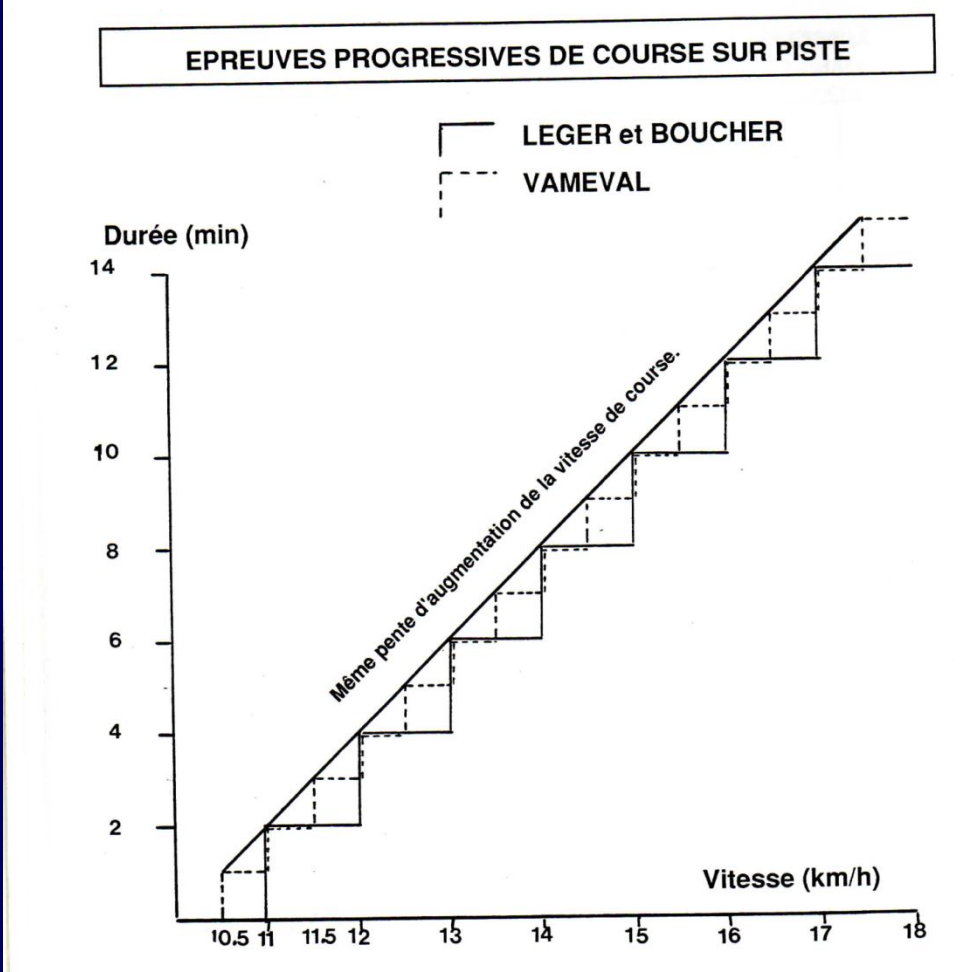
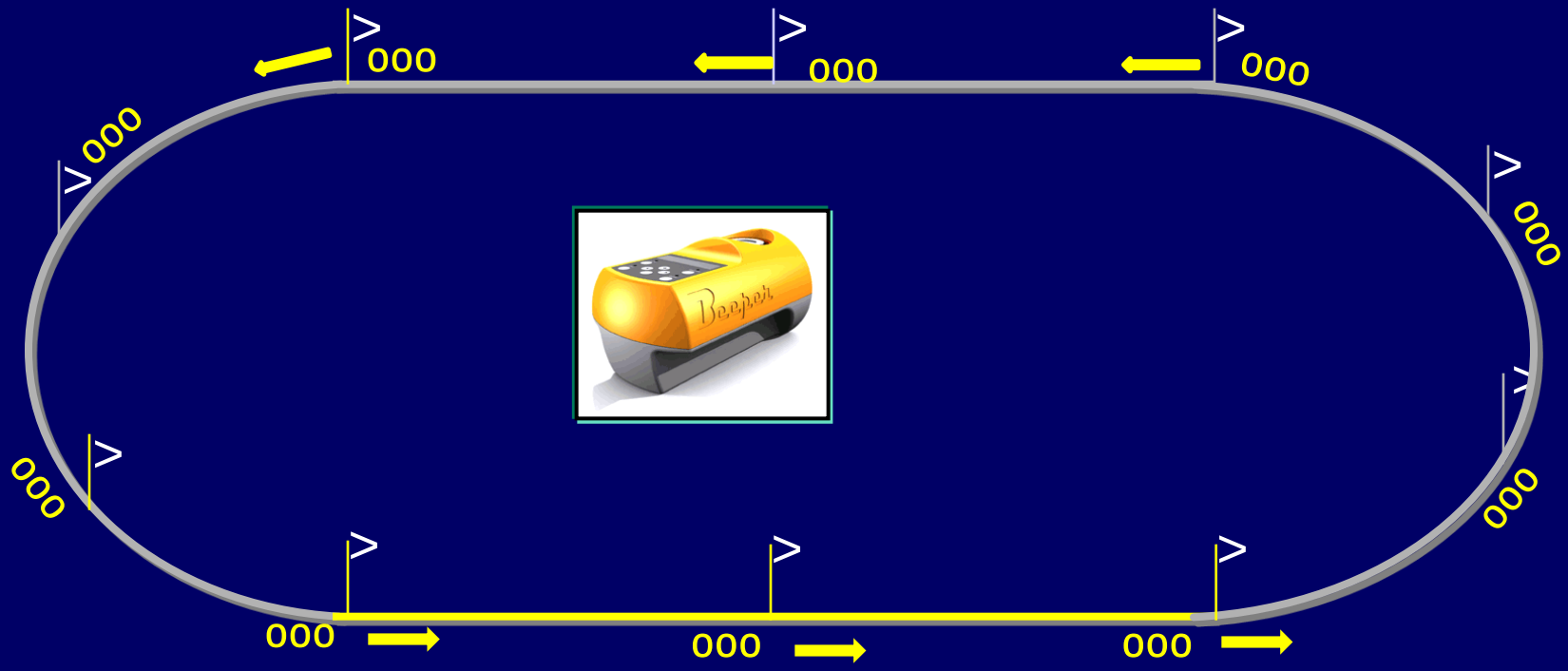


Comparison of incremental increases in the Léger-Boucher and VAMEVAL tests. The rate of speed increase is identical in each.

NO SIGNIFICANT DIFFERENCE BETWEEN THE LEGER-BOUCHER AND VAMEVAL TESTS

n = 10	VO2 (L.min^{-1})	VO2 ml.min^{-1}.kg^{-1}	Speed km.h^{-1}	Δ sp. L.Bou.	HR (b.min^{-1})	Δ Lactate (mMol/L)		Δ CRP (mg/L)	
30-15s BUCHHEIT	4,91	64,20	20,10*	+ 3,75	192,7	10,82 *	465%	0,700 *	82%
	0,40	5,59	1,13		10,06	2,21	95%	0,080	9%
YO-YO Test	4,90	63,50	18,31*	+ 1,96	193	10,50 *	426%	0,686*	82%
	0,44	4,01	0,77		9,64	2,27	92%	0,130	15%
LEGER BOUCHER	4,87	62,78	16,35	Réf.	192,2	8,13	347%	0,268	33%
BENCHMARK TEST	0,80	5,12	1,47		8,12	1,92	82%	0,065	8%
VAMEVAL	4,84	62,20	16,65	+ 0.3	192,5	8,20	324%	0,254	30%
	0,60	5,22	2,68		8,34	1,62	64%	0,059	7%
SHUTTLE RUNS L. LEGER	4,91	63,40	13,36*	- 2,99	193,4	8,14	332%	0,335	39%
	0,64	7,62	1,11		10,19	1,32	54%	0,043	5%

By putting three or four players at each marker, several teams can be tested at the same time.



CONTENTS

1 – Definitions

2 – How to choose a test

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6 – How to use maximum aerobic speed (MAS) in training

HOW TO USE RESULTS OF THE VAMEVAL TEST TO ASSESS THE PHYSIOLOGICAL CAPACITY OF A FOOTBALLER

Where can you find examples of using MAS to manage the intensity of different training sessions?

*www.**cress-sport.com***

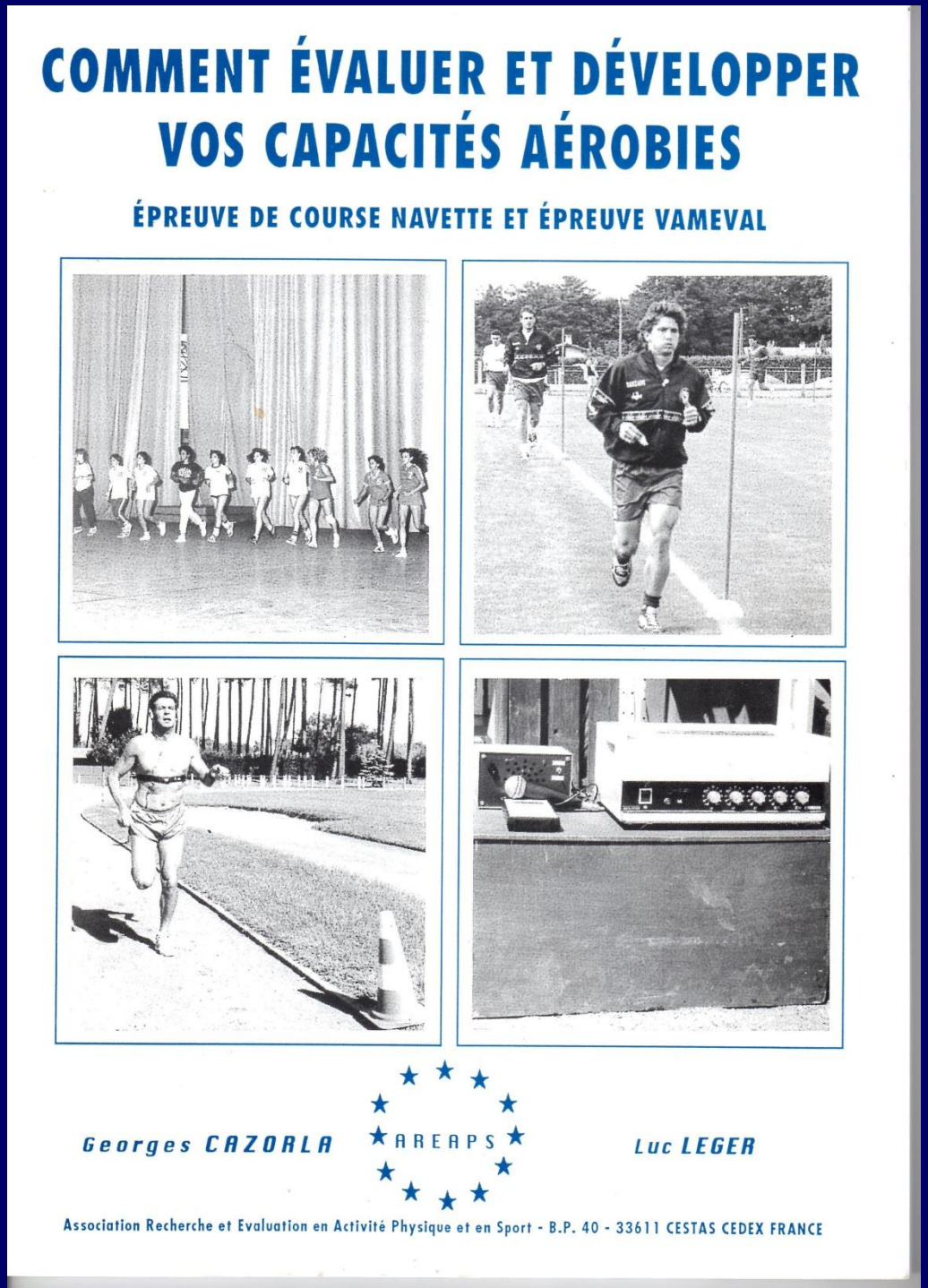


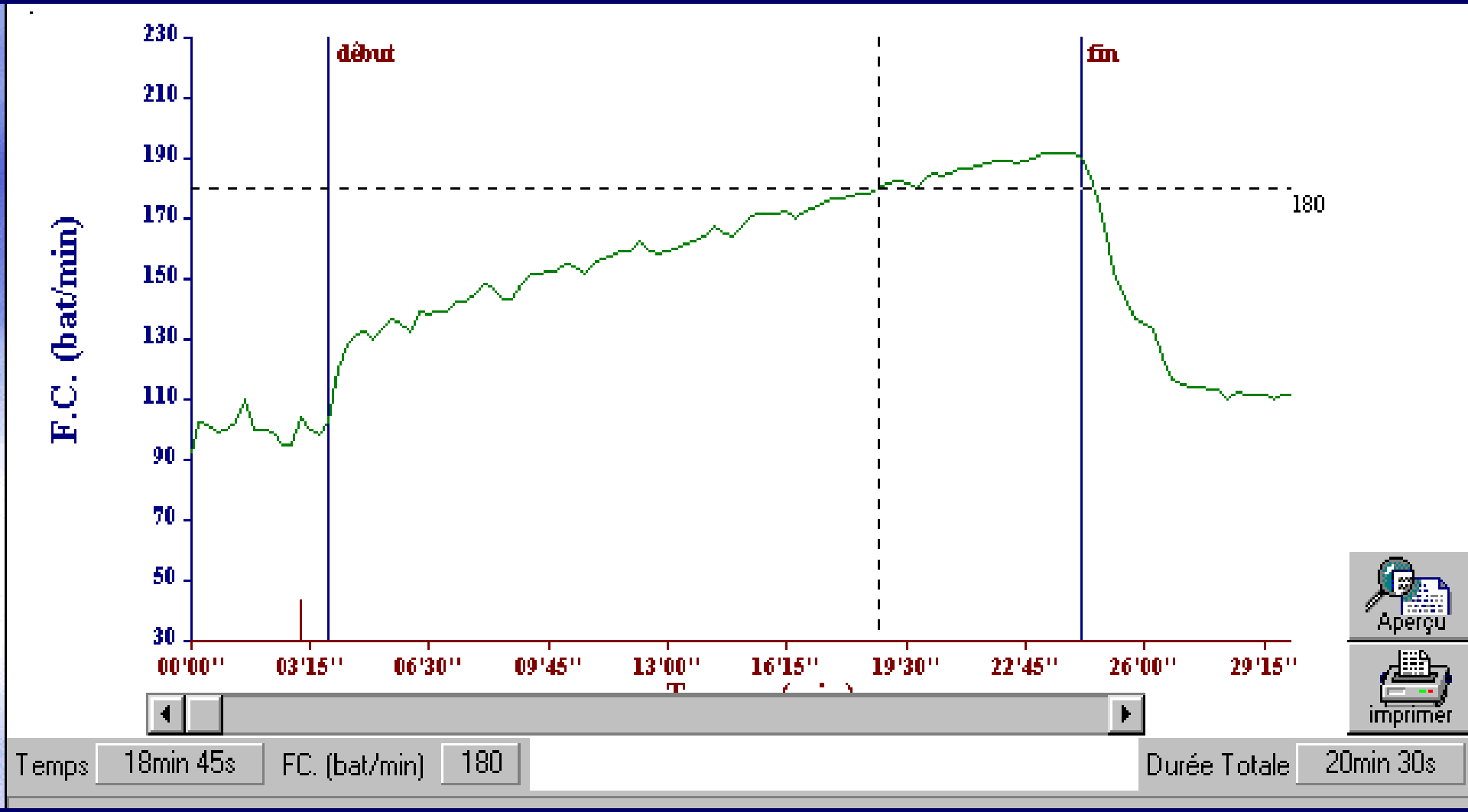
Tableau 11 : EPREUVE PROGRESSIVE DE COURSE CONTINUE A PALIERS DE UNE MINUTE : VAMEVAL

PALIERS 16 à 20

Paliers indiqués par l'enregistrement	**Vitesses** correspondantes (km/h)	**Durée** de l'intervalle entre chaque 20 m (s, 1/1000)	Consommations maximales d'oxygène extrapolées en fonction de l'âge : $\dot{V}O_2$ max ($ml.min^{-1}.kg^{-1}$)											
			6 ans	**7 ans**	**8 ans**	**9 ans**	**10 ans**	**11 ans**	**12 ans**	**13 ans**	**14 ans**	**15 ans**	**16 ans**	**17 ans**	**18 ans et +**
PALIER 16	**16.0 km/h**		**69,4**	**68,3**	**67,2**	**66,1**	**65,0**	**63,8**	**62,7**	**61,6**	**60,5**	**59,4**	**58,2**	**57,1**	**56,0**
15 s	16.1		70,0	68,9	67,7	66,6	65,5	64,3	63,2	62,1	61,0	59,8	58,7	57,6	56,4
30 s	16.3	4.364	70,5	69,4	68,3	67,1	66,0	64,8	63,7	62,6	61,4	60,3	59,2	58,0	56,9
45 s	16.4		71,1	69,9	68,8	67,6	66,5	65,3	64,2	63,0	61,9	60,8	59,6	58,5	57,3
PALIER 17	**16.5 km/h**		**71,6**	**70,5**	**69,3**	**68,1**	**67,0**	**65,8**	**64,7**	**63,5**	**62,4**	**61,2**	**60,1**	**58,9**	**57,8**
15 s	16.6		72,2	71,0	69,8	68,7	67,5	66,3	65,2	64,0	62,8	61,7	60,5	59,4	58,2
30 s	16.8	4.235	72,7	71,5	70,4	69,2	68,0	66,8	65,7	64,5	63,3	62,1	61,0	59,8	58,6
45 s	16.9		73,2	72,1	70,9	69,7	68,5	67,3	66,2	65,0	63,8	62,6	61,4	60,2	59,1
PALIER 18	**17.0 km/h**		**73,8**	**72,6**	**71,4**	**70,2**	**69,0**	**67,8**	**66,6**	**65,5**	**64,3**	**63,1**	**61,9**	**60,7**	**59,5**
15 s	17.1		74,3	73,1	71,9	70,7	69,5	68,3	67,1	65,9	64,7	63,5	62,3	61,1	59,9
30 s	17.3	4.114	74,9	73,7	72,5	71,2	70,0	68,8	67,6	66,4	65,2	64,0	62,8	61,6	60,4
45 s	17.4		75,4	74,2	73,0	71,8	70,5	69,3	68,1	66,9	65,7	64,5	63,2	62,0	60,8
PALIER 19	**17.5 km/h**		**76,0**	**74,7**	**73,5**	**72,3**	**71,1**	**69,8**	**68,6**	**67,4**	**66,2**	**64,9**	**63,7**	**62,5**	**61,3**
15 s	17.6		76,5	75,3	74,0	72,8	71,6	70,3	69,1	67,9	66,6	65,4	64,2	62,9	61,7
30 s	17.8	4.000	77,0	75,8	74,6	73,3	72,1	70,8	69,6	68,3	67,1	65,9	64,6	63,4	62,1
45 s	17.9		77,6	76,3	75,1	73,8	72,6	71,3	70,1	68,8	67,6	66,3	65,1	63,8	62,6
PALIER 20	**18.0 km/h**		**78,1**	**76,9**	**75,6**	**74,3**	**73,1**	**71,8**	**70,6**	**69,3**	**68,0**	**66,8**	**65,5**	**64,3**	**63,0**
15 s	18.1		78,7	77,4	76,1	74,9	73,6	72,3	71,1	69,8	68,5	67,2	66,0	64,7	63,4
30 s	18.3	3.892	79,2	77,9	76,7	75,4	74,1	72,8	71,5	70,3	69,0	67,7	66,4	65,2	63,9
45 s	18.4		79,7	78,5	77,2	75,9	74,6	73,3	72,0	70,7	69,5	68,2	66,9	65,6	64,3

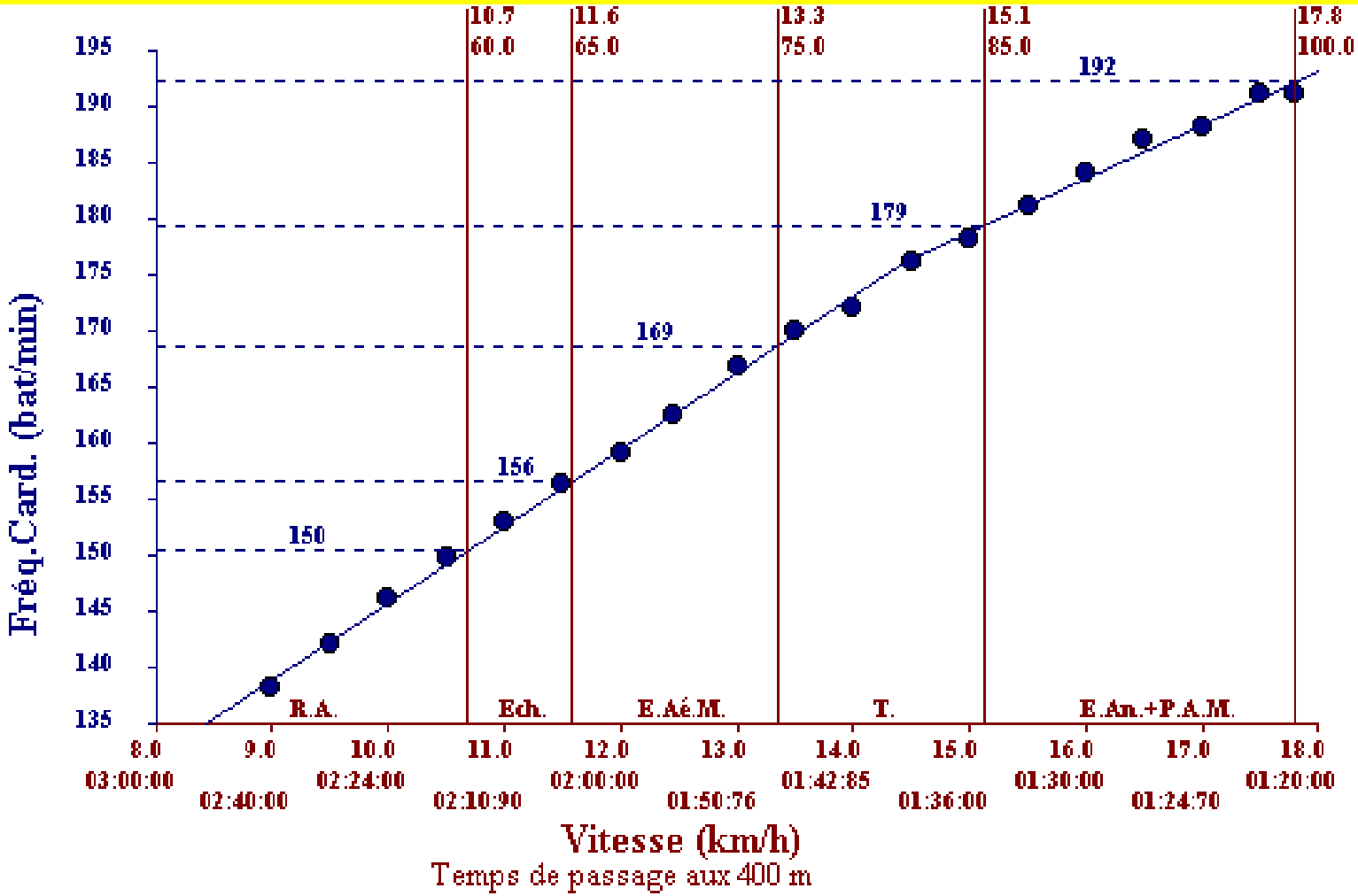
WITH A HEART RATE MONITOR…

Standard measurement of heart rate during the VAMEVAL test (Biologiciel®)



Calculating the ratio between heart rate and running speed and defining training zones: A.R.: active recovery, WU: Warm-up, MAE: moderate aerobic endurance, T: transition zone, AnE + MAP: anaerobic endurance + maximum aerobic power.

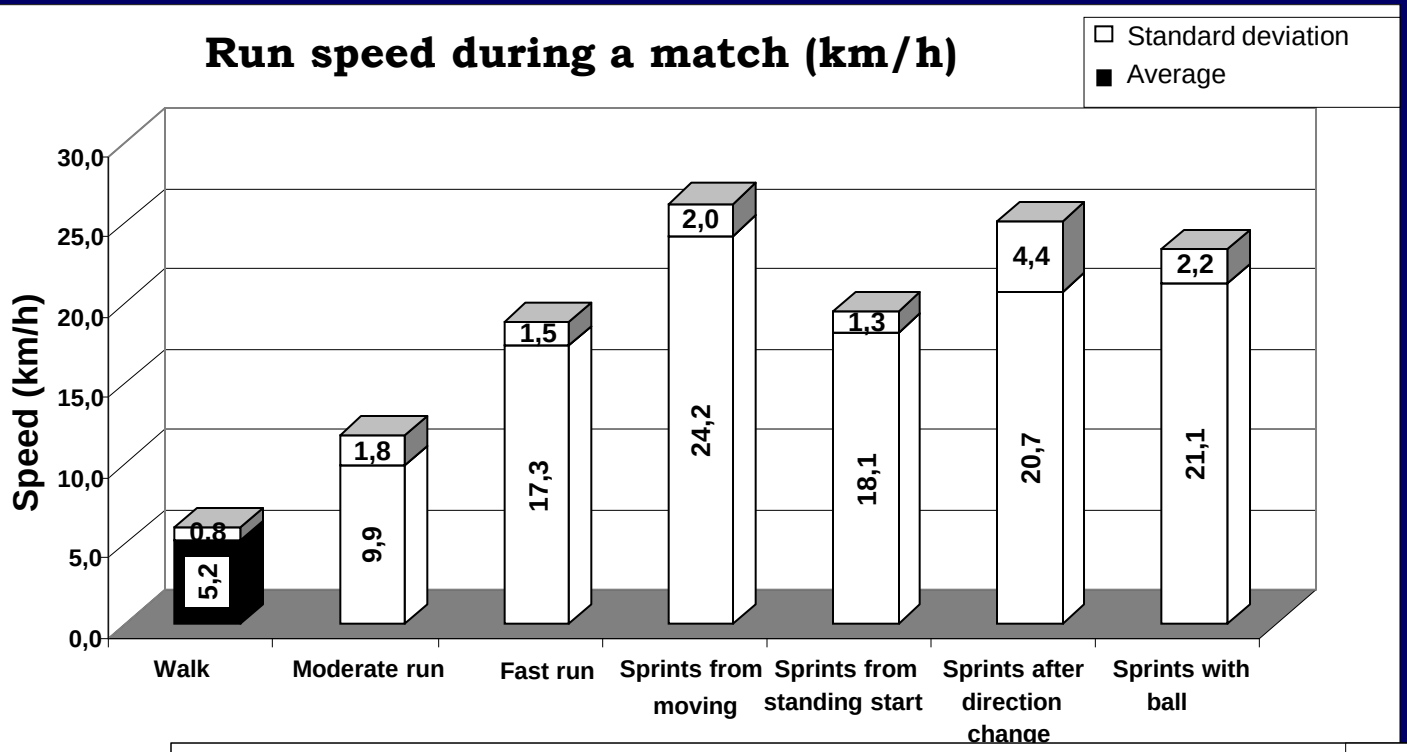
HR, % of MAP (or MAS), speeds and interval times over the 400m distance used here are Automatically calculated for each zone by Biologiciel (the software used).



FC1 = 6.808*Vit+77.623 r = 0.999
FC2 = 4.799*Vit+106.629 r = 0.992

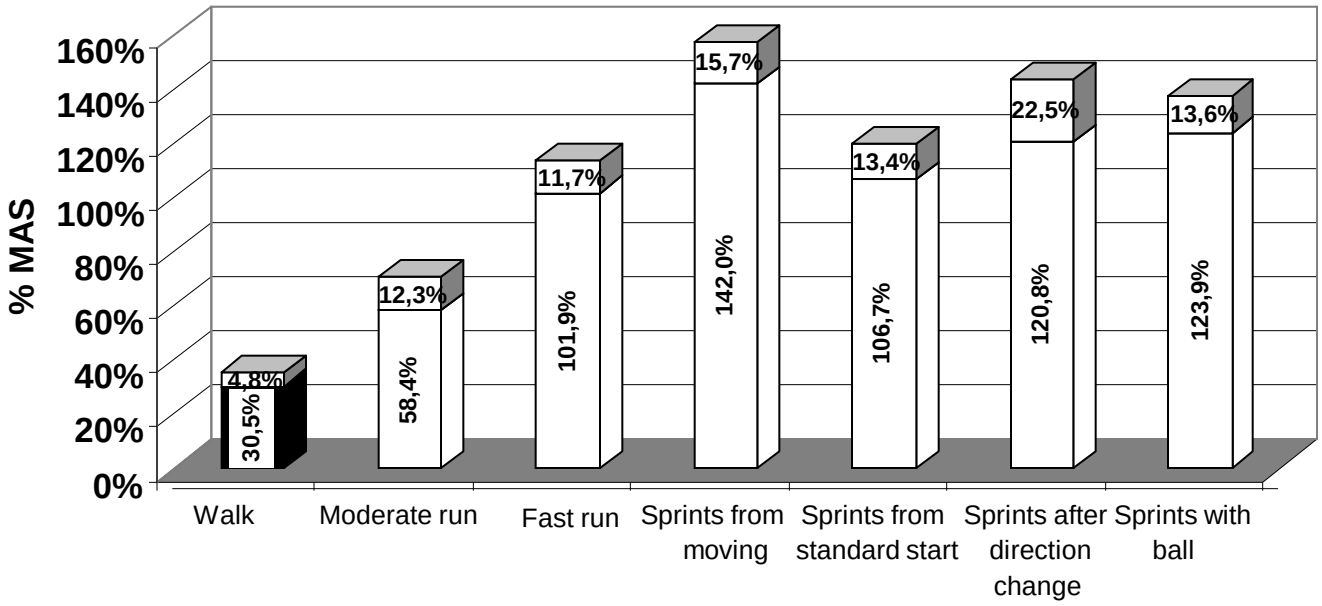
Equations allow HR to be extrapolated based on run speed

ESTABLISHING THE LOAD OF A MATCH OR TRAINING SESSION ON THE BODY



GPS + video

GPS + MAS knowledge



Cazorla et al. 2009

ARE THERE BENCHMARKS FOR COMPARING FOOTBALLERS WHO HAVE BEEN TESTED?

SCALE OF MAXIMUM AEROBIC SPEED (MAS) FOR STRIKERS

SCALE	VAMEVAL MAS STRIKERS (km/h)							SCALE
Marks/20	13 yo	14 yo	15 yo	16 yo	17 yo	18 yo	19 yo+	Marks/20
20	17,7	19,3	18,7	18,1	18,8	19,1	19,0	20
19	17,4	18,9	18,5	17,9	18,7	18,9	18,8	19
18	17,1	18,6	18,3	17,7	18,5	18,7	18,6	18
17	16,9	18,3	18,1	17,5	18,3	18,5	18,3	17
16	16,6	17,9	17,9	17,3	18,1	18,3	18,1	16
15	16,3	17,6	17,7	17,1	18,0	18,1	17,9	15
14	16,0	17,2	17,5	16,9	17,8	17,8	17,7	14
13	15,8	16,9	17,3	16,7	17,6	17,6	17,4	13
12	15,5	16,6	17,1	16,5	17,4	17,4	17,2	12
11	15,2	16,2	16,9	16,4	17,3	17,2	17,0	11
10	14,9	15,9	16,7	16,2	17,1	17,0	16,7	10
9	14,6	15,6	16,5	16,0	16,9	16,8	16,5	9
8	14,4	15,2	16,2	15,8	16,7	16,6	16,3	8
7	14,1	14,9	16,0	15,6	16,6	16,3	16,0	7
6	13,8	14,5	15,8	15,4	16,4	16,1	15,8	6
5	13,5	14,2	15,6	15,2	16,2	15,9	15,6	5
4	13,3	13,9	15,4	15,0	16,0	15,7	15,3	4
3	13,0	13,5	15,2	14,8	15,9	15,5	15,1	3
2	12,7	13,2	15,0	14,6	15,7	15,3	14,9	2
1	12,4	12,9	14,8	14,4	15,5	15,1	14,7	1
0	12,2	12,5	14,6	14,2	15,3	14,8	14,4	0

SCALE OF MAXIMUM AEROBIC SPEED (MAS) FOR MIDFIELDERS

SCALE	VAMEVAL MAS MIDFIELDERS (km/h)							SCALE
Marks/20	13 yo	14 yo	15 yo	16 yo	17 yo	18 yo	19 yo +	Marks/20
20	19,2	20,0	19,0	19,4	19,1	19,3	19,7	20
19	18,8	19,6	18,8	19,1	18,9	19,1	19,5	19
18	18,5	19,2	18,6	18,9	18,7	18,9	19,2	18
17	18,1	18,8	18,4	18,6	18,5	18,7	19,0	17
16	17,7	18,4	18,2	18,4	18,3	18,5	18,7	16
15	17,4	18,0	18,0	18,1	18,2	18,3	18,5	15
14	17,0	17,6	17,7	17,8	18,0	18,2	18,2	14
13	16,6	17,2	17,5	17,6	17,8	18,0	18,0	13
12	16,3	16,8	17,3	17,3	17,6	17,8	17,7	12
11	15,9	16,4	17,1	17,1	17,5	17,6	17,4	11
10	15,5	16,0	16,9	16,8	17,3	17,4	17,2	10
9	15,2	15,6	16,7	16,5	17,1	17,2	16,9	9
8	14,8	15,2	16,5	16,3	16,9	17,0	16,7	8
7	14,4	14,8	16,3	16,0	16,7	16,8	16,4	7
6	14,1	14,4	16,1	15,8	16,6	16,6	16,2	6
5	13,7	14,0	15,9	15,5	16,4	16,4	15,9	5
4	13,4	13,6	15,7	15,3	16,2	16,2	15,7	4
3	13,0	13,2	15,4	15,0	16,0	16,0	15,4	3
2	12,6	12,8	15,2	14,7	15,9	15,8	15,1	2
1	12,3	12,4	15,0	14,5	15,7	15,6	14,9	1
0	11,9	12,0	14,8	14,2	15,5	15,4	14,6	0

SCALE OF MAXIMUM AEROBIC SPEED (MAS) FOR DEFENDERS

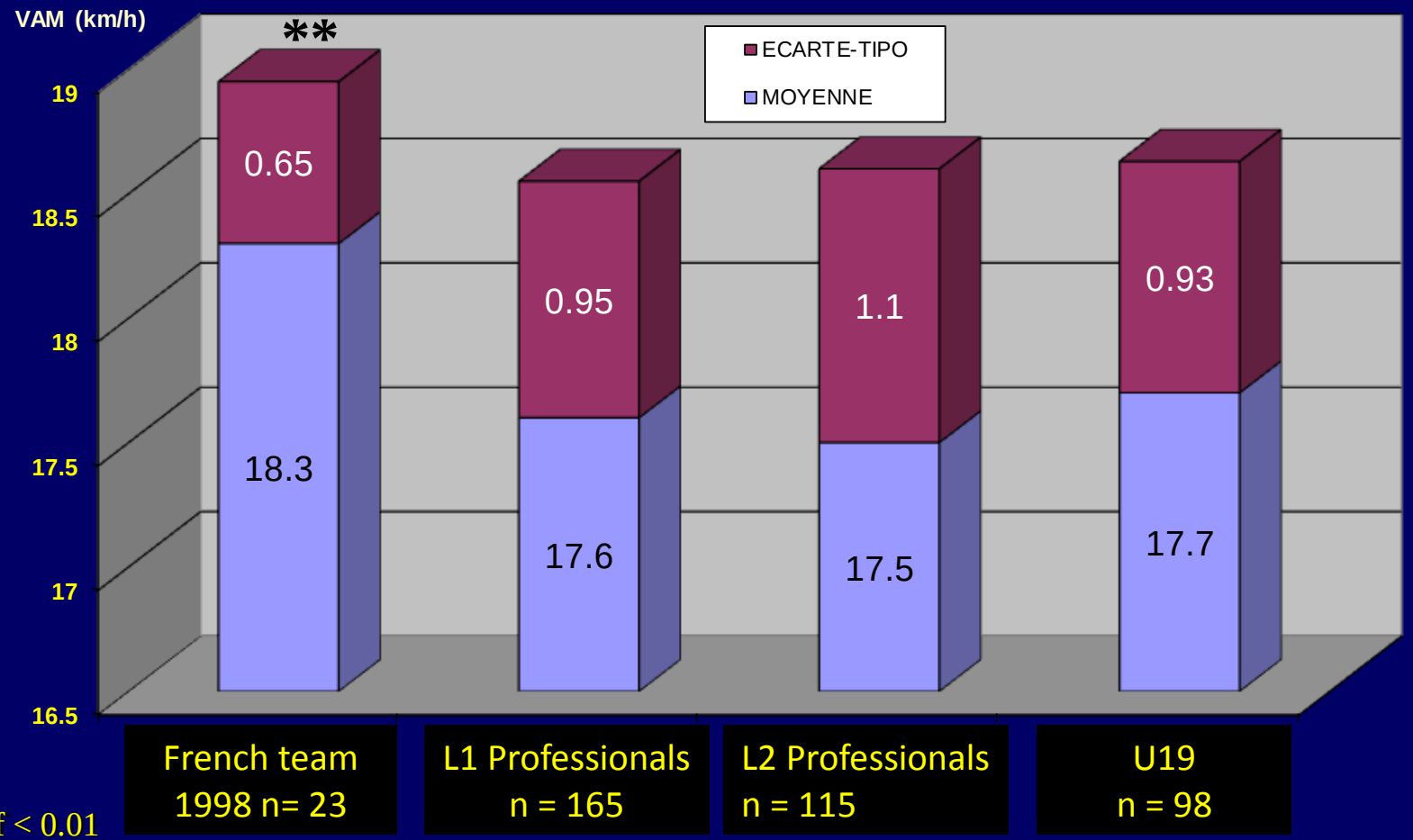
SCALE	VAMEVAL MAS DEFENDERS (km/h)							SCALE
Marks/20	13 yo	14 yo	15 yo	16 yo	17 yo	18 yo	19 yo +	Marks/20
20	19,1	18,2	19,0	18,5	18,6	18,8	19,1	20
19	18,7	17,9	18,7	18,3	18,4	18,6	18,9	19
18	18,4	17,6	18,4	18,0	18,3	18,5	18,7	18
17	18,1	17,4	18,1	17,8	18,1	18,3	18,5	17
16	17,8	17,1	17,8	17,6	17,9	18,1	18,3	16
15	17,4	16,8	17,5	17,4	17,8	17,9	18,1	15
14	17,1	16,6	17,2	17,2	17,6	17,7	17,9	14
13	16,8	16,3	16,9	17,0	17,4	17,5	17,7	13
12	16,4	16,1	16,6	16,7	17,3	17,4	17,5	12
11	16,1	15,8	16,3	16,5	17,1	17,2	17,3	11
10	15,8	15,5	16,0	16,3	16,9	17,0	17,0	10
9	15,4	15,3	15,7	16,1	16,8	16,8	16,8	9
8	15,1	15,0	15,3	15,9	16,6	16,6	16,6	8
7	14,8	14,7	15,0	15,7	16,4	16,5	16,4	7
6	14,4	14,5	14,7	15,4	16,3	16,3	16,2	6
5	14,1	14,2	14,4	15,2	16,1	16,1	16,0	5
4	13,8	14,0	14,1	15,0	15,9	15,9	15,8	4
3	13,4	13,7	13,8	14,8	15,8	15,7	15,6	3
2	13,1	13,4	13,5	14,6	15,6	15,5	15,4	2
1	12,8	13,2	13,2	14,4	15,4	15,4	15,2	1
0	12,4	12,9	12,9	14,1	15,3	15,2	15,0	0

SCALE OF MAXIMUM AEROBIC SPEED (MAS) FOR GOALKEEPERS

SCALE	VAMEVAL MAS GOALKEEPERS (km/h)			SCALE
Marks/20	14-15 yo	16-17 yo	18 yo +	Marks/20
20	18,0	18,0	18,3	20
19	17,8	17,7	18,0	19
18	17,6	17,5	17,8	18
17	17,4	17,3	17,5	17
16	17,2	17,0	17,2	16
15	17,0	16,8	17,0	15
14	16,8	16,5	16,7	14
13	16,6	16,3	16,4	13
12	16,4	16,1	16,2	12
11	16,2	15,8	15,9	11
10	16,0	15,6	15,7	10
9	15,8	15,3	15,4	9
8	15,6	15,1	15,1	8
7	15,4	14,9	14,9	7
6	15,2	14,6	14,6	6
5	15,0	14,4	14,4	5
4	14,8	14,2	14,1	4
3	14,6	13,9	13,8	3
2	14,4	13,7	13,6	2
1	14,2	13,4	13,3	1
0	14,0	13,2	13,0	0

MAXIMUM AEROBIC SPEED and LEVEL OF PROFICIENCY

A minimum MAS of 17.5 km/h seems to be needed in order to play football at a good level.

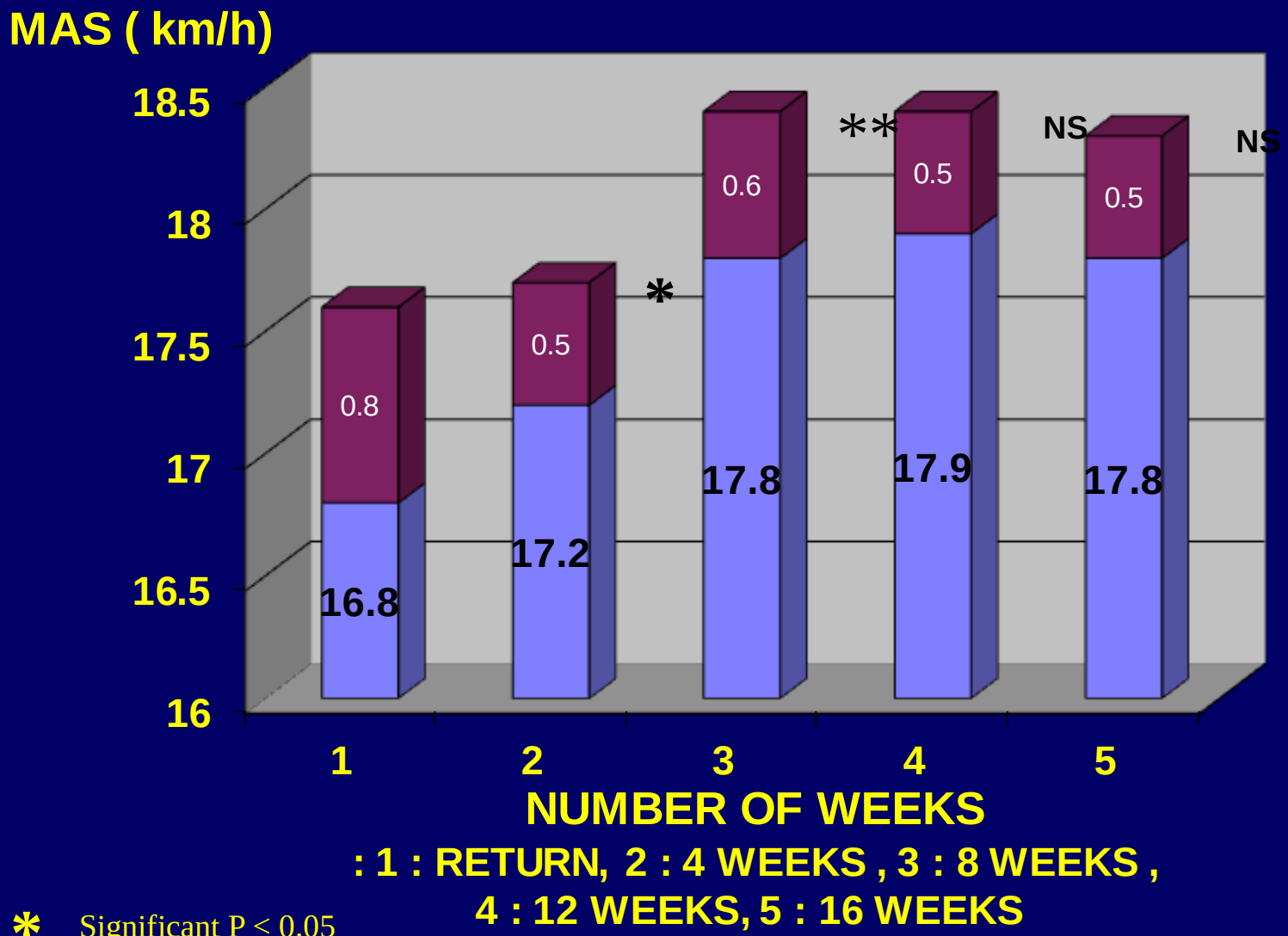


** sinificatif f < 0.01

WHEN SHOULD THE VAMEVAL TEST BE USED DURING THE SEASON?

MAS DEVELOPMENT DURING A SEASON

MAS increases during the first eight weeks of the season but not afterwards



* Significant P < 0.05

* * P < 0.01

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MAS can allow you to

1

VO_2max (ml.min^{-1}.kg^{-1})
= MAS (km/h) x 3.5
à ± 5% *Léger and Mercier (1983)*

Extrapolate VO_2 max

2

Calculate endurance

Endurance = time maintaining a % of MAS (limited period)

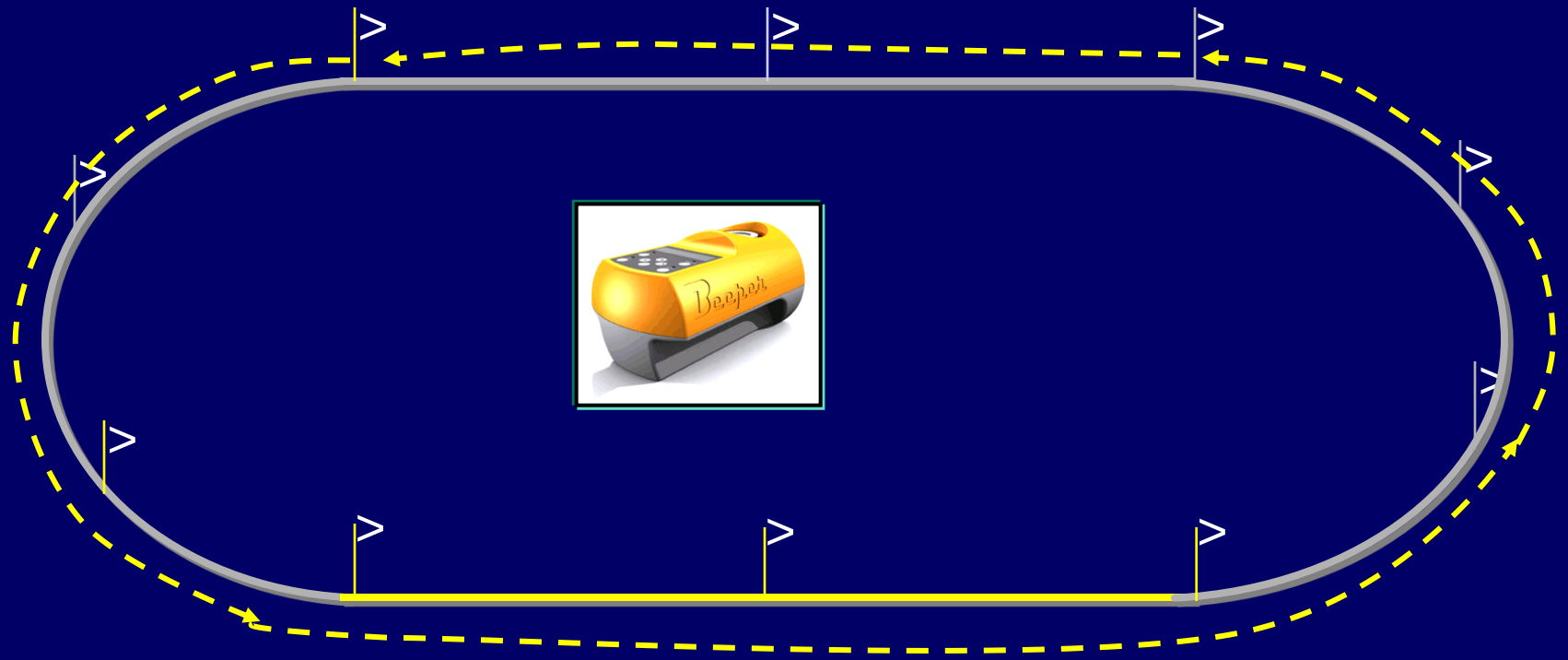
3

Manage the intensity of running sessions

ASSESSING AEROBIC ENDURANCE IN A LIMITED TIMEFRAME

Aerobic endurance, which is the % of MAS which can be used over a long time period, can also be assessed using the VAMEVAL test.

Start by conducting the VAMEVAL test 2) separate groups by ability 3) programme the beeper or use the pre-programmed CD: set MAS at a % = 90, 95, 100, 105%..., start the stopwatch…



Single limited-duration test

Time spent at 100% of MAS

AEROBIC ENDURANCE				
VERY HIGH	HIGH	AVERAGE	LOW	VERY LOW
> 15 min.	9 - 11 min.	6 - 8 min.	5 min.	< 4 min.

MAS determined by Léger et Boucher's (1980) running test

TIME SPENT AT 100% OF MAS = AEROBIC ENDURANCE				
Very high	High	Average	Low	Very low
> 11 min	7-10 min	5- 6 min	3-4 min	< 3 min

MAS determined by the VAMEVAL test

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MAS can allow you to

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à ± 5% *Léger and Mercier (1983)*

Extrapolate VO_2 max

2

Calculate endurance

Endurance = time maintaining a % of MAS (limited period)

3

Manage the intensity of running sessions

HOW SHOULD MAS BE USED IN TRAINING?

Different types of training session:

- **Continuous training, submax (60–80% MAS) long duration** *(aerobic endurance development: pre-season and first week back at training),*

- **Fartlek** *(Mixed development of endurance + maximum aerobic power: first 15 days of training),*

- **Interval training:**

  - **Long intervals ([4 to 8 min: 1 min recovery] x 3–6 reps) submax and max (80–100 % MAS):** *(Mixed development of maximum aerobic power + endurance: first 3 weeks back at training),*

  - **Short intervals ([30sec to 3 min: 3-4min recovery] x 2–4 reps) max and ABOVE max (100–130 % MAS)** *(Anaerobic lactic power development 30–60 s + anaerobic endurance: 2–3 min: 6 weeks after returning to training)*

  - **Sprints ([10 sec on, 15 sec off/20 sec on, 15 sec off] x 40) : intermittent short above max (110–130 % MAS):** *maximum aerobic power development*

- **Short sprint reps: ([20m x 12–15 reps: 30sec] x 2–4 sets: 4–6 min activity):** *Development of sprint repetition capacity + increased aerobic-oxidative muscle power*

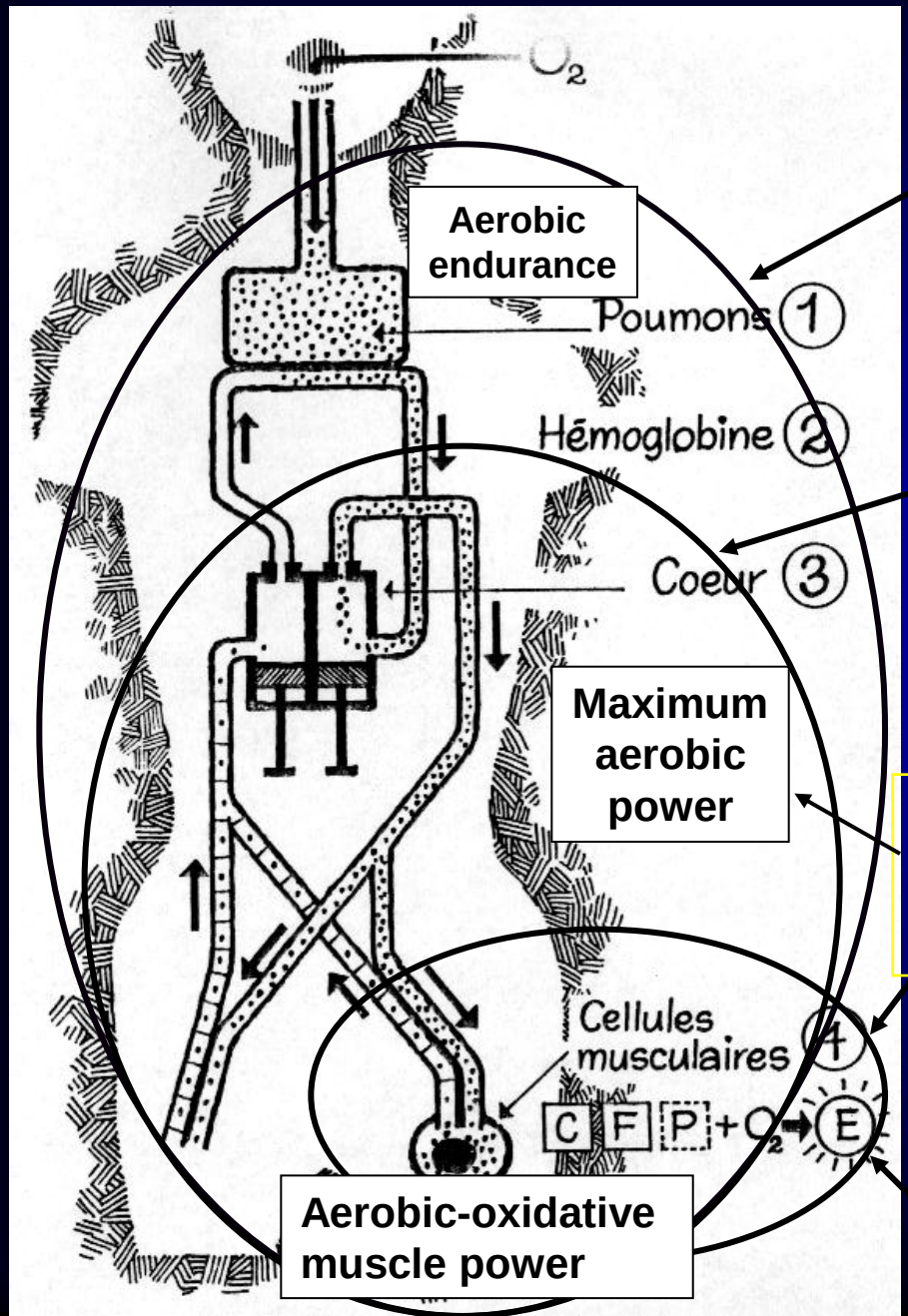
Different training sessions dependant on % of MAS:

Type of training	Characteristics	Duration	% MAS	Rest period	Development
Continuous	Submax long duration, marathon type. Long Slow Distance (LSD),	> 30 min	60–80		**Aerobic endurance**
Mixed	Fartlek (3/4-1/4; 2/3-1/3; 1/2 –1/2)	> 20 min	110–140	Active 40–60	**Endurance + MAP**
Interval training:					
Long	Submax, max	5–8 min x 4–6 reps	80–100	Rest 1–2 mins	**Endurance + MAP + anaerobic lactic power development**
Medium	Max and above max	30 sec–3 min x 3–5	100–140	Rest 3–4 mins	**Anaerobic lactic power development + MAP**
Short	Intermittent runs	10–20 sec x 30–40	110 –130	Rest 15–30 sec	**MAP**
Very short	Sprint reps	20–30m x 10–15	Max speed	Rest 30–40 sec	**Speed endurance + aerobic-oxidative muscle power**
Intermittent	Competition time, or by 4, 5, 6...10	Depends on comp.	> Race speed	Active	**Specific endurance**

Physiological impact depending on % of MAS used in training.

% of MAS		TYPE OF EXERCISE	DESIRED OUTCOME. POINT IN SEASON
50–55		9–10 minutes continuous physical activity	Active recovery after exercise over lactate threshold
55–65		7–10 minutes continuous physical activity	Pre-training warmup. No effect on aerobic capacity development.
65–75		> 15 mins continuous physical activity	Moderate endurance: beginning of pre-season.
75–85		< 15 mins running or constant activity	Developing specific endurance: Pre-season and during competition season (individual sports)
85–100		Long intervals: 3–5 min with 2–3 min recovery	Developing maximum aerobic power and lactate tolerance. Pre-season and during competition season (team sports)
100–130		Short intervals (15s–15s)	Maximum aerobic power development. Beginning of season and competition season (team sports)
100–155		Exercises over short intervals: 1–2 min with 4 min recovery	Endurance and anaerobic lactic power. Pre-competition period (for highly trained athletes)

DEVELOPING AEROBIC CAPACITY DURING THE SEASON



Aerobic endurance: Off season < MAS (65–85% MAS, > 20 min)

MAP: fartlek: beginning of the season: (10–20s accelerations at 120–140% of MAS) × 15–20 reps > 20 min

Sprint intervals: In season [10–15s at 110–130% of MAS: 15–20 s rest] × 30–40 reps

Sprint reps: In season [3–5 s at 96–100% benchmark speed: 30–40 s rest] × 10–15 reps

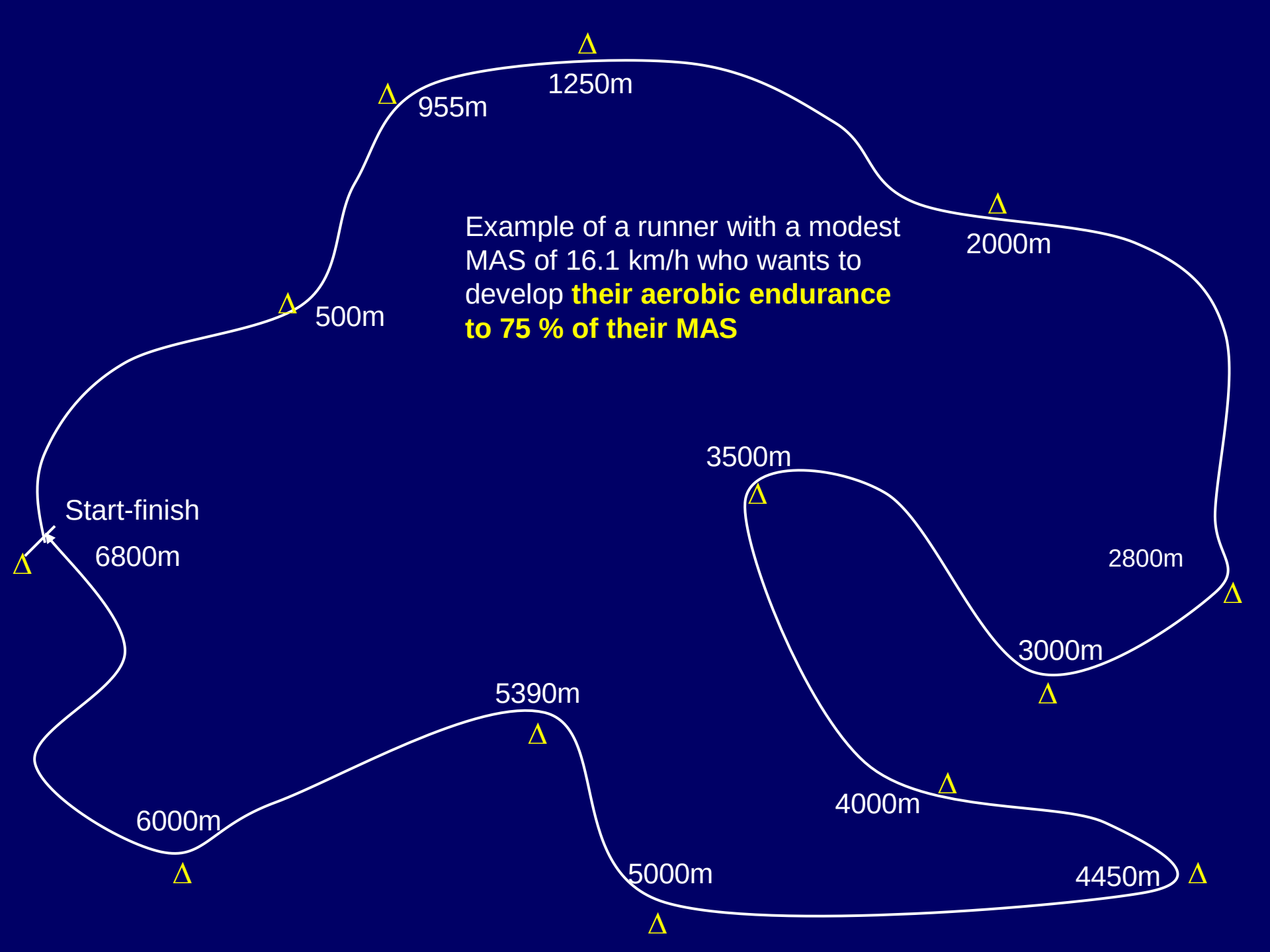
DEVELOPING AEROBIC CAPACITY

AEROBIC ENDURANCE

DURING THE OFF-SEASON, PRE-SEASON TRAINING

OR DURING WARMUPS

Examples of continuous exercises which use MAS


Example of a runner with a modest MAS of 16.1 km/h who wants to develop **their aerobic endurance to 75 % of their MAS**
Start-finish
6800m
500m
955m
1250m
2000m
2800m
3000m
3500m
4000m
4450m
5000m
5390m
6000m

ENDURANCE AEROBIE ET PUISSANCE AEROBIE MAXIMALE : 75 à 85% de V...

AFIFI	Zouheir	16/07/2004

Aperçu | Imprimer | Quitter

ACTIONS PHYSIOLOGIQUES :

Développe la capacité maximale de transport et d'utilisation de l'oxygène. Sollicite de plus en plus les réserves musculaires de glycogène. Le muscle atteint, voire dépasse sa capacité oxydative et

EXERCICES CONSEILLES :

1- course par intervalles longs : 4 à 6min. Récupération incomplète : 1 à 2min. Durée totale supérieure à 30min.
2- course en Fartlek : Enchaînement de courses

Tableau des Temps de passage(h:min:s)

VAM : 16.1 km/h — DISTANCES (m) de 1 à 99 999

%VAM	FC (bt/min)	500	955	1 250	2 000	2 800	3 000	3 500	4 000
75	173	02:29	04:44	06:12	09:56	13:54	14:54	17:23	19:52
76	174	02:27	04:40	06:07	09:48	13:43	14:42	17:09	19:36
77	175	02:25	04:37	06:02	09:40	13:33	14:31	16:56	19:21
78	177	02:23	04:33	05:58	09:33	13:22	14:20	16:43	19:06
79	178	02:21	04:30	05:53	09:26	13:12	14:09	16:30	18:52
80	179	02:19	04:26	05:49	09:19	13:02	13:58	16:18	18:38

Tableau des Distances(m)

DUREES (h:min:s)

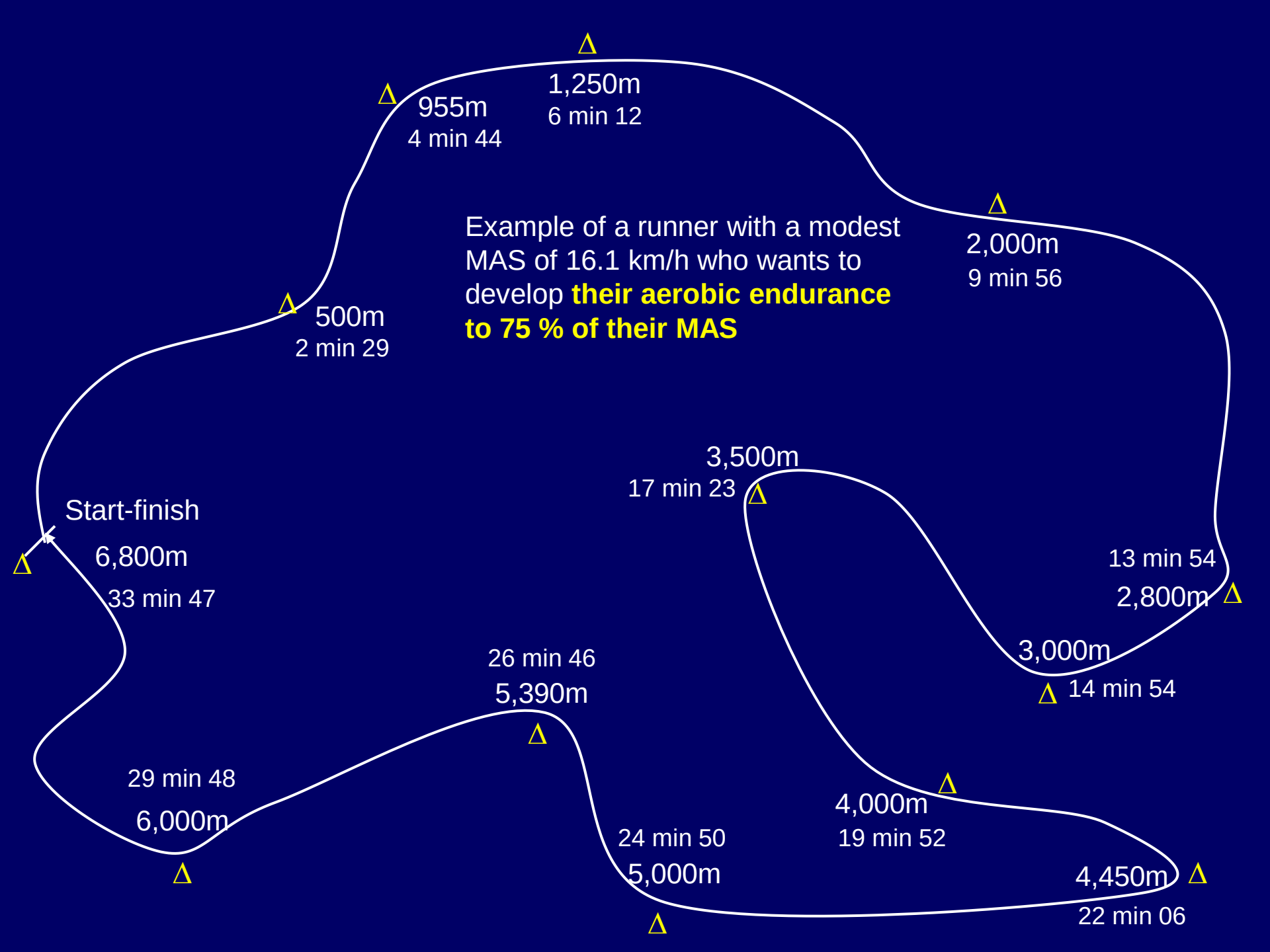
%VAM	FC (bt/min)	00:01:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
75	173	201							
76	174	204							
77	175	207							
78	176	209							
79	177	212							

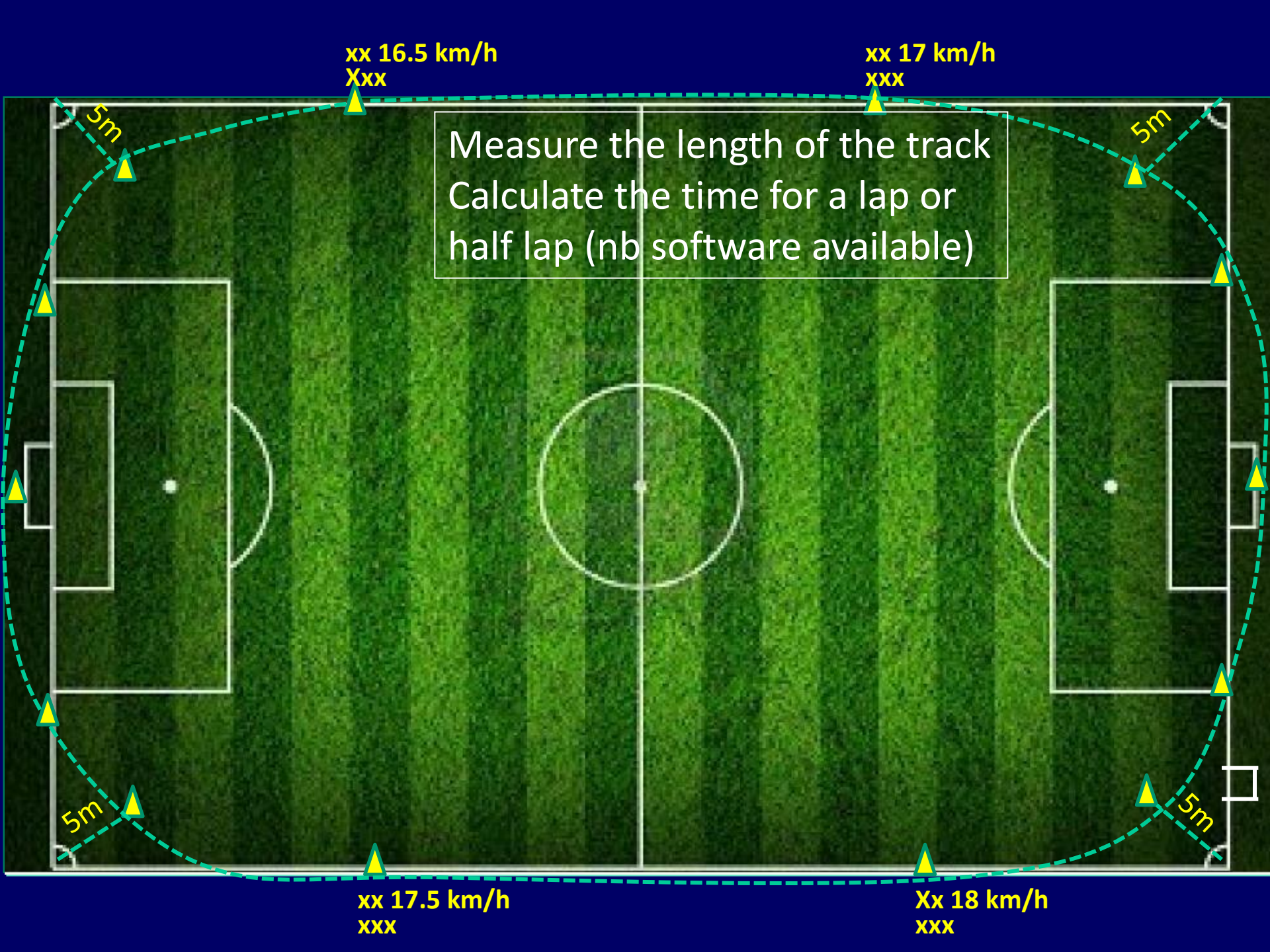
Calcul de la distance à parcourir pour un pourcentage de V.A.M. donné et une durée d'exercice donnée

VITESSE AÉROBIE MAXIMALE V.A.M. (en km/h)	% de V.A.M. (Intensité de l'exercice)	DURÉE DE L'EXERCICE (en hh:mm:ss)	DISTANCE À PARCOURIR (en mètres)
20	120%	00:00:30	200,00

Calcul de la durée d'un exercice à un pourcentage de V.A.M. donné et une distance donnée à parcourir

VITESSE AÉROBIE MAXIMALE V.A.M. (en km/h)	% de V.A.M. (Intensité de l'exercice)	DISTANCE À PARCOURIR (en mètres)	DURÉE DE L'EXERCICE (en hh:mm:ss)
20	120%	200	00:00:30


Example of a runner with a modest MAS of 16.1 km/h who wants to develop **their aerobic endurance to 75 % of their MAS**
Start-finish
6,800m
33 min 47
955m
4 min 44
1,250m
6 min 12
500m
2 min 29
2,000m
9 min 56
3,500m
17 min 23
13 min 54
2,800m
3,000m
14 min 54
26 min 46
5,390m
29 min 48
6,000m
4,000m
19 min 52
24 min 50
5,000m
4,450m
22 min 06


xx 16.5 km/h
Xxx
xx 17 km/h
xxx
5m
5m
Measure the length of the track
Calculate the time for a lap or
half lap (nb software available)
5m
5m
xx 17.5 km/h
xxx
Xx 18 km/h
xxx

MAXIMUM AEROBIC POWER

Throughout the season

Example of interval training using MAS

Interval training: 15sec Sprint – 15sec Recovery

- With sprints of equal rest, short interval training can be 1.5–2 times as effective a mode of training as continuous exercise.
- There are numerous variations thatcan be introduced… with and without a ball.
- The variations of intensity, duration of exercise, duration of recovery period and total number of reps depend on the fitness level of the players.

1- Don’t plan this type of training any earlier than two or three weeks back into pre-season training (in the case of three training sessions a week)

2- Start with short duration and limited above max intensity (105–110% of MAS), recovery time double the interval time and with a number of reps giving a total duration equal to or slightly more than ten minutes.

Example: [10 sec sprints at 110% of MAS: 20 sec recovery] x 25

Then progressively increase volume first of all:
- Increase the number of reps from 25 to 30, 35, 35 and then 40
- Increase duration of each sprint from 10 seconds to 15

Next increase intensity

- Increase MAS from 110 to 115, 120, 125 then 130%
- Decrease recovery time from 20 seconds to 15 then 10

Putting in place one of these training sessions with a group of players of similar ability and fitness is easy: a football pitch is the ideal size

1- Start by evaluating the MAS of your players (VAMEVAL or Léger-Boucher test)

2- Group athletes with the same MAS together (five or six athletes in each group).

3- Calculate the distance to be covered in each interval, for example over 15 sec at 110% of MAS for each group. (These calculations can be done using Excel: *see example*)

Calcul de la distance à parcourir pour un pourcentage de V.A.M. donné et une durée d'exercice donnée

VITESSE AÉROBIE MAXIMALE V.A.M. (en km/h)	% de V.A.M. (Intensité de l'exercice)	DURÉE DE L'EXERCICE (en hh:mm:ss)	DISTANCE À PARCOURIR (en mètres)
14,5	120%	00:00:10	48,33

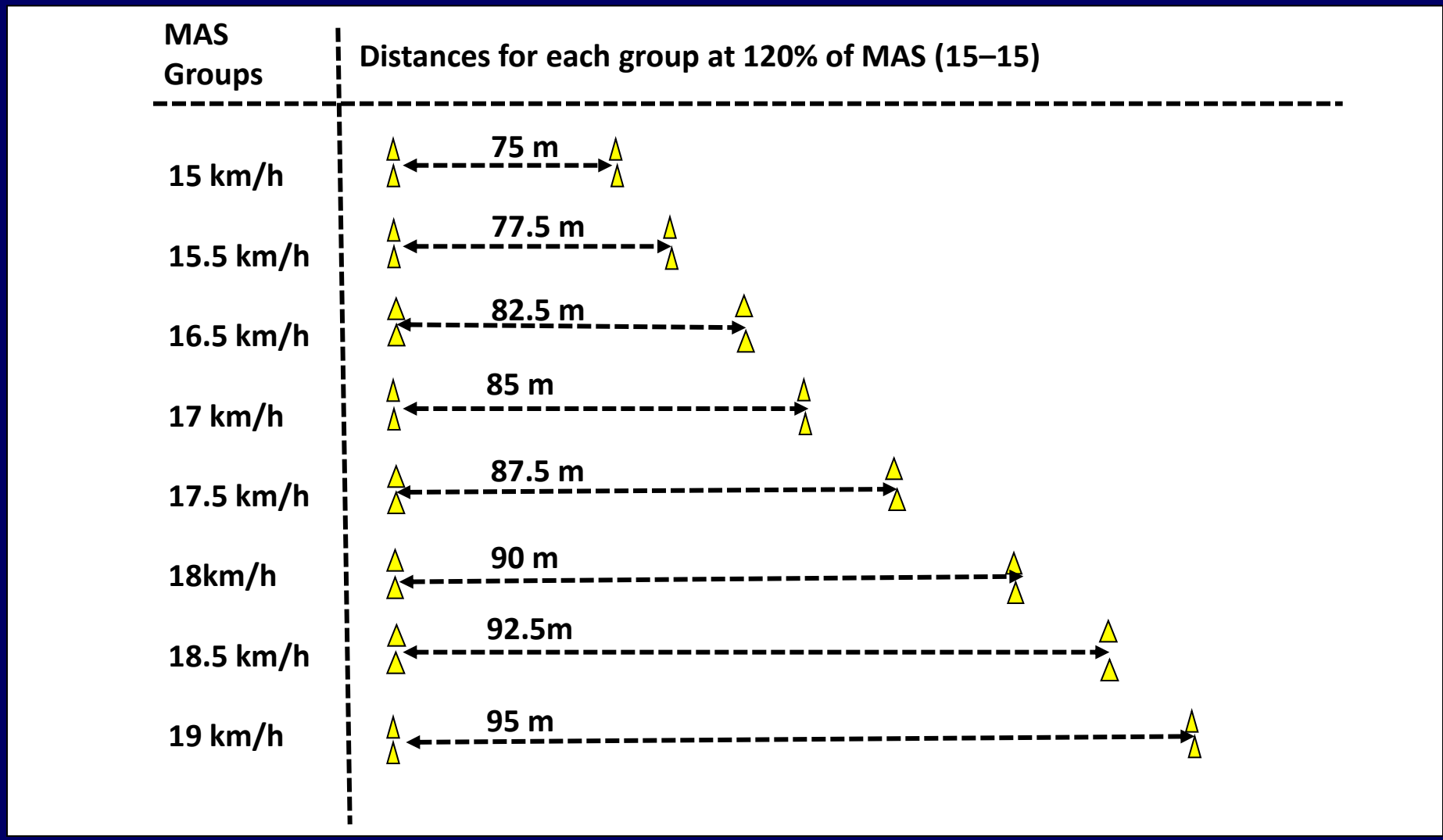
Calcul de la durée d'un exercice à un pourcentage de V.A.M. donné et une distance donnée à parcourir

VITESSE AÉROBIE MAXIMALE V.A.M. (en km/h)	% de V.A.M. (Intensité de l'exercice)	DISTANCE À PARCOURIR (en mètres)	DURÉE DE L'EXERCICE (en hh:mm:ss)
14,5	120%	30	00:00:06

4- If the training session format is 15 sec sprints – 15 sec recovery, blow the whistle every fifteen seconds.

Each group must run the set distance in the 15 second period

Short interval training session: 15 second sprints – 15 second recovery at each end. The footballers should be divided into groups according to their MAS. Use of a distance measurer can help mark out the length of each interval.



EXAMPLES OF INTERVAL TRAINING SESSIONS FOR DEVELOPING

- MAXIMUM AEROBIC POWER AND
- SPECIFIC ENDURANCE FOR FOOTBALL

These sessions can also be done with a ball, which increases their intensity

Increase the number of reps and then increase intensity and decrease recovery time:

Example 1: [10 sec sprints at 110% of MAS: 20 sec recovery] x 25

Example 2: [10 sec sprints at 110% of MAS: 20 sec recovery] x 30 (sets of 2 x 15 or 10 +20 or 30) then 40 reps

Example 3: [15 sec sprints at 110% of MAS: 20 sec recovery] x 30 (sets of 2 x 15 or 10 +20 or 30) then 40 reps

Example 4: [15 sec sprints at 115% (then 120, 125, 130) of MAS: 20 sec recovery] x 40

Example 5: [15 sec sprints at 115% (then 120, 125) of MAS: 15 sec then 10 sec recovery] x 40

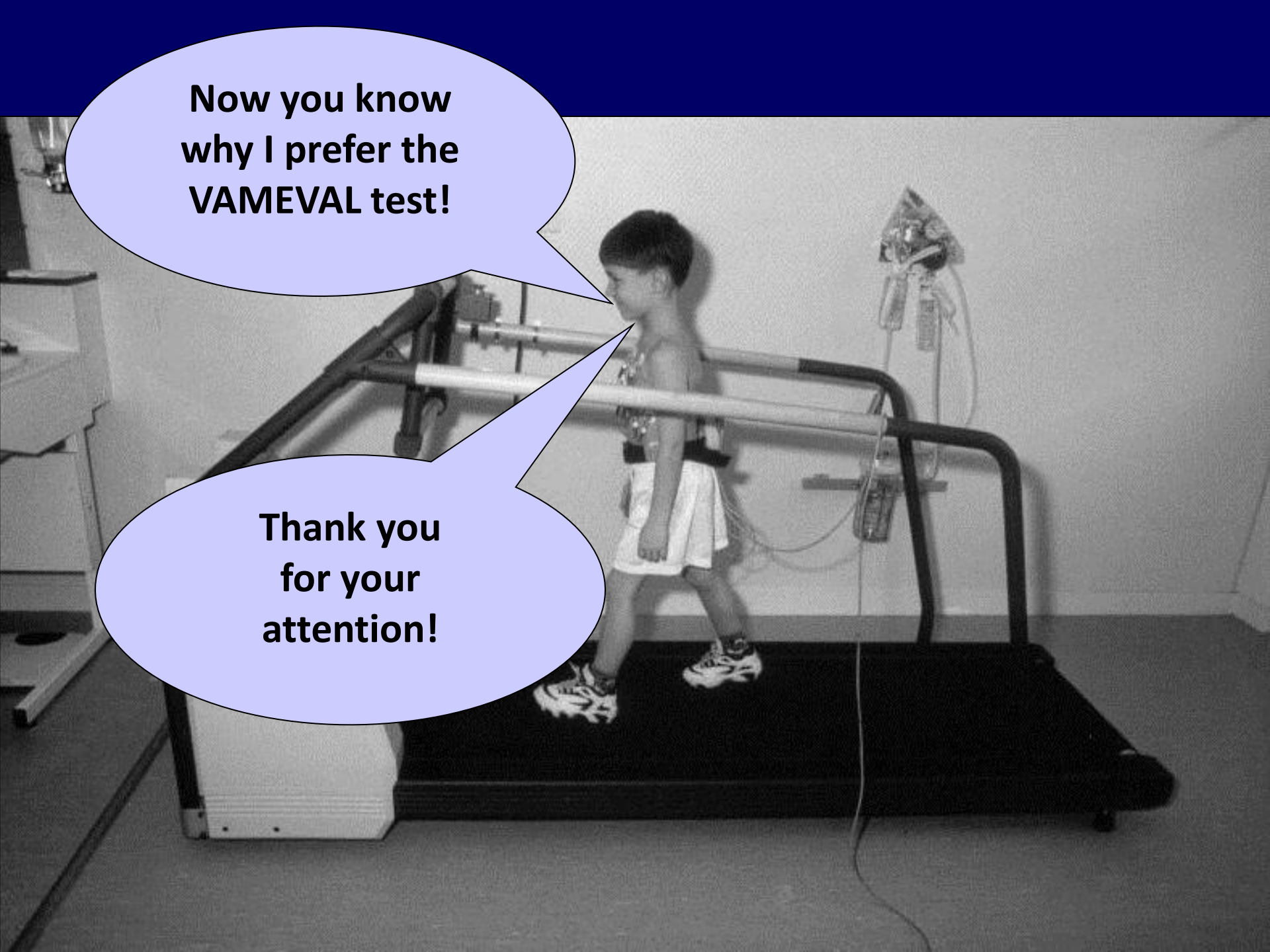
SOME FINAL THOUGHTS

1) ATHLETIC-TYPE PHYSICAL PREPARATION

The athlete-player. Aimed at players who can train more than three times a week (professional clubs)

The younger the footballer, the more use should be made of game-situation methods (contextualised physical preparation 4 × 4, 5 × 5, 6 × 6) and then integrated methods become the priority.

However the VAMEVAL or Léger-Boucher test can help to test VO2max at the beginning and throughout the season.


Now you know why I prefer the VAMEVAL test!
Thank you for your attention!