ISAF Guide to Sail Measurement 2001-2004

INTRODUCTION

Where a term defined in the Equipment Rules is used in this guide in its defined sense it is printed in **bold blue** type.

Abbreviations

ISAF International Sailing Federation
MNA ISAF Member National Authority
ICA International Class Association
NCA National Class Association
ERS The Equipment Rules of Sailing
RRS The Racing Rules of Sailing

PART A - General

A.1 About this Guide

This guide is intended to help measurers and others understand the ISAF Equipment Rules of Sailing for sail measurement and associated racing rules and to assist in achieving correct, accurate and consistent measuring of sails. It is not part of any rules and has no such status. It should not applied in conjunction with the IYRU Measurement Instructions.

This guide will be updated as and when considered necessary by the ISAF. The date of issued of this edition is: - **1 September 2001**

A.2 Responsibilities and Authorities

Should a measurer be in any doubt as to the application of or compliance with a rule or measurement instruction, the question should be referred to the measurer's MNA or its delegate (ERS H.1.2).

It is not a measurer's job to make rule interpretations.

Measurers are responsible for:

a) Providing the measuring equipment and possessing complete and up to date copies of **class rules** and interpretations, racing rules, and any other relevant documents.
b) Carrying out measurement so that the dimensions are taken accurately.
c) Measuring as required by **class rules** and the relevant racing rules, and recording their findings, either on the class Measurement Form, if measuring at the request of the owner or manufacturer, or in a report to the appropriate race committee.
d) Keeping a record of each completed Measurement Form or measurement report, giving the date of measurement, the effective date of the **class rules** used, the class of boat, sail and plaque number, actual measurements taken, and any relevant comments.
e) Ensuring that they have the necessary authority to undertake the measurement.

The authority afforded to a measurer falls into three distinct categories (ERS C.4)

f) **Official Measurers**
Official measurers have the authority to measure new or replacement items, and to carry out **fundamental measurement**. This type of measurement is not normally undertaken at events. **Official measurers** also have the authority to certify certain items of equipment like sails. When acting in this capacity, the measurer is responsible to the owner, the MNA and to the **certification authority** to which the measurer should make all formal reports. With some classes and rating authorities an **official measurer** will also be required to be recognized by the class association or authority in addition to the MNA.

g) **Event Measurers**
Event measurers are afforded authority to measure at a specific event by the race committee. When acting in this capacity, the measurer is under the sole jurisdiction of the race committee, to which all formal reports should be made (RRS 78.3).

h) **International Measurers**
International measurers are appointed by the ISAF to act at international events. Their authority is the same as those of **event measurers**.

With the exception of adding sail or buoyancy endorsements or other items as permitted by the **class rules**, a measurer has no authority to add to or alter any of the details of a **certificate**. If it is brought to the attention of a measurer that the details of a **certificate** are in some way incorrect, then the measurer should tell the owner and the **certification authority**.

A.3 Fees

Measurers are recommended and encouraged to charge for their service. This is important as, unlike a jury member, the actions of a measurer might have long-term ramifications for a class. A measurer is also responsible for providing and ensuring the accuracy of measurement tools and equipment as well as being professionally responsible for the service they provide.

A.4 Fundamental Measurement

Fundamental measurement is the initial measurement of new (or replacement) sails prior to their being **certified** by a measurer. Except in the case of MNA approved “In-house certification”, all the dimensions required to be taken by **class rules** should be checked, and a record kept of the measurements found. Where required by **class rules** or an MNA, the sail should also be inspected in relation to other **class rules** and with RRS 77 & RRS Appendix G, Identification On Sails and RRS 79 & RRS Appendix 1, ISAF Advertising Code.

When measuring a new sail, the measurer is acting on behalf of the owner and the MNA (or its delegate) and should, within the limits of the applicable rules, endeavour to safeguard the interests of that owner and MNA.

No sail should be **certified** until its full and complete compliance with the applicable rules has been established.

A.5 Event Measurement Checks

Event measurement is normally undertaken at an event prior to the first race, when the time available is usually at a premium. For this reason it is common for only partial measurement of all, or just some, sails to be undertaken. In addition, in an endeavour to speed up procedures, changes are often made to the way in which measurement is carried out. Sometimes this is merely visual inspection, verification of **fundamental measurement** or just the application of **event limitation marks.**

If, during **event measurement**, there is doubt as to the compliance of a sail, the measurer should use the fundamental measurement procedures.

When event measuring, a measurer is acting on behalf of or as part of the race committee and, as such, is bound by the Notice of Race, Sailing Instructions and RRS 78.3. Although there is good sense in a race committee appointing an **official measurer** to act at an event, this is not mandatory. Similarly, an MNA, ICA or NCA should beware of usurping a race committee's authority during **event measurement**.

A.6 Class Rules

Where a particular **class rule** and the ERS are in conflict, the **class rule** shall prevail. Where no limits for a particular dimension are given in **class rules** nor in the RRS, then the item is not controlled and need not be measured.

A.7 Headsail or Spinnaker

Neither the ERS nor this guide attempt to make a distinction as to whether a particular sail is a headsail or a spinnaker. The difference should normally be specified in **class rules** or by the owner, as, due to the close similarity in shape of some of these sails, the difference between the two types is purely a matter of usage rather than measurement. Regardless of the shape of a sail, if **class rules** or the owner call it a headsail, or where **class rules** require it to be measured as a headsail, the sail should be measured as a headsail. Similarly, if **class rules** or the owner call a sail a spinnaker, or require the sail to be measured as a spinnaker, it should be measured as a spinnaker. In cases where a visual distinction as to type is unclear the measurer should mark the measurement type use on the sail i.e. *measured as a headsail* or *measured as a spinnaker.* The ISAF recommended **certification mark** design has a box where this can be inserted. Where neither **class rules** nor the owner make a distinction as to whether the sail is headsail or spinnaker RRS 50.4 should be applied.

PART B - Fundamental Measurement

B.1 Tools and Equipment

In the majority of cases, the accurate measurement of a sail may be undertaken using the following tools and equipment: -
steel tapes of good quality
micrometer
feeler gauge
batten of uniform flexibility
pencil
permanent marker pen
stamp and ink pad
Additional equipment is required to measure **ply** weight

A measurer may supplement this list with other tools or equipment that either improves the accuracy of, or the time taken on, measurement. For pre-event check measurement this is encouraged as detailed in Part C of this guide. (Appendix I gives suggestions for suitable equipment)

B.2 Sail Construction (ERS G.1)

B.2.1 What is meant by the word Ply?

A **ply** is a sheet of **sail** material made up of one or more lamina. For example a layer of film bonded to a woven fabric is a **ply**; in fact a **laminated ply**. A **sail** with its body made from one sheet of this **ply** would be a **single-ply sail**. If two sheets of the material were used next to each other this would be a **two-ply sail**. The word **ply** is both singular and plural.

If **class rules** give no restriction as to the number of **ply** that may be used it can be assumed that the number is optional.

B.2.2 What is Woven Ply?

When a **woven ply** is torn it will be possible to separate the fibres without leaving evidence of a film. Thus **ply**, (often referred to as "Mylar" a trade name for one particular polyester film), which comprises a woven base on which a plastic film has been bonded is considered to be non-woven.

B.2.3 Soft Sail

It is normally quite easy to establish if a **sail** is soft without having to fold it and risk "damaging the **ply**". However, in cases of doubt, if it is claimed that the **sail** is soft, a measurer should fold the **ply**, usually in an area of **secondary reinforcement**. If the measurer is unable to flatten the **ply** when applying pressure between forefinger and thumb or the **sail** suffers damage more than a crease line, then the **sail** is not **soft**.

B.2.4 Ply Weight

There are a number of classes which specify minimum **ply** weights. Before discussing the problems associated with such rules, it is necessary to be aware of the different units used to describe **ply** weight.

These are:
ounces (oz)
ounces per square yard (oz/sq yd)
grammes per square metre (g/m2)

When the weight is given as x ounces, this refers to the weight of one yard run of cloth 724 mm (28.5 inches) wide - this being the standard width in which the **ply** used to be woven. It is the way in which most sailcloth is described in the United States.

Figure 1a shows the comparison between the three units, and enables conversion to be made from one system to another.

A manufacturer's quoted **ply** weight may be for the material before the addition of finishes. This will not be the same as the weight of the material used in the construction of **sails**, so care should be taken to avoid confusion.

It is difficult to determine whether or not a **ply** is in accordance with a weight control in **class rules**. There are two ways of undertaking this: -

a) determining the weight of the **ply**
b) measuring the thickness of the **ply**

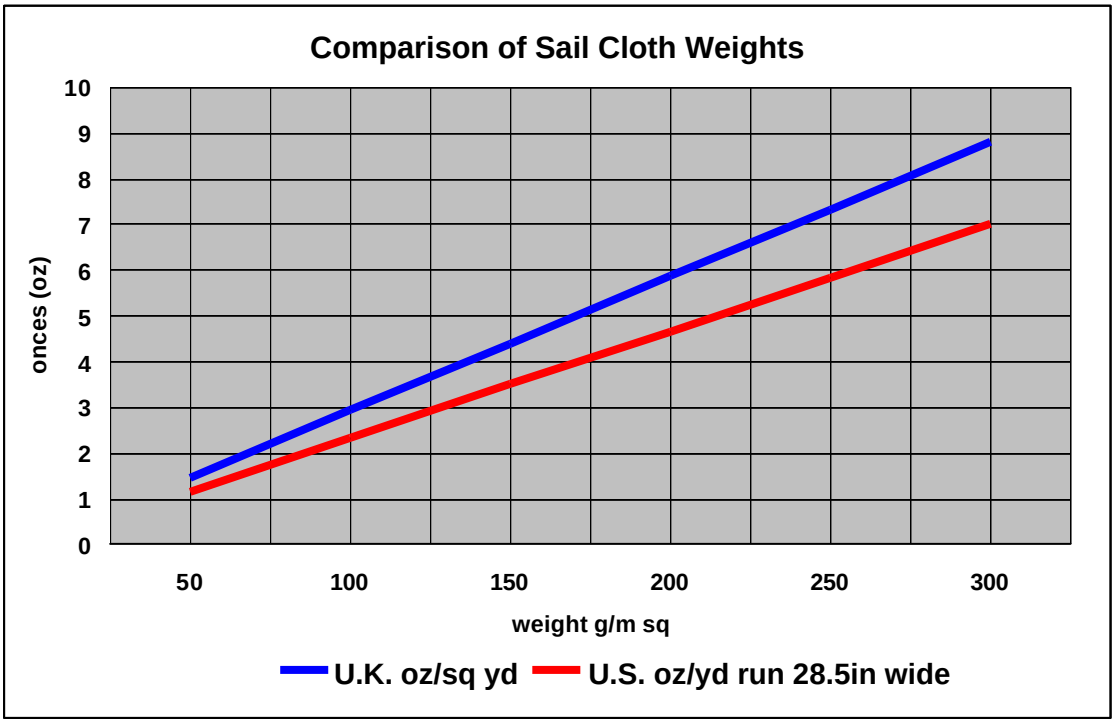

Figure 1a.

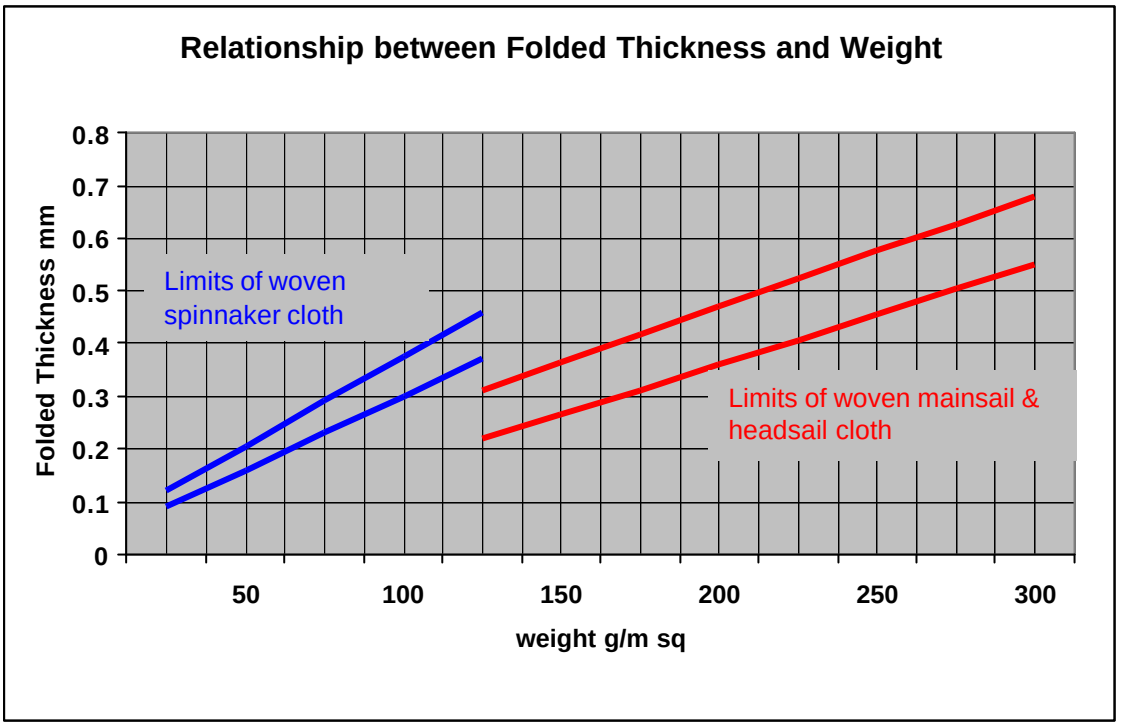

Figure 1b.

B.2.4.1 Procedure for Determining the Weight of Ply

Equipment: -
Sample cutter and scales
Details of approved equipment are given in Appendix I.

Method
Five samples of **ply** should be accurately "die-cut" from different places in the **sail**, not less than 25% of the **foot length** apart. All five samples must be carefully placed in the draught-free compartment of a levelled laboratory scale, the scale carefully balanced, and the combined weight of the five samples read off. This weight, divided by five and corrected to the units specified in the **class rules**, shall be taken as the weight of the **ply**. Great care should be taken during the scale zeroing operation.

B.2.5 Ply Thickness

Some classes control **ply** thickness and as there is a loose relationship between the thickness of **woven ply** and its weight, some classes use this to approximate **ply** weight by thickness measurement. There are, however, a number of factors, including closeness of the weave, the nature of the filaments and the types of finish applied, which make this relationship less than precise. This is shown by Figure 1b which compares of **woven ply** weight with upper and lower limits of the folded thickness.

Measurers should also be aware that sail material from a single roll might vary in thickness by up to 10%.

B.2.5.1 Measuring the Thickness of Ply

Where **class rules** control **ply** thickness, this is usually the minimum thickness. It is thus important that measurement is taken at the thinnest area, particular if the **sail** is lofted from a laminated **ply** with open weave scrim. If the micrometer measuring surfaces permit, thickness measurements should be taken between the scrim. The measurer should take as many thickness measurements as necessary to be satisfied that a **sail** is in compliance with **class rules**. The dimensions recorded shall be absolute and not averaged.

Figure 2. Measuring the thickness of **Ply**

A micrometer and, if the **ply** has no scrim, a feeler gauge will be needed.

Before taking any measurements carefully clean the micrometer measuring surfaces and zero or calibrate it using the feeler gauge.

Always bring the measuring surfaces together slowly and uniformly using the micrometer ratchet when checking zero and when taking measurements.

Do not scrape the sail cloth with the micrometer while positioning for a measurement or during removal, as this may result in a resin build up on the measuring surfaces, which can cause erroneous readings.

When taking double thickness measurements, which will be necessary to measure in the body of the **sail**:

a) fold but do not crease the **sail**.
b) open the micrometer wide enough to enable the jaws to pass over the doubled roll without scraping.
c) If the **ply** has no scrim, place the feeler gauge between the two **ply** layers. This prevents the surface of one layer meshing with the other. Subtract the feeler gauge thickness from the micrometer reading.

Stiff cloth may require two or more padded clamps carefully placed near the point of measurement to hold the two layers together.

Re-check for clean measuring surfaces and zero or re-calibrate frequently, especially before re-checking measurements close to or outside specified class limits.

B.2.6 Reinforcement

Check **class rules** for the permitted limits and material of **primary** and **secondary reinforcement**.

B.3 Measurement Points (ERS G.4, G.5 & H.4.2)

B.3.1 Corner Measurement Points and Aft Head Point (ERS G.4 & G.5.5)

To find a **corner measurement point** or the **aft head point** may require the extension of the line of the **edges of the sail** adjacent to the **point**.

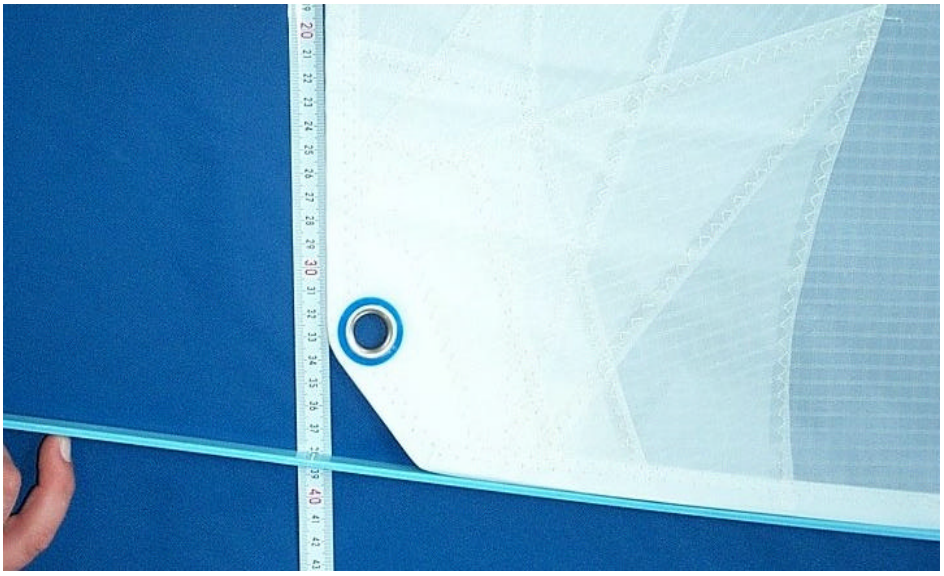

Figure 3. Headsail **Clew Point**

Where the line of the extension of the edge is obvious, it should be used. Placing a batten along the edge can often help to give a true extension line continuing any curve (see Appendix 1).

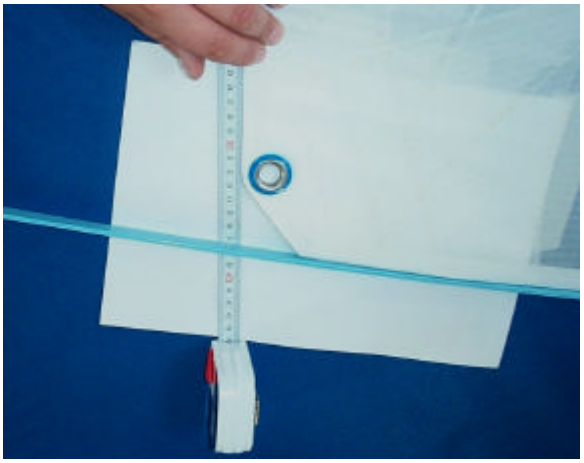

Figure 3a.

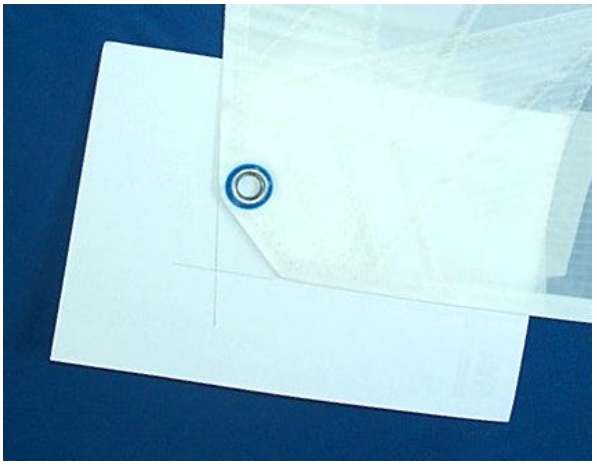

Figure 3b.

Marking the extension lines on paper taped to the underside of the sail helps to retain the point during measurement

Where the line of the extension of the edge is uncertain and not repeatable leading to inconsistent measurement points, the measurement of the sail should be refused.

B.3.2 Leech Points (ERS G.5.1 to G.5.4)

Note: hollows may affect the position of leech points. See B.3.4

The **half leech point** is found by folding the **head point** to the **clew point** and equally tensioning the two halves of the **leech** so formed. The **half leech point** is the intersection of the fold and the **leech**. See figures 4 and 5.

Figure 4. Finding a Mainsail **Half Leech Point**

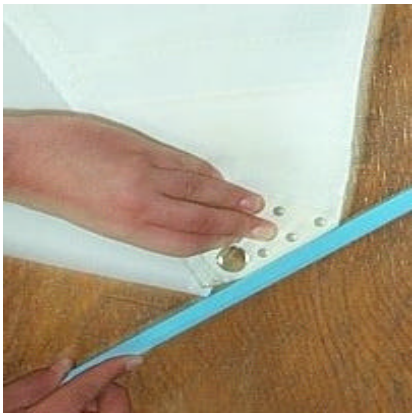

Figure 4a.
Place the **head point** over the **clew point.**

Figure 4b.
Marking the edge of the sail in the fold at the **leech point**.

Figure 5. Finding a Spinnaker **Half Leech Point**

The **quarter** and **three-quarter points** are found similarly by folding the **clew point** and the **head point** respectively to the **half leech point**. The **points** are the respective intersections of the folds and the **leech**. See figures 6, 7, 8 and 9.

Figure 6. Finding a Mainsail **Quarter Leech Point**

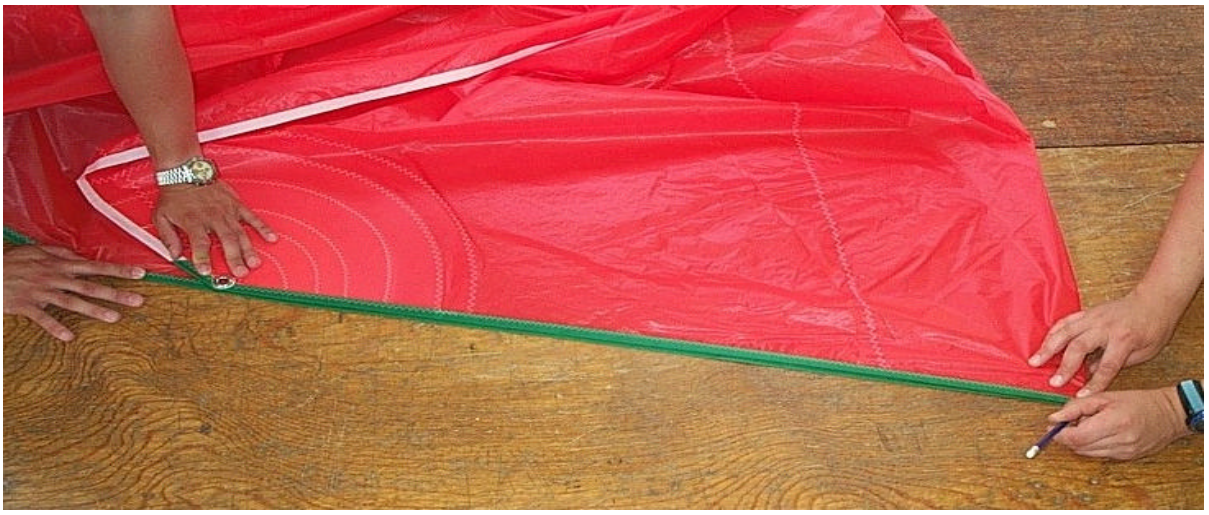

Figure 7. Finding a Spinnaker **Quarter Leech Point**

Figure 8. Finding a Mainsail **Three-quarter Leech Point**

Figure 9. Finding a Spinnaker **Three-quarter Leech Point**

The set distance of the **upper leech point** from the **head point**, when specified in **class rules**, is measured in a straight line across the **sail** as defined.

B.3.3 Mid Foot Point (ERS G.5.6)

The **mid foot point** is found by folding the **tack point** to the **clew point** or, with a spinnaker, one **clew point** to the other **clew point**, and equally tensioning the two halves of the **foot** so formed. The **mid foot point** is the intersection of the fold and the **foot**.

Figure 9a. Finding a Spinnaker **Mid Foot Point**

B.3.4 Hollows (ERS H.4.2)

The presence of a hollow shall be determined with the **sail** flat in the area between the items referred to in ERS H.4.2.

Where a hollow exists in the vicinity of a **measurement point**, e.g. on the **edge of a sail** at the end of the **half leech point**, the **sail** shall be flattened out in the area of the hollow, the hollow bridged by a straight line, and the shortest distance from the measurement point to the bridge line shall be added to the measurement being taken.

B.4 Condition of Sail During Measurement (ERS H.4.1)

B.4.1 General

The **sail** shall be as required by ERS H.4.1 and be at ambient humidity and temperature.

B.4.2 Shape of the sail edge (ERS H.4.1)

To check the shape of the **sail edge** the **sail** shall be flat in the area being checked. This is achieved as follows: -

a) lay the **sail** out on a flat surface. Figure 10
b) fold or flake the **sail** as shown in Figure 11.
c) work any wrinkles near the edge into the fold.
d) Without pulling out the fold, apply just sufficient tension to the edge to ensure it is flat.

The shape of the edge, which should now be flat, can be gauged against a straight line produced by a string, or the edge of a measuring tape, stretched along the edge of the sail.

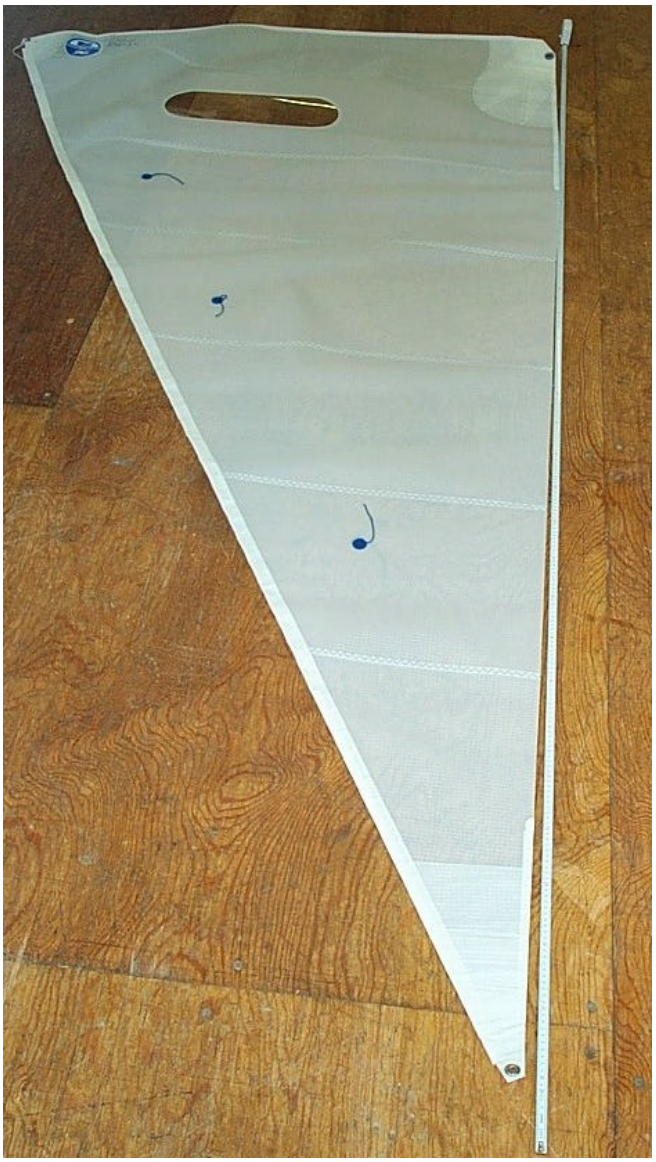

Figure 10. Sail before flaking

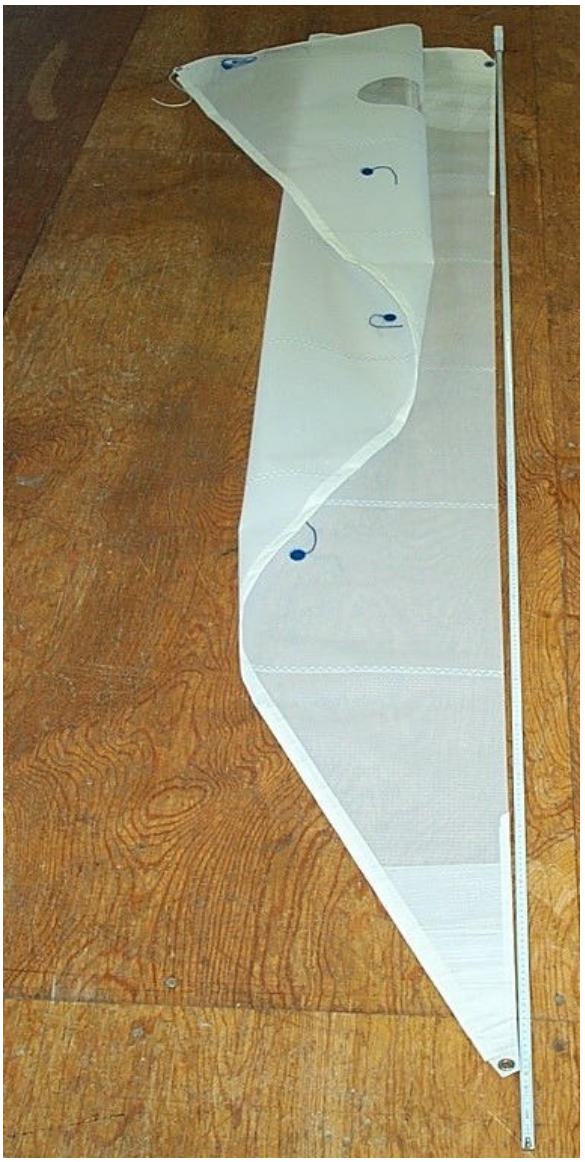

Figure 11. Sail after flaking

B.5 Lengths (ERS G.7)

B.5.1 Foot, Leech & Luff Lengths, Diagonal and Foot Median (ERS G.7.1, G.7.2, G.7.3, G.7.9, G.7.10)

All lengths shall be measured as the straight line distance as defined. Lengths shall be measured with the **sail** laid out with the tension applied as required by ERS H.4.1. **Corner reinforcements** which cannot be "straightened" at the head of the spinnaker may necessitate the taking of two part measurements to an intermediate point, with the sum of these giving the dimension of the defined measurement. See Figures 12 and 13.

Figure 12. Measurement of head part of **Foot Median**

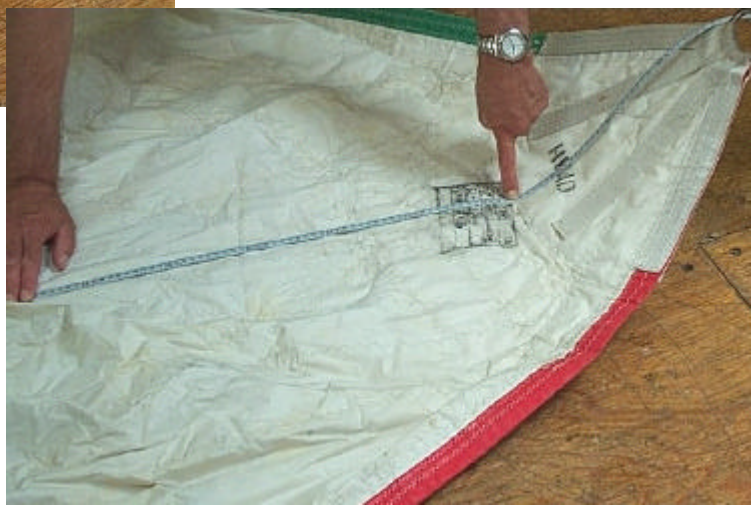

Figure 13. Measurement of remainder of **Foot Median**

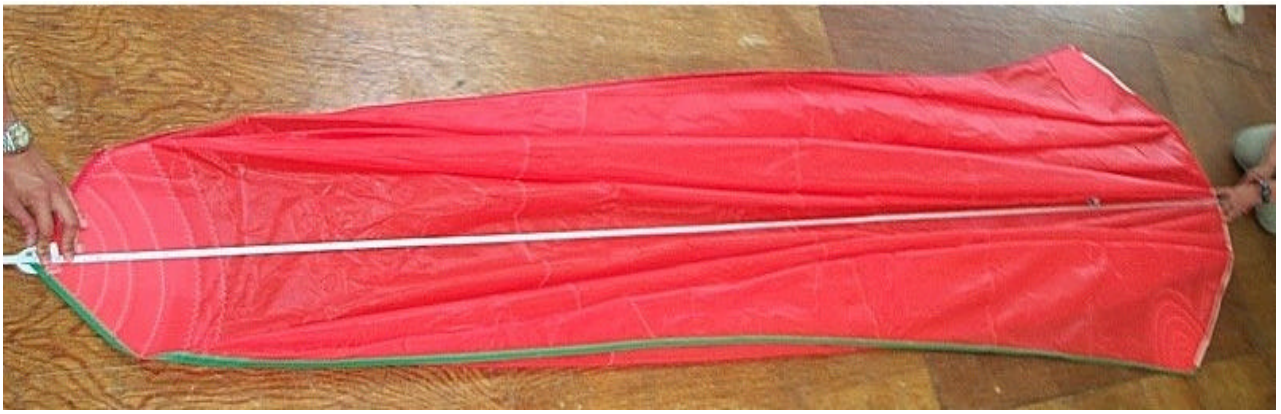

Figure 12a. Measurement of spinnaker **Foot Median**

B.5.2 Luff Perpendicular (ERS G.7.11)

The **luff perpendicular** shall be measured as the shortest straight line distance swung across the **sail** by a tape from the **clew point** to the **luff** as appropriate, including bolt rope if any, as illustrated in Figure 14. The measurement shall be taken with the **sail** laid out with the tension applied as required by ERS H.4.1.

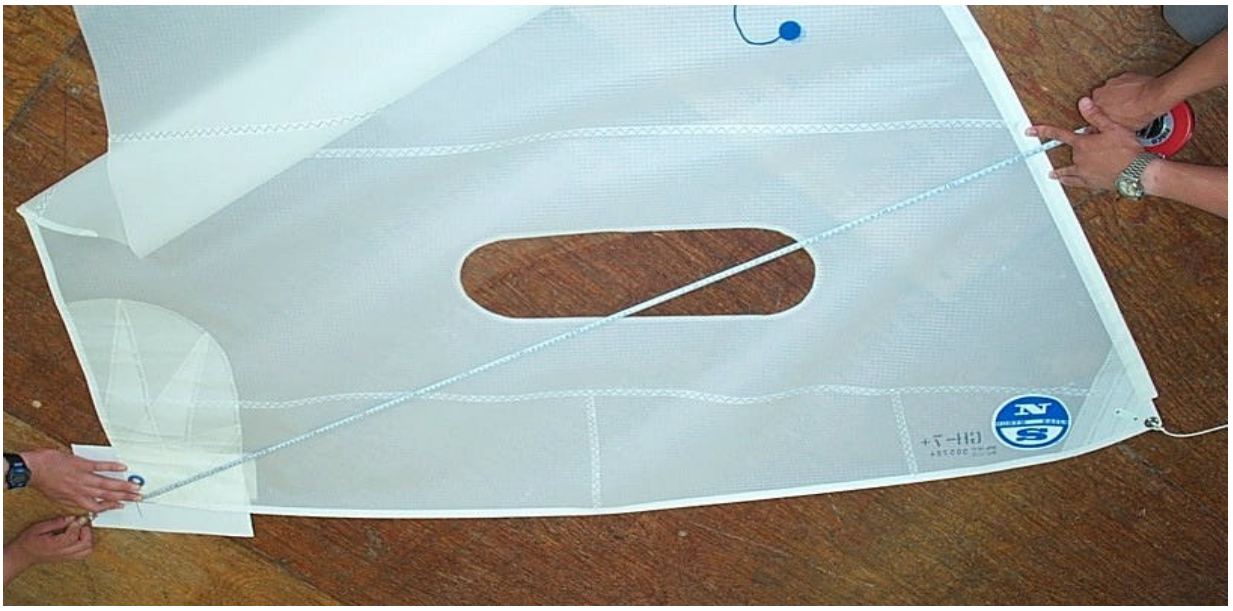

Figure 14. Headsail **Luff Perpendicular**

B.6 Widths (ERS G.7)

B.6.1 Mainsail and Headsail Quarter, Half, Three-quarter and Upper Widths (ERS G.7.4, G.7.5, G.7.6, G.7.7)

Mainsail and headsail widths, except **top width**, shall be measured as the shortest straight line distance swung across the **sail** by a tape from the **leech point** to the **luff** including bolt rope if any, as illustrated in Figure 15. The measurement shall be taken with the **sail** laid out with the tension applied as required by ERS H.4.1.

Figure 15. Mainsail **Half Width**

B.6.2 Spinnaker Quarter, Half, Three-quarter and Upper Widths (ERS G.7.4, G.7.5, G.7.6, G.7.7)

The spinnaker widths shall be measured as the straight line distance between the **leech points** as defined. The measurements shall be taken with the **sail** laid out with the tension applied as required by H.4.1. See Figure 16.

Figure 16. Spinnaker **Half Width**

B.6.3 Top Width (ERS G.7.8)

Top width shall be measured as the straight line distance as defined. It shall be taken with the **sail** laid out with the tension applied as required by H.4.1. See Figure 17.

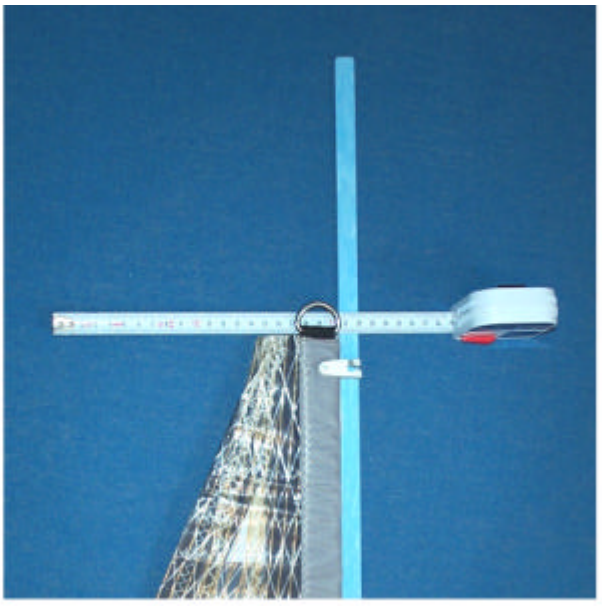

Figure 17. Headsail **Top Width**

B.7 Other Measurements (ERS G.8)

B.7.1 Reinforcement size (ERS G.8.4)

Corner **reinforcement** size, whether **primary** or **secondary**, is measured from the **corner measurement point**, which may be outside the **sail**. The measurement is the greatest dimension from the **corner measurement point** to the outer edge of the **reinforcement**, and should be found by swinging an arc with the tape as illustrated in Figure 18. Permitted **tabling** is not included in the measurement of **reinforcement**.

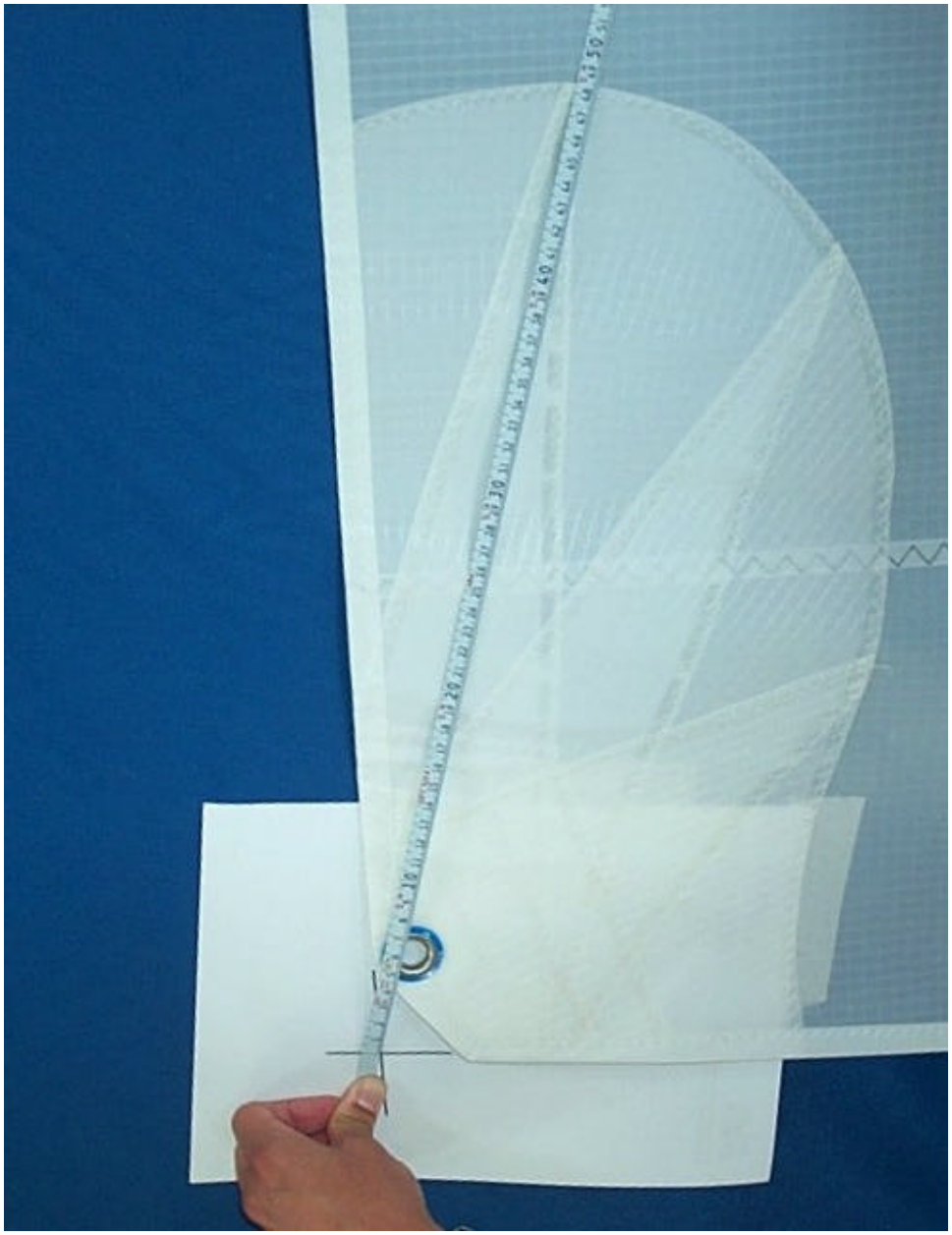

Figure 18. Clew Reinforcement

The measurement of any **reinforcement**, other than at one of the corners of the **sail** shall be taken to be the greatest dimension between any two points of the same **reinforcement**. This may not necessarily be continuous across the **reinforcement**.

B.7.2 Batten Pocket Length (ERS G.8.1)

The inside and outside lengths of a **batten pocket** are measured ignoring the effect of any elastic or other batten retaining device.

The inside length is the greatest dimension measured parallel to the centreline of the pocket from the **sail edge** to the inside of the stitching, fold or similar at the inside end of the pocket.

The outside length is the greatest dimension measured parallel to the centreline of the pocket, from the **sail edge** to the extreme end of the pocket.

B.7.3 Batten Pocket Width (ERS G.8.2)

Local widening for batten insertion is not included in the measurement of either inside or outside **batten pocket width**.

The inside width is measured at 90º to the centreline of the pocket, between the inside of the stitching or similar on each side of the pocket.

The outside width is measured at 90º to the centreline of the pocket, between the outside edges of the pocket.

B.7.4 Foot Irregularity (ERS G.8.3)

With the **sail** flat in the area of the **foot**, the **tack point** should be folded over and run down the edge of the **foot**, and its extensions if necessary, until it reaches the **clew point**. During this procedure, the greatest dimensional difference between the two parts of the **sail edge**, measured at 90º to the edges, should be noted. The same procedure should be undertaken, folding over and running the **clew point** down the edge of the **foot** until it reaches the **tack point**. Again, the greatest dimensional difference between the **sail edges** should be noted. The **foot irregularity** is the greater of the two noted dimensions.

B.8 Sail Numbers (RRS 77 & RRS Appendix G)

Measurement requirements for the size, shape and position etc. of class insignia, national letters and sail numbers are laid down in RRS 77& RRS Appendix G, and in most individual **class rules**. These shall be checked when required to be so by **class rules** or an MNA.

Where there are differences between the RRS and **class rules**, the **class rules** shall prevail. Where **class rules** invoke the RRS then, except when altered by **class rules**, the RRS shall be applied.

RRS Appendix G - 1.2(a) requires, amongst other things, the national letters and sail numbers to be "clearly legible". Determination of this requirement will be relative and is not strictly a matter of measurement.

Several classes specify the colour of insignia, letters and numbers. Where this is not the case, the RRS Appendix G - 1.2(a) rule should be applied. This requires the national letters and sail numbers (but not the insignia) to be of the same colour.

RRS Appendix G - 1.2(b) gives the boat's overall length as the criteria for character size and the space between adjoining characters. Overall length shall be taken as **hull length** (ERS D.3.1).

RRS Appendix G - 1.3(a) requires the class insignia, national letters and sail numbers on the starboard side of mainsails and headsails to be higher than those on the port side. For clarity, each of these items should be treated separately, i.e. the starboard insignia should be higher that the port insignia (subject to 1.3(b)), the starboard national letters shall be higher than the port national letters and the starboard sail numbers should be totally above the port sail numbers.

RRS Appendix G - 1.3(c) requires that, on sails measured after 31 March 1997, where national letters are displayed, these are placed above the sail numbers.

B.9 Advertising (RRS 79 & RRS Appendix G)

The size and position of permitted advertising on sails is governed by RRS 79 & RRS Appendix 1.

There are two categories of advertising, A and C with Category A permitting only limited advertising and Category C much more advertising. There is no category B. The Category permitted for a particular boat will normally be as specified in **class rules.** If it is not specified in **class rules,** Category A will apply. **Class rules** may only specify the Category; they may not change the requirements of the RRS Appendix.

For Category A boats (the default category), the only advertising permitted on a **sail** (in addition to the class insignia) is one sailmaker's mark per side. Each mark shall fit into a 150mm x 150mm square and, except on a **sail** measured as a spinnaker, shall be totally within a distance from the **tack point** of either 300mm or 15% of the **foot length**, whichever is the greater. The table below gives the greater of these dimensions for most international classes. This limit should be measured in a similar manner to corner **reinforcement.**

Figure 19. Measuring limit of sailmakers mark

Limit of Sailmakers Mark from tack point					
Class	**Mainsail**	**Headsail**	**Class**	**Mainsail**	**Headsail**
Cadet	300	300	H Boat	450	425
Contender	405		J 24	445	655 / 435
Dragon	520	530	Lightning	445	350
Enterprise	400	300	Mirror	320	300
Etchells	530	380	OK	405	
Europe	410		Optimist	300	
Finn	490		Snipe	381	300
Fireball	425	300	Soling	480	400
5-0-5	430	345	Star	610	337
Flying Dutchman	425	520	Tempest	510	375
Flying Fifteen	450	355	Tornado	355	300
470	400	355	Vaurien	330	300
420	360	300	Yngling	390	300

B.10 ICA Sail Buttons and Labels

Some classes require all **sails** to carry an ICA sail button or label. These are a means of raising revenue and can normally be purchased from the class association.

Where the **class rules** lay down a requirement for sail buttons or labels no **sail** shall be accepted by a measurer unless the button or label is securely attached to the **sail**.

Buttons and labels are not transferable from one **sail** to another and therefore the measurer, when satisfied that the **sail** complies with all the relevant rules, should sign or stamp across the button or label and onto the **sail**. This is in addition to the normal sail **certification mark**. It follows from this that a measurer should refuse to sign a **sail** where the button or label already has a signature across it.

Figure 20. Mainsail tack with Sail Label

B.11 Certifying and Certification Marks (ERS C.6.3)

When satisfied that a **sail** complies with all applicable rules, the measurer is required to **certify** it by the attaching a **certification mark**. This is undertaken in different ways in different countries. In Germany, for example, the **certification mark** takes the form of a sail button marked DSV (Deutscher Segler-Verband). Other countries use **certification mark** labels or stamps. The ISAF recommendation is a stamp or label of the design shown in Figure 21. Printed in black would indicate **official measurer** measured where as in red would indicate “in-house” certification.

Figure 21. Certification Mark labels from Sweden

In the absence of any specific national or class requirements, the measurer should **certify,** by signing and dating, the **sail** in the **tack** on mainsails and headsails and in the **head** on spinnakers. **Event limitation marks** should be in the **clew**. In addition, to enable a particular **sail** to be identified in the future, if it is not marked with a manufacturer's serial number then the measurer should add one. Also, if **class rules** limit the number of **sails** permitted to be used by a single boat then, to prevent the swapping of **sails** between **boats**, the measurer should add a sail or plaque number to the **mark**. (Appendix I gives suggestions for suitable marking pens etc.)

A measurer should keep a record of all **certified** sails, detailing the date and serial number of each against the sail or plaque number of the boat. In addition, if required by **class rules**, this information should also be added on the **certificate**.

This guide has been prepared at the request of the ISAF by the
Royal Yachting Association
together with the help of the
Danish Sailing Association
Deutscher Segler-Verband
Swedish Sailing Federation

PART C - Event Measurement

C.1 Introduction

In this part of the guide the term **event measurement** refers to the measurement, inspection, checking and/or control of equipment undertaken at an event solely in support of the event. It does not include any measurement necessary to obtain a **certificate** or **certification mark**, which might otherwise be a requirement of **class rules**. Care should be taken not to confuse **event measurement** with **fundamental measurement**, as a measurer's authority and channel of communications in each case are very different.

Although **event measurement** can encompass the complete boat, this guide deals mainly with the measurement of **sails**. If more than just **sails** are to be measured then the recommendations given in this guide should be included as an integral part of the full measurement planning and strategy.

C.2 Event Measurer's Authority

Event measurers obtain their authority solely from the race committee of the event at which they measure (RRS 78.3). **Official measurers** and **International measurers** have no authority to undertake **event measurement** unless specifically appointed for the task by the race committee. ISAF appeal case 57 refers. Should an MNA or CA wish one of its measurers to be involved in **event measurement** then it should ask the race committee to appoint him well in advance of the event.

Although it is common practice with a number of classes for **fundamental measurement** to be undertaken just prior to a major event, it is wise for such measurement to be undertaken by a measurer other than the **event measurer**. To act in both capacities creates a conflict of authority. It follows that where an **event measurer** is presented with an item of equipment, which he initially measured, then, if possible, he should pass the item to another **event measurer** for checking.

An **event measurer** is under the sole jurisdiction of the race committee to which all formal reports of non-compliance should be made (RRS 78.3). Should an **event measurer** be in any doubt as to the application of a rule or measurement instruction, the question should be referred to the **certification authority** for the class in the country where the event takes place (ERS H.1.4).

C.3 Class Association Authority

A CA has no direct authority or jurisdiction over **event measurement** except in the capacity of an organising authority or part of an organising authority (RRS 87.1). A **certification authority** has no power to invalidate or withdraw the measurement **certificate** of a boat while it is competing in an event. ISAF appeal case 57 refers.

C.4 Racing Rules

The racing rule with most relevance to **event measurement** is RRS 78.3. This is reproduced below.

RRS 78.3
When a measurer for an event concludes that a boat or personal equipment does not comply the class rules, he shall report the matter in writing to the race committee, which shall protest the boat.

C.5 Event Measurer's Responsibility

RRS 78.3 gives **event measurers** initial authority for determining whether or not an item complies with **class rules**. This authority is only held while event measuring.

If the measurer formally concludes that an item does not comply, he has no alternative other than to report the matter in writing to the race committee, which ***shall*** protest the boat.

In most cases it is unlikely that a protest committee will take action against a boat until after it has raced and so, in reality, an **event measurer's** strategy in dealing with a boat found not to comply will differ depending upon whether he is acting before or after the boat has raced.

Prior to racing

Prior to racing, and in the case of a series this should be taken to mean the first race of the series, an **event measurer's** prime responsibility is to achieve a state where all equipment complies with the rules. In line with this responsibility, if a measurer establishes non-compliance then he should require correction. It is only after a measurer has done this and the defect is not corrected that he should report the matter to the race committee.

In other words, prior to racing the **event measurer** should actively endeavour to achieve rule compliance, but be conciliatory, with the interests of the competitors in mind.

After the start of racing

After racing has started, an **event measurer's** prime responsibility is to judge compliance as required to do so by the race committee, through the Sailing Instructions, or by the protest committee as a result of a protest.

When an **event measurer** is given the authority through Sailing Instructions to undertake spot checks, care should be taken in the choice of the items to be checked. It should be borne in mind that there are no alternative penalties for the infringement of an equipment rule. Non-compliance with even a minor, non-performance or non-safety related measurement rule is likely to lead to disqualification. Measurers should be cautious when checking an item that was not measured prior to racing or which might have inadvertently changed or distorted since **fundamental measurement**. If a competitor deliberately cheats then the item will either be obvious, in which case it is incumbent on another competitor to protest, or be so obscure that it is unlikely to be found by random spot checks.

Therefore, after racing has started the **event measurer** should be a reactive policeman in a similar manner to a Juror.

C.6 Event Measurement Planning

Pro-active **event measurement** of **sails** should be undertaken prior to the first race. Subsequent **sail** measurement will be reactive and, apart from ensuring that some measurement facilities are available, cannot be planned.

Planning for pre-event measurement is usually a matter of "horse trading" between a CA, measurement authority, organising authority and the **event measurer** as to the amount of time, help and money available for the job. Before planning is started, the **event measurer** should open lines of communication with these organisations and continue to consult them on all matters of planning and resources. This dialogue will also highlight measurement concerns and areas where measurement data is needed, and may be important in cases where rule interpretations are required.

Consultation should be started in sufficient time to enable the **event measurement** requirements to be included in the Notice of Race and Sailing Instructions (see Appendix IV & V).

C.7 Sail Limitations

It is important to know whether or not the event will be subject to **sail** limitations where each boat is permitted to use a limited number of mainsails, headsails and spinnakers. **Sail** limitations will help to provide an estimate of the number of **sails** to be measured and will also mean that **event limitation marks** have to be applied as a priority measurement task, with appropriate rubber stamps and ink pads available. If **sail** limitations are not in force then an indication of the likely number of **sails** each boat will use will be required. This will vary from class to class.

C.8 Time, People and Money

Start the planning process by calculating the amount of time needed to measure all **sails** fully.

Apply the expected number of entries and the number and type of **sails** each is likely to use to estimates of time needed for measurement as given in the tabulation below.

For example - if there are likely to be 50 boats each with two mainsails, two headsails and two spinnakers then, using the tables below, the total time will be: -

(50x2x10½) [Mainsail] +(50x2x7)[Headsail]+(50x2x7½)[Spinnaker] = 2,500 mins
increase this time by 20% as a contingence.

2500 x 1.2 = 3,000 mins i.e. 50 hours
this estimate can be used to assess the time and the number of measurers/helpers needed.

A typical event measurement day is 10 hours and the measurement team needed to measure each sail will consist of a measurer and a helper. (The owner/competitor should not be included as the helper).

Taking the 50 hours requirement from the above example would give 5 days using one measurement team or 1 day using 5 measurement teams or any variation in between.

If it is not possible to achieve the day/team requirement then the extent of measurement will need to be reduced until a balance is reached. This should be undertaken by omitting the measurement of the least performance related items as listed in the tables below. Omit items from the bottom of each table first and move up the lists omitting items until the balance is reached.

Note that limitation stamping must not be omitted if the event is subject to **sail** limitation rules.

Whatever is finally decided regarding measurement time and the number of measurers/helpers, this must be agreed with the organising authority and referred to in the Notice of Race and Sailing Instructions (see Appendix IV & V).

Each of the following tables lists individual **sail** measurements in the order in which measurement should be undertaken together with the approximate time needed for each. The times assume template measurement for mainsail and headsail and batten measurement for spinnakers with all measurement undertaken on tables.

Mainsail	**Mins**
Limit Marking and recording	2
Leech Length Half Width Three-quarter Width Quarter Width Upper Width Top Width Foot Length Luff Length	2
Cloth Type Cloth Weight	1
Upper Batten Pocket Position Upper Batten Pocket Length	1/2
Primary Reinforcement at Corners Primary Reinforcement elsewhere Secondary Reinforcement at Corners Secondary Reinforcement elsewhere	1
Lower Batten Pocket Position Lower Batten Pocket Length	1/2
Intermediate Batten Pocket Position Intermediate Batten Pocket Length	1/2
Tabling Seams Window area Window position Class insignia Sail numbers Sailmaker's mark	3

Headsail	**Mins**
Limit Marking and recording	1
Luff Length Leech Length Foot Length Foot Median Luff Perpendicular Top Width	2
Cloth Type Cloth Weight	1
Primary Reinforcement at corners Primary Reinforcement elsewhere Secondary Reinforcement at corners Secondary Reinforcement elsewhere	1
Tabling Seams Window area Window Position Sailmaker's Mark	2

Spinnaker	**Mins**
Limit Marking and recording	1
Leech Length Foot Median Foot Length Diagonals Half Width Three-quarter Width Quarter Width	3
Cloth Weight	1
Primary Reinforcement at corners Secondary Reinforcement at corners	1/2
Tabling Seams Sail Numbers Sailmaker's mark	2

C.9 Measurer's Fees

Any fees or expenses required by the measurers are the responsibility of the organising authority. It is important that agreement on this point is made prior to the event. The **event measurer** should not assume payment or expect to cover costs direct from competitors (see A.3).

C.10 Facilities

Event **sail** measurement should be carried out under cover in good conditions of light, without wind or draughts. Ideally measurement should be carried out on tables. These should be about a metre high with a single flat working surface, although separate tables with their legs taped together will often suffice. Measuring on tables eliminates the need to bend down and to kneel and thus minimises the fatigue associated with **sail** measurement. If tables are not available then a gymnasium or dance floor is a good measuring surface. If the only available floor is concrete this can be covered with polythene sheeting taped down over the measurement templates. Measuring on grass will not give satisfactory results. Allow sufficient room for all measurement teams to be working simultaneously.

A table and chairs should be provided for each measurement team and food and drink should be available at normal times.

C.11 Preparation

a) Documentation
In addition to the RRS, ERS, **class rules**, Measurement Forms, interpretations and the Guide to Sail Measurement etc, an event measurement form, a measurement log and a sail number change request form will be needed.

The event measurement form, issued to competitors upon registration, should detail the boat and its sail and plaque number (taken from the **certificate**) and give advice as to where and when to attend for measurement, the number of **sails** permitted, the state in which they should be presented, and a section enabling the **event measurer** to record measurement details and stamp. The final part of the form, the declaration, should be signed by the competitor upon completion of measurement. This declaration officially confirms the items marked and that they will not be changed during the event without the prior approval of the Jury.

The measurement log, which is often a simple exercise book, should be used by the measurer to record the number of **sails**, their serial number, manufacturer etc. against each of the boats competing in the event. It is recommended that at least one separate page is used for each boat and, within the time available, as much relevant information as possible is recorded.

The sail number change request form should be a proforma for issue to competitors wishing to request the permission of the race committee to use **sails** displaying different sail numbers from those required by their **certificate** and **class rules**. This is a request for a dispensation under RRS 77 & RRS Appendix G. These forms are not specifically related to measurement but do help to reduce time and are convenient for competitors.

Illustrations of typical documentation is given in the Appendix VI & VII.

b) Setting out
Event sail measuring to the ERS should be undertaken using templates and measuring battens for small and medium size **sails**. Large **sails** should be measured with steel tapes.

c) Mainsails and Headsails
CAs will often have ready made mylar or similar area check templates which, if possible, should be used. These can be laid flat on the measuring surface, taped or pinned down and checked against the **class rules** for accuracy using **fundamental measurement** procedures. If ready made templates are not available they can be created using masking tape directly on the measuring surface. The following diagram illustrates a typical mainsail tape template. If measurement is to be undertaken on a polythene sheet then the masking tape should be fixed to the surface below the sheet. Use actual **sails** to help position and lay out templates.

d) Spinnaker
Because of the difficulty in laying spinnakers flat, it is not advisable to measure these using templates.

For small sized spinnakers measurement battens are recommended. If these are already available from the CA then the dimensions should be checked prior to use. Alternatively it is quite easy to make suitable battens, marking the dimensions with felt tipped pens.

For large spinnakers, measurement with a steel tape using **fundamental measurement** procedures is recommended.

e) Reinforcement and sail numbers
For **reinforcement** and sail number sizes, perspex or rigid polythene transparent templates may be used. These can be placed over the item being measured and any deviation in size seen through the template.

f) Batten Pocket Lengths and Widths
Batten pocket length, inside and outside, and width may be checked using measurement battens similar to those used for spinnaker measurement.

g) Other Equipment
In addition to templates and battens, equipment recommended for **fundamental measurement** should also be available (see Appendix I).

C.12 Undertaking Measurement

C.12.1 Prior to racing

a) Certification mark checks
Prior to measurement, checks should be made to verify that the sail number displayed on a **sail** corresponds with that of the boat and also that the **sail** possesses an authentic **certification mark**.

If the sail number is different from the boat, the competitor should complete a sail number change request form for submission to the race committee (see Appendix VI).

If a **sail** does not posses an authentic initial **certification mark** as required by most **class rules**, it should not be measured. The competitor should be asked to present an alternative **sail** or to arrange for independent initial measurement prior to resubmitting the **sail** at a later time.

Event measurers should be aware of the common misunderstanding that a **sail** has been measured and **certification marked**, usually at a previous event, when in fact such was purely check measurement. Sometimes **event limitation marks** have been marked at the tack and not the clew contrary to ISAF recommendations.

b) Limitation marking

Where the event is subject to sail limitations each sail to be used should be marked prior to the first race.

Marking should be undertaken only when the measurer is satisfied that the sail complies with pre-event measurement requirements. The **event limitation mark** should be positioned at the clew. Additionally, on headsails, the sail number of the boat should be added next to the **event limitation mark** to enable the sail is attributed to the correct boat when checking **event limitation marks** during the event.

Similar marking techniques as those used for initial sail **certification marks** may be used, although the mark will probably be to a unique design and if possible state, "sail limitation mark".

Figure 22. Typical Sail Limitation Mark

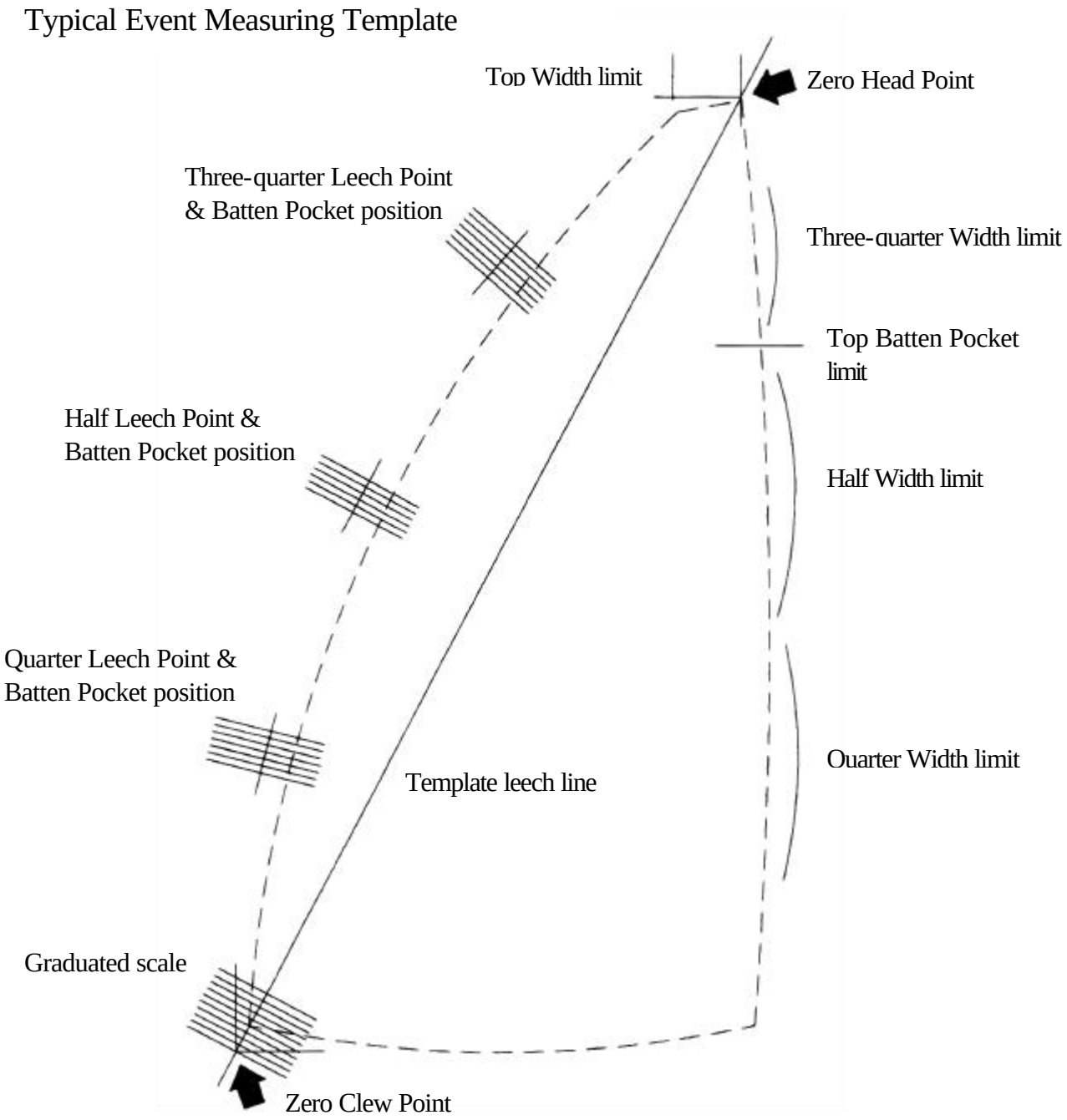

Figure 23. Typical Event Measuring Template

c) Mainsail Measurement

When checking a measurement by template, the sail shall be pulled with sufficient tension to remove the wrinkles across the line of the measurement, as specified in ERS H.4.1.

The sail should be laid on the measuring template so that the **head point** is on the template's zero head point and the **clew point** is on the graduated scale of the template leech line in the area of the clew. Use the normal sail measurement batten to determine corner points if necessary. The measurer should be at the clew with helper at the head. The measurer should advise the helper of the gradation upon which the

clew point rests and the leech points marked on the sail at the corresponding leech gradations.

Lengths and widths may now be measured and the **batten pocket** positions and **top width** checked. If any of these is close to the rule limits then it should be rechecked using **fundamental measurement** procedures.

Cloth type and weight are checked using a standard thickness micrometer and feeler gauge (see B.2).

The measurement helper can next check the inside and outside **batten pocket** lengths and widths, using measurement battens, at the same time as the measurer checks **reinforcement** and sail number using a perspex template.

Any remaining measurement can be carried out using either perspex templates or battens as appropriate.

d) Headsail measurement
The headsail should be checked in a similar manner as the mainsail.

e) Spinnaker measurement
Due to difficulty in laying a spinnaker flat, it is not recommended that template measurement is used. Accordingly, if widths and the foot median are to be measured, it will be necessary to fold the sail to find **leech points** and **mid foot point**. This should be done first, with the points being clearly marked on the **sail**.

Leech length and **foot median** should be checked against the measuring batten. The helper should zero the batten at the **head point** and the measurer check the **sail** at the other end. The batten should be placed on top of the sail, which should be pulled with the tension as required by ERS H.4.1.

The sail may now be moved around under the measurement batten to enable the **widths** to be checked.

Cloth weight, **reinforcement**, sail numbers and any other items may be checked in a similar manner as for the mainsail.

f) Action in cases of non-compliance
During pre-race measurement, if a measurer concludes that a sail does not comply with rules, in the first instance, the competitor should rectify the item either by alteration or by the submission of an alternative sail. If the competitor challenges the accuracy of the **event measurement**, the sail should be remeasured, preferably by another measurer, using the **fundamental measurement** procedure. If the sail still proves to be unsatisfactory (or in cases of doubt) the competitor should again be requested to rectify the item. If this request is still refused, the measurer should make a report to the race committee in accordance with RRS 78.3.

g) Recording
During pre race measurement, upon completion of the measurement and prior to stamping the sail, the event measurement form should be completed and details of the sail entered into the measurement log. It is important that the sail can be uniquely identified and so, if it does not possess a manufacturer's serial number or an initial measurer's unique number, the **event measurer** should mark such on the sail.

h) Impounding of sails prior to racing
It is sometimes the case that, subsequent to measurement but prior to the first race and where sail limitation is in force, a competitor decides to change his choice of sails and requests the measurement of alternatives. In such cases, prior to measuring the replacement, the competitor should present one of the previously checked and **event limitation marked** sails for the **mark** to be crossed out or the sail impounded for the duration of the event. Impounded sails should not be returned until after the last race (unless otherwise dictated by the Jury).

C.12.2 After racing has started

The only sail measurement that should be undertaken after racing has started is limitation stamp checking and any measurement required by the race or protest committee. In the latter case it is recommended that this is undertaken using the **fundamental measurement** procedures.

C.13 Notice of Race & Sailing Instructions

The pre and post race measurement requirements should be included in the Notice of Race and Sailing Instructions. See Appendix IV & V for suggested wordings.

C.14 Measurement Protests & Appeals

a) Who can protest?
A boat and the race committee may protest a boat in respect of class rule and measurement/rating **certificate** infringements. An MNA, CA and an **event measurer** have no right to protest. RRS 60.1, 60.2 and 78.3 refer.

b) Making a report under RRS 78.3
Where a measurer makes a report to the race committee in accordance with the requirements of RRS 78.3, such report should be in writing, giving details of the sail number and plaque number, name and owner of the boat in question, together with details of the **class rule** or rules and interpretations considered defective, at what time these were noted as being defective, what action if any has been undertaken by the owner or representative and whether or not, in the opinion of the measurer, the defect was in existence before and/or after a race.

In receiving a report under RRS 78.3 the race committee has no alternative other than to protest the boat. A measurer should bear this in mind and may consider discussing the matter informally with the chairman of the protest committee before making a formal report, particularly if the deficiencies are in respect of many boats.

c) Giving evidence
When asked to give evidence to a protest committee a measurer should restrict his comments to fact and not enter into discussions as to the meaning or interpretation of either class or racing rules. It should also be noted that convention and precedent only exist in cases of official rule interpretation by the authorised authority or racing rule appeal cases. The fact that something was permitted at the last major event of the class does not mean that it should be considered as a precedent for future events.

d) Damaged equipment
A competitor will sometimes request permission from a protest committee to use an

alternative sail when that previously measured and limitation stamped has been damaged. The measurer may be asked to give evidence as to whether or not, in his opinion, the extent and cause of the damage justifies a replacement.

In such a case the measurer should decline to give evidence respectfully pointing out that the cause and extent of damage to the sail and its possible future use is not a matter dealt with by class rules or measurement but a matter for subjective consideration. The protest committee itself may well be more qualified to judge these matters than an **event measurer**.

e) Class rule interpretation or application

Where, under RRS 64.3(b), a protest committee is in any doubt about the meaning of a measurement rule, it should refer the question, together with the facts found, to the authority responsible for interpreting the rule. This authority will usually be the ISAF, an MNA, or a CA technical committee. It is not an **event measurer**.

f) Action under RRS 69 - Gross Misconduct

Action or the promotion of action under RRS 69 is a very serious matter and should only be entered into after due consideration of all the factors involved in the alleged gross misconduct.

To date there have only been two types of incidents where such action has been undertaken involving measurement or a measurer.

The first was where an **event measurer**, whilst carrying out his duties, was verbally abused by a competitor. In such a case only the measurer can judge the degree of abuse and whether or not this warrants promotion of action under this rule.

The second was where there was an undisputed case of either measurement cheating or fraudulent **certification marking**. In such cases, provided that there is no doubt whatsoever, the measurer should not hesitate to promote the initiation of action under RRS 69.

g) Appeals

The right of appeal is dealt with by RRS 70. This permits a race committee to appeal the decision of a jury provided that the race committee was a party to the protest. This would be the case if action had been taken under RRS 78.3 and the protest hearing was not undertaken by the race committee itself.

An **event measurer** and a CA have no right of appeal.

C.15 Post Event Action

Subsequent to the event, the **event measurer** should ensure that all impounded sails and any **certificates** retained for the duration of the event are returned to their rightful owners. In addition, a written report giving details of the extent of measurement, any problems encountered and any subsequent action take, should be prepared and passed to the NA and class concerned. The measurer should also prepare a report of the event measurement and submit this to his authorising authority.

This guide has been prepared at the request of the ISAF by the
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together with the help of the
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Deutscher Segler-Verband
Swedish Sailing Federation

Sail Measurement

Appendix I – Sail Measurement Equipment

In the majority of cases, the accurate measurement of a sail may be undertaken using the following tools and equipment: -

Steel tapes of good quality
Sail measurement batten
Pencils and permanent marker pens
Masking tape and plain paper
Method for **certification** – labels, buttons or stamp and ink pad etc.
Sail number and sailmaker mark templates
Micrometer and feeler gauge
Equipment required to determine **ply** weight (if required this should be hired)

A measurer may supplement this list with other tools or equipment that either improves the accuracy of, or the time taken on, measurement. For pre-event check measurement this is encouraged as detailed in Part C of this guide.

Steel Tapes

Good quality steel tape measures should be used. Plastic or cloth tapes, even if incorporating steel or glass fibre cores, are unsatisfactory.

Figure 1

Ideally all tapes should be manufactured to an appropriate Standard. Metric tapes marked with an ‘oval’ including a Roman ll have been granted EU pattern approval with their scale marked to an acceptable level. Additionally, tapes marked with the temperature 20ºC and the force 50 Newtons have had their blades printed so that they are most accurate when used in that temperature with that force applied.

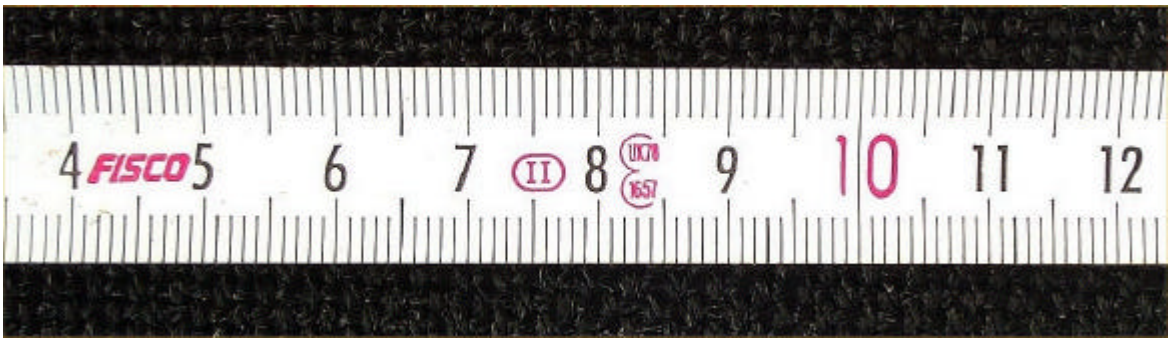


Figure 2

If possible tapes with their scale commencing some distance from the tape end-hook, and without “sharp” end-hook gripping devices are preferable for sail measurement. An example is shown in figure 3.

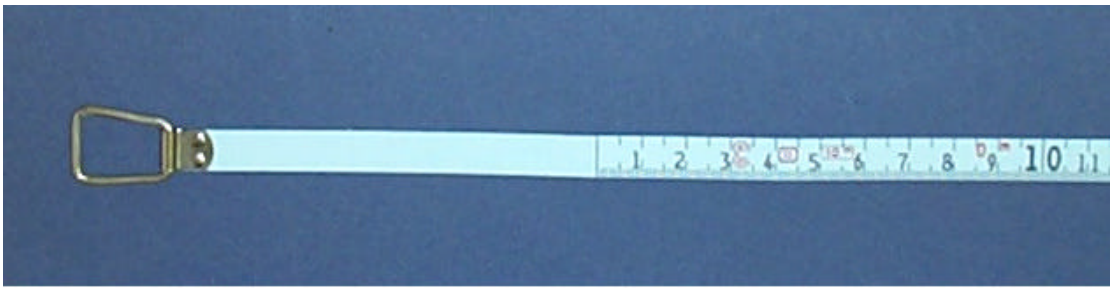


Figure 3

Printed scales should be metric and extend across the full width of the tape which itself should be as narrow as possible. For most ISAF classes a 5 metre and 10 metre tape will suffice. For larger, offshore and metre classes a 20 metre or 30 metre tape may be required.

Sail Measurement Batten

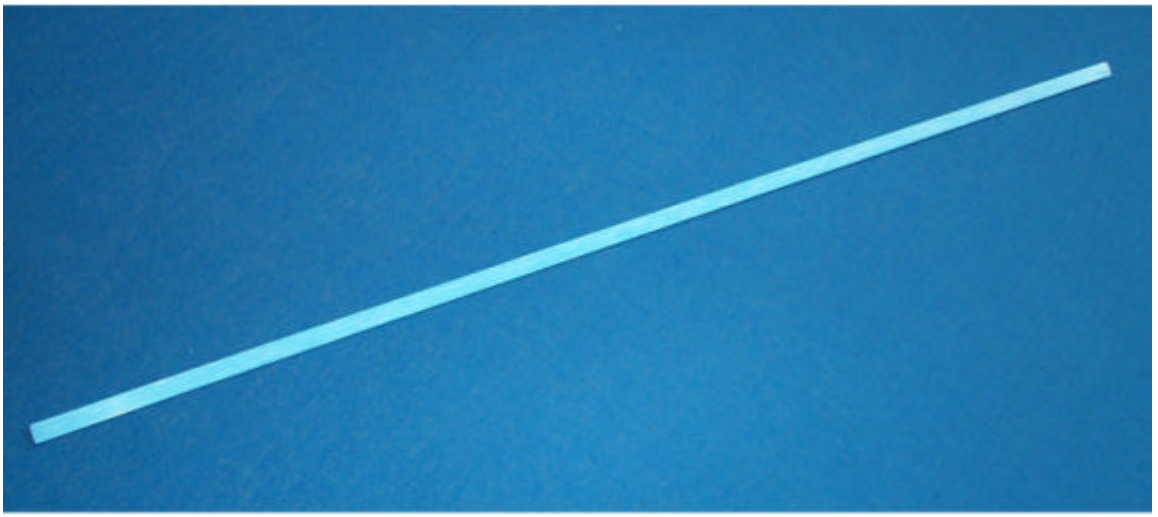


Figure 4

In many places the ERS referred to a **measurement point** being at the intersection of two **sail edges**, each extended as necessary and it is when an extension is necessary that the sail measurement batten should be used.

The batten should be 1 metre in length and of uniform thickness and width giving uniform bending characteristics.

When used the batten should be held at its extreme ends and placed against the **edge** of the sail being extended so that one end of the batten falls near the **measurement point**. The batten should be bent so that its greatest length is touching the **edge** of the **sail** being extended.

Pencils and Permanent marker Pens

Figure 5

Pencils are used for marking the folds in **sails** at **leech** or **foot** points (It is sensible to be equipped with a pencil sharpener).

Marking pens are used to **certify sails** and/or otherwise mark **sails** for identification purposes. Permanent markers are essential and black is the preferred colour as this is less likely to fail. Measurers may also consider equipping themselves with a white permanent marking pen, which can be used to modify oversize, or incorrectly spaced sail numbers or sailmakers marks.

The type of pen used for marking is very important, as the mark has to remain visible for several years. Ordinary ballpoint pens are not adequate and neither are ordinary felt tip pens. Laundry markers or permanent markers, such as Pentel N50, Edding 750 - which also comes in white or Papermate Permanent Marker are usually satisfactory, but it is recommended that

a rag be marked with the pen intended to be used, and then thoroughly washed in very hot water to see whether the mark remains.

Most of these pens will also mark film **sails** satisfactorily, provided that the ink is given time to dry and care is taken not to abrade the mark. No **certification mark** will remain for long if marked on a damp **sail**.

Masking Tape and Plain Paper

Plain paper taped to the underside of the **sail** at a corner is often useful when the **corner measurement point** is not at the **edge** of the sailcloth. By use of the sail measurement batten and/or straight edges, the extension of the **edge** of the **sail** may be drawn on the paper to determine the **measurement point**.

Method for certifying

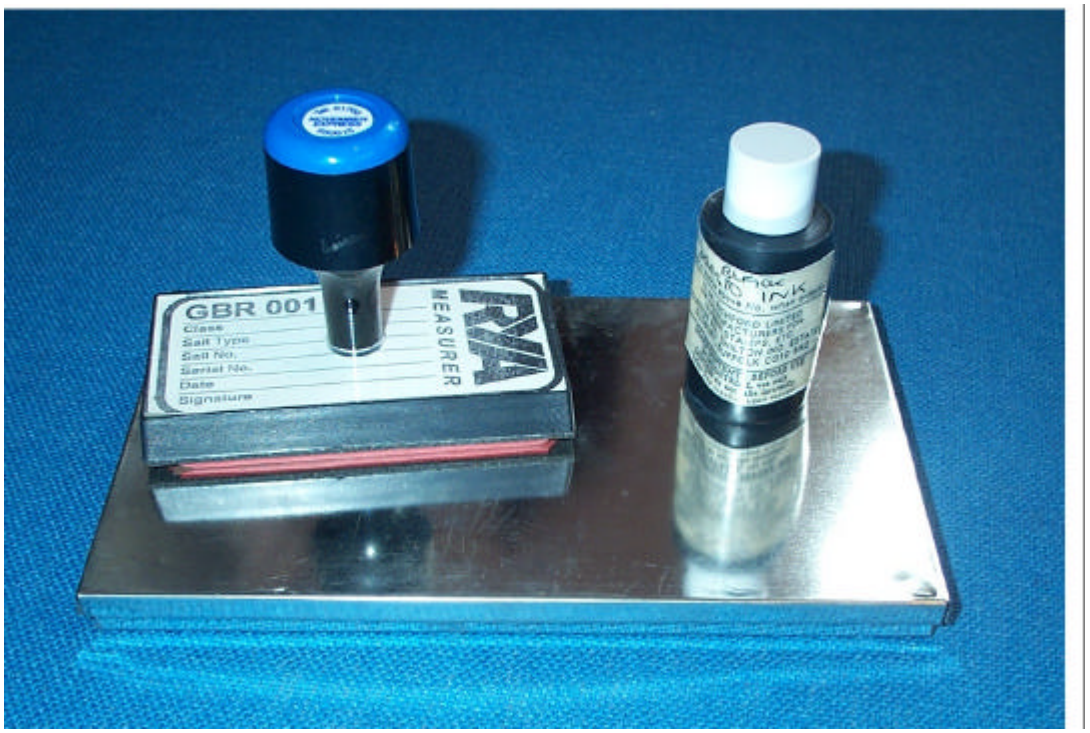


Figure 6

Certification marks take different forms in different countries. The traditional method was by the stamping and signing of a **sail**. The disadvantages are that stamps can sometimes go missing and that the ink used in the stamp pad is often susceptible to fading, particularly if the **sail** is damp when stamping. Ink stamping can also be problematic on film **sails**.

More recent **certification marks** have taken the form of sail buttons or sail labels. The preferred ISAF method is currently the attachment of a **sail** label. This should be manufactured from conventional sailcloth and either stuck or sowed onto the sail or both. Provided the label is of the right material and applied correctly then it will be impossible to remove it from a **sail** without destroying its shape. As the sail label **certification mark** is made of woven material, endorsements added to it by permanent marker pen will be more readily absorbed into the label and should therefore last longer.

Remember **certification marks** are applied at the tack of fore and aft sails and at the head on spinnakers, and should be black and undertaken by a Measurer in the field. A red **certification mark** indicates in-house certification. See figure 7.

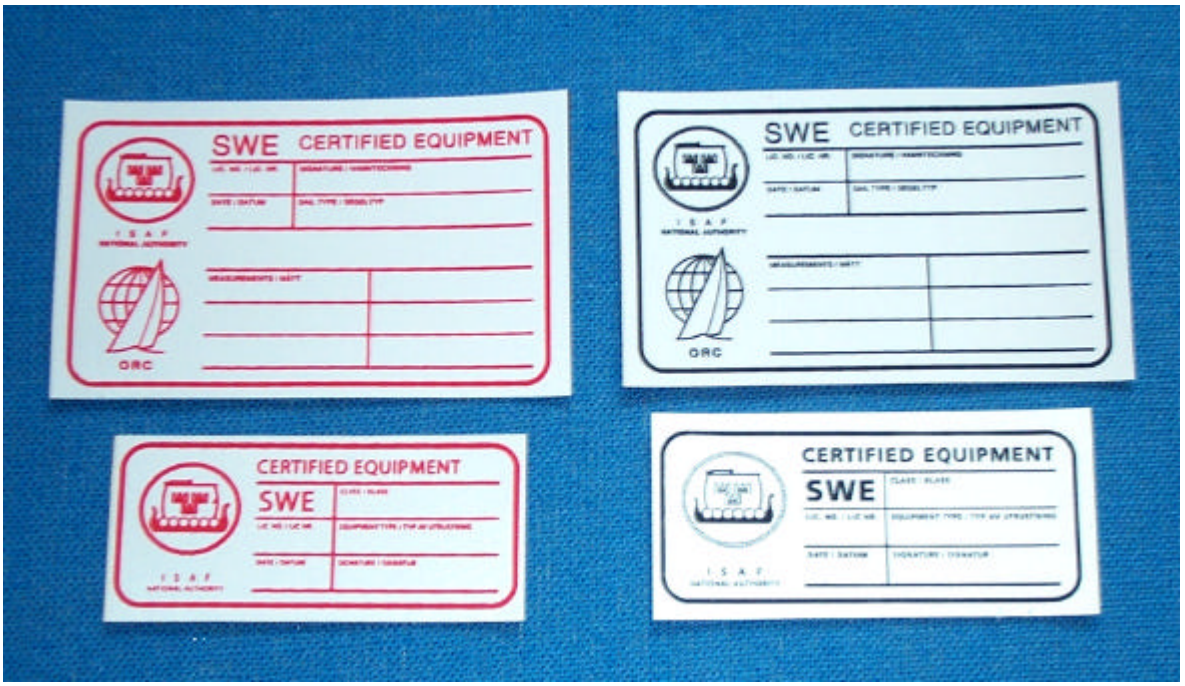


Figure 7

Sail Number and Sailmaker Mark Templates

A transparent template will be helpful to check sail numbers and sailmakers marks particularly during **event measurement.** The limits of the numbers or marks can be scribed onto the template made of Perspex or some other similar transparent material. This can then be placed over the number or mark to ensure that it complies with the maximum and minimum requirements.

Micrometer and Feeler Gauge

Figure 8

The micrometer shall have the following characteristics:

- Ratchet stop
- Measuring surfaces diameter as specified in **class rules** or, as a default, of 6.5 mm
- 400gf – 600gf applied to the measuring area
- Throat depth of approximately 21mm minimum
- Graduations to 0.001mm (0.00005in)
- Overall accuracy of plus or minus 0.002mm
- Flatness of anvil and spindle tips = 0.0006096mm or better or a parallelism of anvil and spindle tips = 0.00124mm or better
- Spindle lock

Padded carrying case

Note: A digital readout type is highly recommended to ensure speed and accuracy for regatta measurement.

Standard automobile feeler gauge.

Equipment Required to Determine Ply Weight (if required this should be hired)

Sail ply weighing equipment (it is recommended that this equipment is hired).

A national governmentally approved laboratory type scale, approved to weigh samples to an accuracy of 0.01% to be used in accordance with its manufacturers' instructions
or
Yield scale type "E/M" and Sample Cutter 'ERC-2' manufactured by Alfred Suiter Co. of Orangeburg, NY, USA.

END

MEASUREMENT AND CALCULATION OF SAIL AREA

1 GENERAL

1.1 The intention is to establish a reliable and simple method of measuring the whole driving area of the sail plan, including the spars, foils, and flaps (or wing sails).

1.2 It is not possible to frame methods to deal with every eventuality and therefore in the case of unique or different shapes of rig the measurer may need to use his judgement in dividing the rig for measurement in order to calculate the area accurately. **Combination** rigs such as a soft trailing edge on a heavily shaped wing spar of a rig where the camber and shape is produced by tensioning when it is on the yacht, may be more conveniently and equitably measured in an **assembled for sailing** condition, rather than in component parts. In these cases the measurer shall record the method used.

1.3 Elements of the sail plan which are vertical, or nearly so, when the yacht is not heeled shall be measured. Elements of the sail plan which are horizontal or nearly so when the yacht is not heeled, such as fences and end plates, are not measured provided that:

(i) The surfaces of such elements are not able to make an angle, measured at right angles to the fore and aft axis of the yacht greater than 10 DEG to the horizontal when the yacht is not heeled, and

(ii) the total area or their surfaces does not exceed ten percent of the measured sail area excluding such surfaces.

For the purpose of calculating the area of horizontal, or nearly horizontal surfaces, only the area of one side of each fence and the surface of an end plate, which is adjacent to the sail, shall be included in the area.

1.4 A soft sail is any sail made up of cloth or other material which is flexible and can be rolled up or folded.

1.5 For the purposes of measurement of **sail** area the term sail shall be deemed to be that part of a soft sail outside the spars and includes the headboard, tabling and battens, which extend beyond the edge of the sail. It shall not include cringles, which are wholly outside the sail or bolt or footropes, which are inside the spars.

1.6 The area of any hole in the sail, the maximum dimension of which does not exceed 50mm, shall not be deducted from the measured area.

2 SPARS AND WING SAILS

2.1 The guiding principal is paragraph 1 (general). Except as provided below, the area of that part of any spar (including the luff spar of a headsail) or wing sail, which projects above the sheerline, shall be measured.

2.2 Devices of fairing added to a spar or wing sail shall be measured as part of that spar or wing sail.

2.3 If the mast, spar, flap or sail is of constant section throughout its length then the area shall be its length multiplied by the mean half girth.
If the mast, spar or sail is not of constant section, and its profile forms a fair curve or curves, it shall be divided into a suitable number of equal lengths and **Simpson's rule** used to calculate the area, using the half girth measurements (see below) as offsets.

Simpson's rule

AREA = L/3 (a + 4b + 2c + 4d + 2e... 2x + 4y + z)

Where L is the uniform distance between offsets and a, b, c, d, e,... x, y and z are offsets. Note: there has to be an odd number of offsets.

If the mast, spar or sail is not of constant section and its profile is not a fair curve, it shall be considered as a number of trapeziums and half girth measurements shall be found at the end of each. The sum of the areas of all the trapeziums is then the area of the mast, spar or sail.
The girth measurement shall be taken as the distance from the centreline round the surface of the spar or wing sail to the same point on the centreline. The resultant dimension shall be divided by two, to give the half girth measurement.

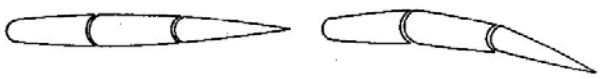
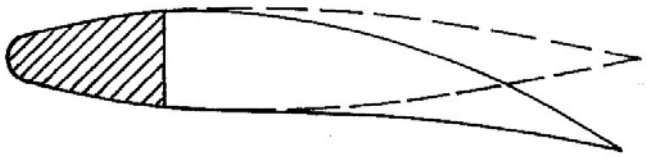


Figure (1)

Figure (2)



2.4 An articulated wing sail, such as that shown in fig. 1, shall be measured as described above except that the skin girth shall be taken over all the sections when they are in the position that gives the greatest girth.

Note: the greatest girth may occur when the sail is at maximum camber (see fig. 2).

2.5 A spar which supports the rig on which no sail is set directly, (e.g. a bipod straddling the hull, a structure fore and aft to support a main staysail or boom from which a loose footed sail is set) shall not be included in the measured sail area provided the maximum vertical or fore and aft dimension of the spar does not exceed one and a half times the maximum horizontal or transverse dimension.

2.6 The measured area of a boom shall be taken as its overall length multiplied by its mean depth in the vertical plane.

3 SOFT SAIL SET ON SPAR(S)

3.1 When the sail is set on spars and between measurement bands the distance between the bands is used to obtain the primary dimensions of the main triangle.

3.2 Area using measurement bands:

(i) With battens set in their pockets the sail shall be pegged out on a flat surface with just sufficient tension to remove waves or wrinkles from the edge rounds and to spread the sail, as far as possible, substantially flat. Once the sail has been pegged out in this way all the required measurements shall be taken and no alterations to the tensions shall be made.

(ii) Needles shall be fixed at the head and clew, making allowance for that part of the sail inside the spars so that the distance between the needles is the length of the leech. A third needle shall be fixed at a point so that it is the distance between the measurement bands on the mast from the head needle and also the distance of the boom measurement band from the mast from the clew needle. If the boom is shorter than the foot of the sail or if there is no boom the length of the foot shall be that found by the measurement with the sail set on the mast. A thin line shall be stretched round these needles to define the main triangle (see fig. 3).

(iii) The area of the main triangle shall be calculated from one of the following formulae or by a scale drawing.

$$\text{AREA} = s\,(s - a)\,(s - b)\,(s - c)$$

where $s = a + b + c / 2$
and a = length of luff
b = length of leech
c = length of foot

AREA = AB X CP / 2 where CP is the minimum distance from C to the thread
from A to B.

(iv) The area of the luff round shall be calculated and added to or subtracted from the area of the main triangle. If the curve is fair and continuous its area shall be taken as two thirds of the product of the chord length and the maximum perpendicular offset to the chord. In fig. 3 above the area of the luff round is 2g (AY) / 3. The offset to the chord shall be taken as the maximum distance between the point on the sail corresponding with the aft edge or the mast, and the thread defining the main triangle.

(v) The area of the leech round shall be found as follows:

Either - Where the leech is a continuous fair curve from point A to point C the area is taken as AC / 4 (1.16d = e = 1.16f)
Where AC is the leech length indicated; d, e and f are the perpendicular offsets between the points on the thread from A to C 1/4, 1/2 and 3/4 of the distance between the leech measurement points A and C and the edge of the sail. For the purposes of the measurement of the offsets, any hollows in the leech shall be bridged.

Or - Where the leech is not a fair curve from point A to C the area of the leech round shall be found by dividing the area into trapeziums, triangles and segments and measuring each. For the purpose of this instruction the area of a segment shall be taken as two thirds of the product of the chord of the round and the maximum perpendicular offset to the chord.

(vi) The area of the foot round, if the sail can be pegged out substantially flat, shall be measured in the same manner as the luff round.

(vii) Where the foot has a **shelf** or a substantial amount of shape so that when the foot is extended there is loosed or bulging material above it; then the area of the **flow** of the bulging material shall be determined as follows (see fig. 4):

A measurement shall be taken from the straight line joining the tack to the clew, in the way of the greatest fullness, to an arbitrary point where the sail does lie flat.
A second measurement is then taken from the arbitrary point of greatest fullness following the folds or bulges or material.
The difference between the two measurements represents the offset of the rounded foot. The area of the foot round is taken as two thirds or the length between the tack and the clew multiplied by the offset.

(viii) The area of the shape BYTX (fig. 3) is not deducted from the area of the main triangle.

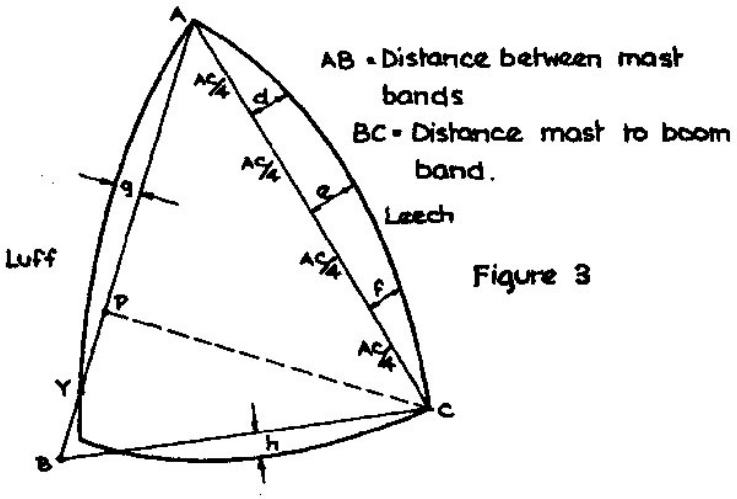


Figure 3

3.3 Where there are no measurement bands on the spars:

(i) With the battens set in their pockets the sail shall be pegged out on a flat surface with just sufficient tension to remove waves or wrinkles from the edges and to spread the sail, as far as possible, substantially flat.

(ii) Needles shall be fixed at the head, tack and clew. A thin line or thread shall be stretched tight between head, tack and clew to define the main triangle.

(iii) The area of the main triangle shall be calculated in the manner indicated above.

(iv) The area or the luff, leech and foot rounds shall be found in accordance with the instructions above.

4 SOFT SAIL NOT SET ON SPAR

4.1 A soft sail which is not set on a spar, such as a headsail, set on a stay or flying, shall be measured in accordance with the instructions above, except that if the leech has an offset not exceeding 5% of the leech length and is a fair curve, the area of the leech round shall be measured in accordance with the above rules.

4.2 If the luff of the sail is wired, sufficient tension shall be applied to remove bends or kinks in the wire.

5 SAIL OF UNUSUAL SHAPE

The foregoing instructions assume that the sails are essentially triangular. If a quadrilateral or multilateral sail is to be measured, the sail is to be divided into suitable triangles whose area can be measured and added. The areas of luff, foot and leech rounds shall also be added, or subtracted as the case may be. The measurer shall record the method he has used to asses the area of mainsail.

6 SPINNAKER

6.1 A spinnaker is a sail which is set: forward of the mast, with its tack in close proximity to a boom fastened to the mast and on the windward side of the forestay and on the opposite side of the yacht to the mainsail.

6.2 The area of the spinnaker shall be taken as:

SF x SL/ 2 + 2(SMG - SF/ 2) SL/ 3 where:

SF = Width of foot; measured round the edge of the sail between the lowest point on the leeches.
SL = Leech length, measured round the edge of the sail from the highest point on the sail at the head to the lowest point of the sail on the leech. If the two are not equal, SL shall be the mean of the two leech lengths.
SMG = Width at half height; shall be taken as twice the distance between the mid-point of the leech shall be determined by measuring round the edge of the sail half the length of the leech from the head.

ISSUED: APRIL 1985