world rowing™

The FISA Coaching Development Programme

HANDBOOK – LEVEL II

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Preface

The FISA Coaching Development Programme represents the synthesis of the movement for international cooperation in developing and expanding the scope of the sport of rowing. The programme started in 1985 as part of FISA Competitive Commission's activity, with support from IOC Olympic Solidarity programme, and already in February 1986 a working group of international coaches met in Ratzeburg, Germany to discuss and form a policy for the programme. The members of that group were:

Reinhold Batschi (AUS)	Mauro De Santis (ITA)
Roman Jermiszkin (POL)	Walter Schroeder (GER)
Franz Held (GER)	Rolf Seterdal (NOR)
Ricardo Ibarra (ARG)	Mike Spracklen (CAN)
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In the following years, the Coaching Manuals were produced, and many National Federations supported the programme and provided source material. The main supporters where: the former Amateur Rowing Association (GBR) now entitled British Rowing, Canadian Amateur Rowing Association (CAN), Deutscher Ruderverband (RFA), Deutscher Rudersportverband (RDA) and Federazione Italiana Canottaggio (ITA).

The programme was revised in 1991 and again in 2002. Not many changes have been made from the original material. Rowing technique, methodology, exercise physiology etc have not been through any revolutions, the progress in speed is more likely to come from more time invested in training, better material and more sophisticated talent identification programmes and, we hope, better coaches.

During the 16 years the programme has been in activity more than 4,000 coaches worldwide have participated in Level 1 courses, approximately 2,000 in Level 2 courses and 60 at the Coaching Academy, representing Level 3. It is the hope that the new version, represented by this booklet, will continue to assist new coaches – to become better coaches!

Thor S. Nilsen
FISA Development Director
October 2002

1 Basic Rigging

1.1 Introduction

Rowing is a sport that requires concerted motion between the athlete and the boat. To row effectively and to learn correct technique, it is clear that the boats and equipment must be properly adjusted and well-maintained. The construction of modern boats offers the possibility of individualised rigging to allow the coach to take into account the anatomical and physiological aspects of each athlete.

In this course, the terminology of the principal parts of the boat and equipment will be presented. You will be introduced to the basic adjustments and the tools necessary to make the adjustments. Also, guidelines for the proper care and repair of the materials will be presented to assist in prolonging the life of the boat and equipment.

By the end of this course you will learn that the basic adjustments are easy to accomplish with the knowledge of the necessary measurements and a few simple tools. You, the coach, will then be able to provide the athletes with properly adjusted boats and equipment, which will allowWR the athletes to increase the benefits of training.

1.2 Measuring aids and tools

It is necessary in the beginning to acquire a few simple measuring aids and tools to be able to make the adjustments on the boat and equipment. They are as follows:

- 1m length of string,
- straight piece of wood, 1.5m in length,
- tape measure or measuring stick,
- screwdriver,
- set of wrenches (10mm, 11mm, 13mm and 17mm),
- spirit level.

It is important to keep these measuring aids and tools together in a kit or tool box as this will ensure that time is not lost in searching for missing items.

1.3 Terminology

The sport of rowing is divided into two distinct categories: sculling and sweep rowing.

Sculling events require each athlete to use two oars, which are pulled simultaneously and range from the single sculls to the quadruple sculls. Sweep rowing events require each athlete to use one oar and range from boats containing as few as two athletes to as many as eight with one coxswain.

There are three types of sculling boats: the single, the double and the quadruple. These have one, two and four athletes, respectively. There are five types of sweep rowing boats: the pair with coxswain, the pair without coxswain, the four with coxswain, the four without coxswain, and the eight with coxswain. The pairs, of course, have two athletes per boat.

Generally, the terminology used in naming the part of the boat and equipment and the points of adjustment for sculling and sweep rowing are identical. However, to ensure that this terminology is standardised, figures 1 to 3 present the basic terminology for the parts of the oar (figure 1),

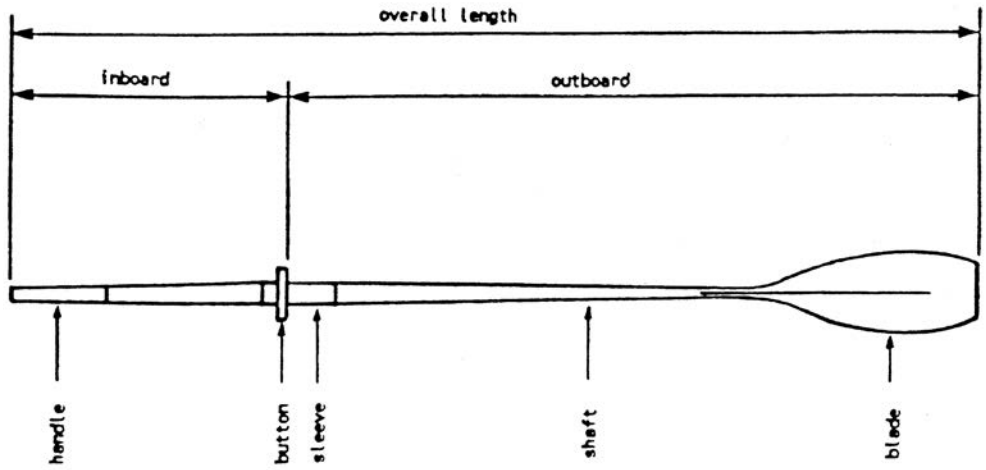


Figure 1 – Parts of the Oar

the parts and adjustment points of a sweep rowing boat (figure 2) and a sculling boat (figure 3).

The placement of the athlete in a boat, except in a single scull,

is generally designated by a numbering system that commences with the number one for the seat closest to the bow and continues to the number that corresponds to the seat position closest to the stern. The first and last seat positions may also be designated bow and stroke, respectively.

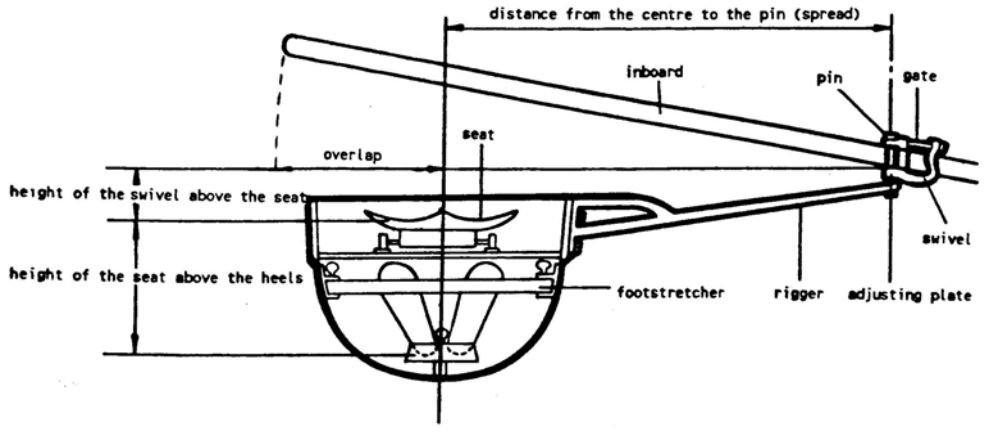


Figure 2 – Parts of a sweep boat

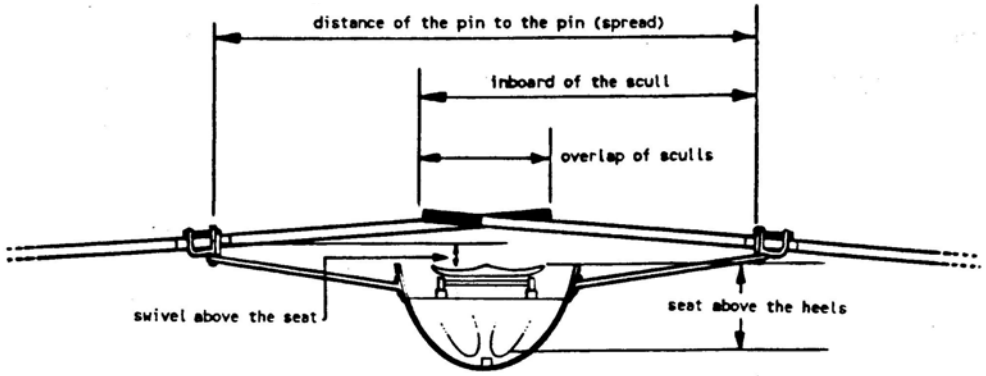


Figure 3 – Parts of a sculling boat

The oars may be identified by seat placement and the rowing side by the use of a numbering system (similar to the system for the placement of the athlete) and by the use of a coloured tape or letter to designate the rowing side.

Generally, the letter “S” or red tapes identifies the stroke-side (the left side of the boat as viewed standing at the stern and facing the bow of the boat) and the letter “B” or green tape identifies the bow-side (the right side of the boat as viewed standing at the stern and facing the bow of the boat).

1.4 Adjustment of boats and equipment

In theory, the adjustments to the boats and equipment are the same for either type of boat, sculling or sweep. This section will present the information necessary to prepare a rowing boat.

Length and placement of the tracks

The length of the tracks can vary from 65cm, in the old boats, to 85cm, in extreme cases. The normal length is between 70 and 75cm. The tracks (see A in figure 4) are generally placed in a position that allows at least 65cm between the extreme bow end of the tracks to a line that is perpendicular to the boat at the position of the working face of the swivel.

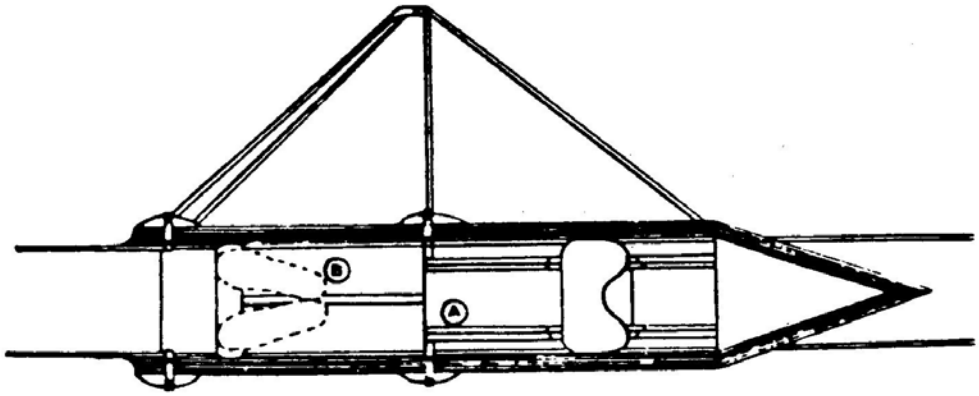


Figure 4 – Placement of the tracks

Angle, height and placement of the foot stretcher

Although in many boats the angle and height of the foot stretcher are fixed by the boat builder, it is important to obtain a good position for the athlete which allows free and comfortable movement.

Therefore, in most new boats the angle and height of the foot stretcher are adjustable.

It has been found that a good position for the angle of the foot stretcher (see figure 5) is between 38 and 42 degrees. It has also been found that a good position for the height of the foot stretcher (the vertical distance from the seat down to the heel of the foot stretcher, see figures 2 and 3) is about 15cm to 18 cm.

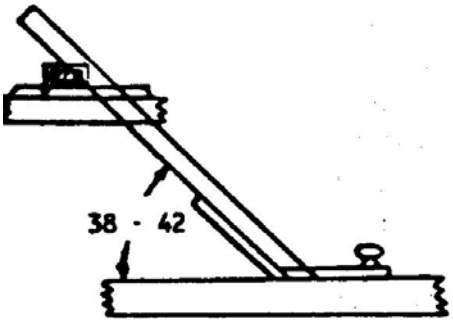


Figure 5 – Angle of the foot stretcher

The placement of the foot stretcher is important because it controls the position of the oar at the entry and finish. Therefore, consideration must be given to the rowing technique utilised by the athlete and the athlete's position in relation to the working face of the swivel. Further, in all boats, the correct placement of the foot stretcher must ensure a correct and uniform finish position.

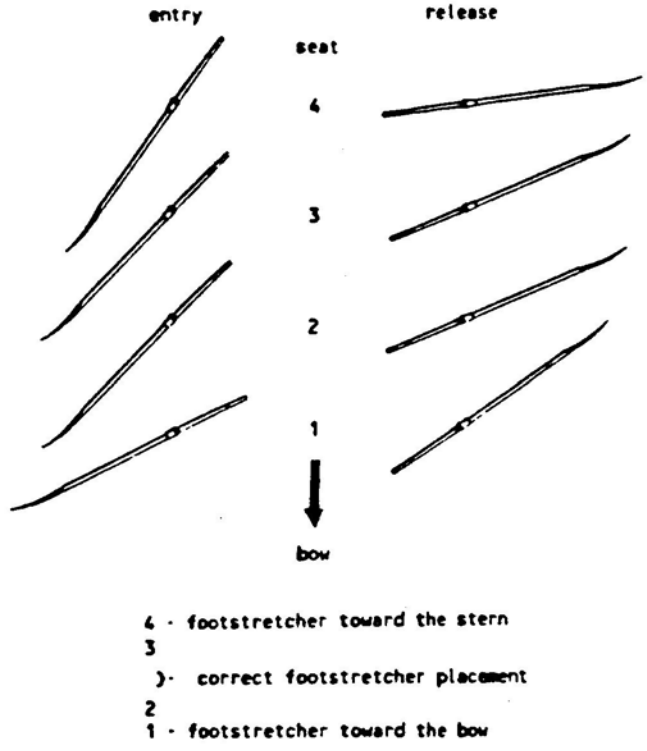


Figure 6 – Placement of the foot stretcher

The effect of the placement of the foot stretcher is demonstrated in figure 6. The athlete in the top of the drawing has the foot stretcher placed too close to the stern of the boat and the athlete in the bottom of the drawing has the foot stretcher placed too close to the bow of the boat.

The athletes in the middle positions of the drawing have the foot stretchers placed in the correct position.

Spread in sculling and sweep rowing

Pin-to-pin distance in sculling

In a sculling boat, the place of measurement of the spread is from the centre of the pin of one rigger to the centre of the pin of the rigger directly opposite. This distance is usually measured within the range of 156cm to 160cm (see figure 7). It should be noted that it is important to ensure that each pin has the same distance from the centre of the boat.

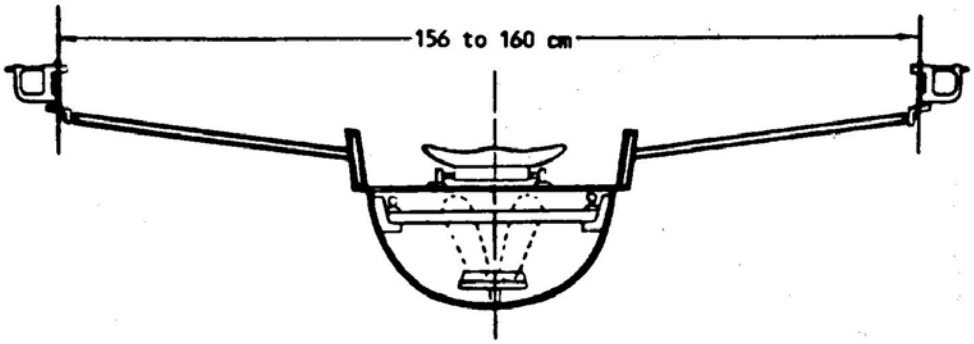


Figure 7 – Measuring the distance from pin to pin

Distance of the pin from the centre in sweep rowing

The place of measurement of the spread in a sweep rowing boat is different. The usual practice is to measure the distance of the pin from the centre of the boat on a line drawn perpendicular from the pin to a line extending lengthwise down the centre of the boat.

This distance varies from boat to boat because it is dependent upon the size and strength of the crew and the type of boat.

Use the following procedure to adjust the distance of the pin from the centre for each seat in a sweep rowing boat:

1 Measure the width of the boat at the point perpendicular to the pin (see 1 in figure 8).

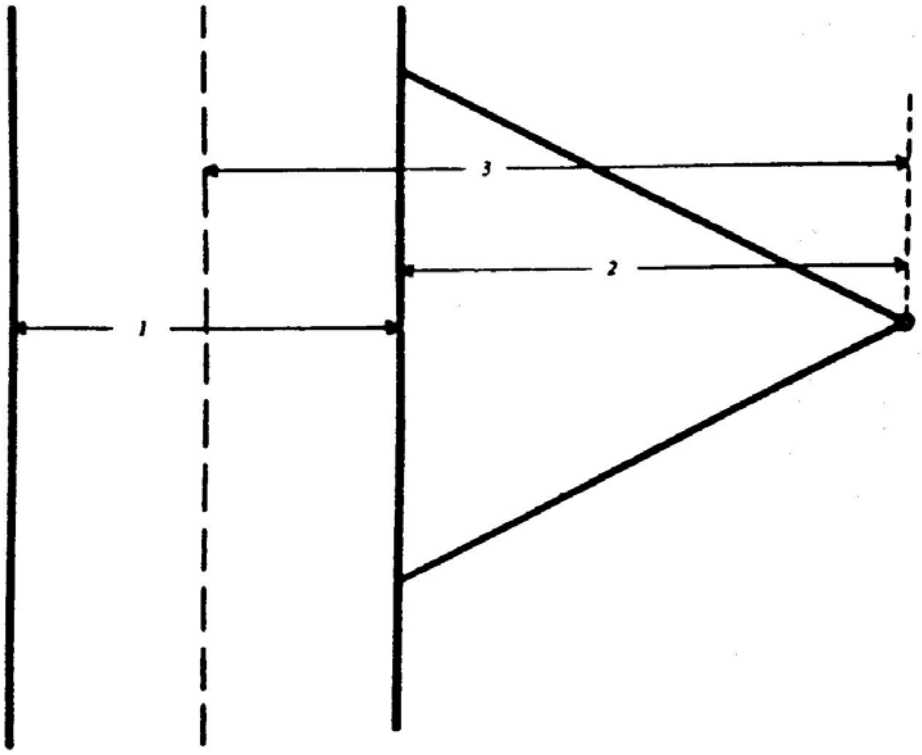


Figure 8 – Measuring the distance from the pin to the centre of the boat

2 Determine the distance from the edge of the boat to the centre of the pin (see 2 in figure 8).

3 The result of measurement 2 added to one-half of measurement 1 will provide the measure of 3 (see figure 8) which is the distance of the pin from the centre of the boat. This distance is usually measured within the range of 80cm to 90cm (see figure 9).

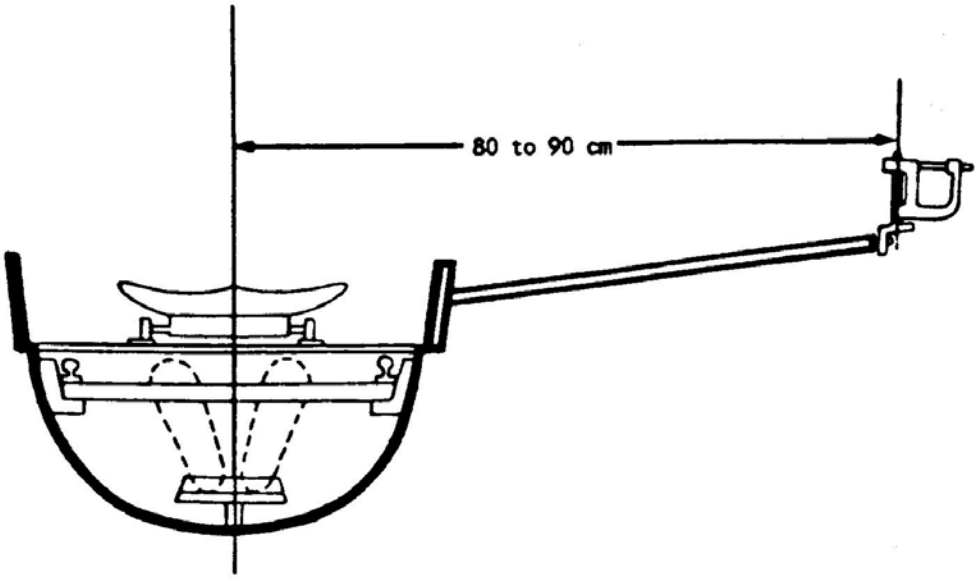


Figure 9 – A standard measurement

Height of the swivel

The height of the swivel is measured identically in sculling and sweep rowing boats. The height is the measure of the vertical distance from the lowest point of the seat to the top of the sill (or horizontal arm) of the swivel (see figure 2).

The height of the swivel is generally measured by placing the board across the gunwales of the boat at a position that is perpendicular to the swivel and measuring down to the seat and up to the swivel, both measured from the top face of the board. The point of the seat you choose to use should be consistently used from boat to boat as your reference point. These two measurements are then added to provide the measurement of height. The height is generally measured within the range of 16cm to 18cm.

The height may be changed by either raising or lowering the rigger on the boat or by altering the height of the swivel on the pin by the removal or addition of washers or spacers above or below the swivel.

Placement of the button on the oar

The sculls and sweep oars are both divided into two parts by the position of the button. These two parts are termed the inboard and the outboard (see figure 1). The position of the button may be changed simply by loosening the nuts and bolts that secure the button to the oar, mowing the button either towards or away from the blade, and tightening the nuts and bolts. Although it is important to have the correct outboard distance, the measurement for the correct position of the button is generally from the end of the handle or grip to the face of the button nearest the blade, the inboard distance.

The inboard distance is usually measured within the range of 85cm to 90cm for sculling oars and 110cm to 118cm for sweep oars, depending on the overall length of the sculls or sweep oars.

Pitch of the blade

This section will explain the measurement and adjustment of the pitch of the blade. The pitch of the blade is a measure in degrees of the inclination of the blade towards the stern of the boat during the drive phase of the stroke cycle.

It is important, in the beginning, to level the boat, both across the width of the boat and along the length of the boat (see figure 10).

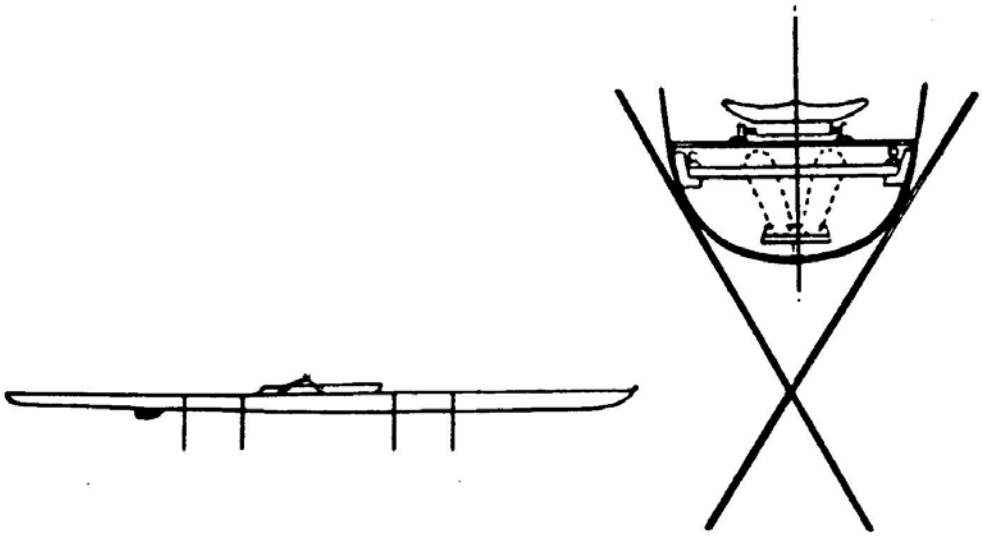


Figure 10 – Level of the boat

Next, it is necessary to check the angle of the pin. The pin should be vertical in all planes: outward and inward (the lateral angle) and the forward and backward (the stern angle).

Although the pin may be inclined outwards (and should never be inclined inwards), it has been determined, for the purposes of this course, that the lateral angle be zero degrees. This position will maintain the same pitch of the blade from the entry to the finish positions of the stroke cycle. It will be explained in the Level II course of the FISA CDP that experienced athletes should use an outward lateral pitch of about one to two degrees. The purpose of this adjustment and the procedure to make the adjustment will also be explained in that course.

As the stern angle of the pin (the forward and backward inclination) should be zero degrees, the pitch of the blade is determined by the sum of the angle of the working face of the swivel and the angle of the flat back of the shaft or working face of the oar.

Generally, the working face of the swivel has a forward angle of four degrees while the working face of the oar has a forward angle of zero to four degrees. Depending on the choice of oars, this would result in a pitch of blade between four and eight degrees.

It is recommended that the pitch of the blade be about eight degrees for novices or beginners. As the athlete improves in technical proficiency, the pitch of the blade may be decreased. The amount of the decrease is also dependent upon the event or type of boat. Further information on decreasing the pitch of the blade will be presented in Level II of the FISA CDP.

Next, it is necessary to measure the pitch of the blade. To measure the pitch of the blade:

1. Place the oar in the swivel and have an assistant firmly hold the flat back of the shaft or working face of the oar at the button against the flat or working face of the swivel.
2. Place the oar perpendicular to the boat and hold it at a level comparable to its depth in the water.
3. Place a weighted string over the top of the blade, at a point 5cm from the tip of the blade and allow it to hang in front of the blade until stable.
4. Measure the horizontal distance between the bottom edge of the blade and the hanging string (see figure 11).
5. Measure the width of the blade at the point 5cm from its tip.
6. With these two measurements, refer to the chart shown in Appendix B to determine the pitch of the blade.

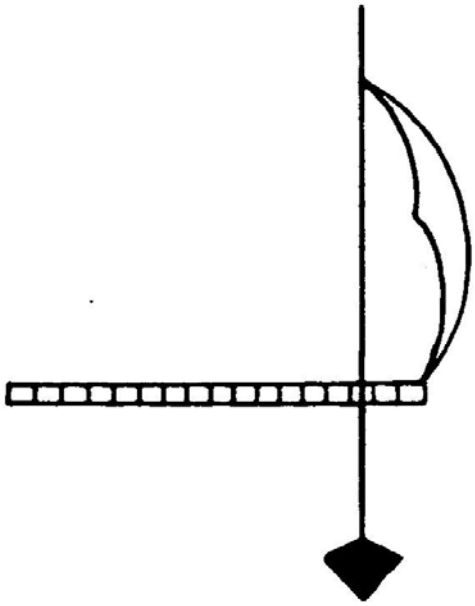


Figure 11- Measuring the pitch of the blade

The desired pitch of the blade may be obtained by a simple adjustment of the equipment. Generally, this adjustment is made by either changing a plate on the face of the swivel or by loosening the locking devices on the swivel assembly and making the appropriate adjustment. In regard to the latter adjustment, it is preferable that the adjustment not alter the vertical position of the pin. With modern swivels: inserts with different degrees can be changed to adjust the inclination.

Summary

This section has provided you with the basic knowledge of rigging the boat and its equipment. The standard procedure presented in Appendix A provides a convenient checklist for the preparation and adjustment of the boat and equipment.

1.5 Basic equipment care

Proper care of the equipment is extremely important if the equipment is to function properly over a number of years. As the coach, your attitude towards the care of the equipment is reflected by the athletes. A talk to the athletes at the beginning of the year and intermittent discipline during the year can ensure that the athletes treat the equipment with respect. Besides, proper care of the equipment is the best preventative medicine available to prevent breakage during racing.

Maintenance

The boats and oars should be cleansed with water after every training session. Salt water and chemicals in lakes, rivers and bays can corrode the materials of the boat. Proper cleansing with fresh water can retard this deterioration. Tracks, seat wheels and swivel pins should be cleansed and lubricated at least once a week during your training season.

It should be noted that the common practice of adding grease of petroleum jelly to the swivel, to allow the oar to be turned more easily, may allow sand and other particles to accumulate causing damage to the swivel and oar. Therefore, the grease or jelly should be removed and replaced regularly.

The following is a list of possible trouble areas that should be examined and corrected prior to the problem becoming more serious and causing further damage to the boat and its equipment.

Possible trouble areas:

1. Worn swivel
2. Loose-fitting rigger components
3. Loose nuts and securing devices
4. Badly worn buttons or sleeves on the oar
5. Oar too loose or too tight in the swivel
6. Badly worn tracks
7. Badly worn seat wheels and axles

Simple repairs of wooden material

Even with the best preventative medicine there will still be equipment wear and deterioration. When breakage occurs, it will most likely occur during a training session on the water. The coach should be prepared with a toolbox containing the appropriate spare parts: swivels, pins, buttons, nuts, bolts and screws. These parts should be in the same kit as your rigging tools.

If there is an accident during training, such as colliding with floating debris or another boat, you can minimise the potential damage with some simple first aid. First, retrieve any shattered or splintered parts from the water to use later in the repair. Second, clean and dry the area around the crack, if not severely damaged. Third, cover the crack with some waterproofing tape. This will minimise the contact of the wood with the water and, thereby, reduce decay. However, if major damage occurs, head directly for land and get the boat out of the water to minimise exposure to the water.

After training, the crack should be properly repaired. The boat builder can recommend the best glue to use for repair. The glue is placed on both sides of the crack and the two sides are pressed together until the glue is dry. The repaired area is then covered with varnish to provide waterproofing protection.

The same procedure is also necessary for wooden oars. Any scratches or punctures should be dried, sanded and varnished. The coach should be prepared for all this maintenance because good care of the material is required to preserve the basic elements of his passion: the boats and the oars.

For more information about repairs and maintenance, as well repair of composite boats, oars and sculls, see "Guide for Maintenance and Repair of Rowing Equipment", produced in 1999 by the former FISA Material Commission, now entitled the FISA Equipment and Technology Commission.

1.6 Appendices

Appendix A

Standard procedure for the preparation and adjustment of the boat and equipment

1. Place the boat on suitable supporting structures in an open-working area.
2. Clean the boat and its equipment.
3. Check all moving parts on the boat.
4. Check and secure the rigger bolts.
5. Check and secure the position of the tracks.
6. If the angle and the height of the foot stretchers are adjustable, make the appropriate adjustments.
7. Set the pin-to-pin distance the distance between the pin and the centre of the boat and mark the position with a marker or tape.
8. Set the desired height of the swivel.
9. Set the inboard or outboard on the oar.
10. Level the boat lengthwise and sideways.
11. Place and hold the oar firmly in the swivel and perpendicular to the boat. With the blade at the correct height, set the pitch of the blade.
12. Re-check the height of the swivel.
13. Check the locking devices on the swivel.
14. Check that the swivel swings freely.
15. Check that all nuts and locking devices on the rigger are secure.
16. When the boat has been placed on the water, check that the foot stretchers are properly set to ensure a correct and uniform finish position.

Appendix B

Table for measuring the pitch of the blade:

Blade	Degrees				
cm	4	5	6	7	8
13	9.1	11.3	13.6	15.8	18.2
14	9.8	12.2	14.6	17.1	19.6
15	10.5	13.0	15.7	18.3	21.0
16	11.2	13.9	16.8	19.5	22.4
17	11.9	14.8	17.8	20.7	23.7
18	12.6	15.6	18.8	21.9	25.0
19	13.3	16.5	19.9	23.2	26.5
20	14.0	17.4	20.9	24.3	28.0
21	14.7	18.3	21.9	25.5	29.5
22	15.4	19.2	22.9	26.7	31.0
23	16.1	20.1	23.9	27.9	32.5

Appendix C

Table of recommended measurements

Club level – Macon blade – all measurements in centimetres (cm)

Sculling	Spread	Outboard	Inboard	Length	Overlap
Men	158-160	212-210	86-88	298	18-22
Women	156-158	211-209	85-87	296	18-22

Club level – “Big Blade” – all measurements in centimetres (cm)

Sculling	Spread	Outboard	Inboard	Length	Overlap
Men	158-160	204-202	86-88	290	18-22
Women	156-158	200-202	86-88	288	18-22

Sweep Rowing:

Club level – Macon blade – all measurements in centimetres (cm).

Boat	Spread	Outboard	Inboard	Length	Overlap
Men					
2-	87	265	117	382	30
2+	88	264	118	382	30
4-	85	267	115	382	30
4+	86	266	116	382	30
8+	84	268	114	382	30
Women					
2-	86	264	116	380	30
4-	85	265	115	380	30
8+	84	266	114	380	30

Club level – “Big Blade” – all measurements in centimetres (cm)

Boat	Spread	Outboard	Inboard	Length	Overlap
Men					
2-	87	257	117	374	30
2+	88	256	118	374	30
4-	85	259	115	374	30
4+	86	258	116	374	30
8+	84	260	114	374	30
Women					
2-	86	256	116	372	30
4-	85	257	115	372	30
8+	84	258	114	372	30

2 Basic Rowing Physiology

2.1 Introduction

Rowing is a sport which requires a well-conditioned body to operate at a high-performance level during periods of training and competition. During training and competition, the human body acts as the engine to propel the rowing boat across the water. As an engine, the body requires energy to enable it to operate. The source of the energy for muscle contraction is the breakdown of chemical bonds in the muscle cells. However, these chemical bonds must be replaced by body fuels. The fuels of the body are carbohydrates and fats from the food we eat. They are stored in the body in the form of glycogen and fat and, when needed, are used to restore the chemical bonds in the muscle cells.

In order to improve the efficiency of the human body to utilise the fuels and produce energy, many adaptations take place within the body during exercise. In this course, the physiology of exercise will be presented in a way that will allow an understanding of some of these adaptations.

2.2 The rowing motion

It is necessary, in the beginning, to study the rowing motion to enhance the understanding of the physiology of rowing. The rowing motion is created by an athlete seated in a boat moving forwards and backwards on a sliding seat while pulling on an oar placed in the water. This will result in the boat being pried forwards across the surface of the water. When the athlete is pulling on the oar, he creates a positive directional force on the boat and, when the oar is out of the water and the athlete is moving in the opposite direction of the boat, he creates a negative directional force.

The method or technique that the athlete uses must coordinate the proper use of the muscle groups and the movement of the boat to maximise the positive directional forces and minimise the negative directional forces. This will optimise the prying motion of each stroke and cause the greatest possible velocity to be achieved during a 2,000m rowing race. During each stroke, the athlete applies the equivalent of a 40kg to 45kg load to the oar-handle in each of the 220 to 250 strokes that occur during the race.

2.3 The rowing race

Next, we will examine a rowing race. The 2,000mrowing race consists of three parts or phases: the start phase, the middle or distance phase, and the finish or sprint phase.

During the start phase, the rowing boats generally start the race at a stroke rate that is higher than the stroke rate of the middle or distance phase and the velocity of the boat is higher than the average velocity achieved by the boat during the race. The energy used to achieve and maintain this increased velocity is obtained from the stored chemical bonds in the muscle cells and the breakdown of stored fuels. However, during this phase of the race, the muscle cells are operating without sufficient oxygen in the breakdown of these fuels. This process is termed anaerobic (or without oxygen) metabolism and results in the production of a waste product, lactic acid. The accumulation of lactic acid causes pain in the athlete's muscles.

During the middle or distance phase, the athlete is using energy that is obtained by converting the stored fuels into energy using oxygen. The presence of sufficient oxygen in the system results in the more complete breakdown of these fuels and is termed aerobic (or with oxygen) metabolism. This phase will continue for about 4 to 6 minutes until the finish phase.

It should be noted that the aerobic process is about 18 times more productive than anaerobic metabolism and does not produce the debilitating waste product, lactic acid. However, anaerobic metabolism provides energy more quickly and can support high velocity muscle contraction.

As with the start phase, the crews will increase the stroke rate during the finish or sprint phase in an attempt to increase the velocity of the boat over the remaining one to two minutes of the race.

This increase in stroke rate, and resultant increase in boat velocity, will increase the energy requirements of the body to a level that will exceed the capacity of the aerobic metabolic process to provide sufficient energy. Therefore, the anaerobic metabolic process is called upon to contribute and the waste product, lactic acid, is produced in increasing amounts.

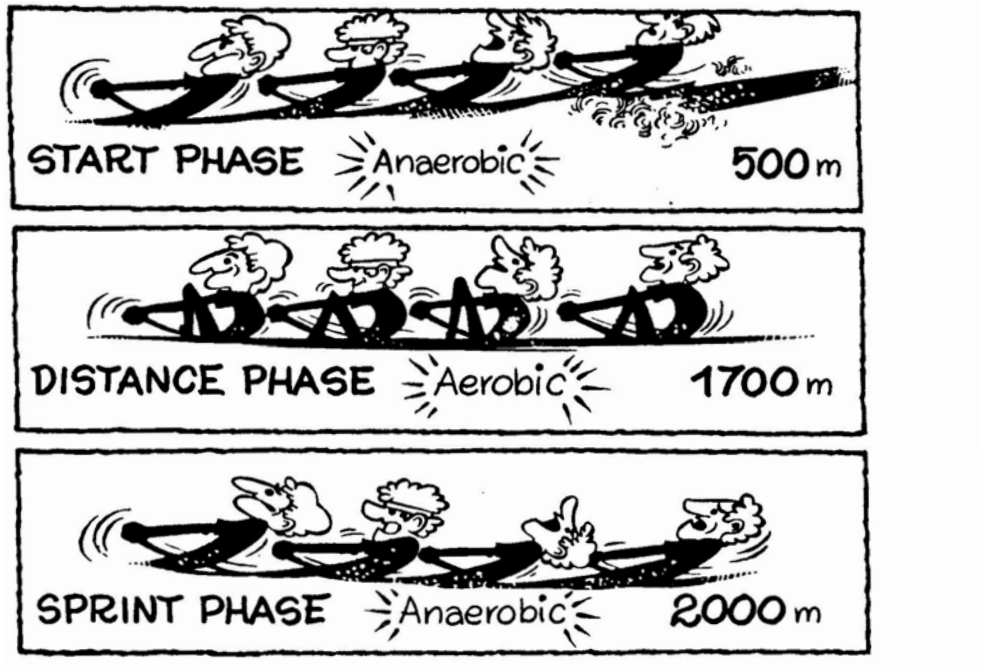


Figure 1 – The race phases

In order to improve the athlete's ability to move the boat over the water, it is necessary to increase the athlete's capacity to produce energy and to improve the athlete's ability to endure the physical demands placed upon the body. This is called the athlete's endurance capacity. But what exactly is endurance capacity?

2.4 Endurance capacity

Endurance capacity is defined broadly as the ability to persist in the performance of physical activity. However, a more precise definition would be the athlete's ability to perform at a given load over a period of time.

For the athlete to perform at a greater load (and, thereby, move the boat over the race course in a shorter period of time), it is necessary to increase the athlete's endurance capacity by proper training.

As a rowing coach, you have a responsibility to understand the effects of training on your athletes. This knowledge will assist you in the preparation of training programmes that will more effectively produce the desired physiological adaptations. Your goal will be to give the athlete an opportunity to obtain an increased performance level and, thereby, realise his or her potential.

2.5 Aerobic metabolism

Proper training to increase the endurance capacity of the athlete must include training the aerobic metabolic process since this system contributes 75 to 80 per cent of the energy used in a rowing race. Thus, the importance of oxygen transportation and utilisation is very clear. However, this raises two important questions: How do we get oxygen from the air to the muscle cells? And, what happens to produce energy at the muscle cells? As the process which utilises oxygen in the muscle cells to produce energy is complex, it will be discussed in Levels II and III of the FISA CDP.

Oxygen transportation system

There are three systems involved in the journey of oxygen from the air to the muscle cells. The first system, the respiratory system, takes air (containing oxygen) into the lungs by breathing. Approximately 21 per cent of the air is composed of oxygen (O2).

After the lungs receive air, the oxygen diffuses from the air through the walls of the tiny air sacs (alveoli) of the lungs into the blood.

The second system, the circulatory system, carries the blood, now saturated with oxygen, from the lungs to the heart where it is pumped out through the arteries to the areas most in need of oxygenated blood, namely the exercising muscles. As the blood travels through the circulatory system, the arteries become smaller and branch off into thousands of small arteries called capillaries. The capillaries are small enough to surround the individual muscle fibres.

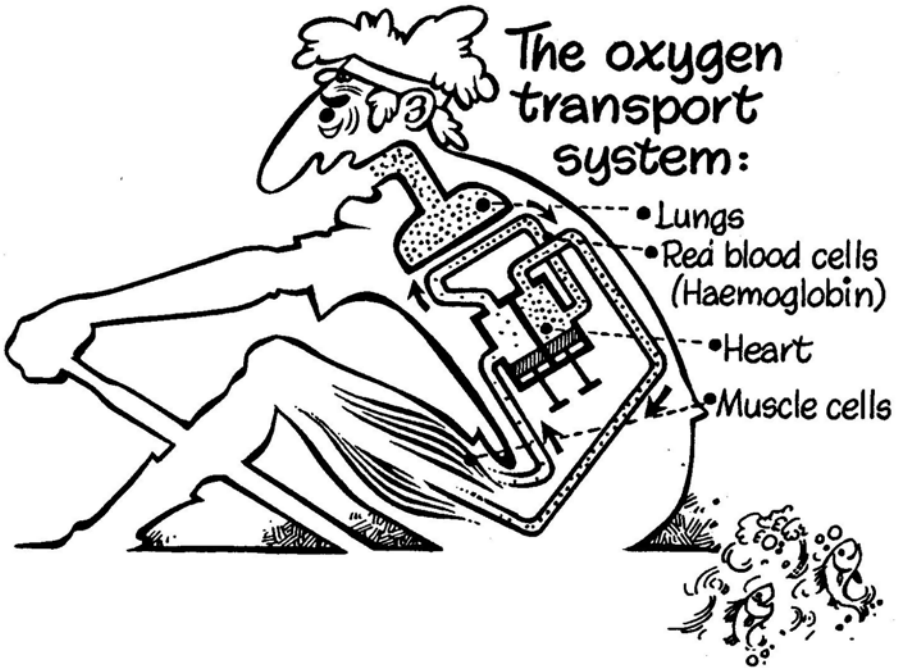


Figure 2 – Oxygen transportation system

In the third system, the muscular system, an important transfer or diffusion of oxygen occurs as oxygen is passed through the capillary walls to the muscle cells. In the muscle cells, the oxygen is taken to the mitochondria (power plants of the muscle cells) and used in the conversion of fuels to energy in the oxygen utilisation process.

We have now seen that the oxygen utilises three different systems while reaching the muscle cells where it is used to produce energy in the aerobic metabolic process: the respiratory system, the circulatory system and the muscular system.

The air that is inhaled into the lungs is the primary carrier of oxygen. From the lungs, the oxygen is then transferred to the blood.

The blood then becomes the second oxygen carrier . The oxygenated blood is carried to the heart, pumped out through the arteries and then to the capillaries.

When the capillaries carrying the blood reach the muscle fibres, the oxygen is then transferred to the muscle cells. Within the cells the oxygen is used in the process of producing energy. We shall now look more closely at the major components of these three systems and the possibility of increasing their effectiveness through training.

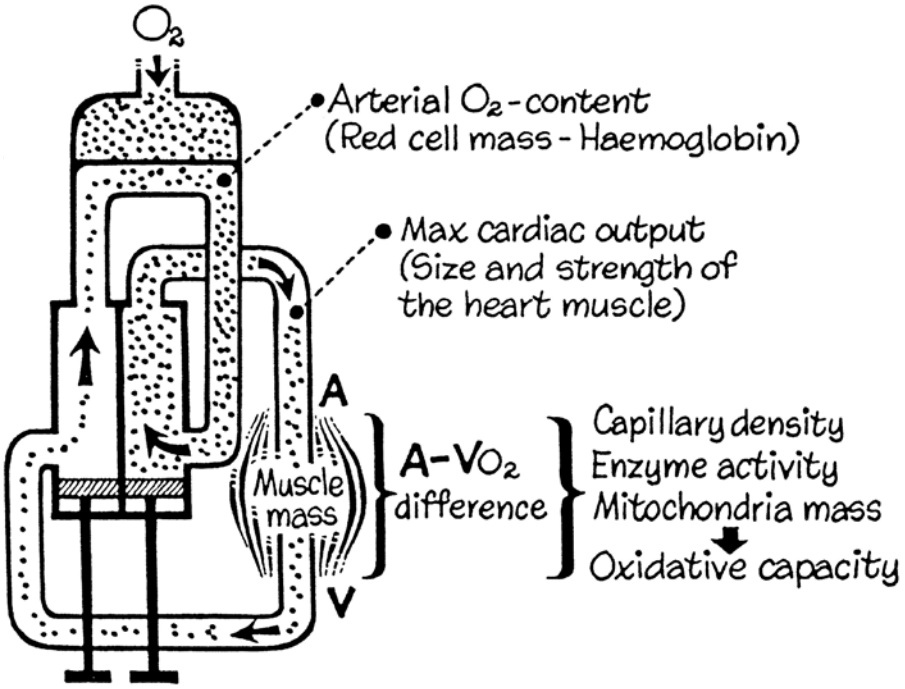


Figure 3 – The transport system simplified

Major components of oxygen transport

The first component is the lungs. The lungs can take in 120l to 180l of air per minute during exercise in normal people. Top rowing athletes have been observed with an intake of over 200l of air per minute.

Considering that the air we breathe contains approximately 21 per cent of oxygen, this means that up to 42l of oxygen per minute can be inhaled by a heavyweight athlete during heavy exercise. This is considered enough oxygen for the metabolic demands of the body and does not change significantly with training.

The second component is the ability of the blood to carry the oxygen. This is dependent on the volume of blood and the number of red blood cells in the blood. The red blood cells carry haemoglobin which actually carries the oxygen within the blood. Trained athletes generally have more total blood volume and a greater number of red blood cells than untrained persons. It has been observed that endurance training can produce up to a 16 per cent increase in resting blood volume. This change is caused by an increase in plasma volume and red blood cell volumes.

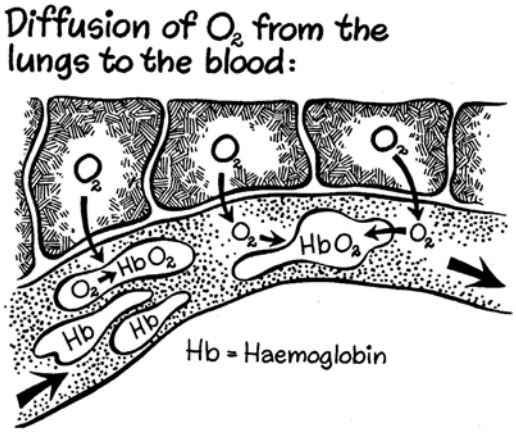


Figure 4 – Diffusion of O2 to the blood

The third component is the heart. The cardiac output is the measure of blood quantity pumped by the heart through the circulatory system to the body in one minute. It is equal to the blood volume pumped in each beat (stroke volume) multiplied by the heart rate. The volume of blood pumped can be increased by training.

Cardiac output varies from 5l per minute at rest to over 40l per minute during strenuous exercise. Reductions in exercise heart rate and resting heart rate, that typically occur with training, are indicators that stroke volume has increased.

Illustration: Considering that a normal male can pump approximately 110ml of blood per heart beat during exercise and assuming a heart rate of 200 beats per minute, the result is 22l per minute of blood being pumped. In athletes, stroke volumes of 160ml (lightweight men) and up to 200ml (heavy- weight men) can produce 32l and up to 40l of blood pumped per minute at maximum exercise. Therefore, blood, having a haemoglobin level of 15g per 100ml blood and carrying 200ml of oxygen per litre, can deliver up to 8l of oxygen per minute to the muscular system.

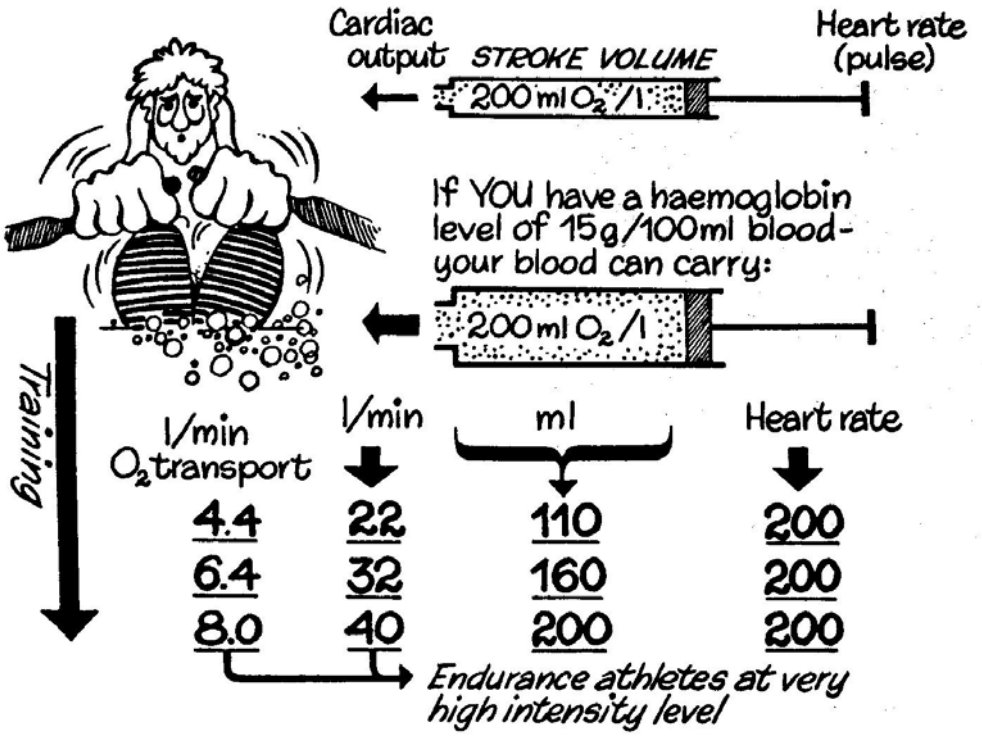


Figure 5 – Cardiac output

The fourth component is capillary density. Each muscle fibre is surrounded by capillaries which are the extensions of the arteries. An increase in the number of capillaries surrounding a particular muscle fibre will deliver more blood to the area and, therefore, deliver more oxygen to the muscle.

It has been shown that training probably increases the total number of functional capillaries surrounding muscle fibres and, thereby, allows more oxygen to be available to the muscles.

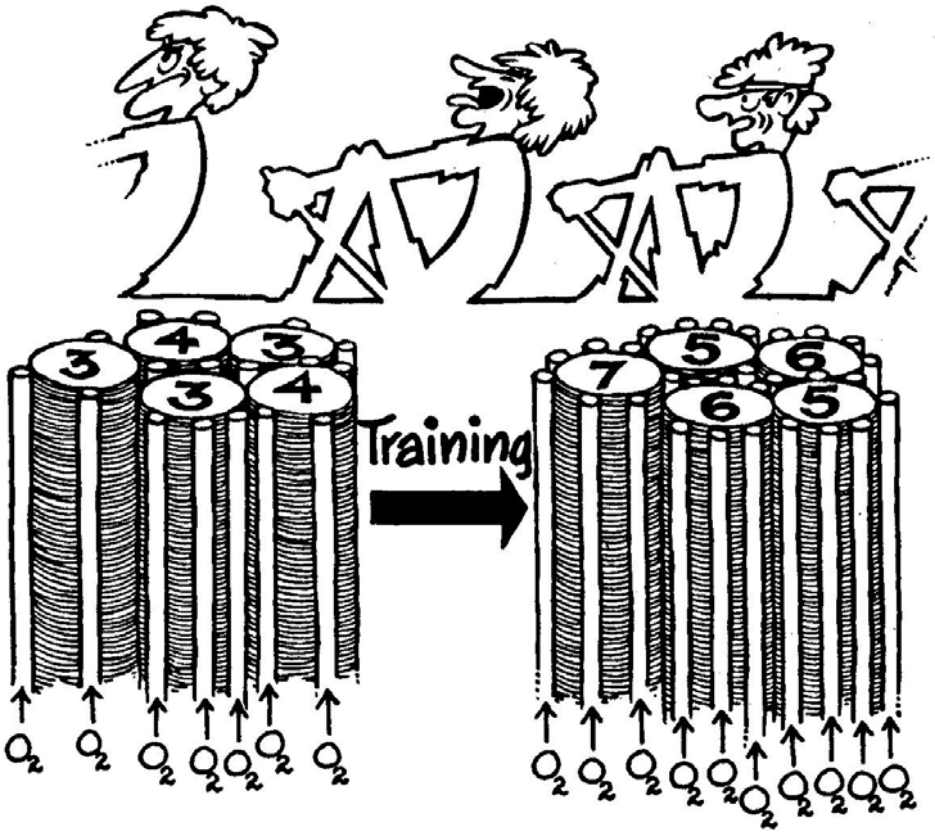


Figure 6 – Capillary adaptation

Another component of oxygen transportation is the flow of blood to the working muscles. During exercise, the flow of blood to the working muscles does increase because arteries carrying blood to inactive areas tend to constrict while arteries carrying blood to areas that are requiring greater amounts of oxygen tend to dilate. Research indicates that training will increase the blood flow to working muscles.

Many adaptations also take place in the muscle cells themselves to increase the consumption of oxygen. Endurance training has been shown to increase the effectiveness of the machinery within the muscle cells to produce energy.

Again, the adaptations that improve oxygen utilisation will be discussed in Levels II and III of the FISA CDP.

Limitations

The major components involved in the transport of oxygen have been discussed. They are, however, not equally important in a discussion of the limitations in the transport process. The respiratory system delivers more oxygen to the circulatory system than can be transported in the blood. Thus, the lungs are not considered a limitation to a rowing athlete's performance.

However, the circulatory system can be improved with training and can have a strong influence on the physiological capacity of the athlete. To produce a training effect in the circulatory system, any type of exercise that loads the heart can produce improvement in oxygen transport and, therefore, oxygen uptake.

In the muscles, the oxygen is taken up and utilised in the conversion of fuels into energy. These two processes have also been shown to improve significantly with training and, therefore, contribute to improved physiological capacity. Many exercise physiologists consider the muscular system to have the greatest potential for improving aerobic metabolism. To produce a training effect which will influence the utilisation of oxygen by the muscle cells, training should remain specific to the sport by loading the muscles which are principally used in the motion specific to the sport at a medium training load for a long duration. Later, we will relate specific types of training to the systems involved.

As stated, aerobic metabolism is not capable of supplying all the energy needs of the body during work periods at a high load. We will now look at the other system that provides energy to the body in the absence of oxygen.

2.6 Anaerobic metabolism

We have now completed our discussion of the aerobic metabolism process. However, there is another source of energy that contributes 20 to 25 per cent of the energy used in a rowing race. We call this anaerobic metabolism.

Anaerobic metabolism is utilised primarily in the start and finish phases of the rowing race. It should be noted that, during the initial seconds of the race, energy is provided by the chemical bonds stored in the muscle cells. After this initial period, the body must rely on the anaerobic breakdown of glycogen to provide the remaining energy requirement of the start phase. The intensity experienced during the start and finish phases of the race necessitate the use of the anaerobic metabolic system to support high velocity muscle contraction and provide sufficient energy to meet the high energy demands on the body.

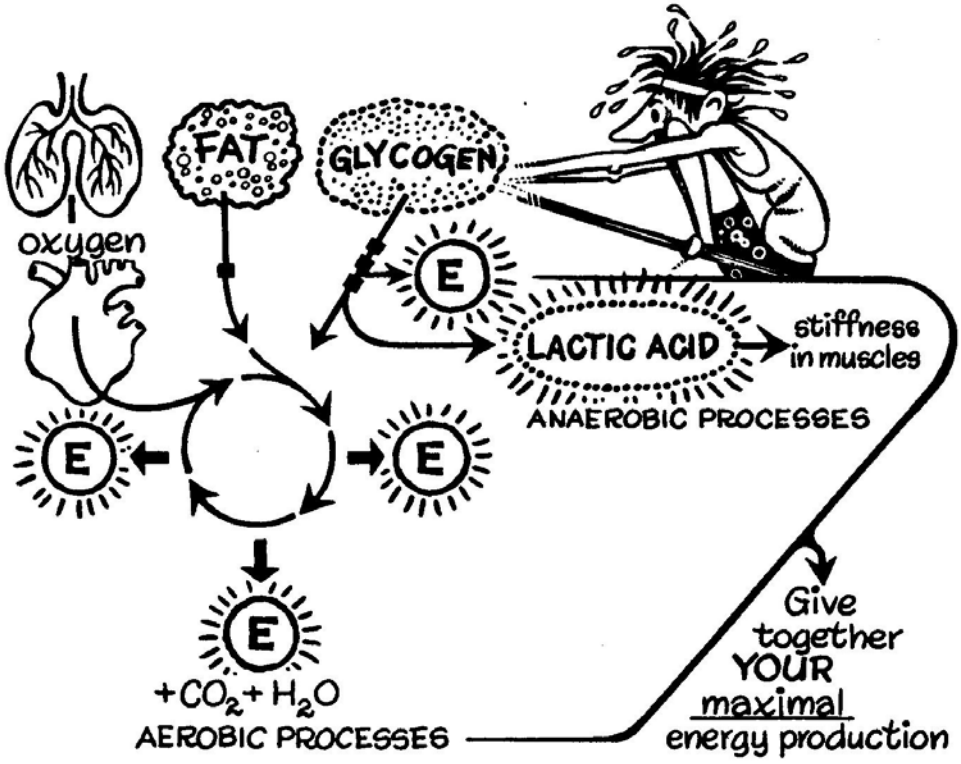


Figure 7 – Energy production

The use of the anaerobic metabolic system for the breakdown of fuels produces the waste product known as lactic acid. The accumulation of lactic acid causes fatigue and reduces the ability of the muscles to contract.

Training improves the athlete's ability to tolerate the accumulation of lactic acid and improves the mechanism for its removal. However, because the aerobic metabolic system is more efficient and contributes a greater proportion of the energy requirements of the rowing race, this course will emphasise aerobic metabolism. Further information will be provided on both of these metabolic systems in Levels II and III of the FISA CDP.

2.7 Measurement

How does one measure the ability of athletes to work efficiently with their bodies? By using laboratory instruments, exercise physiologists can evaluate the athletes' maximal oxygen uptake or VO2 max. VO2 max represents the body's maximal total aerobic metabolic rate. This is an important measurement because of the relative importance of the aerobic metabolism to rowing. The difference between the oxygen content of the inhaled air and the oxygen content of the exhaled air is measured (we know that the air inhaled from the atmosphere is 20.9 per cent oxygen). This difference is multiplied by the amount of air exhaled (ventilation) to arrive at the absolute maximal oxygen consumption of the athlete. This value is expressed as litres per minute of oxygen.

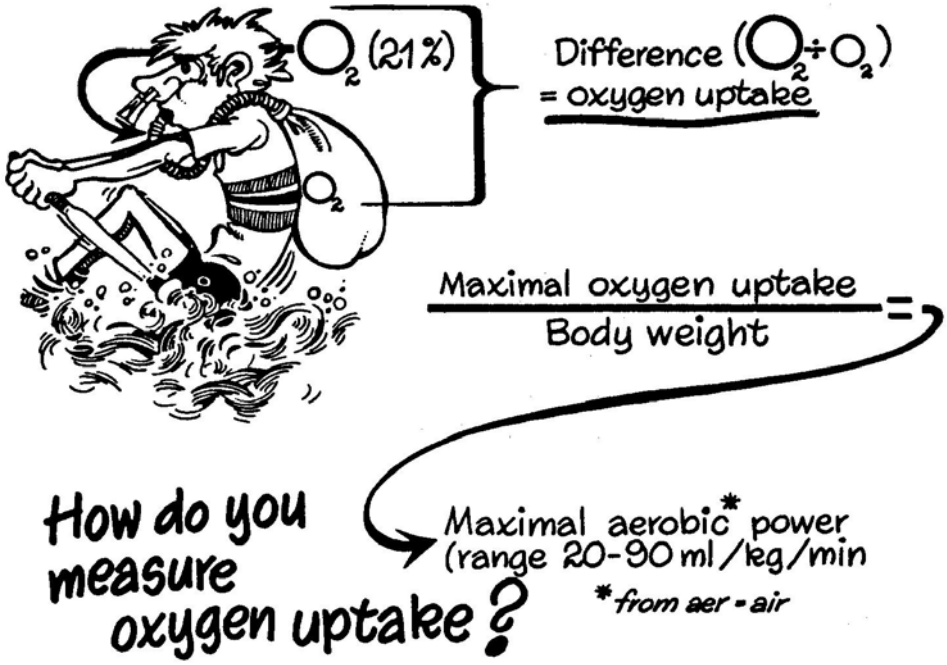


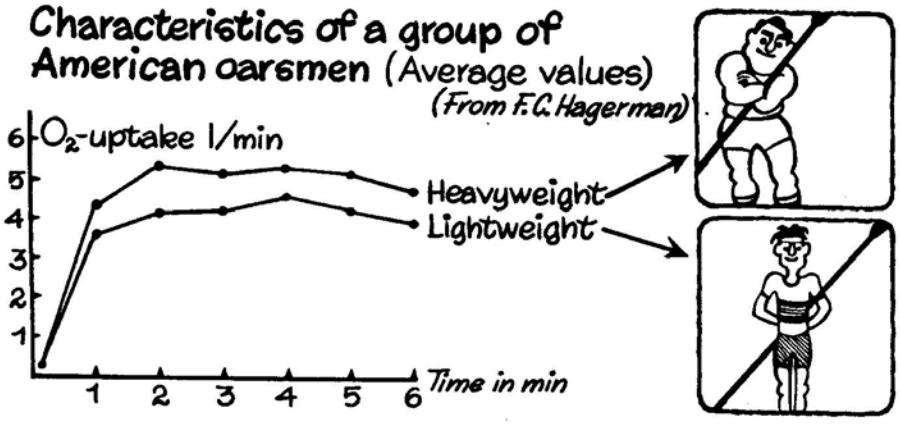
Figure 8 – Maximal oxygen uptake

The following average VO2 max values have been observed for international athletes in rowing:

Heavyweight men:	6.2 litres per minute
Lightweight and junior men:	5.3 litres per minute
Heavyweight women:	4.4 litres per minute
Lightweight and junior women:	3.9 litres per minute

VO2 max can also be expressed as the relative oxygen consumption of the athlete by dividing VO2 max by the athlete's body weight in kilogrammes. For example, using the relative VO2 we have observed average consumptions of 68ml/kg/min for heavyweights and 71ml/kg/min for lightweights.

Although the measurement of oxygen uptake requires the use of expensive equipment and the assistance of an experienced exercise physiologist, this information is not necessary to produce world-class rowers.



Number invest.	Time (min)	Watt	l/min	ml/kg/min	Category
503	6	374	6,1	68,9	Heavyweight
120	6	358	5,1	71,1	Lightweight

Figure 9 – Characteristic statistics

Further measurement systems for aerobic and anaerobic metabolism will be discussed in Level II and III of the FISA CDP. It is now important to look at the training methods that will improve the aerobic metabolic system.

2.8 Training methods

To relate the information presented to practical training methods, we will focus on training methods which will affect the principal systems of aerobic metabolism. The three systems are represented by the lungs, the heart, and the muscles.

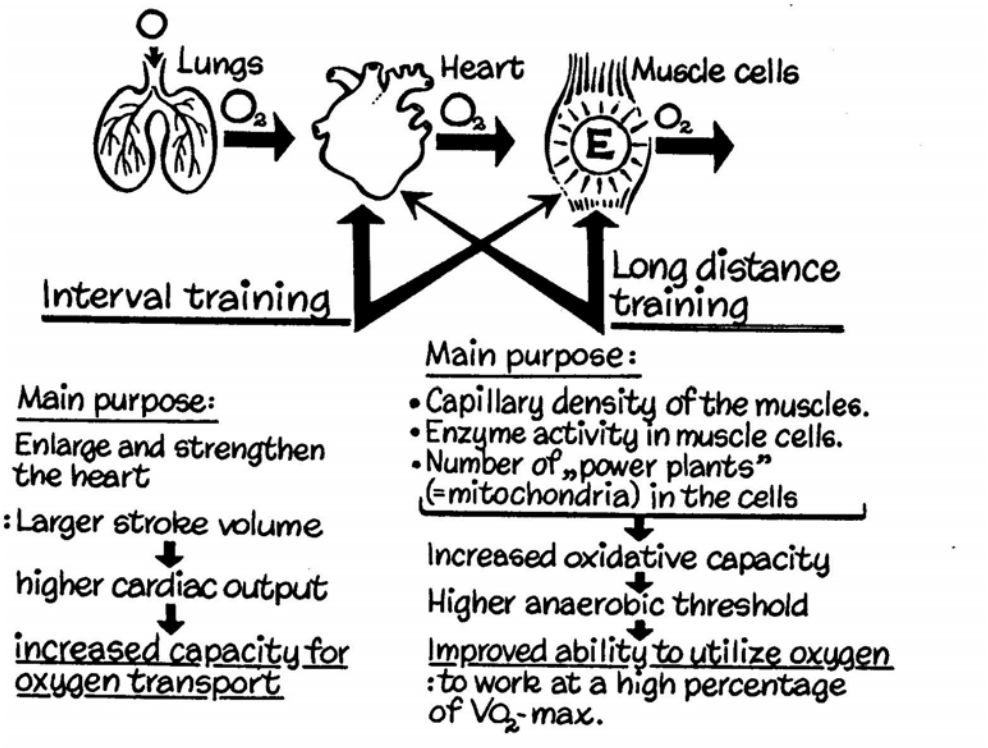


Figure 10 – Training the body systems

Lungs

The respiratory system cannot be significantly improved to increase the efficiency of the entire system. Although the lungs adapt to the load imposed by the increased breathing that occurs with training, the respiratory system is not considered to be a limitation to physiological improvement.

Heart

The circulatory system can be improved with training. The most effective type of training places a demand on the heart that causes it to enlarge and strengthen itself. The best type of training to produce this effect is interval training. Interval training is a systematic procedure that utilises short periods of work at a high training load alternating with periods of recovery. This type of training will result in a higher cardiac output to the body and, therefore, an increased capacity for oxygen transport.

Muscles

The muscular system can also be improved with training. The most effective type of training places a demand on the muscle fibres to utilise oxygen. The best type of training is long-distance training. Long-distance training is a systematic training procedure that utilises long periods of work at a medium training load which may or may not alternate with periods of rest. This type of training increases the number of functional capillaries around the muscle fibres and increases the activity and mechanisms in the muscle cells to utilise oxygen.

This is a very brief description of the types of training that will increase the athlete's performance level. Other courses in Levels I and II of the FISA Coaching Development Programme will provide further information.

2.9 Summary

You should now have acquired a basic understanding of the physiological requirements of the sport of rowing. With this information you will be able to assist your athletes in their understanding of the body systems that are important to rowing and how to improve these systems.

3 Basic Rowing Technique

3.1 Introduction

An athlete's technical proficiency, combined with a good physical capacity, can greatly enhance the level of his performance. Although the role of technique is common to every sport, rowing must be considered a sport that requires considerable technical proficiency to achieve a high level of performance.

Many different factors are combined in rowing, but only if we understand and master the technical factors will we be able to realise the complete benefit from training.

Although the technique of sculling and sweep rowing is essentially identical, the symmetrical movement of sculling is recommended for beginners. Therefore, the Basic Rowing Technique section of the FISA Coaching Development Programme Course presents a basic description of sculling technique.

There are many possibilities for defining a particular technique. The system presented is one used by many countries around the world.

3.2 Why technique?

It is of little value to develop strength, endurance and other physiological capabilities if these qualities cannot be used to increase the speed of the boat. As stated in the introduction, a benefit from training that increases the speed of the boat is realised when the athlete understands and practices an effective rowing technique.

3.3 Physical laws

When analysing rowing, we observe that the movement of the athlete and the boat are based mainly on physical laws that are the foundation for any discussion about rowing technique. The goal in rowing is to have the athlete, the moving power, propel the boat through the water.

In other types of boats the moving power can be a sail or a motor. Continuously turning a propeller or filling a sail provides the power. In rowing, the moving power is determined by the athlete's physical capacity of the level of technical proficiency.

In rowing boats, the propulsive force is supplied intermittently because the oar is both in the water, with force being applied, and out of the water, with no force being applied. During the stroke cycle, the athlete is moving forwards and backwards on the sliding seat creating positive and negative forces.

The positive force causes the boat to advance forwards and the negative force causes this advancement to be hindered (figure 1). This fact compels us to concentrate our efforts to increase the influence of the positive force and to limit, wherever possible, the influence of the negative force.

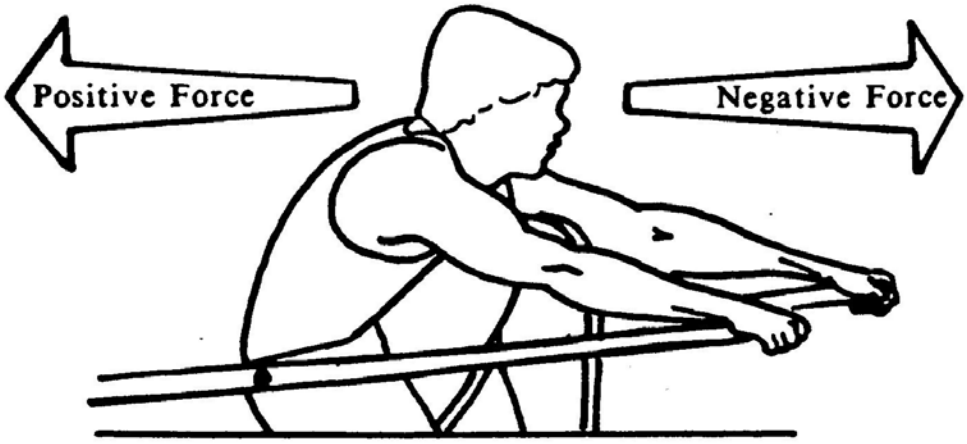


Figure 1 – The directional forces of rowing

3.4 Dynamics of rowing

To understand how these forces are working, we can study diagram 1 to examine the velocity changes of a competition boat during the stroke cycle. These curves are the result of a study conducted by Wenzel Joesten of Berlin who analysed a film of the boat's movement and the athlete's technique.

1. Velocity of the boat (curve a)
2. Acceleration of the boat (curve b)
3. Bow and stern pitching (curve c)

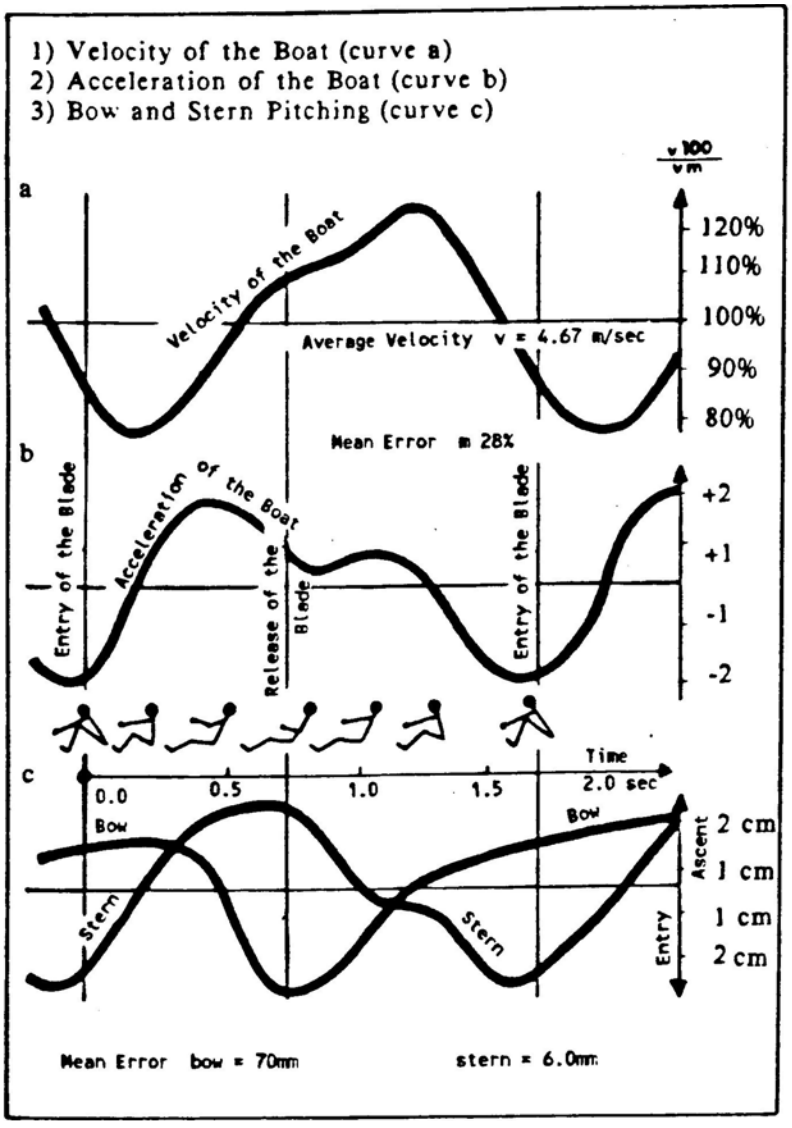


Diagram 1 – Analysis of a competition rowing boat

The curve of velocity in the diagram (curve a) is the most interesting for it demonstrates the velocity variation of the boat during one stroke in relation to the average velocity. We can use this curve to analyse the technique of a good or a bad crew. A good crew has less variation from the average velocity while the characteristic of the curve does not vary.

The curve of acceleration (curve b) shows the acceleration of the boat. The boat attains the greatest acceleration during the drive and the least acceleration during the recovery. The stick figures located below curve b demonstrate the athlete's position during the stroke cycle and in relation to time in seconds. The curve of pitching (curve c) in the diagram demonstrates pitching, the longitudinal oscillation of the boat. There are two curves, one indicates the bow movement and the other shows the stern movement.

3.5 Mass + movement = force

Our analysis will now be focused on curve a, the curve of the velocity variation, and on the stick figures of the athlete during the stroke cycle as they both appear in diagram 1. As you can observe in the diagram, the maximum velocity is achieved immediately after the extraction of the oar from the water and the minimum velocity immediately after the oar has entered the water. To explain the observations of maximum and minimum velocity, we must examine the athlete's movement from the extraction of the oar to the entry of the oar in the stroke cycle. During this period the athlete's body weight moves from the bow to the stern (figure 2). For example, in a men's eight-oared shell with an average weight of 85kg per athlete, there are 680kg of mass in movement.

If we now consider the formula MASS + MOVEMENT = FORCE, the question must be raised: Where does this force go?

When the new drive starts, the mass in movement towards the stern has to stop and change direction and, at this moment, a large quantity of force is produced which opposes the velocity of the boat. This negative force is transmitted to the boat by the foot stretcher (see A in figure 2). In the release, the opposite occurs. The body mass is inclined towards the bow of the boat and this allows a free movement of the boat with a minimum of resistance.

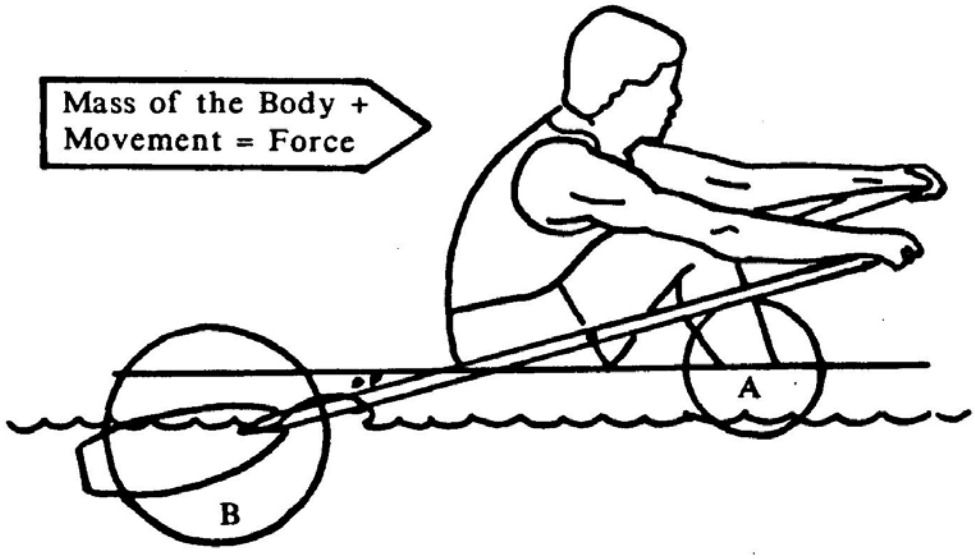


Figure 2 – Points of contact

The only way to reduce the influence of the negative force is with a proper entry of the oar to the water (see B in figure 2).

Remember, one of the purposes of good technique is to limit the effect of the negative forces. Here we can clearly observe the difference between good and bad crews. It is not an exaggeration to state that the most important point of the stroke is the entry. With a direct entry (the oar must enter the water before all the force is pushing on the foot stretcher), we can reduce the influence of the negative force by transferring that force to the blade.

However well the entry is performed, there will always be some negative force and we will always have the lowest velocity immediately after the entry. Our objective in improving technique will be to reduce the variation in velocity.

This effect of interaction between negative and positive forces is repeated between 220 and 250 times within the 2,000m race distance. A small loss of velocity during each stroke will result in the boat having a lower average velocity and covering less distance per stroke. For example, a reduction of 5cm per stroke in distance travelled multiplied by the number of strokes in a race, results in a loss of about 12m5 over 2,000m.

3.6 Phases of the stroke

We will now examine, one by one, the phases of the stroke cycle and provide technical explanations based on the effectiveness of the various movement possibilities. There are various possibilities for technique; the one we are presenting is a clarification of the movements that is relatively easy to understand.

Preparation

It is important that the athlete utilises his total height in a natural position and that he does not push his shoulders ahead too far assuming an unnaturally forced position. The angle of the body (approximately 45 degrees) allows the adequate use of the slide and is ideal for the transmission of the leg force to the stroke (figure 3).

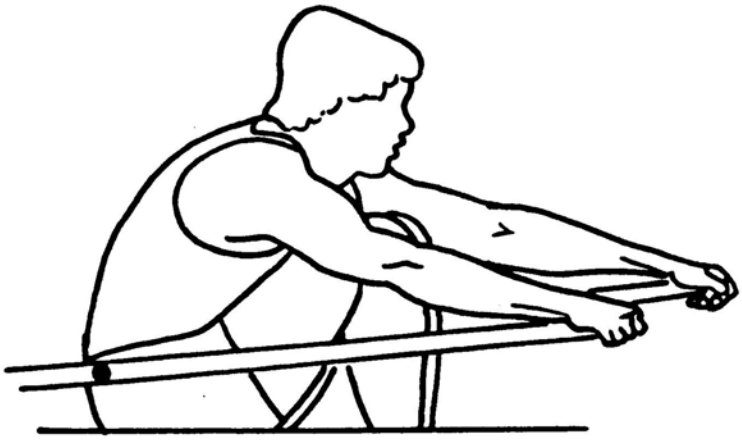
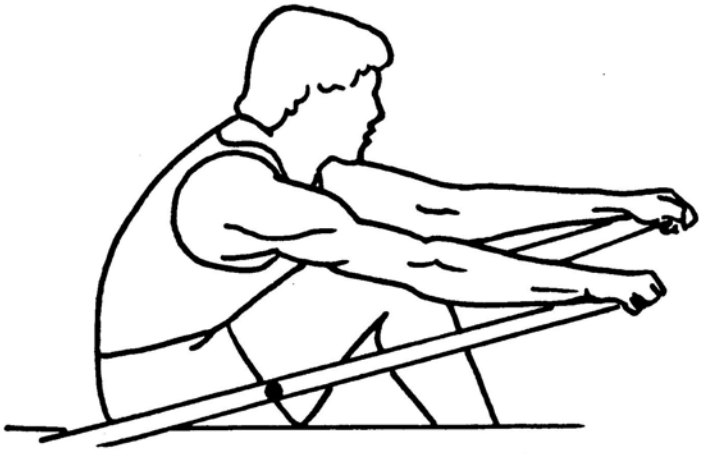


Figure 3 – Preparation

Entry and first half of the drive

During the entry the body weight is transmitted to the foot stretcher using the force of the legs; this is especially noticeable in this first phase of the stroke. At the same time, the athlete is actively utilising the other body muscles to produce efficient work in the water (figure 4).



4 – The entry and first half of the drive

Finish of the drive

In relation to the muscular force, the first half of the drive is relying primarily on the legs. Further in the drive, the back muscles enter into action and, towards the end, the shoulders and the arms.

It is important that the body weight is utilised at all times and that the work is transmitted to the oars (figure 5).

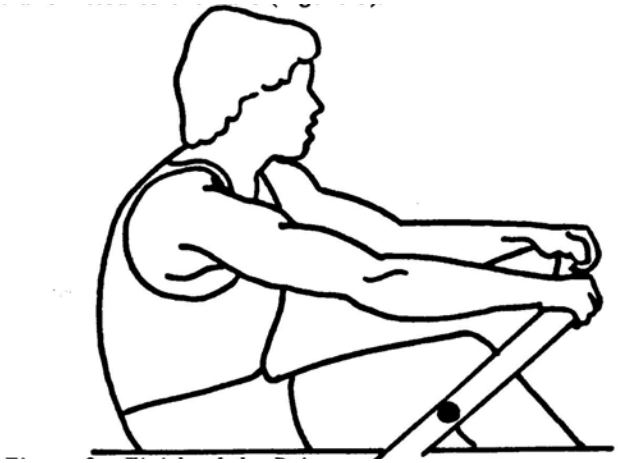


Figure 5 – Finish of the drive

Finish and release

As described for figure 5, the shoulders and the arms close the drive. During this part of the stroke it is important to always keep the body weight behind the oars to achieve the maximum effect at the finish of the stroke (figure 6).

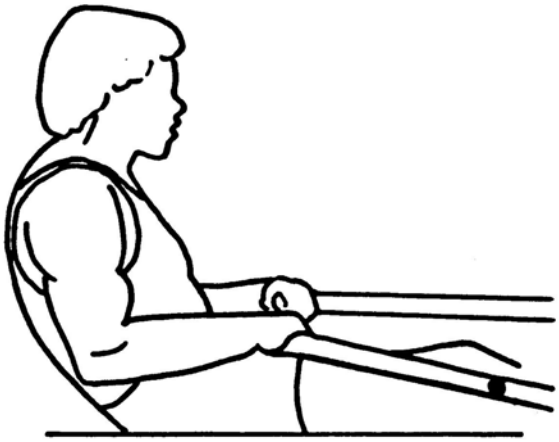


Figure 6 – Finish and release

First half of the recovery

In the recovery, it is necessary to think that the hands are directing the movement by quickly and fluidly pushing the oars away from the body after the release.

The movement that follows starts when the arms are fully extended (figure 7).

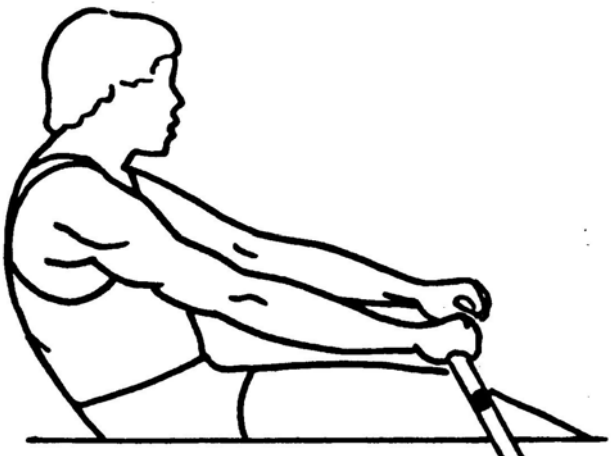


Figure 7 – First half of the recovery

Second half of the recovery

While the hands continue to advance, the upper body starts fluidly to lean forward until it reaches the correct position of the entry (45 degrees). When the arms are extended and the upper body is in the entry position, the athlete starts moving the seat forward to initiate the new stroke (figure 8).

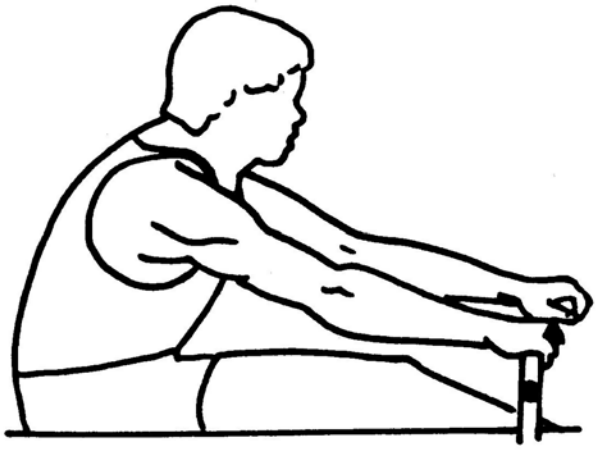


Figure 8 – Second half of the recovery

It should be noted that, in the sculling movement, the FISA Coaching Development Programme recommends the adoption of a standard hand position with the left hand in front of the right hand during the drive and recovery.

3.7 Summary

This analysis is technical and, in practice, all movements have to follow each other in a fluid, continuous cycle. It is extremely important that the upper body is properly prepared for the next stroke before the seat begins to move forward.

As stated in the introduction, the technique of sculling and sweep rowing is essentially identical, though the asymmetrical movement of sweep rowing does require an adaptation of the body to the movement of one oar. This adaptation will be discussed in Levels II and III of the FISA Coaching Development Programme Course.

4 Basic Training Methodology

4.1 Introduction

The role of the coach in the development of athletic potential is very interesting and challenging. It is also a very demanding role because it requires knowledge of all aspects of the athlete's life and the requirements of the sport. With this information, you, as the coach, are in a position to prepare a training programme that will assist the athlete to achieve his or her training objectives. The training programme will provide the format that will guide the athlete through the proper sequence of development throughout his or her athletic career.

The FISA Coaching Development Programme provides information in this course on the basic principles of training, the concept of periodisation and the development of a training programme. This course is intended to provide you with the ability to design and implement simple training programmes. Courses to be offered in the FISA CDP Levels II and III will provide more specific information, particularly in regard to the integration of the principal components in the development of athletic potential – the physical, technical and psychological components.

4.2 Basic principles of training

Basic training methodology has its own principles, which are based on scientific investigations. These investigations provide guidelines which systematically direct the whole process of training and are known as the principles of training.

Active participation

The coach and athlete should be active participants in a joint effort to design and implement a training programme. This principle is more important with experienced athletes than with beginners since beginners do not possess the knowledge and are subject to the direct control and guidance of the coach. The coach and athlete should develop training objectives and work together in the development of short and long term training programmes. Experienced athletes may be encouraged to develop their own programme with the assistance of their coaches to ensure the quality of the programme.

The coach and athlete should establish tests and standards to be met periodically during the training season in order to monitor and control the effectiveness of the programme. This will provide information to assist in the modification of the programme during the training season and from season to season.

This active participation will provide a motivating force to enhance the commitment of the athlete and encourage the pursuit of excellence in training.

All-round development

All-round physical preparation is an essential part in the development of athletes. In fact, the establishment of a broad base of physical development should be considered a prerequisite for specialisation in any sport. This is particularly important for youth and beginners because it is necessary to build a large base of physical fitness and skill to prepare the athlete for the increasing demands of the rowing-specific training that will occur as the athlete develops.

Although the developing athlete will always maintain an all- round physical preparation programme, rowing-specific training will become more important both during the training season and from season to season throughout the athlete's career.

Specialisation

During the athlete's career, he or she trains with the purpose of specialising in rowing. This specialised training for rowing is necessary given the high level of competition in sport today. This applies to all aspects of training and results in the amount of special rowing exercises being progressively and constantly increased.

Although specialisation is a complex process, these special exercises may be divided into two groups. The first group comprises exercises that are similar to the sequence of the movement requirements of the sport (for example, utilisation of the rowing ergometer or on the water technical exercises). The second group comprises exercises that represent partial movements of the whole sequence of movements. These exercises activate single or multiple muscle groups in a way similar to the movement requirements of the sport (for example, utilisation of a strength training programme).

Therefore, the development of training programmes will present the interesting challenge of properly utilising exercises for both all-round development and sport specialisation while giving consideration to short and long term athletic development.

Individualisation

It is necessary to individualise training to enhance the prospects for reaching personal training objectives because of variations in each athlete's ability, potential, characteristics of learning and the specific requirements of rowing.

These variations will result in different individual capacities and, therefore, a training programme for one athlete may not provide the proper development for another athlete.

This realisation is particularly important in the event that a programme that has been designed for a senior or experienced athlete is utilised in training a junior or beginning athlete.

The sport of rowing with events for individuals and crews offers the challenge of developing training programmes that are both individual and crew specific with consideration also being given to short and long term objectives. This ability is the real art of coaching and is developed after years of practice.

Variety

The utilisation of a variety of physical activities provides two benefits. One is physical; the other is psychological.

A variety of physical activities, particularly during the early part of the training season, increases the all-round physical development of the athlete and, thereby, improves the peak performance capabilities that may be achieved with rowing specific training.

The increasing demands of rowing specific training, which necessitates a high volume of training and the utilisation of repetitive special exercises, may result in the athlete becoming stale and suffering mental fatigue.

Therefore, it is important for the coach to be creative by drawing upon a repertoire of variations in training in order to maintain the athlete's interest and motivation to achieve short and long term performance objectives.

Progressiveness of training

The improvement of physical performance comes with the adaptation of the human body to a certain quality and quantity of work. After the athlete's body has adapted to the given work, no further improvement can be expected unless an increased training load is used to force the body to a further adaptation and, therefore, to a further improvement of physical performance.

Essentially, the training programme must provide an adequate amount of work to cause the athlete to become fatigued. After the athlete has had an opportunity to recover and adapt, and is thus prepared for an increase in work, the training programme must systematically increase the amount of work. This will result in higher levels of adaptation and improved performance capabilities.

Systematisation

In the preparation of the training programmes, it is necessary to develop a systematic plan. This plan should be based on scientific and training principles and be arranged methodically in a form that organises the training of the athlete and ensures the proper regularity of training.

The development of a systematic plan will improve the quality of training because the plan would provide a format in which the athlete and coach could test, monitor and control performance capabilities. A systematic plan will also provide a model to be reviewed and revised for the next training season and throughout the athlete's career.

4.3 Periodisation

Periodisation is the process of dividing an annual training programme into periods of training to allow the programme to be set into manageable segments and to ensure a correct peaking for the main competition or training objective of the year.

The process of periodisation depends on the use of the concepts of training loads and the wave principle of training. This information will enable better understanding of the principal components of periodisation: training period, training cycle and training session.

Training load

The training load consists of the quantity and quality of work. Quantity is represented by distance of work, time of work, or number of repetitions, etc. Thus, a rowing training session may be described as, for example, 16km in distance during which three repetitions of ten minutes of work will be performed.

Quality is the effort exerted in the training session. It may be represented as the speed of running, the amount of weight lifted, heart rate maintained, or, in the boat, a combination of pressure applied on the blade and the stroke rating, etc. Thus, the example rowing training session above may be further described as three repetitions of ten minutes of work at a rating of 26 strokes per minute while maintaining a heart rate of 140 to 170.

In a systematic plan of training, the training load goes from quantity to quality. This means that, after a period of adjusting to a new training season, the training starts with a large quantity of a relatively low or medium quality of work to provide all-round development and improvement in endurance capabilities.

As the training season progresses, there is a gradual increase in quality and a corresponding decrease in quantity. This enables the development of the specific needs of the sport of rowing and the necessary performance capabilities to achieve the training objective.

Although this procedure is for the major part of the programme, it must be considered as a guide because training in any period of the year is complex and must cover all aspects of the work requirements of rowing.

Training cycles – the wave principle of training

The training cycle is a limited period of training, usually between four and eight weeks, during which the programme is directed toward a certain training objective. Training cycles follow the wave principle of applying alternating phases of increasing and decreasing training load.

It has been demonstrated that this step or wave approach is more efficient than the linear or continuous method of loading. As opposed to the continuous method, the wave principle requires that a training load increase must be followed by a decrease in training load during which the athlete's body is able to recover and adapt to the training load. This enables the athlete to be subjected to progressively increasing training loads.

It has also been demonstrated that the best results in improvement of performance can be achieved if the training load is gradually increased during three successive training sessions up to the athlete's maximum load capability (for example 50%, 75%, 100%) and followed by a very light training session or a complete rest. This applies to training programmes of five or more sessions per week. If the frequency of training sessions is less, the programme can be designed with one day off after every outing and with the training load being gradually increased to its maximum on the weekend.

The wave principle of changing the training loads will apply throughout the training cycle, which means that the maximum load will vary from week to week creating the wave approach to training. Appendix A provides an example of this principle.

Planning each training period

A systematic training programme based on scientific and training principles is fundamental to the successful pursuit of high level athletic performance. The systematic training programme is developed by working in reverse chronological order from the date of the main competition or training objective and dividing the training season into the appropriate number of training periods.

Each period has different aims and, to some extent, will continue the application of the concepts of training load and the wave principle of training.

The periodisation of the training season may be represented as follows:

- Preparation period (six months).
- Competition period (five months).
- Transition period (one month).

The aims of each period are:

Preparation period

1. To develop general physical fitness.
2. To develop rowing technique, specific physical fitness for rowing and psychological preparedness for the coming competition period.

Competition period

1. Further development of rowing technique, specific physical fitness for rowing and psychological preparedness for competition mainly by training in the boat.
2. To develop and stabilise competition performance.

Transition period

1. Physical and mental relaxation
2. Relief from the pattern of systematic training

Planning each training cycle

Each period is divided into one or more training cycles of four to eight weeks in length. The plan for each cycle gives the athlete an outline of the particular activities on the land and in the boat. It shows the kinds of exercises, the quantity and quality of the work, and a detailed programme for each training session in the cycle. The plan for each cycle takes into consideration the different degrees of training load and rest intervals within the week and within the whole cycle (see Appendices A & B).

Planning each training session

The aim of the period and cycle and the purpose of each session should be carefully explained to the athlete. Every training session must begin with a good warm-up on land (five to ten minutes of light jogging and five minutes of mobility exercises) and also in the boat (systems of warm-up in the boat vary from crew to crew).

After the warm-up in the boat, there is a time for technical exercises because the teaching of technique or correction of technical faults requires mental concentration, which deteriorates with the increasing fatigue of the athlete during the training session.

After the technical exercises have been completed, the main part of the session is devoted to the principal aim of the training period and the training cycle. The last part of the training session is for relaxation and a warm-down. During the training session, the coach should present a clear purpose for the session by keeping unnecessary communication to a minimum and concentrating on a few important points that will assist the athlete in maintaining the proper focus during each session.

At the conclusion of each session, the coach should exchange observations with the athlete or crew and evaluate the session. This procedure will assist in the process of monitoring and controlling the training programme and, thereby, increasing the benefits to be derived from each future training session.

A yearly training programme

Appendix B has been included to present an actual year-round training programme that you may use to train your club athletes. It is important to realise that these programmes must be adapted to the specific needs of your athletes giving consideration to their individual state of development and future training objectives.

4.4 Planning a training programme

An annual training programme is the most important tool for the coach to direct and guide athletic training over the training year. It is based on the principles of training and the concept of periodisation.

Planning a training programme requires a clear understanding of the objective of the programme and a procedure to achieve the objective. This purpose may be accomplished by utilising the following guidelines:

1 Establish an objective
2 Develop a systematic plan
3 Implement the plan
4 Monitor and review the plan

Establish an objective

The objective of a training programme will be the achievement of a defined performance level at a designated competition. This competition may occur at the culmination of either a few months of training (a short-term objective) or many years of training (a long-term objective).

It should be noted that, as athletic potential may only be optimised by year-round training, emphasis should be placed upon the development of year-round training programmes.

Develop a systematic plan

A systematic plan is developed by working in reverse chronological order from the date of the objective of the plan and dividing the training season into the appropriate number of training periods. This procedure is called periodisation (see section 3.0) and may be represented as demonstrated in diagram 1.

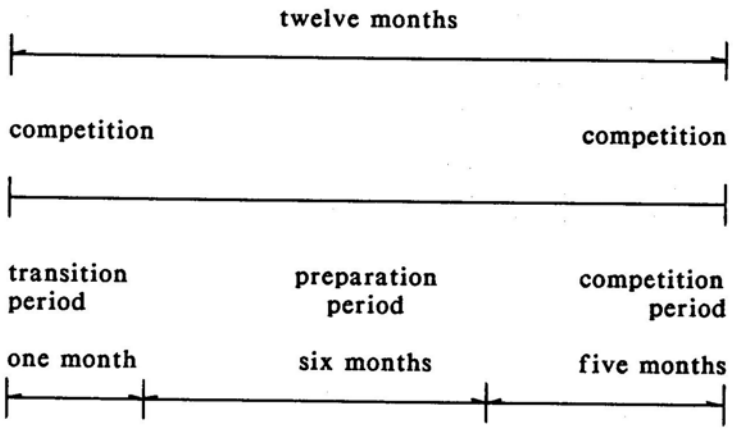


Diagram 1 – Periodisation plan

It is important to realise that a systematic plan must be developed in conjunction with an understanding of how to implement the plan. This is probably the most difficult aspect of designing and monitoring a training programme. It requires an understanding of the basic principles of training (see section 2.0), the concepts of training loads and training cycles (see sections 3.1 and 3.2), the energy systems, proper rowing technique and the methodology of learning.

Implement the plan

The coach and athlete must make a conscious decision to proceed with the plan and become active participants in the training process. This ensures that the athlete maintains the proper motivation in the pursuit of the training objective and that the athlete trains regularly and conscientiously.

Monitor and review the plan

It is important that the plan includes various tests and standards that are to be attempted and successfully completed, both on and off the water, during the training season. These tests and standards will provide valuable information on the athlete's developing capabilities and on the effectiveness of the plan in directing the athlete towards the training objective.

As well, it is important that both the coach and athlete maintain a training journal to document their observations and comments about the training. This information is invaluable in the process of reviewing the plan both during and after the training season. This review will allow modification to be made in the programme during the season and from season to season to enhance the athlete's opportunity to achieve his or her athletic potential.

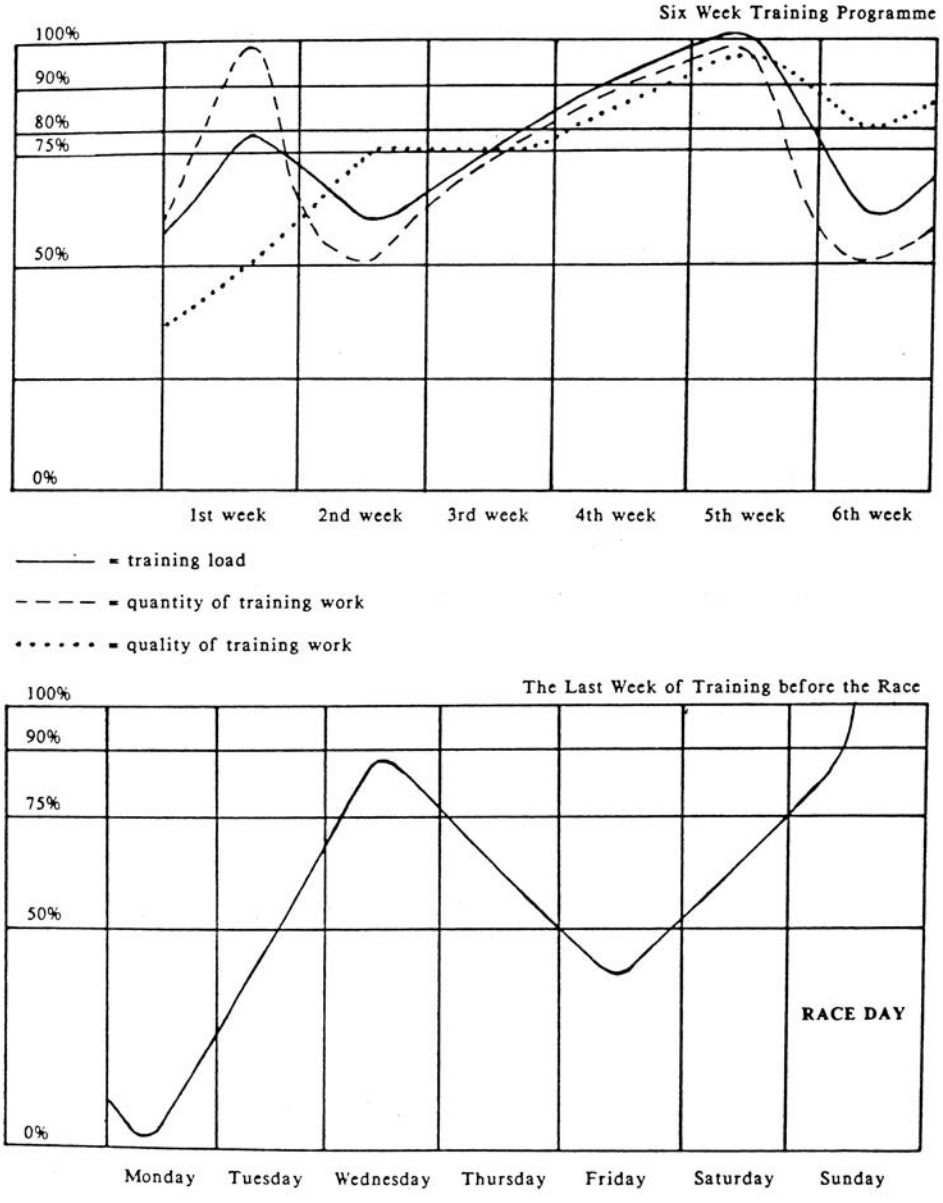
This procedure for the planning of a training programme should be repeated for each new training season in order to develop a training programme that is appropriate to the growing and ever- changing needs of the athlete.

4.5 Summary

The information presented in this course will enable you, the coach, to prepare training programmes that will assist your athletes in the achievement of their training objectives. This ability will be enhanced after practice and years of experience.

4.6 Appendices

Appendix A – Wave principle of training



Appendix B – Author: Thor S. Nilsen, NOR

Introduction

This "Training Programme for Clubs" is based on The FISA Development Club Programme distributed in 1993. Many coaches have asked for an update, but in training methodology and rowing technique not much has changed, and the basics stay the same. Anyhow, some training models have been improved and distribution of time looks a bit different.

The difference from 1993 is the higher number of hours invested in training by the international elite. With more than 40 hours a week in training a lot of injuries in form of stress fractures and lower back problems occurred.

Among the lightweight rowers it looks as if the immune defense got strongly reduced and common colds, influenza and other fever-related illnesses caused many breaks in the training system. This is probably a result of high training load and reduced intake of food to keep the weight down. A problem we must address strongly in the time to come.

In this programme we have two new appendices presenting a better programme for flexibility and series of additional exercises to give the clubs the possibility to create a more "all-round" training programme and avoid "disharmony" between the different groups of muscles. Many injuries could be related to underdevelopment in non-specific rowing muscles (see chapter 5 – General Fitness Training).

The aim of the programme will follow the same lines as the last edition:

- Increase maximum VO2
- Increase strength endurance
- Increase maximum strength
- Higher efficiency of rowing technique
- Better flexibility and coordination

The programme is divided into five periods as follows:

Period 1: October – January (Preparation period 1)

Programme October	Main effect:	Maximum strength
	Secondary effect:	General endurance
Programme November	Main effect:	Maximum strength and general endurance

Period 2: January – February (Preparation period 2)

Programme January- February	Main effect:	General endurance and muscular endurance

Period 3: March – April (Pre-competition period)

Programme March – April	Main effect:	Basic specific endurance and rowing technique

Period 4: May – June – July (Competition period)

Programme Weeks without competition	Main effect:	Increased specific endurance
Programme Weeks with competition:	Main effect:	“Supercompensation” effect and race preparation
Programme “Peak” for championships or important regatta	Main effect:	“Peak” for the championships

Period 5: (August) September. (Recovery period)

Programme September:	Main effect:	Active recovery.

How to use the programmes?

Intensity

The intensity is expressed in “heart rate” with an indicated “target zone”, based on percentage of “maximum heart rate”. Maximum heart rate is estimated as 220 minus age. In the programmes 200 HR is used as maximum and 180 HR as minimum. Individual variations will occur frequently.

All training models where HR is indicated show the physiological effect expected, and refer to the oxygen transport system.

Target Zone:	Percentage of Max:	Training effect:
130-150	Up to 75%	Utilisation
140-160	” ” 80%	Mainly utilisation
150-170	” ” 85%	Anaerobic threshold
170-190	” ” 95%	Transportation
Max.	” ” 100%	Anaerobic

It is not necessary to stay strictly within the “target zone”, but to obtain maximum training effect these rules should be respected:

Training effect:	Training time in ” “target zone”:
Utilisation:	80%
Anaerobic threshold:	70%
Transportation:	50-70%
Anaerobic:	5-10%

Indicated stroke rate

The stroke rate is closely connected to the heart rate, but has its own technical effect. Close to the regatta season, and inside the regatta season, it is important to train in the “stroke rate area” where we are supposed to compete.

The single sculler and the eight will use different “stroke rate areas”, and in the programme the lowest number is an indication for the slow boats and the highest number for the fast boats. Weather conditions must be taken into consideration with slower rate in headwind and upstream.

Lightweight rowers

Lightweight rowers should not use the “volume” or “maximum strength training”, because it will increase bodyweight and muscle volume. With the “top pyramid”, maximum strength can be improved without weight gain.

Junior rowers

Junior rowers should have passed puberty and have a settled body before they start with heavy weight training. The best period to improve muscle volume and strength seems to be between 18 and 23 years. For younger rowers their own body weight can be used as load. Circuit training and endurance training are to be preferred.

Women

Women can follow the same training principles as men. Their maximum strength is lower and muscle volume smaller, but their adaptation to endurance is as high as for men. Some scientists insist that women recover faster from heavy endurance load than men do.

Be careful with weight training, and take time to learn a good lifting technique.

Time requirement

To follow the programme completely from October to the end of August, you will need approximately 650 hours of effective training. Total numbers of kilometres on the water are of approximately 4,000.

An international elite rower will use up to 1,500 hours/ year and row between 7 and 9,000km. Remember: less quantity needs more quality.

Reduction of the programme

School and work problems might reduce the possibility to follow the programme and reduction will be needed. With reduction try to keep the endurance part, and give priority to the boat training.

Terminology

To avoid misunderstanding we will explain the following “terms” used in the programme.

Steady state

Aerobic training with metabolic balance. Energy covered 100% aerobic or with small amount of anaerobic capacity involved, but without accumulated production of acid lactate.

”LSD” Long Slow Distance

Training after the continuity principle to increase or maintain oxygen utilisation in the muscle fibres recruited. Energycovered 100% aerobic.

Interval

Interval principle: Training with periodic changes between exertion and rest, or between high and low workload (interval work).

The various types of interval training can be divided into two categories: short interval training and long interval training.

Short interval involves work periods of up to two minutes and rests that are so short that oxygen uptake and the pulse (in the rest) does not decrease appreciably before the start of the next work period.

Long interval involves work periods from two minutes and up to between 10 and 15 minutes, and rest lengths such that work intensity can be maintained approximately constant during each work period.

The short interval is very important during the regatta season to keep a good quantity of training in the right area of race velocity, and use of stroke rate valid for competition. Training after the interval principle will increase or maintain the heart’s stroke volume (increased aerobic capacity).

Rhythm variations

Training with mainly aerobic effect, but also with some input of anaerobic energy. The training gives a good opportunity to control and train the technique at different levels of intensity.

Fartlek

Training according to the interval principle, of relatively long duration (8-12km), with improvised alteration between high and low intensity, and with the main purpose of increasing or maintaining aerobic endurance. Gives a good opportunity to control the technique at different levels of intensity.

Model training

Training that simulates the race condition including warming up, start proceeding and tactic. Should be organised with other crews and made as close up to regatta conditions as possible. (Used in connection with “supercompensation”.)

Speed training

This term is used as a description of high intensity training in preparation for regattas (supercompensation principle.) It means mainly overproduction of speed (speed higher than race speed.). This is the only specific anaerobic training in the programme. It also has a technical element and overstimulates the muscular contraction velocity.

“Race-training: 4-2-1”

Training that stimulates race conditions, physiologically and mentally, about 60% aerobic and 40% anaerobic with increased load. The model has also a good technical element.

Technical “drill”:

Training with specific exercises to improve the rowing technique. The rowing stroke divided into sections and trained separately followed by combined sections – up to the full stroke.

Training Programme: October

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Volume-training*)**				
	C) Flexibility – Gymnastic				
Tuesday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C) Flexibility – Gymnastic				
Wednesday	A) Running: Slow Distance		130-150		10-12
	B) Flexibility				
Thursday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C Flexibility – Gymnastic				
Friday	A) Running: Warming up		130-150		3-4
	B Hillrunning: Ca. 5 min 3-5 rep.	4'-6'	170-190		5-8
	C) Flexibility				
Saturday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C) Flexibility				
Sunday	A) Rowing (or)		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	C) Flexibility				

* See program for Weight training. ** Lightweight rowers should use program “Top-pyramide”

Training Programme: November

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Maximum strength training*)**				
	C) Flexibility – Gymnastic				
Tuesday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C) Flexibility – Gymnastic				
Wednesday	A) Rowing/Running: Slow Distance		130-150	(15-18)	10-12
	B) Flexibility				
Thursday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C) Flexibility – Gymnastic				
Friday	A) Running: Warming up		130-150		3-4
	B) Hillrunning: Ca. 5 min 3-5 rep.	4'-6'	170-190		5-8
	C) Flexibility				
Saturday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Volume-training)				
	C) Flexibility				
Sunday	A) Rowing (or)		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	B) Flexibility				

* See program for Weight training. ** Lightweight rowers should use program “Top-pyramide”

Training Programme: December

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Maximum strength training*)**				
	C) Flexibility – Gymnastic				
Tuesday	A) Running: Long Slow Distance		130-150		10-12
	B) Flexibility				
Wednesday	A) Warming up: Rowing/Running/ Gymnastic 30 min		130-150		
	B) Weight training (Maximum strength training)				
	C) Flexibility – Gymnastic				
Thursday	A) Running: Warming up		130-150		3-4
	B) Hillrunning: Ca. 5 min 5 rep.	4'-6'	170-190		5-8
	C) Flexibility				
Friday	A) Warming up: Rowing/Running/ Gymnastic 30 min	130-150			
	B) Weight training (Maximum strength training)				
	C) Flexibility – Gymnastic				
Saturday	A) Rowing (or)		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	B) Flexibility				
Sunday	A) Rowing (or)		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	B) Flexibility				

* See program for Weight training. ** Lightweight rowers should use program “Top-pyramide”

Training Programme: January

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Maximum strength training)				
	C) Flexibility – Gymnastic				
Tuesday	A) Running: Warming up		130-150		3-5
	B) Running: Short Interval				
	20/10 sec. x 12 min. 2 series.	3'-5'	180-190		4-6
	C) Flexibility				
Wednesday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Weight Endurance)*)				
	C) Flexibility – Gymnastic				
Thursday	A) Running: Warming up		130-150		3-4
	B) Hillrunning: Ca. 5 min. x 5 rep.	4'-6'	170-190		5-8
	C) Flexibility				
Friday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (Weight Endurance)				
	C) Flexibility – Gymnastic				
Saturday	A) Rowing (or) NB!		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	B) Flexibility				
Sunday	A) Rowing (or) NB!		130-150	18-20	20
	Running (or)		130-160		14-16
	Cycling		130-160		35-50
	B) Flexibility				

* See program for Weight training Endurance. NB! = Rowing if possible.

Training Programme: February

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training (“Top-pyramid”)				
	C) Flexibility – Gymnastic				
Tuesday	A) Rowing: Long Slow Distance		130-150	18-20	16-20
	B) Flexibility				
Wednesday	A) Rowing: Warming up/Technical "Drills"		130-150	18-20	3-5
	B) Rowing: 4 x 8 min.	3'-4'	140-160	22-24	10-12
	C) Flexibility				
Thursday	A) Rowing: Technical "Drills"				6-8
	B) Hillrunning: Ca. 5 min. x 3 rep.	4'-6'	170-190		5-8
	C) Flexibility				
Friday	A) Rowing: Warming up/Technical "Drills"		130-150	18-20	3-6
	B) Rowing: 3 x 12 min.	3'-4'	140-160	22-24	10-12
	C) Flexibility				
Saturday	A) Rowing: Technical "Drills"				3-6
	B) Rowing: Slow Distance		130-160	20-22	12-16
	C) Flexibility				
Sunday	A) Rowing: Technical "Drills"				3-6
	B) Rowing: "Fartlek"		130-170	18-28	12-16
	C) Flexibility				

OBS! “Drills” and “Fartlek” see descriptions.

Training Programme: March – April

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Warming up: Running/Gymnastic 30 min		130-150		
	B) Weight training ("Top-pyramid")				
	C) Flexibility – Gymnastic				
Tuesday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Long Interval 3-4 x 5 min.	3'-5'	160-170	26-30	10-12
	C) Flexibility				
Wednesday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 30/20 (strokes) x 10. 2 series	4'-6'	170-180	28-30	10-12
	C) Flexibility				
Thursday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 3 x 12 min	4'-6'	160-170	26-28	12-14
	C) Flexibility				
Friday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 4-3-2-1 x 3 (23-25-27-29)	3'-4'	130-170	23-29	12-16
	C) Flexibility				
Saturday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 40/20 (strokes) x 8. 2 series	4'-6'	170-180	28-30	12-14
	C) Flexibility				
***2**	A) Rowing: LSD		140-160	22-24	16-20
	B) Flexibility				
Sunday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2 x 8 min. (2000 m)	10'-12'	170-180	28-30	12-14
	C) Flexibility				

* = If possible

Training Programme: May – June – July

(Weeks before Regattas)

Day	Program	Rec	Heart rate	Stroke rate	Km
Saturday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 4-6 x 500 m	1'-2'	Max	Max	8-10
	C) Flexibility				
2	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2-3 x 1000 m	6'-8'	Max	Max	10-12
	C) Flexibility				
Sunday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2-3 x 1000 m	6'-8'	Max	Max	10-12
	C) Flexibility				
Monday	A) Rowing 65-70%		140-150	22-24	20
	B) Flexibility				
Tuesday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2-3 x 5 min	4'-6'	170-180	28-30	10-12
	C) Flexibility				
***** 2**	A) Rowing 60-65%		130-140	20-22	12
	B) Flexibility				
Wednesday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 1x1000 m + 1x500 m	8'-10'	Max	Max	8
	C) Flexibility				
Thursday 1	A) Rowing: Fartlek		130-180	18-36	12-16
	B) Flexibility				
***** 2**	A) Rowing: Fartlek		130-180	18-36	12-16
	B) Flexibility				
Friday 1	A) Rowing: Fartlek		130-180	18-36	12-16
	B) Flexibility				
***** 2**	A) Rowing: Fartlek		130-180	18-36	12-16
	B) Flexibility				
Saturday	A) Regatta				
Sunday	A) Regatta				

*** = Second rowing session if possible

Training Programme: May – June – July

(Weeks before Regattas)

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Rowing 65-70%*)		140-150	22-24	16-20
	B) Flexibility				
Tuesday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 4-3-2-1 x 3	10'-12'	140-180	26-32	12-14
	C) Flexibility				
****2**	A) Rowing: 65-70%		140-150	22-24	12-16
	B) Flexibility				
Wednesday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 30/10 (strokes) x 10 (60/20 sec) 2 series	6'-8'	170-180	30-34	12-14
	C) Flexibility				
****2**	A) Rowing: 65-70%		140-150	22-24	12-16
	B) Flexibility				
Thursday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Long Interval 3-4 x 5 min.	4'-6'	170-180	28-32	12-14
	C) Flexibility				
Friday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 3 x 12 min.	8'-10'	160-170	27-29	12-14
	C) Flexibility				
****2**	A) Rowing: 60-65%		130-140	20-22	12-16
	B) Flexibility				
Saturday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 17/5 (strokes) x 20 (30/15 sec) 2 series	6'-8'	170-180	34	12-14
	C) Flexibility				
****2**	A) Rowing: 60-65%		130-140	20-22	12-16
	B) Flexibility				
Sunday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2-3 x 2000 m (1250/500/250) or 7 min. (4-2-1) (30/32-32/34-34/38)	15'-20'	180-190	30-38	41974
	C) Flexibility				

* = Every two weeks one session with “Top-pyramid”. ** = Second session if possible.

Training Programme: (August) September

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	Any kind of activity (walking/jogging/ swimming/golf/tennis/soccer or any other ballgame) Rowing if you really feel for it.				
Tuesday	FREE, or some kind of aerobic				
Wednesday	As Monday				
Thursday	As Tuesday				
Friday	As Monday				
Saturday	Free				
Sunday	As Monday				

Do what you feel for; you should enjoy it!

Training Programme: “Peak”

Day	Program	Rec	Heart rate	Stroke rate	Km
Monday	A) Rowing: Long Distance		130-150	18-22	16-20
	B) Flexibility				
Tuesday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Long Interval 3 x 4 min.	4'-6'	170-180	30-33	8-10
	C) Flexibility				
Wednesday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 30/10 (strokes) x 6. 3 series	4'-6'	170-180	30-34	10-12
	C) Flexibility				
Thursday	A) Rowing: Long Distance		130-150	18-22	16-20
	B) Flexibility				
Friday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 3-2-1 x 3 (28-30-34)	5'-7'	160-190	28-34	10-12
	C) Flexibility				
Saturday 1	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: Short Interval 20/10 (strokes) x 6. 3 series	8'-10'	180-190	32-36	10-12
	C) Flexibility				
2	A) Rowing: Long Distance		130-150	18-22	12-16
	B) Flexibility				
Sunday	A) Rowing: Warming up		130-150	18-20	4-6
	B) Rowing: 2 x 2000 m (1250/500/250) or 7 min. (4-2-1) (30/32-32/34-34/38)	15'-20'	180-190	30-38	12-14
	C) Flexibility				

Weight Training

Volume Training

FISA The International Rowing Federation

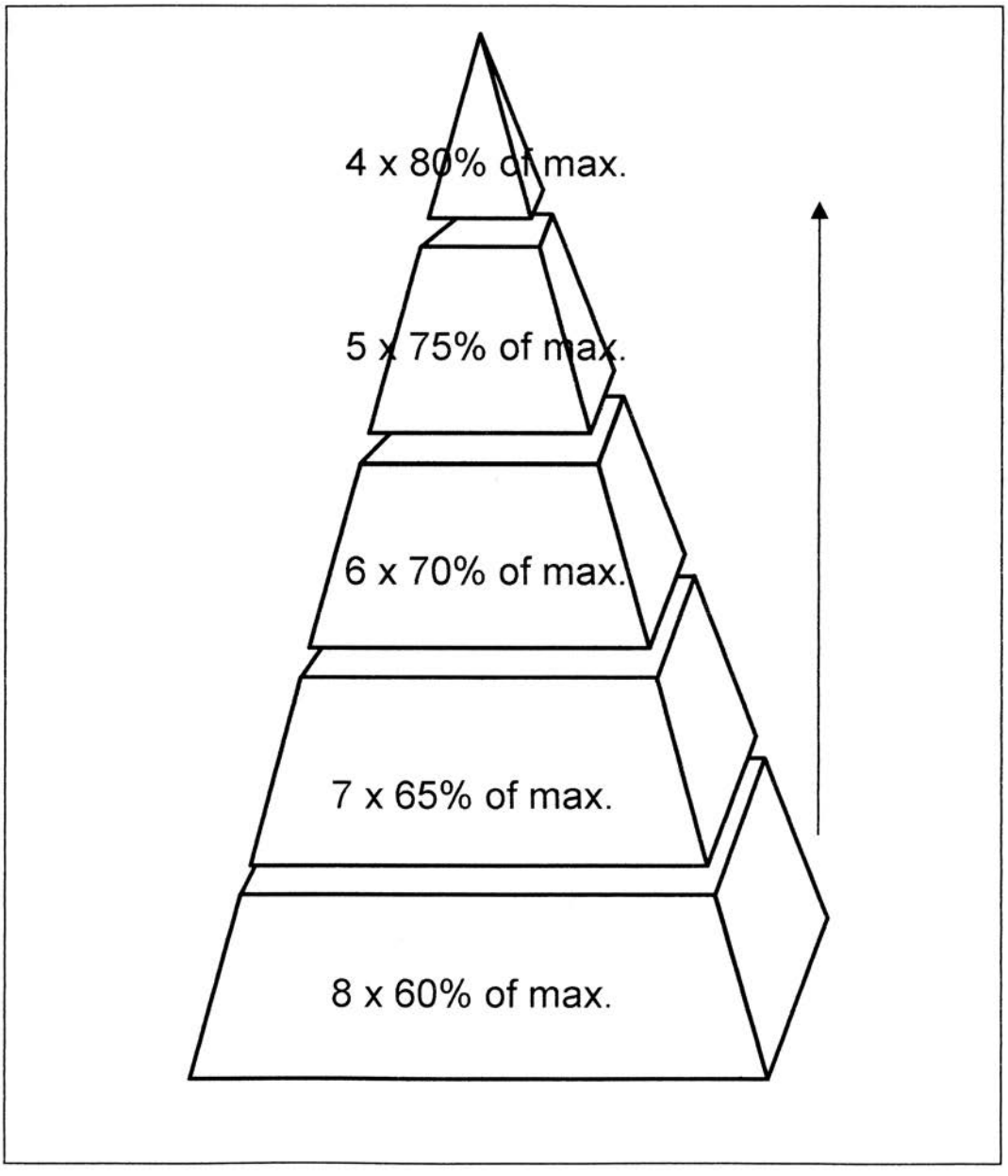


Fig. A

Weight Training

Maximum strength

FISA The International Rowing Federation

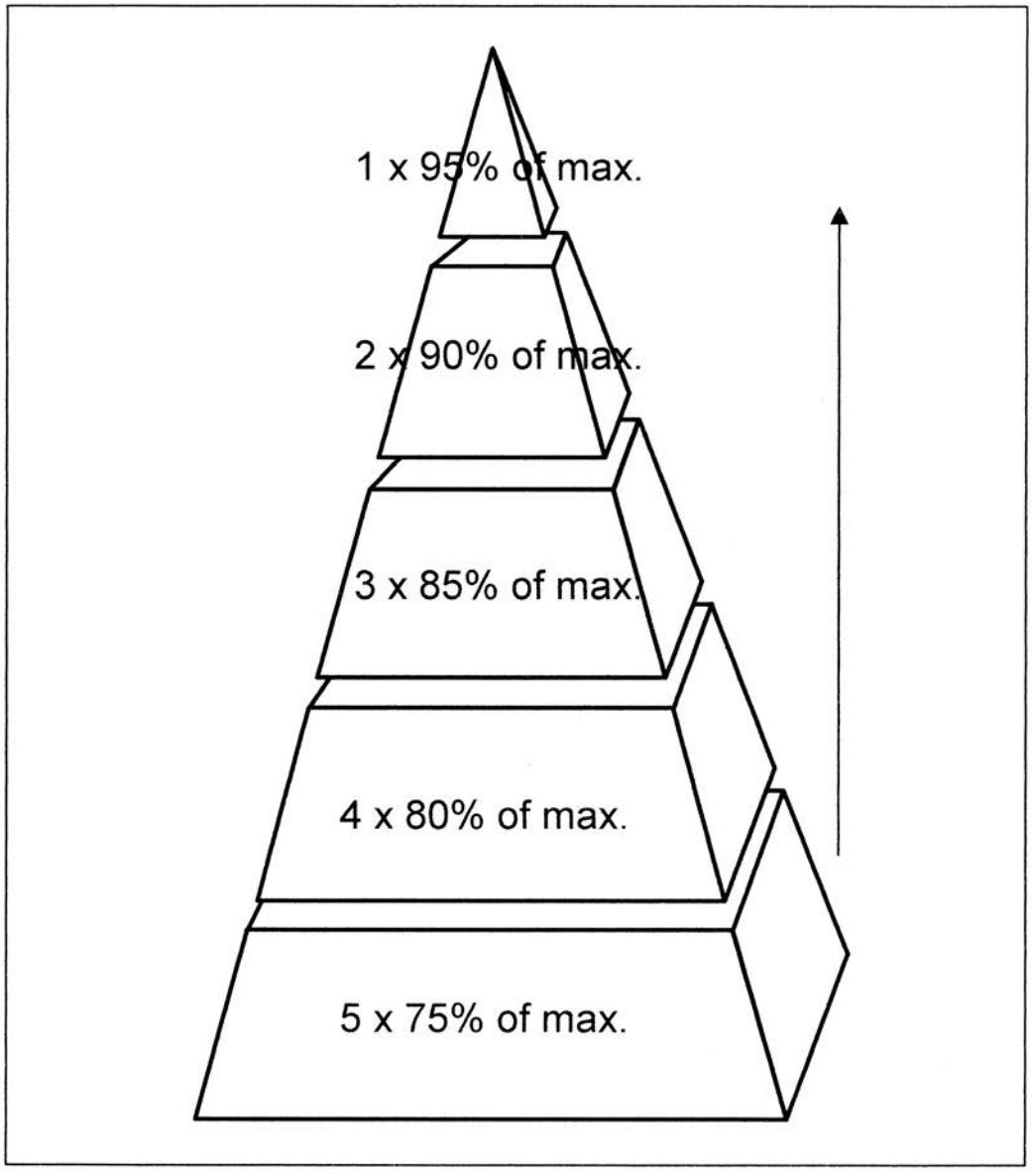


Fig. B

Weight Training

"Top-pyramid" training

FISA The International Rowing Federation

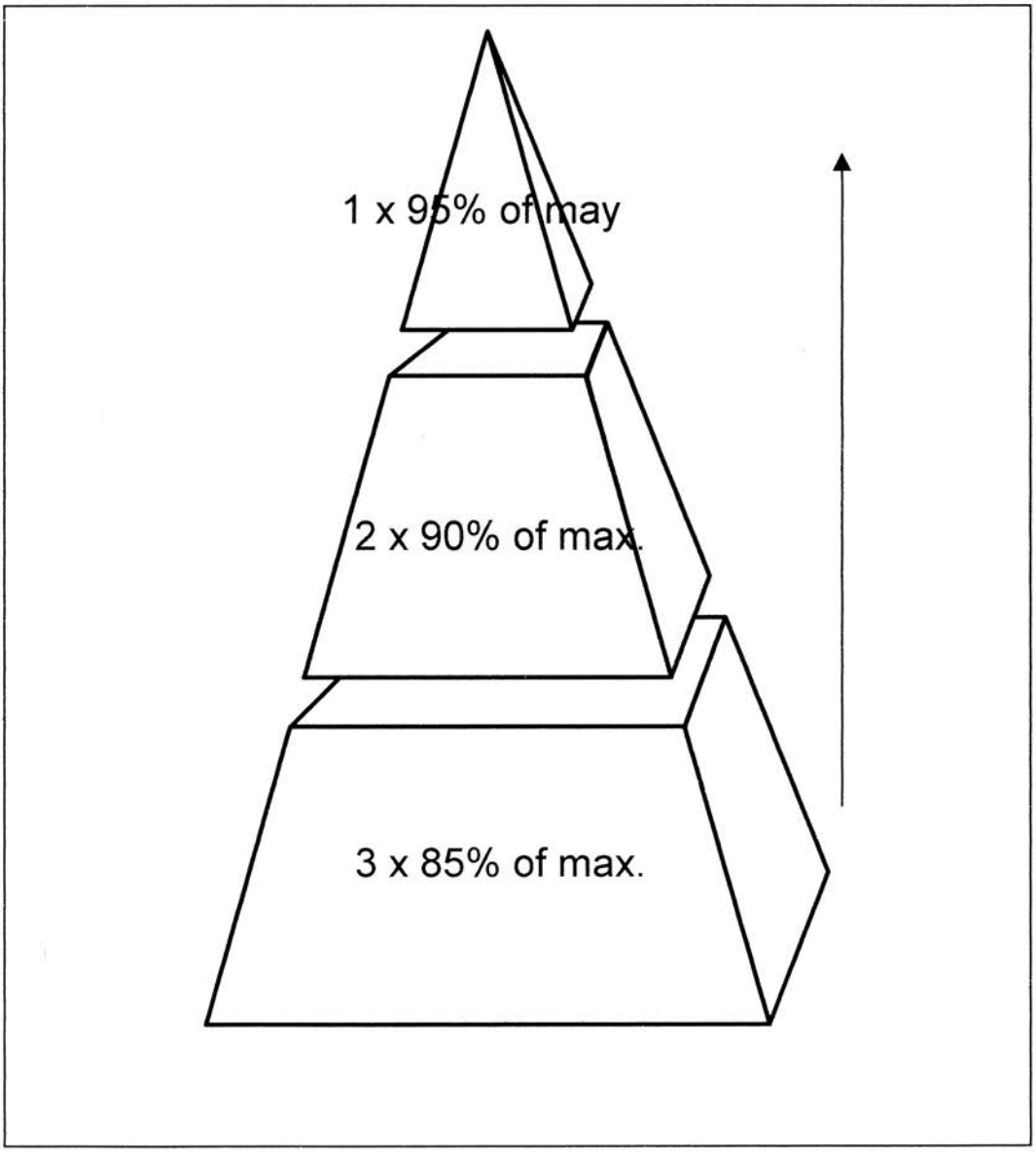


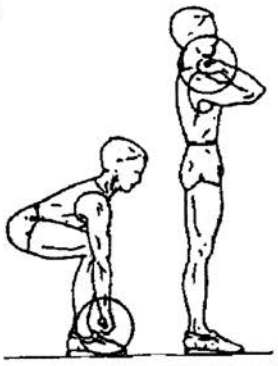
Fig. C

Weight Training

Endurance

FISA The International Rowing Federation

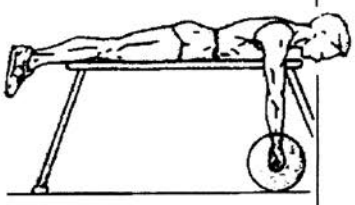
A



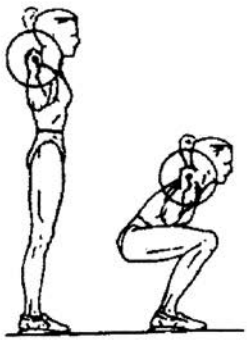
Exercise A and B

Load:
35-45% of max
Series: 3
Rep: 60-80
Rate: 20-26
Rest: 3-4 Min.

B



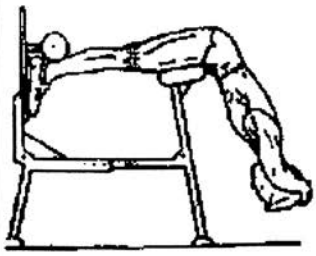
C



Exercise C

Load:
35-45% of max
Series: 3
Rep: 60-80
Rate: 20-24
Rest: 3-4 Min.

D



Exercise D and E

Load:
0-5 kg.
Series: 3
Rep: D/40 E/50
Rest: 3-4 Min

E

Fig. D

5 General Fitness Training

5.1 Introduction

Fitness may be defined as the successful adaptation to mental and physical stress encountered in life. General Fitness Training may be defined as a scientifically-based and systematic training programme to provide the athlete with the basic means to adapt to the physical load encountered through controlled exercise.

Adaptation begins by subjecting the body to a physical load through controlled exercise. Subjecting the body to a sufficient level of physical activity, to cause fatigue, provides the load on the body. After the body has had an opportunity to recover by resting, the body will adapt to this load. The adaptation will now allow the body to be subjected to the same load without becoming fatigued.

5.2 Main features of sport training

Goal-oriented

Training should always be aimed at achieving an increased individual performance level.

Group training

Although training is an individual matter, training in groups is more economical and provides the necessary emotional support for mobilising performance potential.

Effective training

A training programme that provides for increasing physical demands on the athlete will be more effective in developing the athlete's fitness level.

Systematic training

A training programme must be orderly in method or planning.

Scientific training

A training programme must be based on scientific principles.

Role of the coach

The coach's responsibility is to assist the athlete in all aspects and forms of training.

5.3 Main features of general fitness training

Mobility

The first consideration in examining general fitness training is mobility. Mobility is defined as the capacity of joints and joint chains for flexion and extension. In rowing, mobility should be considered in light of an optimum application of force throughout the range of movement used in the rowing stroke. Mobility is examined in section 4.0 of this booklet.

Strength

The second consideration in examining general fitness training is strength. Strength is defined as a muscle or muscle group's ability to develop mechanical force. Strength training is training intended to maintain or increase this ability. Strength is examined in section 5.0 of this booklet.

Endurance

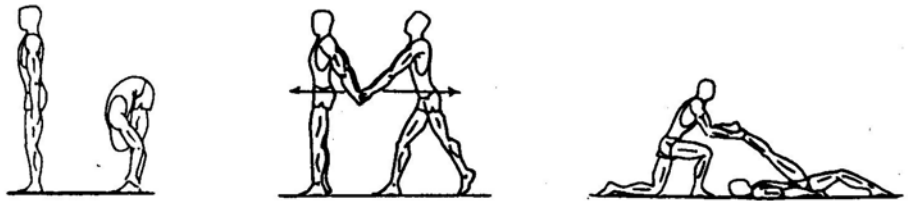
The third consideration of general fitness training is endurance. Endurance is defined as the capacity of the athlete to resist fatigue during applications of work over periods of time. Endurance depends on the maximum aerobic and anaerobic powers and the ability with which they can be utilised. Endurance is examined in section 6.0 of this booklet.

5.4 Mobility

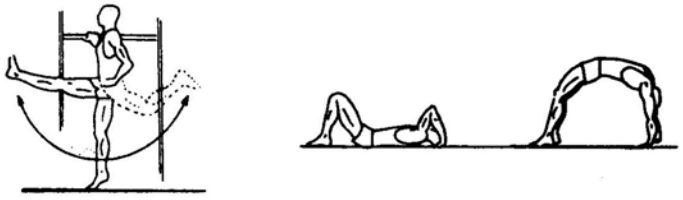
Improvement in mobility enhances the learning of good technique, decreases the risk of injury and provides an opportunity for better development of strength and endurance.

Development of mobility

Active: contraction of muscles, which are naturally related to the movement.



Passive: movement which is effected by an external force



Kinetic: movement which is effected by momentum.

Figure 1 – Types of mobility training

Mobility training is used to maintain or increase the range of joint action. Mobility work should always precede other training and never be practiced in a state of fatigue unless gentle, active mobility is used. There are three types of mobility training: active, passive and kinetic. These are represented in figure 1.

The following order of events should be observed in a mobility training session:

1. Raise the general body temperature by light running and general warm-up exercises.
2. Active and slow sustained exercises for each joint action – maintains range of movement.
3. Passive exercise with partner, apparatus, body weight, etc – increases range of movement.
4. Kinetic exercises and combined strength and mobility exercises – relates movement to dynamics of the sport [advanced athletes only].
5. Work on specific movements involved in the whole movement exhibited through the stroke cycle.
6. Warm down

Factors affecting mobility training

The following are factors that should be considered when planning and implementing mobility training sessions:

1. The elasticity of muscles and tendons of the muscles being stretched and of ligaments supporting the joint involved.
2. The structural barriers of joint and bone construction, any muscle hypertrophy or any skin and tissue folds which prevent freedom of joint range.
3. The strength of the contracting muscle group and the stretch capacity of the opposing muscle group being stretched.
4. The degree of coordination through the range of movement.
5. The effect of an injury in the muscles or joints involved.
6. The internal or external environment.
7. The age and sex of the athlete.
8. The development level of the athlete.

Mobility exercises

Although there are virtually thousands of mobility exercises to choose from, Appendix A at the end of this booklet, has been provided to assist you at this time. You are encouraged to consult one of the numerous texts that are available.

5.5 Strength

Strength, or the ability to express force, is a basic physical characteristic that determines performance efficiency in sport. Strength may be classified as follows:

Maximum strength
muscle or muscle group's maximum ability to develop mechanical force.

Power
muscle or muscle group's ability to overcome resistance with a high speed of contraction.

Strength endurance
muscle or muscle group's ability to withstand fatigue during applications of work over periods of time.

Development of strength

The development of an athlete in the sport of rowing includes a selection of specific exercises to develop strength relevant to the sport. Although this requirement is necessary, it is important that a proper preparation base is established. This preparation base will be established by the performance of general conditioning exercises.

General conditioning exercises are particularly important at the beginning of the training season and have a greater value for the young athlete than for the mature athlete. These exercises could be introduced through the use of games (such as basketball, football, water polo, etc) or strength training programmes.

Strength training is generally performed by a method of training termed circuit training. Circuit training is a training method in which the various muscle groups are worked in a specific sequence. The effects of circuit training vary and depend on the number and type of exercises, repetitions, sets, rest and mode of training. Therefore, circuit training may be arranged to provide a proper preparation base by general conditioning exercises (for example, by performing exercises with one's body or with a partner) or to develop strength relevant to the sport (for example, by performing exercises with the higher training loads provided by barbells or exercise machines).

Circuit training is called station training when more than one set of exercises for a particular muscle group or groups are performed at a station or another fixed location. Station training then refers to the organisation of training.

Basic principles of circuit training:
- Any available space may be used.
- Special equipment need not be used.
- Many people can train simultaneously.
- The quality of training can be controlled.
- People can train at their own level.
- Weaknesses can be spotted and improved.

A circuit training programme for general conditioning should systematically exercise all parts of the body by choosing many different types of exercises. It should be noted that these exercises may not necessarily relate closely to the desired rowing technique but, as a consequence, they ensure that the athlete does not develop disproportionately.

Adapted from Training av bevegelighet by Eystein Enoksen and Asbjorn Gjerset in the series Treningslaere from the Norwegian Sport Federation.

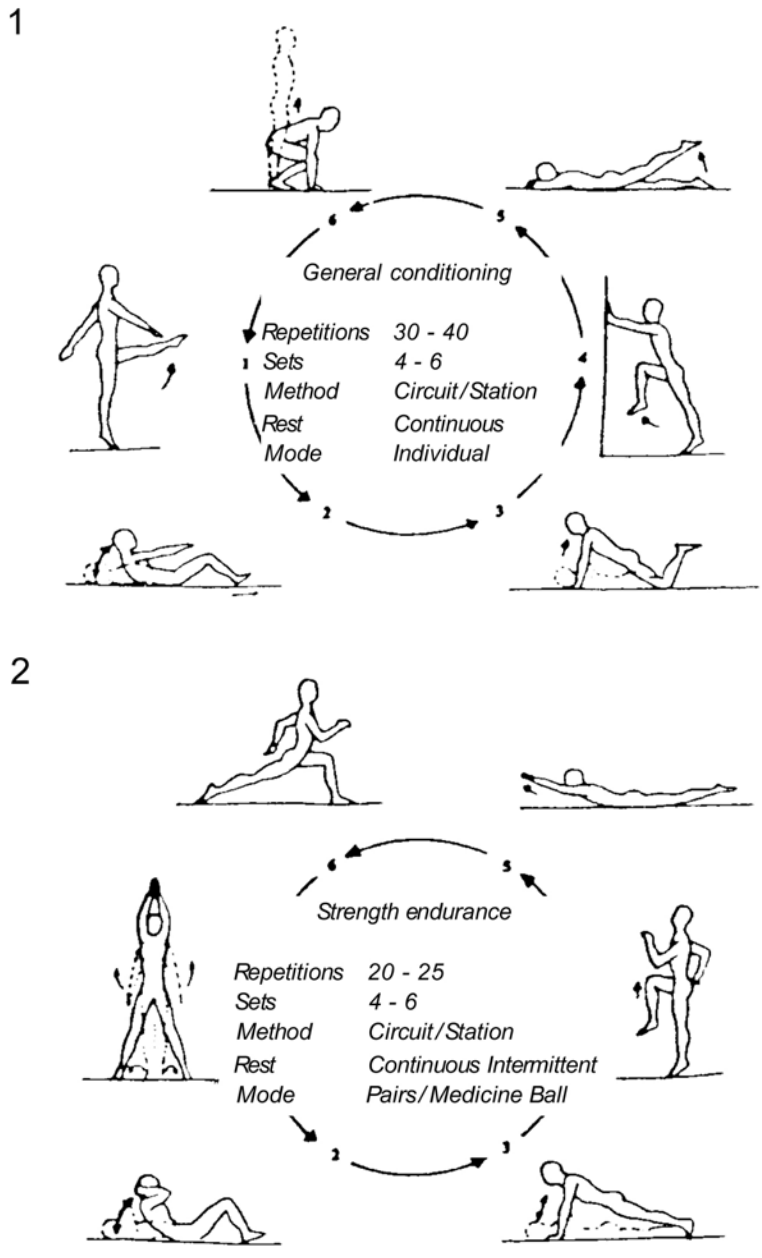


Figure 2.A – Example of circuit training programmes

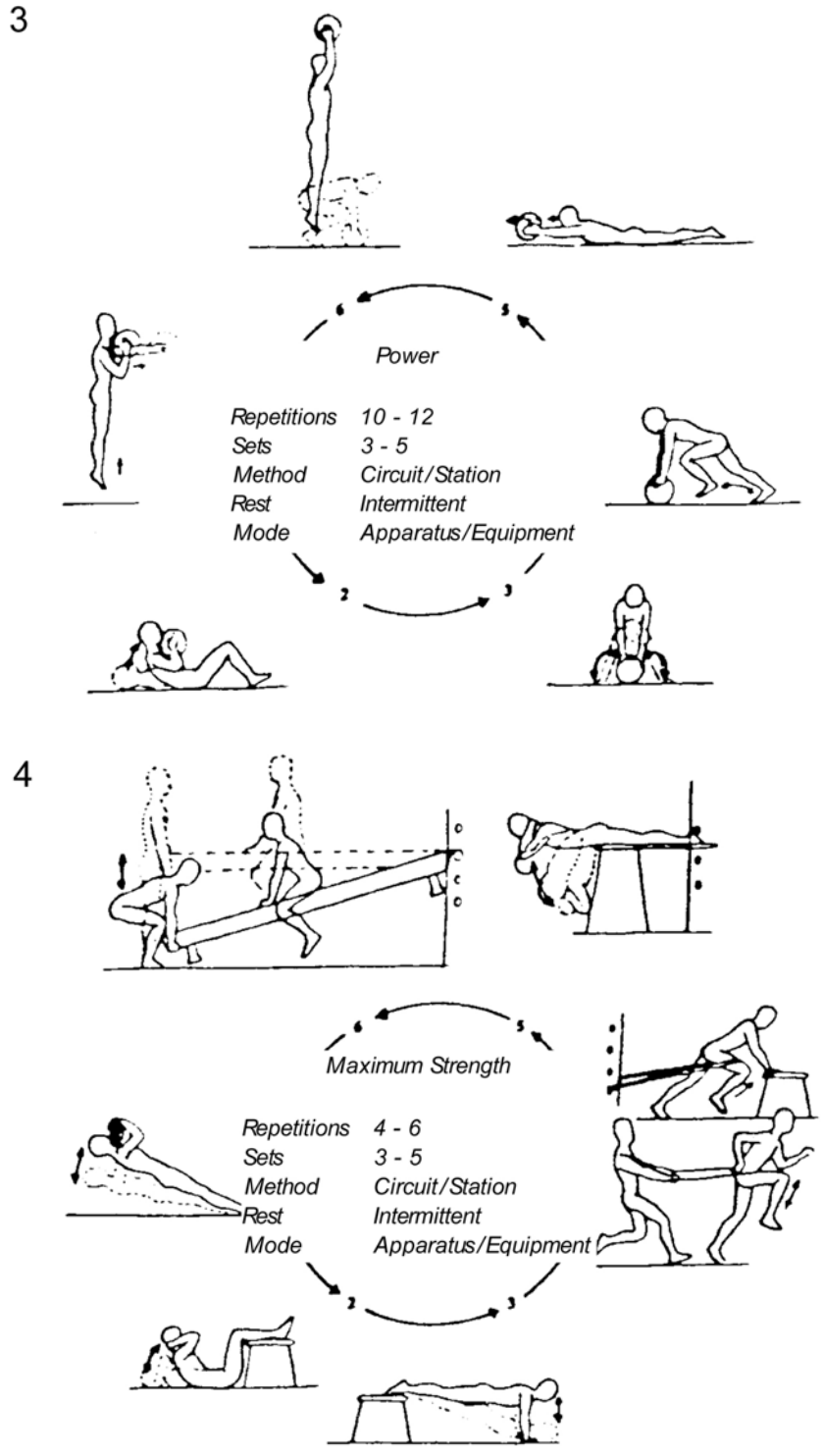


Figure 2.B – Example of circuit training Programmes

The general conditioning programme will establish a broad base of strength on which to build higher levels of strength, particularly strength relevant to the sport. It should be noted that, as the FISA CDP Level I programme is directed to the young or beginner rowing athlete, this booklet will emphasise the utilisation of a general conditioning programme followed by a gradually increasing training load. The establishment of this base will also reduce injuries that may occur during the performance of the more demanding sport-specific exercises.

As the athlete matures and becomes more experienced, the exercises become more specific to the sport and are performed against increasing training loads. This will enable the greatest development of strength relevant to the sport of rowing to occur, particularly strength endurance and power.

This development necessitates the increasing use of apparatus and other devices (barbells, exercise machines, etc) to permit the application of increasing training loads. This is particularly necessary in a circuit training programme designed to improve maximum strength. However, caution should be observed while using this form of strength training.

All strength training should be properly instructed and strictly supervised by the coach or an advisor. The FISA CDP Levels II and III will provide more information about developing strength relevant to the sport of rowing, particularly with the use of increasing training loads provided by the use of barbells and exercise machines.

Factors affecting strength training

The following factors should be considered when planning and implementing strength training programmes:

1. It is essential that mobility and general conditioning exercises that use a full range of movement are utilised to ensure normal growth and development, particularly with young or beginner athletes.
2. It is inadvisable to increase training loads until a proper preparation base has been established.
3. Athletes must be taught the proper technique and be under constant supervision for all exercises using higher training loads.
4. Passive or kinetic mobility exercises must never be used when muscles are fatigued.
5. Activity should cease whenever sharp pain is experienced in the exercised muscles.

Strength training exercises

In order to assist you in designing your strength training programme, Appendix B, Strength training guidelines, has been provided at the end of this booklet. As well, Appendix C provides further examples of circuit training programmes.

5.6 Endurance

Endurance is the capacity of the athlete to resist fatigue during applications of work over periods of time. The proper development of sport specific endurance results in the achievement of endurance specific to the time period of the sport.

Depending on the time period of the sport, sports requiring a measure of endurance may be classified as either short-term, medium-term or long-term endurance events. This classification divides events into those that occur within 45 seconds to two minutes (short-term), two to eight minutes (medium-term) and over eight minutes (long-term). Generally, a 2,000m rowing event is classified as a medium-term endurance event.

This level of endurance performance requires the specific development of both aerobic and anaerobic capabilities. This development will result in the improved functional efficiency of the cardiovascular, metabolic and nervous systems.

It should be noted that, to optimise the utilisation of this improved functional efficiency, the development must occur in conjunction with the increased strength and the improved technical proficiency of the athlete.

Development of endurance

The development of rowing specific endurance requires improving both the aerobic and the anaerobic energy systems. But, as the aerobic energy system accounts for about 75 to 80 per cent of the energy used during racing (see Basic Rowing Physiology), endurance training must emphasise the aerobic energy system. Endurance training that emphasises the aerobic system will result in improving the transport of oxygen to and the utilisation of oxygen by the muscle tissues.

Factors affecting endurance training

Although endurance training is very important to the proper physiological development of the athlete, it also provides another benefit. This benefit is the opportunity for the athlete to develop the necessary technical proficiency during training.

It will be necessary for the coach to commence the training season with periods of shorter duration and increase the quantity of the work over time for the physiological and technical development of the athlete will require long periods of training. The progressive improvement in endurance capacity and technical proficiency will enable the athlete to perform longer and more demanding periods of quality training as the training season progresses. The FISA Coaching Development Programme Course.

Endurance training methods

Endurance training will usually occupy the greatest portion of the athlete's training programme. Although there are many variables in endurance training, Appendix D, Endurance Training Methods for Rowing, provides a summary for an aerobic training programme for rowing. These methods should be performed primarily on the water but may be adapted to other training modes such as running, swimming, cross-country skiing, cycling and strength training programmes (See Basic Training Methodology).

Although training methods for improving the aerobic and anaerobic energy systems are discussed in the Basic Rowing Physiology booklet, this booklet emphasises the development of the athlete's aerobic capacity. The other methods, particularly in regard to the development of the athlete's anaerobic capacity, will be discussed in Level II of the FISA CDP.

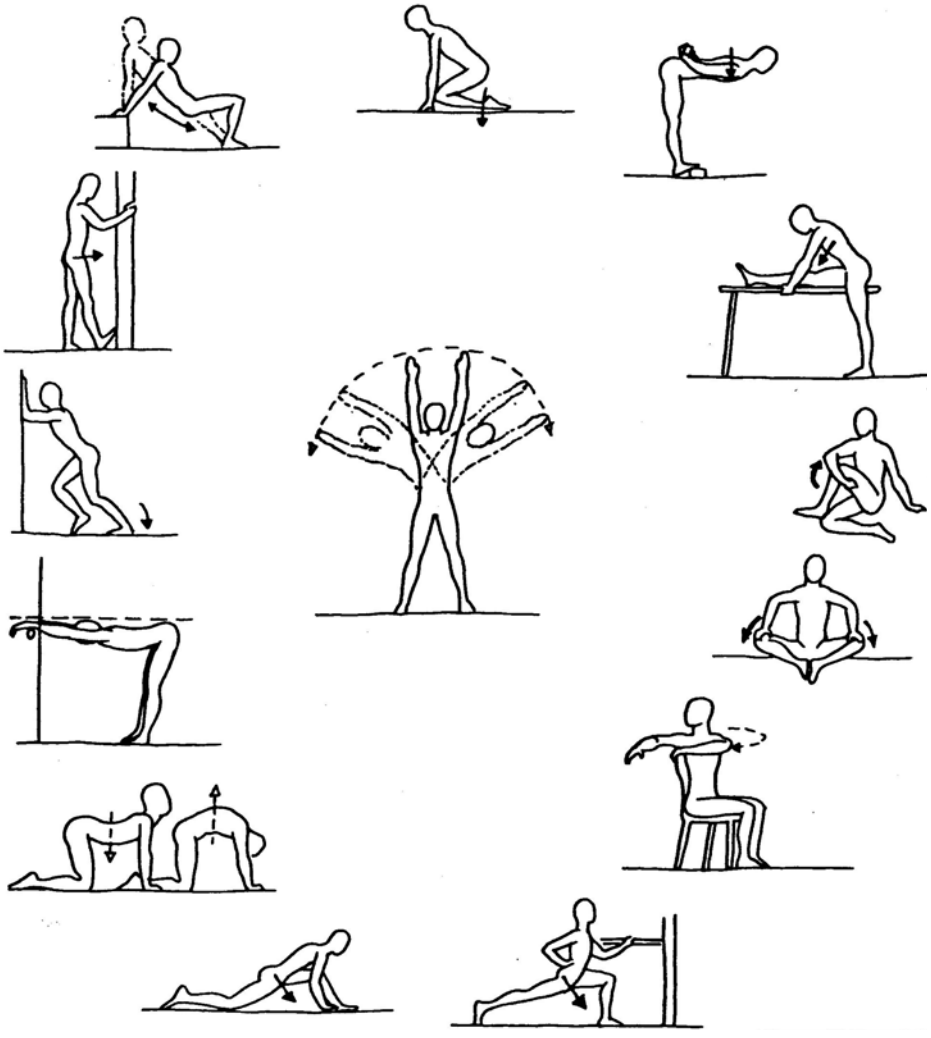
5.7 Summary

The information and suggested training methods presented in the preceding sections are considered basic and of primary importance to young athletes and beginner rowers. It represents the basic physical developmental aspects of good training that will assist this group, in conjunction with improved technical proficiency, to obtain improved benefits from participation in the sport of rowing.

5.8 Appendices

Appendix A – Mobility exercises

In the performance of each exercise, obtain the position indicated in the diagram by stretching the muscles until the initiation of the sensation of pain. Hold the position for about 20 to 30 seconds; increase the stretch and time to 60 to 90 seconds during progressive training sessions.



In the performance of each exercise, obtain the position indicated in the diagram by stretching the muscles until the initiation of the sensation of pain. Hold the position for about 20 to 30 seconds; increase the stretch and time to 60 to 90 seconds during progressive training sessions.

Appendix B – Strength training guideline

Type	1	2	3	4
Purpose:	General Conditioning	Strength Endurance	Power	Maximum Strength*
Exercises:	General	General	General	Specific
Legs:	3	3	2	1
Legs & back:	2	2	1	1
Back:	2	1	1	1
Abdominal:	2	1	1	1
Arm flexion:	1	1	1	1
Arm extension:	1	1	1	1
TOTAL:	10-12	8-10	6-8	4-6
Repetitions:	30-40	20-25	10-12	4-6
Sets:	4-6	4-6	3-5	3-5
Method:	Circuit/station	Circuit/station	Circuit/station	Circuit/station
Rest:	Continuous	Continuous/ intermittent	Intermittent	Intermittent
Mode:	Individual	Pairs/ medicine ball	Apparatus/ equipment	Apparatus/ equipment

General Conditioning:
A training program to systematically exercise all parts of the body to provide a broad base of strength on which to build higher level of strength.

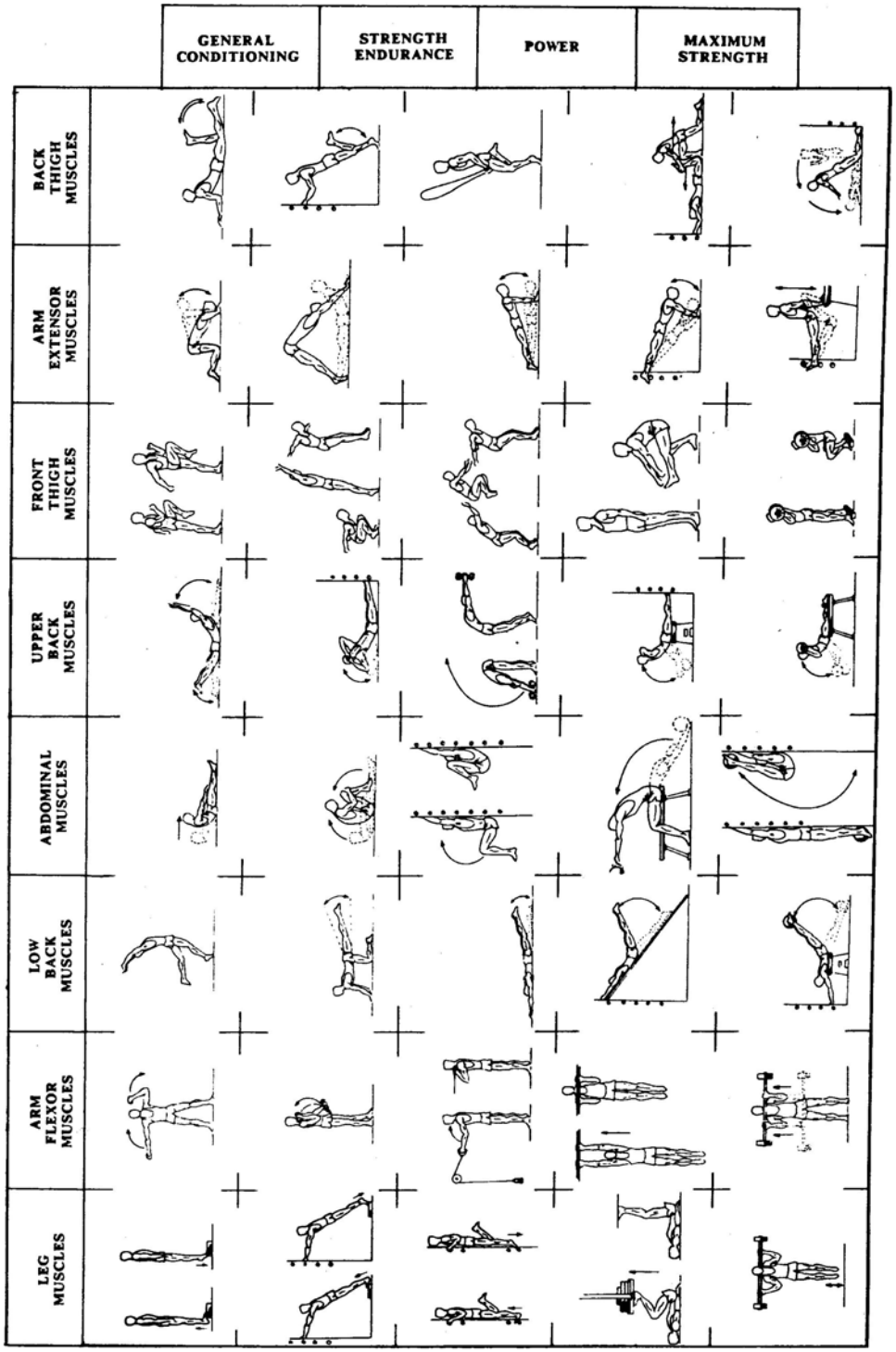
Strength Endurance:
A muscle or muscle group's ability to withstand fatigue during extended periods of strength utilisation.

Power:
A muscle or muscle group's ability to overcome resistance with a high speed of contraction.

Maximum Strength:
A muscle or muscle group's maximum ability to develop mechanical force.

* = Not recommended for young or beginning athletes.

Appendix C – Circuit training programmes



Energy System	Training Effect	Quantity		Quality		Recovery	
		Number Reps/sets	Duration	Heart rate	Stroke rate	Duration Reps/sets	Heart rate
Aerobic:	Utilisation						
	1)	1	20-90 min	130-160	20-24	-	-
	2)	2-3	15-29 min	150-170	22-26	1-3 min	130-140
	Transportation						
	1)	3-8	3-10 min	180-190	26-32	4-6 min	120-130
	2)	10-20	20-60 sec	185-195	28-34	10-45 sec	120-130
Training (Examples):							
Utilisation	1)	1 x	45 min	130-160	20-22	-	-
	2)	2 x	15 min	150-170	22-26	3 min	130-140
Transportation	1a)	3 x	7 min	180-190	26-28	5 min	120-130
	1b)	8 x	3 min	180-190	30-32	2-4 min	120-130
	2a)	2 sets/ 12 min	30 hard/ 10 easy*	185-195	30-32	5-7 min	120-130
	2b)	2 sets/ 20 min	17 hard/ 5 easy*	185-195	34-36	5-7 min	120-130

* = stroke

6 Learning Methodology

6.1 Introduction

The good coach is the person who can control and use time, water space and the coaching environment to the best advantage. The successful coach will have undertaken many tasks. He will be:

- an instructor
- a teacher
- a trainer
- a motivator
- a publicity agent
- a disciplinarian
- a manager
- an administrator
- a social worker
- a scientist

and a student of the sport.

A coach who is able to use these skills will have the ability to:

- assess a situation,
- plan alternative procedures,
- choose the best procedure for the situation,
- control the implementation, and
- assess and redesign, if necessary, the procedure.

The skillful coach is adaptable, resourceful, logical and confident. As a master of technical information, motivational devices and able to communicate easily, the coach should be very successful. But, success is dependent on an understanding of the variables which are interplaying between the coach, crew and environment and is also a demonstration of good planning and organisation by the coach.

6.2 Principles of planning and organisation

Planning requires a clear understanding of the objectives or aims of an athlete development programme and an organised procedure to achieve these objectives.

Objectives

The first step in the development of a plan is the formulation of its objectives or aims. It is essential for the coach to clarify, for himself and for the athletes, the ultimate or long-term objective of the programme and to develop short-term objectives for training that will result in the achievement of the ultimate goal.

It must be remembered that these objectives must be realistic. Goals which cannot be reached due to the age, ability or experience of the individual or group are not helpful and, in fact, may be detrimental.

It is also important that, once these goals have been formulated, the coach must commit them to paper. This written commitment should be examined often during the continual process of reviewing, assessing and planning.

Organisation

The organised coach will have a better opportunity to achieve the training objectives. This first requires an understanding of the factors affecting organisations:

- ability and relative experience of individuals
- range of ability
- size of group
- learning potential
- age
- ratio of athletes to coaches
- expertise of coaches
- length of session
- number of sessions
- time of year
- water conditions
- number and types of boats available
- facilities.

These factors can have a greater or lesser influence at any given moment and can alter the character of an individual or a series of training sessions. Therefore, the coach must learn to be adaptable and flexible.

This knowledge will allow the coach to design an effective organisation which will demonstrate:

a Good utilisation of time:
the coach should expect to spend more time at the sport than the athletes to ensure the best utilisation of their time.

b Proper selection of content:
each training session should have a list of essential elements in priority which may be altered according to changing conditions.

c Effective methods:
a method of instruction should be determined before the session; this may involve verbal and non-verbal techniques while remembering that in the acquisition of a motor skill the most effective technique is HAVING A GO.

d Good observations:
the coach must remember to listen to and observe the group.

e Feedback and guidance:
the observation made and comments received by the coach will allow the coach to provide effective feedback to the group on their efforts.

An effective organisation will also ensure the availability and suitability of the facilities, boats and equipment. This is important for the motivation of both the coach and athlete. With this organisation, the coach is prepared to present new information.

6.3 Presenting new information

This section will introduce a basic model for presenting new information to the athlete by considering the four major steps in coaching sport techniques, namely:

1 Introduction
2 Demonstration
3 Practice
4 Feedback

Introduction

It is important when introducing a new skill or even the sport itself to be enthusiastic in both words and actions. The coach should speak clearly and use language the group can readily understand. If introducing a new skill, such as feathering the blade, the coach should be brief in his comments and remember to:

a Get the group's attention:
by being punctual, speaking directly and with eye contact.
b Arrange the group so all can see and hear:
by avoiding background distraction, such as having the group looking into the sun, and using audio or visual aids when necessary.
c Name the technique and, if appropriate, give a reason for learning it:
for example, "Today we are going to learn to feather the blade. It makes it easier to carry the blade off the water during the recovery and reduces wind resistance."

It is now necessary to demonstrate the skill.

Demonstration

The coach may demonstrate the skill being taught by the use of visual aids, by performing the skill himself or by having an experienced athlete do the performance. It is often useful when coaching a small group of beginners to have them watch each other attempt to perform the required skill. There are a few general principles which apply to this aspect of the presentation, namely:

a Direct the attention of the group to the demonstration.
b Tell the group what to look at.
c If possible, show the skill from different perspectives.
d Demonstrate the whole skill just as if it would be performed.
e Relate the new skill to previously learned skills.
f Answer relevant questions about the skill.

Demonstration is most effective as a teaching method when it is followed by extensive practice.

Practice

It is important that the athletes practise the skill as soon as possible after the demonstration. Particularly with beginners, it is necessary to have the athletes initially try to make an approximation of the whole action of the skill being taught. This will provide a reference for further practice. There are several key issues that the coach should remember, namely:

a Arrange the group and show them how to practise. It is important that this opportunity is well planned, particularly for beginners working on a busy stretch of water.
b Motivate the athletes to practise.
c Answer relevant questions. It is important for the athletes to understand what they are trying to achieve.

During the practice, the coach must be in a position to properly observe the athletes to provide them with feedback on their attempts.

Feedback

The practice must be accompanied by feedback from the coach for optimum learning of the skill and the sport. The feedback provides athletes with information about their performance that will aid in correcting performance errors.

There are three main principles for the coach to observe in providing feedback:

a Observe and evaluate the performance of the athlete in relation to the objective of the session.
b Provide feedback after the performance as soon and as frequently as possible.
c Give effective feedback by keeping it simple and precise and, above all else, only ask the group to concentrate on one thing at a time.

A summary for a basic model of presenting new coaching information to novice or beginners is presented in Appendix A and a coaching checklist for presenting new information is provided in Appendix B.

To effectively present new information, it is also necessary for the coach to understand the stages in learning a skill. These will be examined in the next section.

6.4 Stages in learning

Researchers have demonstrated that there are three stages in learning. While these stages have been identified and chracterised for convenience and analysis, it is always important to remember that learning is a continuous process. The three stages in learning are:

1 the early stage,
2 the grooving stage, and
3 the automatic stage.

The early stage

The movements at this stage are generally slow, inefficient and uncoordinated as the athlete, and in particular the beginner, is trying to convert the coach's directions into actual movement. The thinking processes are heavily involved as the athlete is trying to understand the purpose of certain motor acts, analyse the situation and devise techniques to reach the objective. The coaching principles associated with this stage are:

a concentrate on basics,
b limit the number of tasks,
c short and frequent practice periods,
d limit distractions, and
e keep the task enjoyable.

The grooving stage

This stage occurs when the athlete understands the objective and is able to concentrate on practising techniques which will promote learning. The main coaching principles are:

a quality movement:
the optimum movement pattern should be encouraged.

b repetition:
frequent quality repetitions of the movement should be encouraged.

c relaxation:
short concentrated bouts of practice followed by a contrasting activity to relax the system.

d technique / time:
improving performance will permit a longer practice period and an increase in tasks.

e pressure / speed:
improving performance will permit training at a higher load by an increase in pressure on the blade and speed of movement.

The automatic stage

This stage is considered the final stage in skill acquisition. The athlete is able to process information easily with minimal interference from other activities. Consistency in technique (good or bad) is a feature of this stage and the stroke can withstand an increase in training load. The main coaching principles of this stage are:

a Time:
this stage probably take months but the reward is consistency in performance.

b Differences:
this stage may be reached at different times for different parts of the stroke.

c Regression:
regular observation, analysis and instruction are necessary to prevent regression.

d Over-learning:
too much practice provides limited benefits.

The coach will be more effective during the training sessions with an improved ability to present new information and an understanding of the stages in learning a skill. This effectiveness may still depend on an ability to communicate.

6.5 Communication

This topic has been discussed in other sections of this booklet but further comments are warranted. Many of the greatest coaches in our sport seem to have the ability to build a close bond between themselves and the crew. This has been described as “magic”, “charisma”, etc. but further analysis often reveals that it is communication which is the cornerstone of their success.

Some traits inherent in these coaches are:
a a high awareness level of their athletes and of themselves.
b the gift of being trusted by the athletes.
c the ability to listen to the athletes.

These traits are all developed and demonstrated by the coach over a period which enables an enhancement of the athletes’ performance by the establishment of this close bond.

While a complete discussion of communication is beyond the scope of this introductory booklet, Appendix C has been provided to assist in improving communication skills. The interested reader is encouraged to consult this information as well as take an opportunity to watch and learn from successful coaches.

6.6 Summary

Coaches provide an invaluable service to the development of the sport and its participants at all levels. The best method to improve your coaching skills is to coach and learn how theory actually works in practice.

This booklet has been written to provide information to assist in the evaluation of your coaching and, above all else, to encourage you to coach and develop the sport of rowing.

6.7 Appendices

Appendix A

Presenting new coaching information:

Introduction

1 Get the group's attention.
2 Arrange the group so all can see and hear.
3 Name the skill and, if appropriate, give a reason for learning it.

Demonstration

1 Prepare the group for the demonstration.
2 Demonstrate the whole skill.
3 Relate the new skill to previously learned skills.
4 Answer relevant questions.

Practice

1 Arrange the group and show them how to practise the skill.
2 Motivate the athletes to practise the skill.
3 Practise the skill.

Feedback

1 Observe and evaluate the performance.
2 Provide feedback after performance as soon and as frequently as possible.
3 Give effective feedback.

Appendix B

Coaching checklist for presenting information.

Activity selection

1. Was the activity challenging to the crew?
2. Was it possible for the crew to be successful?
3. Are the athletes making progress?

Instruction

1. Are the athletes aware of the objectives of the session?
2. Did you present a good model of the skill?
3. Did you provide effective feedback with verbal, visual and kinesthetic cues?
4. Did you provide the athletes with time to apply the skill in a typical situation?
5. Did you allow for individual differences?

Participation

1. Did you reduce talking time to a minimum?
2. Were your instructions clear?
3. Did you organise the group effectively?
4. Did the practice situations allow for maximum participation by the group?

Equal opportunity

1. Did you provide for less able rowers?
2. Did you provide for those who were experiencing difficulty in following your coaching methods?
3. Were the presentation techniques suitable for all participants?

Safety

1. Did you present the information in the context of safety?
2. Did you follow the correct procedures when working with equipment which can cause injury?
3. Was the equipment checked before the practice?

Motivation

1. Were the participants successful (i.e. did you present material in such a way as to allow them to achieve your objective)?
2. Did the group enjoy the session?

Appendix C

Communication

Communication is a vast topic and well beyond the scope of this material but there are several key features that should help you to improve your communication techniques: These are:

1. Reduce any "status awareness" between you and the group, that is, develop the appropriate level of language and other communication techniques in accordance with your situation. For coaches with perhaps limited experience this can be very difficult to achieve and some may like to hide behind status anyway!
2. Use as many channels of communication as possible. The hallmark of a good coach is presenting the same information by using different methods.
3. Try to eliminate any sources of interference, disruption or distraction.
4. In most situations, face to face communication is best because it allows for dialogue between the parties involved.
5. As the originator of the message, you, the coach, must accept the responsibility for the effectiveness of the communication.
6. Simple, uncomplicated language which avoids the use of jargon until it is fully understood is often the most effective.
7. Learn to listen to the responses of the receiver of your information since this will often enable you to adjust your technique for the introduction and development of the next piece of information.
8. Try to be aware of the subliminal of body language messages. You might be hindering the group; some coaches, for example, often look bored if they have presented the material on several occasions previously.

Remember, improving your communication skills will enhance the performance level of your athletes.

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