

2.13 GLOSSARY INDEX

acceleration - an increase in speed. It is calculated as the change in speed divided by the change in time. $a = \Delta s / \Delta t$

acceleration curve - a graphic representation of a complete stroke of the boat acceleration over time. p.218.

approach – typically refers to the final movements toward the catch.

athlete stroke length – also work distance. the horizontal distance the athlete moves the oar handle from full reach to the finish position.

average drive speed – the average speed of the boat during the drive phase of the stroke, full reach to finish position. p.341.

average recovery speed – the boat's average speed during the recovery from the finish position to full reach. p.348.

backstops – the tabs on the bow end of the slide tracks, preventing the seat from rolling off the end.

balance – the level setup of the boat during the stroke. p.210.

blade - the flat spoon-shaped portion of the oar.

blade connection – that part of the catch when the force is initiated on the fully buried blade. p.248.

blade depth - the depth of the blade in the water during the drive phase. p.259.

blade extraction - that part of the stroke cycle (drive phase) when the blade is extracted from the water. p.261

blade extraction point - that point during the release just before the blade moves in the same direction as the boat. p.261.

blade feathered – 1. the position of the blade when it is parallel to the water's surface. 2. the point in the stroke cycle when the blade first achieves the feathered position.

blade path - the movement tracking of the blade during the stroke cycle. p.253.

blade squared – the position of the blade when it is perpendicular to the water's surface.

blade-seat timing – the movement of the slide changing direction, and the

blade entry must be simultaneous.

bladework - the movement of the oar blade during the stroke cycle.

boat check – an excessive downward dipping motion of the stern when the crew is in the full reach position.

boat speed data – the time, distance, and interval speed values of the boat movement. p.330.

boat/athlete system – refers to the combined centre of gravity of both the athlete and the boat. The COG moves within the shell during the stroke but is a constant for acceleration on the drive and deceleration on recovery.

boatmanship - also oarsmanship, the ability to control and handle a boat.

body angle - the angle of the upper body (torso) relative to the perpendicular.

breathing - a natural movement of the body to take in oxygen and dispel carbon dioxide.

bucking - a rowing fault where the shoulders move towards the stern during the drive phase of the stroke.

catch - 1. that part of the stroke cycle when the oar enters the water. 2. the action of the oar entering the water.

catch angle - 1. a measurement of rigging, the angle of the oar when it is in the full reach position, p.274. 2. the forward lean of the torso in the catch position.

catch length - a measurement of rigging, the distance parallel with the boat from the center of the oarlock pin to the end of the oar handle.

catch slip – is a measurement of catch efficiency used by NK EmPower Oarlock. the angle in degrees between the oar at the catch (full reach) and the oar when the pressure on the oarlock achieves a set force.

cavitation – is the development of water vapor bubbles caused by a sudden reduction in pressure. p.267.

crab - a fault in rowing technique caused by not getting the blade out of the water before the water pressure builds on the backside of the blade, causing the blade to stick in the water.

deceleration – is negative acceleration.

deceleration time – the measured time between peak speed on the recovery and positive acceleration near the entry. p.355.

depth - 1. a perpendicular measurement downward from a surface. 2. a dimension of the shell.

designed water line - the line on the boat which corresponds to the surface of the water.

dig - a fault in rowing of the blade going too deep during the drive.

distance per stroke – the distance the boat moves in one complete stroke cycle.

double - a shell rowed by two scullers.

drag - a resistance to movement caused by the air or water.

drill – an exercise to enhance a specific aspect of technical movement.

drive - that portion of the stroke cycle between the catch and the finish when the oar is in the water propelling the boat.

drive acceleration – the calculated boat acceleration $a = \Delta s / \Delta t$ between the blade

entry and the blade extraction. p.338.

drive acceleration

efficiency - is a comparison of the boat's projected linear acceleration and the actual movement between the blade entry and extraction. p.341.

drive phase – the portion of the stroke between full reach and finish position. p.217.

drive hump – a loss in boat acceleration following the catch. p.335.

drive time - the time in seconds between blade full bury (entry) and blade feather.

dynamic recovery – rowing technique recovery that combine simultaneous movements of legs, torso and arms from the finish position to full reach. p.240.

early drive – the first part of the power application phase. p.188.

early recovery – the first part of the recovery phase p.226.

effective stroke length – is the distance the boat moves between the entry and the extraction of the blade.

entry – also catch, that part of the stroke between full-reach and blade becomes fully buried. p.224.

entry time – a technique factor. The time measured between full reach and blade entry. p.331.

error – a movement that does not support or inhibits power application or boat speed.

feathering - the turning of the blade from perpendicular to the water's surface to parallel the water's surface.

finish - that part of the stroke cycle nearing the end of the drive phase, but before the release, also late drive. p.234.

finish overlap – a dimension of rigging, from the butt to the center of the boat when the oar is in the finish position.

finish position – the position of the oar and athlete at the end of the drive phase when the body is closest to the bow. p.234.

finish split distance – the distance between the sculling oar handles when the athlete is in the finish position.

finish wash - NK EmPower Oarlock measurement of the angle in degrees between the oar angle when the pressure on the oarlock falls below a certain force and the oar at the finish.

flow - the sequential movements of continued rowing technique.

footstop position – the position of the footstops relative to the oarlock pin.

footstops - the assembly fitting the athlete's feet into the shell.

footstop adjustment - the positioning of the footsteps.

footstop angle – the angle of the footboard to the horizontal level of the boat; a flatter angle may allow additional reach.

footstop distance – the distance from heelcup to the center of the oarlock pin measured horizontally along the centerline of the boat.

footstop height – a measurement in rigging, the vertical distance between the lowest part of the heelcup and the top of the seat.

force - a power that can alter the state of movement.

Force = mass x accel.
 $F=ma$. Force is measured in Newtons.

frontstops - that part of the slide or tracks which prevents the seat from going off at the stern end.

fulcrum - the stationary point to which a lever rotates around.

grip - the position of the hands on the oar handle. p.208.

hull - the main watertight structure of the boat.

impulse (J) - the result of force x time.

individual rigging – is adjusting the rig for the individual athletes.

inside hand - the hand of the athlete closest to the rigger.

intensity – the intensity of the muscle application.

late drive – that part of the power application phase. p.320

late recovery – the final part of the recovery as the athlete approaches full reach and the hull slows. p.214.

layback - the amount of body angle in the finish position towards the bow.

learning styles – different ways in which athletes learn best, visual, tactile, auditory.

leg drive - the action of the legs during the drive portion of the stroke.

length - a measurement between two points.

length ratio - 1. a ratio of the outboard to inboard of the oar. 2. a ratio of the stroke length to the work distance.

leverage - a measure of the rigging dimensions that affect the transfer of force through the oar as a lever, such as inboard to outboard ratio and spread or span measurement.

load – the resistance felt by the athlete on the oar handle during the drive phase of the stroke.

mid drive – part of the power application phase. p.228.

mid recovery – part of the recovery phase of the stroke. p.246.

momentum – a measure of an object's inertia while it is moving, which is equal to the mass times velocity.

neutral spine – the natural alignment of the athlete's backbone.

new-old-new – a coaching method to share the feeling of rowing technique changes with the athletes. p.394.

oar handle catch split – the distance between the butts of the sculling oar handles when the athlete is at full reach. p.222.

oar handle – that part of the oar held in the athlete's hands.

oar handle recovery

height - is the distance the oar handle is above the waterline during the recovery of the stroke.

objective evaluation – using a measurement to evaluate.

over-reach - a fault in rowing technique of reaching past an effective position at the catch.

parallax error – the difference in the measurement between the middle of the video frame and the edge. p.315.

pause drills – drills that incorporate a stationary position for a given time. p.304.

peak speed as percent of recovery - the percentage of the recovery that the

boat achieves peak speed. p.352.

performance factors – technique movements that have been identified by values that may link to performance. p.333.

posture - the position of the athlete's body standing or sitting.

power - a measurement of work divided by time, typically measured in watts (W).

power application stage – part of the stroke cycle sequence from blade entry and extraction. p.218.

propeller motion – is caused by the motion of the blade in the water, acting like a propeller.

puddle spacing – the distance between the puddles made by the blades.

quad – a shell rowed by four scullers.

race start - 1. the start of a race. p.383.

rate – see stroke rate.

ratio - see load ratio or stroke ratio.

recovery - that part of the stroke cycle between the finish and full reach at the catch. p.237.

recovery acceleration - the measured acceleration ($\Delta s/\Delta t$) between boat speed at finish position and peak speed. p.346.

recovery acceleration efficiency – a technique factor. the proportion of boat movements compared to boat acceleration on recovery between the finish position and peak speed. p.345.

recovery peak speed – 1. the percentage of the recovery when the peak boat speed is achieved. p.328. 2. the time within the stroke cycle or the speed at which the boat achieves the maximum speed.

recovery style – the synchronized movements of legs, torso and arms during the recovery phase. p.237.

recovery time – the time taken between the release and the catch during the stroke cycle, p.352.

release - that part of the stroke cycle where the blade is extracted from the water and the handle

release speed change – the difference in boat speed between extraction and feather. p.344.

release time – measured time between the blade extraction and the blade feather. p.343.

rhythm – is the continuous repeated stroke cycle pattern of the athlete(s) timing and movement linking an effective drive phase with recovery phase movements that maximize hull speed at the stroke rate rowed. p.357.

rotational velocity - is the turning speed around a radius point.

rudder - a flat piece of wood, metal, or plastic used to steer the boat.

sculling – rowing in a sculling boat (1x, 2x, 4x) with two oars. p.269.

sculling grip - the position of the hands on the oar handles. p.269.

scull – the act of rowing in a sculling boat.

sculls – the oars used for sculling.

sequencing – separating the movements in order, one after another. p.206.

simultaneous – occurring together at the same time. p.206.

single - the shell rowed by one sculler.

speed – 1. the rate of movement of the boat. 2. a measure of movement distance divided by time.
 $s=d/t$

SpeedCoach – developed by NK to monitor, display and record stroke data and boat movement and speed.

speed curve – a graphic reference of the boat's speed through the stroke. P.313.

speedwork – training that is done at high rates to develop good technique at higher rates.

spiking – is a term that describes changing the path of the boat when it is in the starting gates. p.284.

start technique – the rowing technique used in the first set of strokes in the race. p.283.

steering – controlling the direction of the moving boat. p.275.

stroke - 1. the athlete who is rowing in the seat closest to the stern, 2. the action of rowing.

stroke rate – a measurement of cadence, the number of strokes taken in a minute. p.278.

stroke length - is the distance measured parallel to

the boat from the tip of the blade when the oar is in the catch position to a point even with the tip when the oar is in the finish position.

stroke position –1. the position of the stroke arc relative to the boat measured in degrees at full reach and finish oar angles. 2. the percentage of time on the drive phase, between the times, of the oar full bury to perpendicular to the boat, compared to the time of the oar full bury to extraction.

stroke ratio – is a measurement of the rowing technique, the result (quotient) of the recovery phase time divided by the drive phase time. p.279.

style – specific positions or movements within rowing technique that are insignificant to the athlete's ability to apply power on the drive and do not inhibit rhythm on the recovery.

subjective evaluation - an individual perception.

sweep grip - the position of the hands on the oar handle.

sweet rowing – the action of rowing with one oar in a crew boat.

swing - the movement of the athlete's bodies on the

recovery portion of the stroke.

technique – movements of the body and oar/blade that are critical to the athlete's power application on the drive and movement on the recovery, affecting rhythm.

technique factors – parts of the rowing stroke that have been identified with an objective value relating technique and boat movement. p.329.

timing - the simultaneous movements.

training - that part of a practice that provokes a muscle adaptation, either physical or technical.

training plan – also practice plan, an outline of the intended events during the practice.

training volume – the length of time (sometimes measured in distance) identified in the workout.

transition – that part of the race between start sprints and body pace.

velocity – a measure of speed.

video analysis – the extraction of subjective or

objective information from the video.

video capture – the recording of a crew rowing using a camera or smartphone. p.313.

vortex – the flow of water swirling around forming a whirlpool. p.263, 267.

washing out - a fault in rowing technique, when the blade comes out of the water early before the normal extraction point.

watts – a measure of power, work divided by time.

whole-part-whole – a coaching method to emphasize changes in rowing technique.p.394.

work – a measure of activity calculated as the product of force and distance.

workload – a combination of training volume and intensity that creates fatigue for the training effect.

workout – also practice. the duration of the practice.

Abbreviations & Accronims

Δ	- delta, increment, (symbol for change in)
a	- acceleration (m/s^2), ($a=\Delta v/\Delta t$)
ABS	- average boat speed
ADS	- average drive speed
ARS	- average recovery speed
CL	- catch length
COG	- centre of gravity
COM	- centre of mass
d	- distance
DAE	- Drive Acceleration Efficiency
DSPBS	- Drive Speed as a Percent of Boat Speed
FPS	- video frames per second
F	- force (N), ($1N=1kg\cdot 1m/s^2$)
I or J	- impulse, ($m\cdot\Delta v$), ($N\cdot s$), ($F\cdot\Delta t$),
J	- joule, energy ($N\cdot m$), ($1J=1kg\cdot m^2/s^2$)
KE	- kenitec energy (units: joules)
kg	- kilogram
m	- mass (kg)
m/s	- <i>meters per second (speed)</i>
N	- Newtons (N) ($1N=1kg\cdot 1m/s^2$)
p	- momentum ($m\cdot v$) ($kg\ m\ s^{-1}$)
RAE	- Recovery Acceleration Efficiency
RPS	- Recovery Peak boat Speed
RSPBS	- Recovery Speed as a Percent of Boat Speed
s	- seconds
s	- speed
t	- time
v	- velocity
v_f	- velocity final
v_i	- velocity initial
W	- watts (W) ($1J/s$)
W	- work (Fd)

Video Boat Movement Data Oar Positions

- Vd_{c1} - video boat distance at entry1
- Vd_{c2} - video boat distance at entry2
- Vd_{ex} - video boat distance at the extraction point
- Vd_{fp} - video boat distance at feather (finish position)
- Vd_{ps} - video boat distance at peak speed
- Vd_{fr1} - video boat distance at full reach 1
- Vd_{fr2} - video boat distance at full reach 2
- Vd_{op} - video boat distance at oar perpendicular (drive)
- Vs_{c1} - video boat interval speed at entry1 or catch1
- Vs_{c2} - video boat interval speed at entry2 or catch2
- Vs_{ex} - video boat interval speed at the extraction point
- Vs_{fp} - video boat interval speed at feather
- Vs_{ps} - video boat interval speed at peak speed
- Vs_{fr1} - video boat interval speed at full reach 1
- Vs_{fr2} - video boat interval speed at full reach 2
- Vs_{op} - video boat interval speed at oar perpendicular (drive)
- Vt_{c1} - video frame time entry1 or catch1
- Vt_{c2} - video frame time entry2 or catch2
- Vt_{ex} - video frame time blade extraction
- Vt_{fp} - video frame time feather
- Vt_{ps} - video frame time peak boat speed
- Vt_{fr1} - video frame time full reach 1
- Vt_{fr2} - video frame time full reach 2
- Vt_{op} - video frame time at oar perpendicular (drive)

Formulas

$$a = \Delta v / \Delta t$$

$$a = 2d / t^2$$

$$d = 0.5 \cdot a \cdot t^2$$

$$F = ma \therefore m = F/a \therefore a = F/m$$

$$F \Delta t = m \Delta v \therefore F = m \Delta v / \Delta t$$

$$I = Ft \therefore F = I / t \quad J = I \quad (\text{impulse})$$

$$I = \Delta p$$

$$I = \int_{ti}^{tf} F(t) dt \quad \int = \text{integral}$$

$$KE = 0.5m \cdot v^2, \quad \Delta KE = F \cdot d, \quad KE = p^2 / 2m$$

$$p = mv$$

$$\Delta p = p_f - p_i = m(v_f - v_i) = F(\Delta t)$$

$$v = d / t \therefore d = v \cdot t$$

$$W = \text{watts}, \quad W = \text{Joules} / \text{second}$$

$$W = F \cdot d, \quad N \cdot m, \quad (\text{work}),$$

$$\text{Speed Curve Efficiency} = (\Delta d - v_i \cdot \Delta t) / (\Delta v \cdot \Delta t / 2)$$

$$\text{Impulse for varying force } J = \int_{ti}^{tf} F(t) dt$$

$$\textbf{Concept 2: } 500\text{m split} = \sqrt[3]{(2.80 / W)} \cdot 500$$

$$\text{WATTS} = 2.80 / (\text{SPLIT IN SECONDS} / 500)^3$$

$$\text{Catch Angle Sweep} = \text{ArcSin} [\text{Catch Length} / (\text{inboard} + 2.1)] - 2.3$$

$$\text{Finish Angle Sweep} = \text{ArcSin} [\text{Finish Length} / (\text{inboard} + 2.1)] + 2.3$$

$$\text{Catch Angle Sculling} = \text{ArcSin} [\text{Catch Length} / (\text{outboard} - 1.9)] + 1.1$$

$$= \text{Oar Finish Angle Sculling}$$

$$= \text{ArcCos} [(\text{span} / 2 - \text{finish split} / 2) / (\text{inboard} + 1.9)] + 1.1$$

$$= \text{Oar Catch Angle Sculling}$$

$$= \text{ArcCos} [(\text{span} / 2 - \text{handle split} / 2) / (\text{inboard} + 1.9)] - 1.1$$