COUNCIL OF EUROPE **CONSEIL DE L'EUROPE**

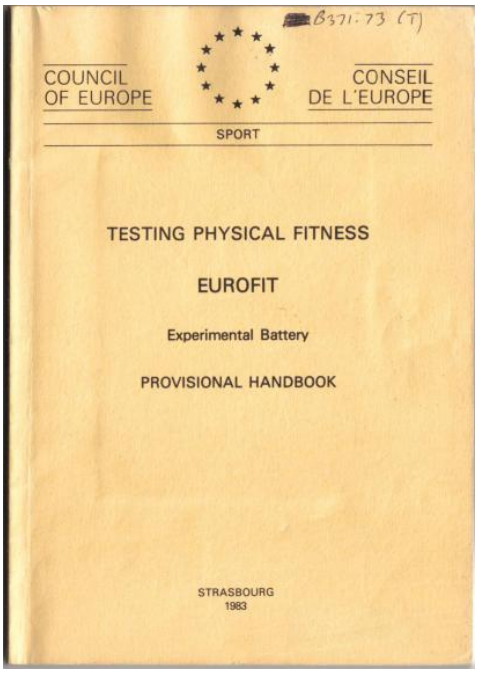
SPORT

TESTING PHYSICAL FITNESS

EUROFIT

Experimental Battery

PROVISIONAL HANDBOOK



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to promote the importance of children's sport & fitness and provide the definitive reference for the Luc LEGER Multistage Fitness Test (MSFT, Bleep or Beep Test) as used in the Bitworks Team Beep Test Software. The foreword and introduction by Dr Erling Asmussen, Professor Vassilis Klissouras and Bill Tuxworth provide an invaluable insight into children's health and fitness in the early 80's, predicting correctly the problems we now face.

STRASBOURG
1983

1. Preface

The European battery of cardiorespiratory and motor tests described in this Eurofit Handbook proposes an experimental series of tests for assessing school-aged children's physical development.

One of its aims is to motivate children to enjoy taking regular exercise in physical recreation and sport, not only at school but also in later adult life.

This is, moreover, the main objective of the Sport for All philosophy espoused by the Council of Europe since 1966.

The "Eurofit" battery is composed of simple and relatively inexpensive tests which can be administered by physical education teachers or others, either as part of or in addition to the regular school physical education programme. It can also be used in sports clubs or in sports medical centres.

This provisional handbook describes the tests and their administration, what precautions to take, how to calculate and assess the results. It is, therefore indispensable for all who will administer these tests.

I firmly hope that efficient co-operation can be established among all parties concerned, in order that each may profit from a well-conducted test programme, for the benefit of our children's health and well-being. I hope too that this battery may be experimented on a wide scale so that in the light of reports received, and evaluation seminar in 1985, the Council of Europe may propose the definitive battery and handbook.

I take this opportunity of conveying my warmest thanks to all the researchers and governmental experts who have worked together to produce this experimental battery.

Franz KARASEK
Secretary General
of the Council of Europe

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2. Foreword

The expression "Physical Fitness" is used nowadays to describe a person's ability to utilize the machinery of his body in sports and exercise. The function of a machine is to transform one kind of energy into another. In the human body the point is to transform chemical energy into mechanical energy. The final steps in this transformation take place in the muscles under the control of the nervous system, but before that occurs, as well as during and after the liberation of mechanical energy, the body must overcome a long series of supply and transportation problems which put serious demands on other organ systems, especially the cardio-respiratory system. A high degree of physical fitness consequent/y imp/ies a perfect functioning of the who/e body.

There is a high degree of correlation between a person's physical activity and his physical fitness—an adaptation takes place, not least in the growing period of one's life, in childhood and adolescence. Spontaneous activity in play and games, participation in the chores and labours of daily living in hunting and farming societies have for millennia sufficed to develop and maintain an optimal physical fitness for the human race. But life in cities, industrialization and automation has broken this natural process. It is deplored by responsible authorities who are worried that a lowered physical fitness in children and adults will have unwanted effects—medical, hygienic, and sociological-—on the population. In order to counteract such a development, authorities and other interested groups have attempted deliberately to substitute or supplement the reduced spontaneous activity by compulsory physical education and sports. The reasons for this deliberation are various and changing, originally perhaps military, but more recently with the main emphasis on health and recreation.

Large amounts of money, and very much time, is being spent on these attempts to improve the physical fitness of children and adolescents. For all participants involved: the authorities, the taxpayers, the physical educators and trainers, and from the young themselves, it is quite natural, therefore, to demand full knowledge about the status of the physical fitness of the children receiving physical education, and about effectiveness of the many efforts invested in improving it. To satisfy this demand calls for objective tests of physical fitness.

As mentioned before, physical fitness depends on the integration of a number of physiological functions. The capacities of every one of these can be measured, but the necessary methods are often complicated, demanding sophisticated apparatus belonging in specialised laboratories, of which only a restricted number exist in the world. A way out of this difficulty is the establishment of a battery of carefully selected tests of physical performances., ideally each depending on and limited by one prime physiological function, e.g. the cardio respiratory system, the muscles, neuromuscular coordination etc. The results can be measured with simple or specific apparatus (stopwatches, tape measures, or ergometric bicycle).

These results—often represented by a time for a performance, a distance, a load overcome, a number of heart beats etc.—must be regarded both as qualitative measures, i.e. as an expression of quality or efficiency of the "machinery" tested, but also as quantitative measures, related to the size and the dimensions of the person tested. In growing children both qualitative and quantitative changes are taking place continuously, for instance in hormonal status, (differently for boys and girls) and as increases in lengths, areas, volumes and weights of the body parts. Such changes naturally must be taken into consideration when test results are being compared, whether over a certain time, or between groups.

Finally, it must be remembered, that the "machinery" underlying the physical fitness of a person, is governed by a brain, the degree of arousal and responsiveness of which depends to a very high degree on psychological and environmental conditions, which consequently must be carefully watched. A selected standardised battery of tests for measuring the physical fitness of children and adolescents such as the one presented in the "Eurofit" handbook is therefore a highly desirable and much needed tool in physical education and sports.

Dr. Erling Asmussen
Professor emeritus,
University Copenhagen

3. INTRODUCTION

3.1. THE ORIGINS AND DEVELOPMENT UF EUROFIT

Physical fitness is used broadly to mean the ability to carry out daily tasks with vigour and alertness, without undue fatigue, and with ample energy remaining to enjoy leisure-time pursuits and to meet unusual situations and unforeseen emergencies.

Measurement and evaluation of physical fitness is an indispensable tool for physical educators, and it is just as indispensable that researchers should give to practitioners properly validated criteria for such measurement.

The publication of Hans Kraus and his associates (Kraus and Hirschland, 1954) which showed American children faring poorly in comparison with European children in tests of minimal muscular fitness, gave an impetus to the use of measurement in physical education and set in motion projects for the development of test batteries and the establishment of national norms of fitness for boys and girls.

Two such test batteries which have been widely used in North America are the AAHPERD[1] Youth Fitness and the CAHPER[2] Fitness Performance Test Batteries. The AAHPERD test battery was developed in 1957 and includes six test items designed to give a measure of physical fitness for boys and girls aged 6-18 years. The tests are: pull-up (with flexed arm-hang for girls-for judging arm and shoulder girdle strength ; flexed leg sit-up—for judging efficiency of abdominal and hip flexor muscles ; shuttle run-for judging speed and change of direction ; standing long jump—for judging explosive muscle power of leg extensors; 50-yard dash—for judging speed; and 600-yard run (with optional runs of 1 mile or 9 minutes for ages 10-12 of 1.5 miles or 12 minutes for age 13 and 0lder)—for judging endurance (AAHPERD, 1976).

The CAHPER test battery which dates back to 1963 was recently revised to include the following items: flexed arm hang, shuttle run, one-minute speed sit-ups, standing long jump, 50 meter run and endurance run (800 m. for 6-9 years, 1,600 m. for 10-12 years and 2,400 m. for 13-17 years) (CAHPER, 1980). The need for testing physical fitness and establishing normative data for European Schoolchildren was first recognised by the Committee of Experts on Sports Research in 1977. Amongst the principal objectives given by the Sports Research Experts for this activity were:

i) The need to have a commonly agreed test battery in Europe
ii) To help in assessing the effectiveness of physical education in schools
iii) To help in measuring the health-related fitness of school children

As a result, a series of European Research Seminars on testing physical fitness was organized under the aegis of the Council of Europe.

1. American Alliance for Health, Physical Education, Recreation and Dance.
2. Canadian Association for Health, Physical Education and Recreation.

The objective of the first Seminar, which took place in the National Institute of Sport and Physical Education (INSEP) in Paris (October 1978), was to discuss the philosophy and to review the methods of investigating physical fitness in schoolchildren. The Seminar was to determine, if possible, the factors which comprise such physical fitness; and having decided upon these fundamental factors, to see whether it might be possible to establish a common strategy, that is to say, a battery of tests which might be used in each and every European country. The work of this Seminar crystallized in agreement concerning the elements of physical fitness, which are (CDDS, 1979):

a. Structural Factors: height, weight, and lean body mass (bone age and physique may also be included, if possible).
b. Functional Factors: Aerobic capacity, muscular strength (static and dynamic) flexibility and speed (running and segmentary).
c. Co-ordination.

It was also decided that the second European Research Seminar to be organised by the Department of Physical Education at the University of Birmingham (June 1980) should discuss the evaluation of aerobic capacity or cardio-respiratory endurance and identify a test for that purpose. lt was agreed that (CDDS, 1981):

a. The Physical Work Capacity at a heart rate of 170 beats per minute (PWC_{170}) test, using a bicycle ergometer and recording heart rate is the best available simple field laboratory test for estimating cardio-respiratory endurance in schoolchildren, being widely used and comprehensively validated with rigorous criteria.
   There was some divergence of experience as to the most suitable ergometric procedure for use with schoolchildren (initial load setting, load increments, number of workloads duration and frequency of pedalling).
b. Because the availability of bicycle ergometers could not be reasonably expected, existing simple field tests, using no special apparatus, and adaptable for either indoors or outdoors according to climate, must be evaluated and, if necessary, new ones devised leading to the recommendation of a standard such test or tests.
   Two working parties were set up in order to conduct further research into these tests and solve methodological problems involved in the evaluation of cardio-respiratory fitness.

The third Seminar, organized by the Institute of Physical Education of the Catholic University of Leuven in Belgium (May 1981), agreed on a range of tests for measuring the motor aspects of physical fitness identified at Paris (Simons and Flenson, 1982).

Lastly, the 4th European Research Seminar in this series, organized by the Sports Research Institute and held at Ancient Olympia (May 1982), finalized the work of the Birmingham Seminar agreeing on two tests for testing cardio-respiratory endurance, The preferred test already accepted at a previous Seminar was the PWC_{170} performed on a mechanically-braked bicycle, with an initial load of 1 watt per kilogram body weight (1 W /kg) and two increments of 0.5 or 1 watt depending on the heart rate reached, each load lasting 2 minutes. A six-minute run was adopted as the outdoor field test. Moreover, two alternative

indoor tests were proposed for further evaluation, namely a multistage 20 metre shuttle run and a 480 metre shuttle run (CDDS, 1982).

On the basis of the work of the aforementioned Research Seminars the Committee of Experts on Sports Research approved the experimental complete Eurofit test battery for testing physical fitness. A synoptic view of this battery follows.

The tests advocated are low-cost and simple ones, normally capable of being administered by teachers or others, in or outside schools, on any child following normal physical education lessons. Most of the equipment required is already possessed or can easily be acquired by nearly all schools. The only relatively expensive piece of equipment is the bicycle ergometer—but the value of testing accurately this particular aspect of fitness is important enough to justify it being provided on an adequate scale.

The Eurofit test battery is proposed as a common core z while it is adequate in itself as an appropriate battery for testing the physical fitness of children, in those countries where other tests have been developed for testing other aspects of physical fitness, such tests may be added to the Eurofit battery.

Professor Dr. V. KLISSOURAS
Director, Sports Research Institute,
Athens

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EUROFIT

Synoptic view of the experimental test battery

Dimension	Factor	Description	EUROFIT TEST	SECOND CHOICE
1. CARDIO-RESPIRATORY ENDURANCE	Cardio-respiratory endurance	Effort on a bicycle ergometer to reach 170 heart beats per minute. Distance in predetermined time	PWC 170 test 6 minute run test	Alternative indoor tests: 480m shuttle run or 20m progressive shuttle run
2. STRENGTH	a. Static Strength	Maximum Strength	Arm pull	Hand grip
	b. Explosive Strength	Maximal Muscular Power	Standing broad jump	Vertical jump
3. MUSCULAR ENDURANCE	a. Functional Strength (dynamic strength)	Upper limb muscular endurance	Bent arm hang	
	b. Abdominal Strength (dynamic trunk strength)	Abdominal muscular endurance	Sit-ups in 30 seconds	
4. FLEXIBILITY	Flexibility (extent of flexibility)	Articulo-muscular range of movement	Sit and reach	
5. SPEED	a. Speed of limb movement	Segmental repetitive velocity	Plate tapping time for 25 cycles	
	b. Running Speed	Total body velocity	Shuttle run 10 x 5 metres	50m sprint
6. BALANCE	Total body balance	Coordination of total body equilibrium	Standing on one foot on a beam for 1 minute, 'flamingo' balance	

7. DETAILS ON:
   Age (Years, months)
   Sex
   Weight (kg)
   Height (cm)

3.2. EUROFIT - A PROGRAMME TO TEST FITNESS OF SCHOOLCHILDREN THROUGHOUT EUROPE

1. Why test children's fitness?

Any parent or teacher will demand a satisfactory answer to this question before proceeding any further. The parent may not suspect that there is likely to be anything wrong with children's fitness today. Almost all schoolchildren have physical education lessons regularly, which their parents, and even more so their grandparents, may not have had; nutrition and general standards of hygiene and medical care in Europe are better now than they have ever been ; and to give us the impression that children's fitness is better than ever, we see standards of achievement in sport rising at all levels, with the champions, particularly in athletics, swimming and gymnastics, becoming ever younger.

All these observations are true, but somewhat misleading for the following reason. The physical and social conditions of our lifestyle, even as children, have changed dramatically in the last 2 or 3 generations, a principal change being a considerable reduction in the habitual activity of ordinary people living normal lives. Physical activity is now more usually a matter of personal choice rather than a necessity. Of course the opportunities are available, as never before, for the active use of leisure and, along with the other favourable conditions referred to above, provide a marvellous environment for the nurturing of physical talent and the raising of standards of physical performance, particularly in the highly gifted few. However, such participation is optional.

The level of physical fitness, particularly that fitness which is related to health, needs assessment in children generally, and in each child, Preliminary studies in several countries of Europe have not been altogether reassuring; they show that ordinary or average levels of physical fitness are often likely to be lower than is desirable.

Children nowadays, despite the provision of physical education, may lead very inactive lives indeed. Walking to and from school is in many areas an exceptional activity. Young children in particular tend to be taken to school by car, whereas the older ones will go by bus.

Television, especially the sometimes excellent provision of children's television beginning soon after the end of the school afternoon, now fills an important hour or two before the evening meal with seated watching, which used to be a time of active play with groups of friends for most children 30 years ago.

Increasing city traffic and other emergent dangers of urban life have contributed to the emphasis on comfortable, safe, sedentary indoor life (particularly if it is convenient for the parents, and educational).

Deprived of physical activity, children tend to become not just relatively unfit, but also overweight. Their food intake will not reduce but is more likely to increase with the availability of many more kinds of sweets, biscuits, crisps and other foods to munch between meals and while watching television. The net result of all this is a substantial excess energy balance in many children leading to real obesity. Physical education lessons occupy at most about 3 hours of the average schoolchild's week and other objectives need to be achieved within that time besides that of improving children's physical condition. Skills need to be taught and personality developed through appropriate physical experiences. It is difficult, if not impossible, for even the best planned curriculum to replace the lost physical activity of a total lifestyle.

The physical education teacher may at this point observe that to use precious physical education time for testing further diminishes the activity time available. However,

a) testing will yield a great deal of information in a relatively short amount of the child's time and only needs to be carried out occasionally;
b) there is a strong case for testing being a non-curriculum part of school provision as is the school dental or medical examination), where the role of the physical education teacher is that of expert adviser and organiser of the school testing programme, and
c) tests of physical capacities can be of educational value in their own right and have already been successfully incorporated into school curricula within the framework of human biology and health education programmes, where it has been shown that a positive interest in fitness by children themselves can be of great advantage when attempting to explain to them the adverse effects of smoking or bad eating habits. It is also perhaps relevant to point out that, as a doctor will make his diagnosis before commencing treatment, the prescription of exercise to ensure optimum physical development of children should be preceded by measures of present status and assessment of needs.

It is the strong conviction of all those involved in the formulation of Eurofit that the assessment of fitness in children is essential information, vital to the future physical well-being of our children. This conviction is reinforced by the results of pilot studies of fitness made in several countries.

2. What sort of fitness is important?

Fitness can range from a general condition of sufficiency in meeting the physical demands of everyday life to highly specific capabilities to perform skilled feats of strength, power or endurance. A high degree of specialisation in sport has led to the emphasis of the latter, although the majority of such sports activities require a good basis of general endurance. While it would be difficult to argue a case for every child, irrespective of aptitude and interest, to become as strong as possible, or to develop the maximum possible joint mobility, there is a firm case for the encouragement of each and every child to attain a good level of general endurance. The reason is that for this aspect of fitness there exists convincing evidence of a positive link with good health. Regular exercise requiring this type of fitness will combat the risk of obesity in children and lay down the foundations of a cardiovascular and respiratory system which in later life will be more resistant to degenerative disease, especially heart disease, the major killer in Europe. This will be particularly effective if during childhood the habit of such exercise is so strongly acquired that it persists throughout adult life.

While general endurance fitness then, is of the most direct value to health and by this token a key element to be tested in the Eurofit battery, the other aspects of fitness : strength, local endurance, power, flexibility and co—ordination, collectively called the "motor" capacities, are also of great importance. The development of these qualities permits a more rewarding and confident participation in practically the whole range of physical and sports activities, increasing the chance that at least one of them will become a source of enjoyment and establish the exercise habit for life. This is after all the best way to take regular exercise - to find an activity which one does primarily for enjoyment and which contributes to health as an

additional benefit, rather then to take up exercise as a dosage in middle age in a desperate attempt to repair the ravages of twenty years of sedentary living.

So we must do everything we can to recognise children's fitness needs in order to design our physical education programme in the best way possible - maybe even to attempt to modify more fundamentally the physical activity component of the lifestyle of the modern child. To do such a thing however needs strong, persuasive action, to change attitudes in society and to alert those responsible for the education, condition and life style of children. Hard facts concerning the levels of fitness in children are essential to such action. These facts are not available. Very few measures have been made in most countries of the fitness of children, and usually those measures have been made on selected groups.

3. What is the general strategy of Eurofit?

The plan for the Eurofit test battery is in the first instance to ensure that enough children are tested to give a representative picture of the levels, range and distribution of children's fitness in Europe and to bring to light particular aspects for attention. The long term objective is to ensure that each child should have the benefit of fitness assessment and monitoring. At this stage, the test battery is still experimental, although, we hope, entirely practical. We need the tests to be used as extensively as possible in as many countries as possible, with both sexes and the entire age range of children, so that this collective experience can be used to produce the definitive test battery and to plan an appropriate long-term European strategy for Eurofit.

Bill TUXWORTH
Department of Physical Education
University of Birmingham

APPENDICES

ALTERNATIVE INDOOR TESTS
of cardio-respiratory endurance

I - 20-metre progressive shuttle run test

II - 480-metre shuttle run test

APPENDIX I
20·METRE PROGRESSIVE SHUTTLE RUN TEST

Factor: maximum aerobic power
Test: 20-metre shuttle run in periods of 1 minute

Equipment needed for test

- Gymnasium or space sufficiently large to mark out a 20·metre track
- width : 1 metre per subject
- tape recording of the protocol
- tape recorder

Instructions for the test subject

"Run for as long as possible there and back along e 20-metre track keeping to the speed prescribed by the tape recorder. A sound signal tells you when you should be at one end or the other of the 20-metre track."

Instructions for the person administering the test

- Read the protocol carefully (see Table II-1)
- Select test site. Ensure that there is a space of at least 1 metre at either end of the track. The wider the area used, the higher the number of subjects that can be tested simultaneously (1 subject per metre-width). The surface should be uniform but the material of which it is made is not specifically important. The two extremities of the 20-metre track should be clearly marked.
- Check the functioning of the sound track and tape recorder. Ensure that the apparatus is powerful enough for group testing.
- Listen to the contents of the sound track (Table II-2). Note the numbers on the tape position indicator so as to be able to locate the key sections of the tape quickly.
- Check the tape speed of the recorder to be used on the day of the test. For this, use the standard period recorder on the sound track for the test.
- Check that all the subjects are in good health.

Results

The interval at which the subject stops is noted, as is the corresponding VO2 (Table 11-I).

TABLE II 1
20 metre progressive shuttle run test
with 1-minute gradations
(LEGER, MAY 1982)

Gradations	$V0_2$ (ml.mn/kg)	Speed (km/h)	Split time
1	16.2	8	9.000
2	29.2	9	8.000
3	32.1	9.5	7.579
4	35	10	7.200
5	37.9	10.5	6.858
6	40.8	11	6.545
7	43.7	11.5	6.261
8	46.6	12	6.000
9	49.6	12.5	5.760
10	52.5	13	5.538
11	55.4	13.5	5.333
12	58.3	14	5.143
13	61.2	14.5	4.966
14	64.1	15	4.800
15	67.1	15.5	4.645
16	70	16	4.500
17	72.9	16.5	4.364
18	75.8	17	4.235
19	78.7	17.5	4.114
20	81.6	16	4.000
21	84.6	18.5	3.892

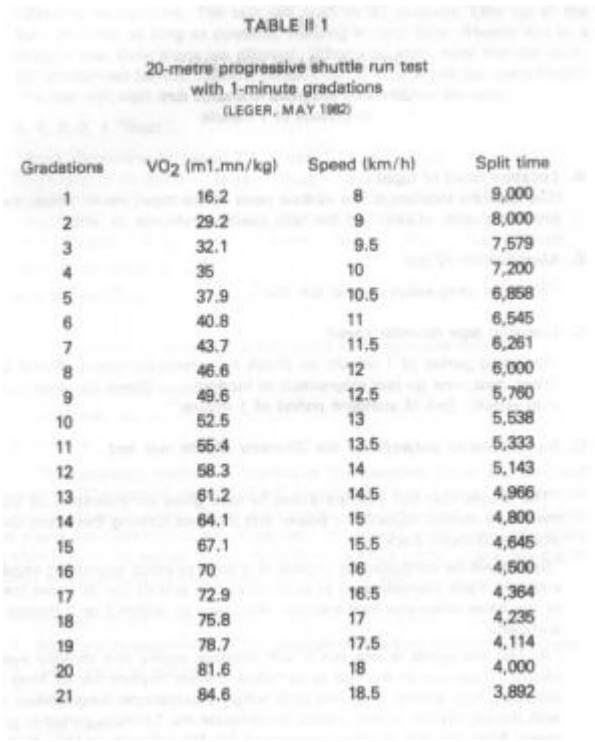

TABLE II 1

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1	16.2	8	9,000
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4	35	10	7,200
5	37.9	10.5	6,858
6	40.8	11	6,545
7	43.7	11.5	6,261
8	46.6	12	6,000
9	49.6	12.5	5,760
10	52.5	13	5,538
11	55.4	13.5	5,333
12	58.3	14	5,143
13	61.2	14.5	4,966
14	64.1	15	4,800
15	67.1	15.5	4,645
16	70	16	4,500
17	72.9	16.5	4,364
18	75.8	17	4,235
19	78.7	17.5	4,114
20	81.6	18	4,000
21	84.6	18.5	3,892

Scanned Stage/VO_2 table from original Appendix,
Eurofit Provisional manual, **STRASBOURG 1983**

TABLE ll 2

SOUND TRACK CONTENTS

20—metre progressive shuttle run

in periods of 1 minute

A. Location (start of tape)

"To facilitate location of the various parts of the tape, count 'three, two, one, zero' and, at zero, set the tape position indicator to 'zero"'

B. Identification of Test

"20 metre progressive shuttle run test"

C. Checking tape recorder speed

"Standard period of 1 minute to check tape recorder speed. Stand by. Three, two, one go (set stopwatch in motion) Stand by, stop (stop stopwatch). End of standard period of 1 minute".

D. Instructions to subjects for the 20-metre shuttle run test

"The shuttle run test you are about to take gives an indication of your maximum aerobic capacity or power and involves running there and back along a 20—metre track".

"Speed will be controlled by means of a tape emitting sounds at regular intervals. Pace yourselves so as to be at one end of the 20-metre track or the other when you hear a sound. Accuracy to within 1 or 2 metres is sufficient".

"At first the speed is low but it will increase slowly and steadily every minute. Your aim in the test is to follow the set rhythm for as long as possible. You should therefore stop when you can no longer keep up with the set rhythm or feel unable to complete the 1—minute period in progress. Note the last number announced for the relevant period - that is your result. The duration of the test varies according to the individual: the fitter you are, the longer the test lasts".

"To sum up, the test is maximal and progressive, in other words easy at the beginning and hard towards the end. Good luck!"

E. Starring instructions

"Starting instructions. The test will start in 30 seconds. Line up at the start. Run for as long as possible, keeping in your lane. Always run in a straight line. Only stops are allowed. When you stop, note the last number announced for the relevant period - this is your result, so don't forget!

The test will start in 5 seconds' time when the buzzer sounds:
5, 4, 3, 2, 1 "Buzz".

"Start. Beginning of period 7 ... buzz ... buzz ... buzz
Beginning of period 9 ... buzz ... buzz ... buzz
End of interval 9 ... buzz ... buzz ... $9^{1}/_{4}$ ... buzz ... buzz $9^{1}/_{2}$ ... buzz
buzz,.. $9^{3}/_{4}$ buzz buzz End of period 10 buzz buzz

$10^1/_4$ buu buzz $10^1/_2$ buzz buzz $10^3/_4$ buzz buzz ... and so on to period 23) ... End of recording".

Procedure for recording sound track for progressive field test

Choose recording method

1. Electronic, or
2. Manual.

The electronic method is preferable but requires more sophisticated equipment. The manual method is still acceptable: even though the chances or error with each sound signal are greater, the margin of error fluctuates and evens out from one signal to the next, the overall effect being practically nil after a 2-minute period. What matters is systematic error (clock gaining or losing) which should be lower than 1% (i.e. 0.01 sec).

Information to be recorded

1. Standard 60 second period for purpose of checking tape recorder speed.
2. Instructions to subjects.
3. Starting instructions.
4. Test itself.

Equipment needed

1. Cassette or reel-to-reel tape recorder (mono or stereo). A "pause" facility is useful.
2. Microphone.
3. Clock with sweep seconds hand (duration of periods).
4. Manually operated clock with non-cumulative split timing facility (timing of intervals between sound signals) OR Electronic clock with adjustable cycles (length of intervals between sound signals), e.g. Lafayette four bank timer 52011 or Lafayette millisecond timer. Accuracy to within 1% (gain or loss) is acceptable, i.e. to within 0.01 second.
5. Sound source (electric bleeper; whistle; voice). With the electronic method, it must be possible to connect the sound source to the electronic clock. A frequency generator (e.g. Eico Audio Generator 377) may be used to change the sound frequency from one period to the next.
6. Magnetic tape for a 20 minute recording. 900 foot tape running at 9.5 cm/s ($3^3/_4$ ips) or 45-minute cassette.

Alain LOFI
Institut National des Sports
et de |'Education Physique, Paris
Luc LEGER
University of Montreal

APPENDIX II
4M-METRE SHUTTLE RUN TEST

Material:

— Slip-proof floor
— As many stopwatches as subjects tested simultaneously
— Measuring tape
— Chalk or white tape
— Traffic cones/skittles

Instructions :

Get ready behind the line, one foot just behind the line. When the start is given, run to the opposite line and cross it with both feet; return to the starting line and cross that with both feet. This is one cycle, and you have to do 12 cycles. Do not start too quickly, for 480m may be longer than you think. The test is done once.

Directives :

— Make two parallel lines on the floor (chalk or tape) 20m apart.
— The lines are 120cm long and the ends of each line are marked with cones (or Indian clubs, blocks, etc.).
— The test leader should make sure that the subject crosses the line with both feet and that he/she remains in the required 'path'.
— After each cycle the number of cycles completed should be called aloud.
— Stop the watch when the subject crosses the finish line with one foot.
— The subject should not slip or slide during the test, so a slip proof floor is necessary.
— These directives describe one 'path'. The test can be done using several paths at the same time. In fact the test should be performed by at least two subjects at the same time, so that a competitive element is added and motivation stimulated. When doing so, it is necessary to provide an adequate number of stopwatches, e.g. one test leader to test four subjects. When testing several subjects at once, it is necessary to let the subjects start