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PHYSICAL TRAINING FOR MEMBERS OF THE SOUTH AFRICAN NATIONAL DEFENCE FORCE

MANUAL ON PHYSICAL TRAINING IN THE SANDF

Introduction

Physical training is an important mechanism, together with sport and recreation, in preparing and maintaining combat and mission ready members of the SANDF. Physical fitness, as only one aspect of total fitness, is achieved through mandatory physical training programmes, supplemented by the participation in sport and recreational activities.

Aim

The primary aim of this manual is to provide clear scientifically based guidelines to Physical Training Instructors' on the how, what, when and why, of the Physical Training that they must present, in order to achieve the best improvement in physical fitness in the members under their instruction.

What is fitness?

Total fitness includes mental, emotional, social and physical aspects and is characterized by the following forms of ability:

- Emotional ability or stability that implies a balanced emotional life.
- Intellectual ability, which implies mental security.
- Social ability; and
- Bodily or physical fitness.

Thus **total fitness** is a broad term denoting dynamic qualities that allow one to satisfy needs regarding mental and emotional stability, social consciousness and adaptability, spirituality, and physical health.

Physical fitness can be defined as the healthy and efficient functioning of various body systems that allows one to engage in activities of daily living, recreation and leisure.

Physical fitness

Physical fitness is classified into fitness components, namely:

- Cardiorespiratory endurance
- Muscular strength
- Muscular endurance
- Flexibility
- Speed
- Power
- Agility

Cardiorespiratory endurance

Cardiorespiratory endurance is the ability to persist in a physical activity requiring oxygen for physical exertion without experiencing undue fatigue. The soldier who runs 2.4km or walks 4km is displaying cardiorespiratory endurance.

The functioning of the heart, lungs and blood vessels is essential for distribution of oxygen and nutrients and the removal of wastes from the body. For performance of vigorous activities, efficient functioning of the heart and lungs is necessary. The more efficient they function, the easier it is to walk, run, study and concentrate for longer periods of time. A more efficient soldier will be able to maintain effort for a longer period of time.

Cardiorespiratory function is characterized by moderate contractions of large muscle groups for a relatively long time, during which adjustments of the cardiorespiratory system to the activity are necessary, as in distance running or swimming.

Cardiorespiratory function may be assessed using a number of tests that measure or predict the maximum rate at which oxygen can be used during exercise.

The SANDF uses the 2.4km run and 4km walk as assessments of the soldiers' cardiorespiratory endurance. It thus stands to reason that should the majority of the soldiers perform poorly in the above-mentioned tests that they then must follow a PT programme designed to improve this component.

In order to improve cardiorespiratory endurance the following guidelines must be adhered to:

- **Frequency:** minimum 3 x/week;
- **Duration:** at least 20 min at desired HR;
- **Intensity:** 70-85% of max HR.

As heart rate is linearly related to the intensity of the exercise and to the rate of oxygen consumption, it becomes a relatively simple process to identify a specific workload (pace) that will make the heart rate plateau at a desired level. By monitoring the heart rate we can determine whether the pace is too fast and too slow to get the heart rate into a target range.

- **How?** The heart rate can be monitored for 10 seconds by placing the your index and middle fingers on the thumb side of the flexor tendon and then multiply it by 6 to give you the number of beats per minute. Regardless of where the heart rate is taken, it should be monitored within 15 seconds of stopping -the exercise.
- **Calculating HR.** Maximum HR= 220 – age.
- **Type:** Aerobic activities that involve repetitive, whole-body; large-muscle movement that are rhythmical in nature and that use large amounts of oxygen, elevate the heart rate and maintain it at that level for an extended period of time.

Basic training activities /methods to develop cardiorespiratory endurance

- Walking
- Jogging/ Running
- Cycling,
- Swimming,
- Rope skipping,

- Stepping,
- Aerobic dance exercise.

Note: Alternate the above activities in order to reduce the risk of developing overuse injuries. These activities should be used to develop cardiorespiratory endurance for at least a period of 3 weeks or the members should have passed their 2.4km run and/4km walk before advanced training methods are incorporated into the training programme.

Advanced training methods to develop cardiorespiratory endurance

Interval training.

Alternating periods of relative intense work with periods of active recovery.

Recommended Interval Training Workout	
Mode	Detail
Intensity during training period	70-95% of MHR
Intensity during recovery period	30-45% of MHR
Frequency	1-2x/week
Duration	Least 20 min of training period
Type	Use the basic method and turn into advanced by changing the intensity and frequency

Example of interval training using walking and running: runs 2 sets of 4 x 40 min in 70 sec with 2 min20sec walking recovery period

Fartlek training.

A type of workout that involves jogging at varying speed over varying terrain.

Par Cours.

A technique for improving endurance that combines continuous training and circuit training.

Cardiorespiratory beginners training program

This programme should be followed for all the members who fail the cardiovascular component of the fitness assessment. I.e. all members who fail the 2.4km run and/or the 4km walk. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week before moving on to the intermediate programme.

Ser No.	Exercise description	Exercise no	Intensity	Time
1	Warm-up			7 min
2	Activity	Walking; Cycling; Swimming; Stepping, Low impact aerobic dance exercise	50-60% of max HR	20 min
3	Cool-down			5 min

Cardiorespiratory intermediate training program

This programme should be followed for all the members who pass the cardiovascular component (2.4km run and/or the 4km walk) of the fitness assessment and achieve a 60-70% pass rate. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week before proceeding to the advanced programme.

Ser No.	Exercise description	Exercise no	Intensity	Time
1	Warm-up			7 min
2	Activity	Walking; Jogging/ Running; Cycling; Swimming; Rope skipping; Stepping, Aerobic dance exercise	60-75% of max HR	30 min
3	Cool-down			5 min

Cardiorespiratory advanced training program

This programme should be followed for all the members who pass the cardiovascular component (2.4km run and/or the 4km walk) of the fitness assessment and achieve more than a 70% pass rate. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week.

Ser No.	Exercise description	Exercise no	Intensity	Time
1	Warm-up			7 min
2	Activity	Jogging/ Running; Cycling; Swimming; Rope skipping; Stepping, Aerobic dance exercise	75-80% of max HR	45 min
3	Cool-down			5 min

Muscular strength

Muscular strength is the ability or capacity of a muscle or muscle group to exert a maximal force against resistance, one time through a full range of motion. This is referred to as the one- repetition maximum, or the 1-RM.

To determine your 1-RM select a weight that you know you can lift at least one time. After a proper warm-up, try to execute several repetitions. If you can perform more than one repetition, add weight and try again to execute several repetitions. Continue doing this until you are unable to lift the weight more than a single repetition. This last weight you are able to lift only once is your 1-RM.

Strength is an important element in all kinds of work, physical and athletic activity. Muscle strength provides greater endurance, power and resistance to fatigue. Additionally it also helps to prevent injuries by providing support to the joints.

No component of the SANDF fitness test directly assesses the individuals muscular strength however strength forms the basis for the following components, namely:

Strength training techniques

There is no such thing as an optimal strength training program. Perhaps the most confusing aspect of training is the terminology used to describe specific programs. The following list of terms with their operational definitions may provide some clarifications.

Terms	Definitions
Repetitions	Number of times you repeat a specific movement
Repetition maximum (RM)	Maximum number of repetitions at a given weight
Set	A particular number of repetitions
Intensity	The amount of weight or resistance lifted
Recovery period	The rest interval between sets
Frequency	The number of times an exercise is done in a week's period.

Muscular endurance

Is the ability of a muscle or muscle group to perform a series of dynamic contractions or to sustain a static sub maximal muscle contraction repeatedly over a period of time. For example, a person can lift a weight 25 times. If muscular strength is increased by 10% through weight training, it is very likely that the maximum number of repetitions will also be increased because it is easier for the person to lift the weight.

Muscular strength versus Muscular endurance

People who possess great levels of strength tend to exhibit great levels of muscular endurance when asked to perform repeated submaximal contractions against resistance.

Sets and Reps.

To develop muscular strength you should use heavier weights (resistance) with a lower number of repetitions. Conversely to develop muscular endurance you should use lighter weights (resistance) with a higher number of repetitions.

When trying to increase muscular strength, for any given exercise the amount of weight (resistance) selected should be sufficient to allow 6 to 8 repetitions maximum (RM) in

each of the three sets with a recovery period of 1 to 2 minutes between sets. Initial selection of a starting weight may require some trial and error to achieve the 6 to 8 RM range. If at least 3 sets of 6 repetitions cannot be completed, the weight is too heavy and should be reduced. If it is possible to do more than 3 sets of 8 repetitions, the weight is too light.

Progression to heavier weights is then determined by the ability to perform at least 8 repetitions maximum in each of the 3 sets. When progressing weight, an increase of about 10% of the current weight being lifted should still allow at least 6 RM in each of the three sets.

To concentrate more on muscular endurance you should use three sets of 10 to 12 reps. The amount of weight used should be selected and progressed according to the same procedure described above. Thus training regimes for both muscular strength and muscular endurance are similar in terms of sets and number of repetitions.

Frequency of exercise.

To most effectively improve muscular strength and endurance, a particular muscle or muscle group should be exercised at least 3 times a week and not more than 4 times per week.

Teaching guidelines for muscular strength and endurance

You can teach muscular strength and endurance concepts and conduct training sessions whether you have state-of-the-art equipment or not. Surgical tubing for resistance bands is inexpensive and readily available. Collect and use cans of food for small weights. You can use balls too, which incorporate balance and strength. There are always body weight and partner-resisted exercises. If you are planning to purchase equipment, focus on buying items that will meet the primary needs of your students. Using traditional weight-training equipment represents only a small segment of exercises and activities. It's important to first manage one's own body weight before lifting increased weights.

Overload, fitt, progression and specificity principles

The principle of overload-progressively placing greater –than-normal demands on the musculature of the body – suggests that individuals involved with activities designed to improve muscular strength and/or muscular endurance will need to increase their workload periodically throughout the course of the program. Specifically, to develop muscular strength, the overload principle dictates increasing the resistance against the muscles involved to a level greater than that used before. To develop muscular endurance, the overload principle dictates increasing the number of repetitions, increasing the length (time) of the repetition, decreasing the rest interval between activities, or a combination of two or three methods. The amount of increase must be appropriate for the age and fitness level of the students.

The principle of progression refers to incorporating a systematic approach to increasing frequency of exercise, the volume of repetitions, and/or the intensity of the activity. To avoid injuries, however, students must understand appropriate progression and set goals accordingly. For example, they should know that adding only a couple kilograms at a time is safer and more realistic than increasing by an excessive amount. There may be instances in which one component may be increased, whereas the other components may actually be decreased. For example, as intensity increases, volume will decrease, and vice versa.

The principle of specificity technically states that the type of demand placed in the body controls the type of adaptation that will occur. Specificity suggests that the activities you select should provide the outcome represented by that day's class objectives.

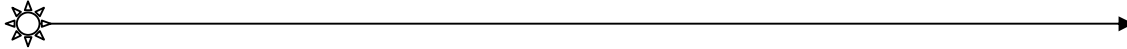
The table below summarizes how to apply the FITT (frequency, intensity, time and type) principle, based on fitness level goals.

Training principles applied to muscular strength and muscular endurance, based on fitness goals			
	Base health-related fitness	Intermediate health-related fitness	Athletic performance fitness
Frequency	2-3 times per week; allow for minimum one-day rest between training sessions	3-4 times per week; alternating upper- and lower-body segments will allow for consecutive training days	4-5 times per week; training activities are specific to sport participation
Intensity	Very light, less than 40% of a “projected” maximal effort	Light to moderate, 50%-70% of “projected” maximal effort	Specific load adaptation required for sport participation
Time	2-3 sets of 6-8 (strength)/ 10-12 (endurance) repetitions	2-3 sets of 6-8 (strength)/ 10-12 (endurance) repetitions	2-3 sets of 6-8 (strength)/ 10-12 (endurance) repetitions
Type	Body weight, single and multijoint activities involving major muscle groups	Resistance exercise such as leg press, bench press, pull-ups additional presses and pulls	Advanced sport-specific, multijoint lifts (clean pulls, power presses, Olympic style lifts)
Overload	Not necessary to bring child to overload during base level	Introduce one of the components of overload; 1-2 times per week	Program design should stress variable intensities and durations to bring student into overload; 2-3 times per week
Progression and specificity	Let student get the idea of correct movement. Progression is minimal	Introduce program design and incorporate variation	Specific sets, repetitions, and exercises to meet desired outcomes

Periodise for strength.

As with any goal-orientated activity, one needs to start at a level that can be managed and was determined by the fitness test and progress with a training programme with the aim, of being able to peak at the required time. Planning for this process is called Training Periodisation, which, in its simplest form, includes General Preparation, Specific Preparation, Pre-peak and Peak Phases.

General Preparation	Specific Preparation	Pre-Peak	Peak
Basic Strength	Maximum strength	Conversion: Endurance Power	Maintenance



Assessment/ Fitness evaluation

Peak/ Follow-up fitness evaluation

Note well: these phases represent a progression. Latter phases should not be attempted without having adequately completed the previous training phases.

Basic strength:

The aim of this phase is to lay a foundation correct technique is paramount and this phase must concentrate on most muscle groups of the body broadly categorized as chest, back, shoulders, arms, legs and abdominals.

Training methods for muscular strength and endurance

Body weight training

Although it is difficult to quantify intensity, sit-ups, curl-ups, push-ups, and flexed arm hangs all help built muscular strength and endurance with little or no equipment.

This type of resistance training is appropriate for the very young (K-4) or the student who is just beginning resistance training activity. It has the advantages of not requiring equipment, which means it's an inexpensive part of a strength and endurance training program throughout adulthood.

Circuit training

Circuit training uses a series of exercise stations that consist of various combinations of weight training, flexibility, calisthenics, and brief aerobic exercises. Circuits may be designed to accomplish many different training goals. With circuit training, you move rapidly from one station to the next and perform whatever exercise is to be done at that station within a specified time period. A typical circuit would consist of eight to twelve stations, and the entire circuit would be repeated three times.

Circuit training is definitely an effective technique for improving strength and flexibility. Certainly, if the pace or the time interval between stations is rapid and if workload is maintained at a high level of intensity with heart rates at or above target training levels for a minimum of 20 minutes, the cardiorespiratory system may benefit from this circuit. However, there is little research evidence that shows that circuit training is very effective in improving cardiorespiratory endurance. It should be and is most often used as a technique for developing and improving muscular strength and endurance. Figure 6-11 provides an example of a simple circuit training setup that can be easily completed by healthy college students.

Plyometric Exercise

Plyometric exercise is a technique that uses specific exercises that encompass a rapid stretch of a muscle eccentrically followed immediately by a rapid concentric contraction of that muscle for the purpose of facilitating and developing a forceful explosive movement over a short period of time. The greater the stretch put on the muscle from its resting length immediately before the concentric contraction, the greater the resistance the muscle can overcome.

Plyometrics emphasize the speed of the eccentric phase. The rate of stretch is more critical than the magnitude of the stretch. An advantage to using plyometric exercise is that it can help develop eccentric control in dynamic movements. Plyometric exercises involve hops, bounds, and depth jumping for the lower extremity and the use of medicine balls and other types of weighted equipment for the upper extremity. Depth jumping is an example of a plyometric exercise in which an individual jumps to the

ground from a specified height and then quickly jumps again as soon as ground contact is made.

Plyometrics tend to place a great deal of stress on the musculoskeletal system. The learning and perfection of specific jumping skills and other plyometric exercises must be technically correct and specific to one's age, activity, physical and skill development.

Partner-Resisted training

This training method is an extension of basic body weight exercises. Using simple equipment, such as a towel, or no equipment, partners can better isolate individual muscle groups than solo body weight exercises, much as weight machines do. When selecting partners, match height, weight, and strength levels as closely as possible to ensure safety and ease of working together. Encourage good communication and demand mature, safe behaviour: Partners should also help each other maintain correct technique and high motivation through monitoring and encourage each other.

Resistance band training

This training method involves using surgical tubing, rubber cords, or bands manufactured specifically for muscular strength and endurance training, such as the Exertube, Dyna Band, Flexi-Cord, or Therma-Band. Use thicker tubing for greater resistance and thinner tubing for less resistance. In addition, a student can adjust resistance by prestretching the cord more or less.

Weight training

A program may use free or machine weights or both, depending on goals, equipment availability, and space in which to safely conduct a weight-training program. Introduce exercises one at a time by discussing each one's purpose, demonstrating correct technique, and outlining ranges of appropriate weight loads, repetitions and speed. In addition, relate these factors to intensity, program goals, and individual goals. While you may opt to use weight training in addition to or in place of other forms of training, also teach students alternative exercises that target the same muscle group.

Beginners muscular strength training programme

This programme should be followed for all the members who fail the muscular endurance/ strength component of the fitness assessment. I.e. all members who fail the sit-up and/or the push-ups. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week before moving on to the intermediate programme.

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
1	Warm-up				
2	Upper body exercise			2-3	10-12
3	Leg exercise			2-3	10-12
4	Upper body exercise			2-3	10-12
5	Abdominal exercise			2-3	maximum
6	Back exercise			2-3	10-12
7	Leg exercise			2-3	10-12
8	Abdominal exercise			2-3	maximum
9	Leg exercise			2-3	10-12
10	Abdominal exercise			2-3	maximum
11	Stretching exercise- upper body			3	20s each
12	Stretching exercise- legs body			3	20s each
13	Stretching exercise- back			3	20s each

Intermediate muscular strength training programme

This programme should be followed for all the members who pass the muscular endurance/ strength component of the fitness assessment and achieve a 60-70% pass rate. i.e. all members who obtain points for the sit-ups and/or the push-ups. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week before proceeding to the advanced programme.

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
1	Warm-up				
2	Upper body exercise			2-3	10-12
3	Leg exercise			2-3	10-12
4	Upper body exercise			2-3	10-12
5	Abdominal exercise			2-3	maximum
6	Back exercise			2-3	10-12
7	Leg exercise			2-3	10-12
8	Abdominal exercise			2-3	maximum
9	Leg exercise			2-3	10-12
10	Abdominal exercise			2-3	maximum
11	Stretching exercise- upper body			3	20s each
12	Stretching exercise- legs body			3	20s each
13	Stretching exercise- back			3	20s each

Advanced muscular strength training programme

This programme should be followed for all the members who pass the muscular endurance/ strength component and achieve above 70% pass rate for this component during the fitness assessment. i.e. all members who obtain points and above for the sit-ups and/or the push-ups. This programme must be followed for a minimum of 3 weeks with a minimum of 3 training sessions per week.

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
1	Warm-up				
2	Upper body exercise			3	10-12
3	Leg exercise			3	10-12
4	Upper body exercise			3	10-12
5	Abdominal exercise			3	maximum
6	Back exercise			3	10-12
7	Leg exercise			3	10-12
8	Abdominal exercise			3	maximum
9	Leg exercise			3	10-12

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
10	Abdominal exercise			3	maximum
11	Stretching exercise- upper body			3	20s each
12	Stretching exercise- legs body			3	20s each
13	Stretching exercise- back			3	20s each

General Physical Training Programme to maintain and improve fitness levels

This programme should be followed for all the members who pass the all the components of the fitness test and need to maintain and/or improve all the components. As the fitness test is conducted every six months the physical training programme should be designed so as to progressively improve all the components and be ready for the next physical fitness test. Thus the programme below should be followed from week 1 to week 12.

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
1	Warm-up				
2	Upper body exercise			3	10-12
3	Leg exercise			3	10-12
4	Upper body exercise			3	10-12
5	Abdominal exercise			3	maximum
6	Back exercise			3	10-12
7	Leg exercise			3	10-12
8	Abdominal exercise			3	maximum
9	Cardiovascular activity	Jogging/ Running; Cycling; Swimming; Rope skipping; Stepping, Aerobic dance exercise		3	10-12
10	Stretching exercise- upper body			3	20s each
11	Stretching exercise- legs body			3	20s each
12	Stretching exercise- back			3	20s each

The programme below should be followed from week 13 to week 24.

Ser No.	Exercise description	Exercise no	Intensity	No. of sets	Reps
1	Warm-up				
2	Upper body exercise			3	10-12
3	Leg exercise			3	10-12
4	Upper body exercise			3	10-12
5	Abdominal exercise			3	maximum
6	Back exercise			3	10-12
7	Leg exercise			3	10-12
8	Abdominal exercise			3	maximum
9	Cardiovascular activity	Jogging/ Running; Cycling; Swimming; Rope skipping; Stepping, Aerobic dance exercise		3	10-12
10	Stretching exercise- upper body			3	20s each
11	Stretching exercise- legs body			3	20s each
12	Stretching exercise- back			3	20s each