



World Sailing Doping Risk Assessment

2025

By

World Sailing Medical Commission

DOPING RISK ASSESSMENT IN OLYMPIC SAILING

INTRODUCTION

The International Standard for Testing (IST) 4.3.2 states that “The Anti Doping Organisation (ADO) shall, as a minimum, evaluate the potential risk of doping and possible doping pattern for each sport and / or discipline.” While the Guidelines for implementing an Effective Whereabouts Program 2.7 further specifies that, “each International Federation / NADO must be able to demonstrate it has made a proper assessment of the relevant risks and has adopted appropriate criteria based on the results of that assessment.”

Among the Olympic slate in sailing, there has been a large increase in boat and board speeds in recent years through the skiffs and hydrofoil. Racing formats have also intensified, with a higher number of daily races. These changes have increased the physical demands of sailing.

Competitive sailors spend more than 25 hours per week training, not only on the water, but also running, cycling, rowing, swimming, or strength training (Castagna et al, 2007). However, mental, cognitive, and psychological skills are still of the utmost importance (Legg et al, 1999): older and more experienced sailors may effectively use these skills to race against (and sometimes beat) younger and physically stronger competitors. In some studies, age appears to be related to on-water sailing performance (Legg et al, 1997). Sailing is a complex sport, requiring physical and mental attributes, along with experience, boat handling, racing strategy and tactics, and wind-reading. With competitive sailing being multidimensional, it is possible that various doping agents can be used to enhance sailing performance. Increased media exposure and prize money in professional events such as the America's Cup (where World Sailing has a separate Anti-Doping Control Plan), provide additional temptations to dope.

This Risk Assessment was undertaken to provide a basis for World Sailing's Test Distribution Plan, Registered Testing Pool and Testing Pool. This Risk Assessment aims to ensure proportionate testing and optimize our Doping Control Program. The IST states that a risk assessment should contain an evaluation of available doping analysis statistics, doping trends, training and competition seasons, the physical demands of each sport, and the performance enhancing effect of the various doping agents. As the demands for each Olympic sailing class is different, this risk assessment is tailored to each class. The physiological profile for each of the sailing classes were extracted from publications in peer reviewed journals and international sailing conferences.

Injured athletes could be tempted to use substances such as anabolic androgenic steroids to reduce muscle wasting and accelerate muscle repair. Therefore, in case of injuries, anabolic agents can potentially be ergogenic in all classes, not only in those where force-generating capacity is of utmost importance. This will not be taken into account in this risk assessment but must be taken into consideration when planning doping controls.

PHYSIOLOGICAL ASPECTS OF OLYMPIC SAILING

The risk of doping substances abuse in sports is usually highest in physically demanding disciplines, where speed, endurance, strength, and muscle mass are essential to compete and win. Table 1 shows the physiological profiles of the Olympic classes and crew positions. Each physiological parameter is scored 0 – 10. The bottom of table 1 matches doping substances against the physiological parameter.

With each class, the physiological profile may change with wind conditions (Vogiatzis et al, 2002; Castagna et al, 2007). For example, the iQFOiL class demands a high aerobic capacity in light winds, while force generating capacity (especially in the lower limb and forearm) is the top attribute in strong wind. A higher-trending optimal sailor weight in the iQFOiL class further increases the risk of doping.

The Formula Kite has a lower aerobic and anaerobic demand compared to the iQFOiL, with a relatively low heart rate during racing and low blood lactate concentration measured on-water (<2 mmol/L in 11-15 knots). However, the Formula Kite requires extremely high force-generating capacity in the lower limbs to counteract the lift from the hydrofoil at high speeds.

Most of the scientific studies on physiological demands of sailing have been conducted on windsurfing (the predecessor to the iQFOiL) and one-person dinghy classes, as they have historically been thought to be the more physically demanding classes (De Vito et al, 1996 and 1997; Guevel, 1999; Vogiatzis et al, 2002, Castagna et al 2007, 2007 and 2008). There are only a few studies on the biomechanics and energy cost of trapezing crew (Mackie et al, 1999; Marchetti et al, 1980; Shephard, 1990). These studies surmise that the board and one person dinghy classes have the highest aerobic demand in strong or light winds.

There is a lack of published data in the 49er, 49er FX and Nacra classes, necessitating the use of expert consensus instead. The consensus is that the crew positions in these classes have a high aerobic and strength demand. For example, in the 49er and 49er F, the crew handles the two most powerful sails, the spinnaker and mainsail, while trapezing to keep the boat balanced.

AEROBIC CAPACITY (VO₂-muscular endurance):

Table 1 identifies Olympic sailing classes that require a high aerobic capacity, i.e.. iQFOiL, ILCA, 49er, 49er FX and Nacra crews.

In our literature review, several scientific studies conducted on these classes (Vogiatzis et al 2003; Allen et al, 2006; Castagna et al, 2007; Burnet 2011) confirm that iQFOiL and ILCA, in both genders, are the most energy-demanding classes.

The sailboard pumping action in iQFOiL, which involves almost all muscles (arms, upper and lower trunk, legs), is responsible for the high energy expenditure, requiring a high contribution of both aerobic and anaerobic metabolism; In dinghies, repeated and prolonged hiking (involving especially lower limb) force sailors to develop strength and muscular endurance and high blood lactate tolerance.

Even in those classes characterized by a high anaerobic capacity, performance can be improved by developing aerobic fitness, to increase energy contribution during all-out bouts and to enhance recovery between bouts, such as when hiking, pumping or grinding.

FORCE-GENERATING CAPACITY

The biomechanics of sailing and the muscular strength and endurance of elite ILCA sailors have previously been measured (Rogge, 1983; Plyley et al, 1985; Legg et al, 1977). Some studies have analysed elite sailors assessing strength with hiking performance (Aagard et al, 1998, Tan et al, 2003). There are also some studies which attempt to quantify the magnitude of external force which an ILCA dinghy demands of the sailor in order to sail the boat effectively in different wind conditions (Mackie et al, 1999). These studies illustrate that in those classes which involve hiking postures, such as ILCA6 and ILCA7, force-generating capacity is the most important attribute in improving performance. Muscles of lower limb need to be strong enough to maintain the hiking posture for as long as possible during the whole race, for some classes longer than 60 minutes. Also muscles of the upper limb are involved by holding the mainsheet.

In the Formula Kite, the high apparent wind generated by the kite drives the hydrofoil through the water at high speeds, generating very high lift from the hydrofoil. This lift needs to be countered by pushing down with the legs, and hence the high force-generating capacity required of both the male and female kite foilers.

In strong wind conditions, iQFOiL sailors also need a high force-generating capacity. The boards are capable of exceeding the true wind speed, but to do so, strength in both, upper and lower limb, is

necessary. In strong winds, when no pumping action is required, the energy demand decreases significantly (Castagna et al, 2007), and the muscles remain in static contraction, which implies a higher demand of force.

The Nacra 17 class and 470 classes, (mixed gender classes) have the option of the male or female taking on the roles of crew or helm. As with the 49er, the energy demands and the force-generating capacity of a Nacra / 470 crew is expected to be higher than that for the helm. This, together with the weight distribution in the boat, will be considerations in the choice of the gender for the crew and the helm in a Nacra / 470, and could probably affect our scores at different physiological aspect of both classes.

BODY WEIGHT

In some classes weight management plays an important role in performance. Some sailors have to gain or lose weight according to the class they are sailing and the wind condition they are expected to deal with in different locations and seasons. The iQFOiL class may require relatively high lean body masses for both genders to be competitive. This increases the risk of doping to gain body mass.

In the Formula Kite class, the top performers tended to have high body masses. Sailors, even those at the top levels, struggle to attain the optimal racing weight, Bulking up to achieve the optimal racing weight is especially challenging for the females. There is therefore a higher risk of doping in order to gain weight in this class.

The Nacra and 470 classes are mixed-gender, where the crew may be male or female. Where the crew is female, a higher force-generating capacity and bodyweight may be desired, thereby increasing the risk of doping.

Table 1. SAILING RISK ASSESSMENT- PHYSIOLOGICAL PROFILES (0-10)

CLASS	VO2 – Strength Endurance	Force Generating Capacity	Coordination /Agility	Tactics	Psychological Skills	Bodyweight Loss	Bodyweight Gain	SCORE*
iQFoil	8	8	8	5	5	1	5	40
iQFoil	8	8	8	5	5	1	5	40
ILCA 6	8	10	5	5	5	1	4	38
ILCA 7	8	10	5	5	5	1	4	38
49er Helm	6	3	10	5	5	4	1	34
49er Crew	7	7	10	5	5	4	1	39
49er FX Helm	6	3	10	5	5	4	1	34
49er FX Crew	7	7	10	5	5	4	1	39
470 Helm	5	4	6	5	5	6	1	32
470 Crew	6	4	8	5	5	6	1	35
Nacra Helm	3	3	8	5	5	4	1	35
Nacra Crew	6	4	8	5	5	1	4	39
Formula Kite (M & F)	3	8	9	5	5	1	8	39

SUBSTANCES								
Blood Doping	X							
Anabolic Agents		X					X	
Insulins		X					X	
Stimulants						X		
Diuretics						X		
Hormones		X				X		
Masking Agents		X						

* scores >38 to tested out of competition

DOPING CONTROL IN OLYMPIC SAILING

A review of the results of the doping tests conducted on sailors worldwide in the past 5 years showed no or very little use of classical doping drugs such as anabolic steroids, oxygen transport enhancers, stimulants, masking agents, hormones and related substances.

In/out-of-competition testing

Many of the substances on the prohibited list are only prohibited during competition. In some classes only In-Competition testing is of interest since only substances prohibited In-Competition have a stimulant potential.

For these classes, then, whereabouts information would not be necessary, and sailors should not be in the Registered Testing Pool (RTP) based on our physiological evaluation. Therefore, WS could concentrate efforts in those classes at a higher risk of using prohibited substances included in the list of Out-of-Competition drugs, such as anabolic agents and substances with similar action, hormones and related substances and blood doping. As shown in table 1, these classes are those that scored over 38 points: IQFoil men and women, Formula Kite men and women, 49er crew, FX and Nacra crew.

We could categorize all classes into 3 groups, based on their physiological profile. The target RTP sailors will be tested out of competition at least three times in accordance with WADA's IST. In table 2 we rate these groups based on the overall risk of doping abuse. This rating is primarily based on the potential for enhancing the physiological properties considered in this risk assessment, using drugs or methods on the prohibited list that have most ergogenic potential in each class. It should be a primary guide to define which classes the majority of tests should be performed in.

Table 2: risk level of doping abuse by classes (risk level relative to sailing and not other sports)

HIGH RISK	MODERATE RISK	LOW RISK
IQFoil (M & W)	ILCA 6 & 7	Nacra 17 Helm
Formula Kite (M & W)		49er & 49er FX Helms
49er & 49er FX Crew		470 Crew
Nacra 17 Crew		470 Helm

Blood profiles

Blood profiles are more or less a premise for detecting the use of EPO and blood doping agents. Profiles are important both for identifying athletes with irregular profiles for further follow up, and for potential sanctioning based on the haematological data as indirect evidence in the future. However, since establishing blood profiles is a major logistical challenge, and by the moment, there is no evidence that any of the Olympic classes are using these methods to enhance their performance, we believe it is unnecessary to apply it in sailing.

Blood profiles are useful in sports where aerobic endurance is the most important performance limiting factor. As shown in the physiological profiles, even though the iQFOiL is considered as a highly aerobic activity, other attributes such as skill, experience and tactics may be compensatory and lessen the risk of doping (De Vito et al, 1997). Therefore, aerobic performance is not the limiting factor to win a race, such as it could be in other endurance sports: triathlon, cycling, rowing, or endurance running.

DOPING RISK ASSESSMENT IN OLYMPIC CLASSES

Given the lack of positive tests in sailing the past 5 years, Olympic sailing can be classed as an almost doping free sport. However, this does not mean that there is no risk of doping in sailing. Highly aerobic performing sailors such as iQFOiL may be tempted to increase their aerobic capacity by the illicit use of oxygen transport enhancer or blood doping. If weight gain is needed too, such as Formula Kite, this could lead to abuse of anabolic agents to increase both mass and strength; having to plan very intensive competitive calendar and schedules, including many competitions with several races per day, long trips to get to the regatta locations, heavy training programs, competitive sailors may also be at risk of drug abuse, in the attempt to quickly recover from fatigue and be fit for the next event.

In table 1 we mapped the different physiological attributes involved in each class (rated 1 to 10 according to their importance to get the best results in performance and competition) and the drugs that may be used to illicitly enhance them. As we mentioned before, mental and psychological skills are of great importance for all classes, whereas the physiological demands vary from between class and crew positions. From this point of view, sailing could be considered at risk of stimulants abuse, but doping tests results show otherwise, perhaps because the adverse side effects of stimulants (e.g. excessive aggressiveness, anxiety, tremors), impair strategy and tactics. Stimulants may also be used as anorexiants to help cutting body weight down.

Therefore, according to their physiological profile, the classes that seem to be at higher risk of doping are sailboard (iQFOiL, both men and women), Formula Kite (men and woman) and 49ers, FX and Nacra crews. The drugs to be tested more accurately in sailing seem to be oxygen uptake enhancer (such as erythropoietin and derivative drugs, including urine ESA) for more aerobic classes (iQFoil, crews), anabolic agents and hormones for strength and weight gaining (LIQ foil, Formula Kite, and crews) and diuretics and stimulants to weight loss.

However yearly data suggest that there is no significant use of these drugs in sailing, so in our opinion it is more useful not to focus on tests for specific substances or methods (such as blood doping) but to keep on performing full range urine tests, both in and out of competition, with particular attention to higher risk classes.

This means that WS would recommend that our Registered Testing Pool would comprise:

IQFoil (M)	IQFoil (W)	49er Crew	49er FX	Nacra 17 Crew	Formula Kite (M)	Formula Kite (W)	TOTAL
3 athletes	3 athletes	3 athletes	3 athletes	3 athletes	3 athletes	3 athletes	21 athletes

It is envisaged that WS would complete at least 3 Out-of-Competition tests on those athletes in our RTP. The remaining budget would be used for In-Competition tests and target testing. This will enable WS to provide close individual monitoring of RTP athletes competition schedule, training schedule and whereabouts information.

WS would recommend that our Testing Pool would comprise:

ILCA 6	ILCA 7	Para	49er Helm/FX Helm	Nacra Helm	470 Crew/470 Helm	TOTAL
2 athletes	2 athletes	2 athletes (1 female, 1 male)	2 athletes	1 athlete	2 athletes	11 athletes

It is envisaged that WS would complete 1 Out of Competition test on those athletes in the TP.

Addendum to Olympic Sailing Risk Assessment (version May 2025)

Paralympic Sailing Risk Assessment Introduction

The literature review and evidence documented for the doping risks in Olympic sailing also apply to Para Inclusive sailing. There are a few other considerations that apply where the presence of a disability provides extra challenges for the sailor. These challenges have been analysed by the members of the WS Medical Commission to determine to what extent disabled sailors are at risk of doping.

The sport of Paralympic sailing commenced with a test event at Lake Lanier Atlanta in 1996. Sailing became a Paralympic event in Sydney 2000 using Sonar and 2.4 metre classes. The Paralympic regatta in Qingdao, China saw the addition of the ballast assisted 2 person SKUD 18 skiffs. These three classes were continued until the Rio 2016 Games. Since 2016 the Sonar, the only boat that needed sailors to be mobile in the boat, is no longer used for the WS Para competitions. Sailing has not been included in the Paralympic Games since Rio 2016.

All the boats now used for international Para competition have forward facing seating, that eliminate the need for moving within the boat, and consequently reduces effort while competing.

As such little research has been conducted specifically related to doping in sailing. However, there are a number of practices and procedures in place which mitigate against doping such as classification and education.

Physiological aspects of Para Inclusive sailing

GENERAL CONSIDERATIONS:

All Para Inclusive sailors undergo a rigorous process of classification using the Para World Sailing Classification Rules. Any increase of function through improvement of muscle strength would possibly result in a higher classification class. Any increase in a sailor's class may decrease the sailor's opportunities for competition. More importantly, there is little incentive to increase strength through doping in the Para Inclusive classes. These aspects are discussed under the following relevant titles containing information in addition to the attached Olympic document.

AEROBIC CAPACITY (VO₂-muscular endurance):

Although aerobic capacity may be of benefit for most sailors it is difficult to influence in people with high spinal cord injury (Para Classes 1 and 2) due to autonomic denervation of the heart and the lack of muscle mass. Most para sailing activity involves upper limb function relying on fast twitch power activities. It is possible to develop only limited aerobic capacity due the greater proportion of fast twitch/white muscle fibres in the upper limb. The use of assistive devices and the limited sail area suggest less need for aerobic fitness than the able-bodied classes. All Para Inclusive boats function with sailors seated forward, so there is little body movement except for leaning to the side. There have been no reports of the use of autonomic manipulation or "boosting" in sailing although the practice may be prevalent in wheelchair endurance sports.

FORCE-GENERATING CAPACITY:

The biomechanics of able-bodied studies have some implications for sailors with disabilities. However, the boats used are especially adapted (by use of pulley systems) to enable persons with limited muscle strength manage the different actions needed to control the boats. Furthermore, boat class rules allow for power assisted “servo” devices in the Hansa Class and RS Venture Class if needed. Some adaptations are subject to a technical inspection at each regatta.

BODY WEIGHT:

In some Olympic classes weight management plays an significant role in performance. Some sailors may wish to gain or lose weight according to the boat they are sailing and the wind condition they are expected to deal with in different locations. Due to the fixed seat position in the Paralympic boats, weight is of little consequence.

COORDINATION:

Para Inclusive sailing is open to sailors with coordination difficulties such as cerebral palsy. Maintaining a warm environment during an event is difficult in cold windy conditions. The use of benzodiazepines, beta blockers or cannabis could possibly be beneficial during competition. However, beta blockers and benzodiazepines are not prohibited substances, while the medical use of cannabinoids may be more widely used around the world and must be declared for TUE if prescribed for management of spasticity.

Doping Control in Paralympic sailing

Infringement of anti-doping regulations is rare in sailors. Although subjected to anti-doping controls, there is no evidence to date of anti- doping violations amongst international Para sailors.

In/out-of-competition testing

Many of the substances on the prohibited list are only prohibited during competition. In some classes, only in-competition testing is of interest since only substances prohibited in- competition have an ergogenic potential. As discussed, there is little incentive for a disabled sailor to increase endurance or strength.

Medications used by the Paralympic group are most often muscle relaxants, although banned substances may be included in pain killers used inadvertently by the athletes, for example against phantom pain. Education in this field is important.

Table 3: Paralympic Physiological profile (1-10)

Class/Position	Strength	Force	Coordination	Tactics	Psychologica	Weight gain	Weight loss	Score
RS Venture Tiller	2	2	4	7	5	1	1	22
RS Venture Crew	4	4	5	5	5	1	1	25
Hansa 303	3	3	4	7	5	1	1	24
2.4mR OD	3	3	4	7	5	1	2	25

As shown in table 3, none of these classes scored over 35 points using the method applied to Olympic sailing. In fact, the analysis logically shows that sailors with a disability score quite low compared to the Olympic sailors.

This assessment is also supported by a recent publication by the Asian Pacific Society of Cardiology

Consensus that classifies sport intensity of para sailing as very low. Continued testing of para sailors is extremely important for WS to obtain readmission into the Paralympics. Although the risk is low, it is still necessary for some testing to take place and hence the inclusion of 1 para female and 1 para male in the World Sailing Testing Pool as set out above.

Table 4: risk of doping abuse by Paralympic classes

HIGH RISK	MODERATE RISK	LOW RISK	VERY LOW RISK
Nil	Nil	Nil	RS Venture Connect
			2.4mR
			Hansa 303 & Liberty

For the above reasons, Paralympic classes should be considered as low risk for doping but continue to be tested at a minimum level in competition.

Summary: DOPING RISK ASSESSMENT IN PARALYMPIC CLASSES

It is known that all elite athletes, in all sports, can be tempted to violate anti-doping regulations. However, certain factors will influence this risk. These include the desire to gain more prize money, the hope of achieving public acclaim, and of course the direct relationship between physical strength and opportunity to win. Furthermore, sports that have good financing and extensive team leadership will have greater ease to budget strength enhancement technology, including doping.

As can be seen from the discussions above, Paralympic sailors are not in a group prone to usage of the drugs prohibited by the WADA anti-doping Code. Except for Paralympic competition, there is never prize money in sailing competitions for sailors with disabilities. As the sport is not a spectator sport, public support and acclaim is low level. Furthermore, necessary muscle power is limited on the boats used in our competitions, in order to enlarge inclusion to a large panel of physical disabilities.

For these reasons, having Paralympic Sailors in a Registered Testing Pool would not constitute an efficient method for fighting against doping in this athlete group. The possibilities offered by personal contact with each athlete and his coach through the Classification teams, associated with efficient educational tools and sessions, would be more effective. It is known that the majority of sailors in general giving adverse results after testing are positive for marijuana. Although, to our knowledge, no Paralympic athletes have been tested positive, the use of recreational drugs, for social or medical reasons may be more prevalent in the group of disabled athletes.

Further research should be conducted, to specifically guide testing and educational efforts directed to the Paralympic athletes in Sailing. Results of targeted in-competition testing will also help orient financial and human resources to ensure clean sport within the group of present and future elite sailors with a disability.

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