MYA CLASS MEASURER
Generic Study Material 1.4

Contents

Generic Study Material

Introduction

To be complemented by Class Specific Sections.

In this document, for the sake of convenience, the male terms ‘he’ and ‘his’ are used but should not be taken to imply that measurers shall be of male gender.

NB
Whereas the IRSA was the authority for the Marblehead and the Ten Rater class rules when this document was drafted, the International Marblehead Class Association (IMCA) and the International Ten Rater Class Association (ITCA), are now the responsible authorities. It may take a while before all the relevant class rules material and links are moved from the IRSA website to the IMCA and ITCA websites.

Abbreviations

CA	Certification Authority
ERS	Equipment Rules of Sailing
IOMICA	International One Metre International Class Association
MNA	Member National Authority
MYA	Model Yachting Association
OM	Official Measurer
RRS	Racing Rules of Sailing
RYA	Royal Yachting Association
WS	World Sailing

Credit

Valuable input from Lester Gilbert, Roy Stevens, Steve Taylor and Janice Uttley is acknowledged in the preparation of this document.

0 BASICS

Basis of measurement

Q What should a measurer be able to do?

A To complete certification control forms accurately and correctly for a given class

In order to prepare for this there are five stages which are identified and expanded upon in this generic study material document.

In addition it is necessary to demonstrate knowledge and abilities related to the class in question – this is covered in class specific study material documents.

1 ROLE

Measurer shall know his role, duties, responsibilities.

1.1 What is an Official Measurer?

Official Measurer
An **Official Measurer** is a term defined by the Equipment Rules of Sailing.

C.4.4 Official Measurer
*A person appointed, or recognised, by the Member National Authority of the country where the control takes place, to carry out **certification control** and when the **class rules** permit, **certification**. An MNA may have delegated this responsibility.*

The class rules (65, IOM, M, 10R, 6M, A Class) all require certification to be carried out by an Official Measurer.

From 1 January 2020 the MYA has entered into a formal agreement with the RYA for the appointment and training of MYA Measurers for these classes.

The formal agreement delegates authority to the MYA to appoint Official Measurers and to develop a Sail Measurement course subject to the approval of the RYA. Applicants to become a Sail Measurer will need to satisfactorily complete the Sail Measurer course. Interested parties should contact the MYA Technical Officer for further information.

Once appointed as a Sail Measurer they may apply to become a MYA Class Measurer. This will entail satisfactorily completing the general and class specific study material.

Exceptionally the 36" class rules do not require certification to be carried out by an Official Measurer and 36" Class Measurers do not have to be appointed as Official Measurers. However, much of the following material remains relevant to the role of 36" Class Measurer.

1.2 What is the role of the Official Measurer

Role of the "Measurer"
Boats are measured principally to establish compliance with the class rules, but there are other times when compliance is checked and the role of the person called a "measurer" varies in each case as follows:

Measurement for Certification – Certification Control
Most classes require all new boats to be measured in order to establish that they have been built in accordance with the class rules before they are eligible to race. Once a new boat has been measured and found to be in compliance with the class rules it is normally issued with

a Measurement Certificate which has to be presented by the owner as proof of eligibility to participate in class racing, RRS 78.

Measurers do not issue certificates. They are normally required to complete one or more certification control forms which provide guidance concerning the equipment to be checked and the type of check required. Once the forms have been completed they are sent to the Certification Authority (Class Registrar) which will determine if the issue of a certificate is appropriate.

> *Extensive and detailed general guidance for the Certification Control of new boats for certification is given in the International Measurer's Manual - see Sections H (hulls), I (appendages), J (Rigs) and K (sails).*

Measurement after alteration of equipment
Some class rules require equipment (which may be the boat) to be re-certified after alteration. The purpose may be to establish that the item remains in compliance (no certification required) or that the item is re-certified (involving a certification mark or certificate). Any Sail Measurer is able to re-certify a repair/alteration to a sail – a class measurer is required for any other equipment.

Event Measurement - Equipment Inspection
Formal inspections to check compliance with the class rules are often conducted by Equipment Inspectors at major competitions. Checks range from checking certain items only, like the weight of boats, or sail measurements, to complete measurement of all competing boats.

C.4.6 Equipment Inspector
A person appointed by a race committee to carry out ***equipment inspection****.*

> *Extensive and detailed general guidance of Equipment Inspection is covered in the International Measurer's Manual - see Section L and also in the relevant parts of sections H, I, J and K, and is to be performed by "equipment inspectors" as defined by the ERS. In major regattas like World or Continental Championships this task is ideally carried out by a team led by International Measurer(s).*

Note that Equipment Inspectors need no formal training or qualification apart from being appointed by the race committee. At lower level events it is normal for Official Measurers to lead this task and for their assistants to be people under their supervision or studying to become Official Measurers.

1.3 Guidance for the Official Measurer

Certification Control Forms – Measurement Forms
It is common practice for measurers to be guided by the use of Certification Control Forms. The use of these is not optional but an obligatory part of the correct measurement process designed to minimise the chance of the measurer making an error through omission.

Although part of the class rules documentation, the content of certification control forms may be varied from time to time. As a result it is always best to obtain fresh forms from the relevant source when required rather than re-printing from an older source file.

The relevant sources are:

36R, 6 Metre, Free Sailing	MYA website
IOM	IOMICA website
M	IMCA website
10R	ITCA website
65, A Class	IRSA website
Other	Class association website

Guidance concerning class rules – Q&As
From time to time measurers and others have doubts about the meaning or correct interpretation of class rules and need guidance. It is important that guidance is sought from the appropriate authoritative source as, otherwise, incorrect guidance can be given resulting in poor local practices. Reference to the appropriate authority is also essential to ensure that it is made aware of any weakness or lack of clarity in the class rules.

The appropriate authoritative sources are:

36R	36R Class Owner Group, MYA website
6 Metre	6 Metre Class Owner Group, MYA website
Free Sailing	Free Sailing Class Owner Group, MYA website
IOM	IOMICA Technical Committee, IOMICA website
M	IMCA Technical Committee, IMCA website
10R	ITCA Technical Committee, ITCA website
65, A Class	IRSA Technical Committee, IRSA website
Other	Class association website

1.4 Specific obligations that apply

Integrity
A measurer must be completely impartial. So as to prevent any questioning of his integrity, and except in cases where In-House Certification has been approved by his MNA or World Sailing, a measurer is not permitted to measure a boat or its equipment of which he is an owner, designer or builder, or in which he has any personal involvement (e.g. if he is a relative of the owner) or financial involvement other than receiving a measurement fee. See ERS H.1.1.

Knowledge of the class rules
A high level of knowledge of the class rules is required for appointment as a Class Measurer. However, it is unreasonable for any measurer to have perfect knowledge of the content of the class rules and guide material – careful use of the certification control forms will prompt the measurer to check the items that require measurement or inspection for compliance.

Where the measurer is not fully confident in his knowledge of the class rules he shall exercise caution and check the class rules and relevant guidance material.

If he remains in doubt he shall report the doubt(s) on the certification control forms/measurement forms and not sign them. See ERS – H1.2.

Record Keeping
Measurers shall keep a record of the work they carry out briefly noting the date, the equipment measured, and retaining copies of any relevant calculations.

Discretion
A measurer shall have respect for the feelings of an owner or builder who may have just learnt from the measurer that his boat requires substantial modification before it can be used. However, a measurer must remember that he is checking that boat for the eventual owner who will be bound by all the class rules when racing. The measurer must not get swayed by the thought that an item is not important or that it does not affect the speed of the boat, nor allow any additional tolerances outside those permitted.

Measurement Fees
A measurer should require a payment for his services to a builder or owner.

Some clubs set out the fees to be charged for measurement and where this is the case that scale of fees should be the basis for the charges made. Those fees may go to club funds, to the measurer or to a designated charity. Some measurers give their fees to a charity of their choice or use the fees to offset the cost of maintaining appropriate and accurate equipment. If significant travel is involved the measurer should ensure that the travel expenses are covered in addition to the measurement fee.

Measurer's Liability
However diligent the measurer will try to be, it is possible for him/her to make a mistake, either as a result of misinterpreting the rules or possibly by making a numeric/recording error. Hopefully, careful study of this manual will help to minimise errors and any error will be minor.

However, even a small correction to a boat at a later date can be a costly exercise and an owner may try to claim against the measurer.

To cover for such a possibility the Official Measurers will be covered by their membership of the MYA. For details of this cover please see the relevant MYA web page.

2 TOOLS

Measurer shall be able to establish that the quality of tool matches the requirement

2.1 Introduction

The words ‘accuracy’, ‘precision’, ‘resolution’, ‘repeatability’, ‘error’, ‘uncertainty’, ‘measurement’, ‘reading’, all have defined but not necessarily well known meanings when used in connection with the process of measurement. Before the sections on tools and their use it is important to be able to define those terms better.

2.2 Definitions

Briefly they are as follows:

Accurate measurement
One that is close to a standard or known value.

Error
The difference between a measured value and a standard or known value

Measurement/measured value/observed value
A figure and unit that show the size or amount of something as a result of a single observation.

Precision
Precision refers to the closeness of two or more measurements to each other. It describes the variation of the measurement from the mean value and is not related to the number of decimal places used or actual accuracy of the equipment. If you weigh a given item five times, and get 3.261 kg each time, then your measurement is very precise. However, it may not be accurate.

Reading
The figure indicated on the measuring instrument.

Repeatability
Almost the same as precision except that, whereas precision requires consistency of readings for the same user in the same environment repeatability requires consistency of readings for different users and in different environments.

Resolution

The resolution of a measuring instrument is the smallest increment that can be detected or displayed on the scale. In all weighing equipment, this quantity is usually determined by the number of digits that are displayed when an object is weighed.

Rounding
Rounding of measurements may be required by the class rules.

Scale division/increment/interval/step size/read out step
The smallest incremental indication marked/displayed on the measuring instrument.

Tare Weight (noun)
The weight of an empty vehicle or container which may have devices for supporting the object(s) to be weighed but which themselves are not to be weighed.

Tare (verb)
Set the machine starting position to zero.

Uncertainty
The range of values within which the true value is thought to lie with some specified level of confidence.

These and related defined terms can be found in the International Measurer's Manual and ISO 5725.

2.3 Length measurement tools

Callipers - Verniers
Electronic/digital Verniers can be quite inexpensive but may lack repeatability, may be less robust, and will rely on batteries to work. The traditional type with a dial gauge is preferred.

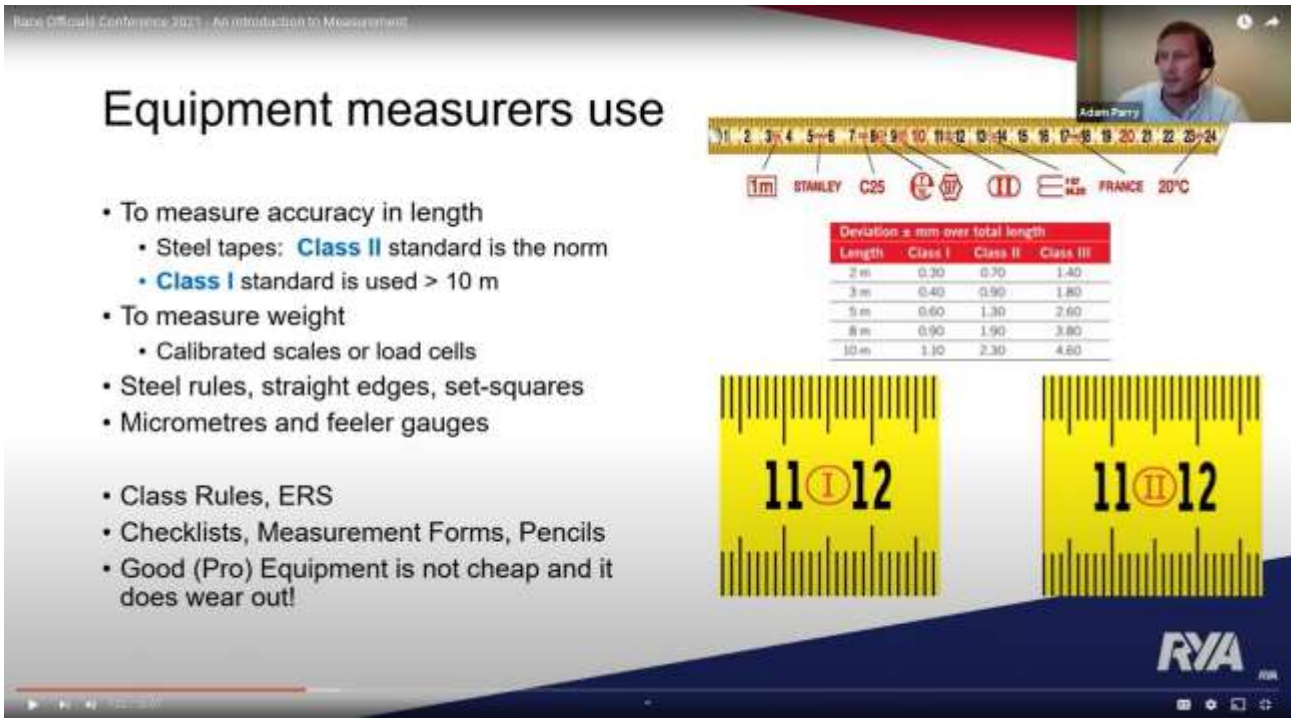
Either type should be capable of giving readings repeatably to 0.03 mm (the usual quoted degree of accuracy) when tested on a good quality piece of metal rod. Test that the jaws are parallel by closing the jaws and holding against a bright light. Reject any tool that has non-parallel or irregular jaws.

Standard of Measurement Tapes and Rules
For measurement tapes there are three classes of accuracy: I, II, III, marked on equipment with the respective Roman numeral. Class I is the highest standard.

Off the shelf steel measurement tapes are surprisingly good, are normally Class II, and can be used for measurement but preferably after comparison with a certified Class I tape to confirm their calibration.

The lower tape in the central illustration has an extension before the zero datum that is designed to avoid any problem with the inaccuracy that may be caused by poor manufacture of, or damage to, the floating end piece of a normal steel tape.

> *The RYA suggests Class II tapes are perfectly good for measurements less than 10 metres.*



Steel tape
One Class I steel tape of minimum length 3000 mm will be sufficient for all applications including testing other rules. Except for measurements less than 10 metres, a Class II tape should be used only after successful comparison with a Class I tape.

Steel Rule
One of 600 mm long is usually sufficient for measuring lengths encountered on sail cross widths. The class of steel rules is not normally noted on the rule. Buying rules made by makers known to provide high quality tools is likely to ensure accuracy. The graduations will be etched or engraved, rather than printed, on better quality tools. See Appendix 4. However, the quality can be checked by comparing the rule with a steel tape of known standard.

Articulated or folding rules, unless officially certified, are not always accurate and should be avoided.

The sharp edges of steel rules can easily damage sail material if handled without perfect care. To reduce this problem you can add a 1 mm radius to corners using a smooth file and fine abrasive paper. Extra care will then be required to ensure the end of the rule is placed at the measurement point.

Straight edge
A straight edge may be required for testing straightness or hollow. At the size we will work at a normal steel rule provides a suitable straight edge. Be aware that some lower quality rules many be bent. Test by placing against another rule, each side in turn, and looking for any gap between the edges.

2.4 Weight measurement tools

Standard of weighing equipment
For accurate and precision weighing digital weighing equipment should be of the same quality as those certified/approved for legal trade and therefore capable of being certified/approved for trade use (i.e. Class III weighing equipment, see notes at end for more detail).

It is not considered essential that the weighing equipment should be certified or approved. Instead it is considered essential that calibration weights of appropriate quality are used to calibrate weighing equipment wherever and whenever the weighing equipment is used. This process is covered in Section 3.

Rounding of weights found when weighing equipment in the class rules is as follows:

Table 2.4.1

Class	Boat weights rounding to nearest	Other weights rounding to nearest
IOM	1 gram (0.001 kg)	1 gram
10R	0.01 kg (10 grams)	-
6M	0.1 kg	1 gram
A Class	0.1 kg	1 gram

Class III weighing equipment has to meet the following requirements:

Table 2.4.2

Range	Most coarse resolution	Class Rule, required resolution
0 to 2000 grams	1 gram	IOM (rudder), 1 gram
2000 to 5000 grams	5 grams	IOM (fin/ballast, boat) 1 gram
5000 to 20000 grams	20 grams	10R (boat), 10 grams
5000 to 20000 grams	20 grams	6M, A Class (boat), 100 grams

Comparing these resolutions for the weighing equipment ranges above with the degree of rounding used in the class rules the following is apparent:

IOM & 10R	Class III weighing equipment resolution does not necessarily meet class rule degree of rounding – but see below
6M & A Class	Class III weighing equipment resolution meets class rule degree of rounding for the boat weight – for the nominal sail weight it does not meet the required resolution

The above suggests great care needs to be taken when choosing equipment on which to weigh IOM rudders, IOM fin/ballasts, IOM boats and 10R boats as even Class III weighing equipment resolution may be larger than the resolution required by the class rules.

In practice most commonly available Class III weighing equipment used for IOM measurement and with a 5 or 6kg range has a resolution of 1 gram.

Choice of 6M and A Class boat weight is less problematic as the resolution of suitable weighing equipment is generally smaller than the rounding of weight required by the class rules.

The exception, for the 6M and A Class, is the weighing equipment used to prepare and check the nominal sail weight which is specified to be 100 grams. The nominal sail weight should be treated as for IOM equipment.

Currently the availability of high quality, modestly priced electronic weighing equipment usually meets the requirements of Class III and the difficulties identified above can normally be avoided by choosing weighing equipment that meets the following specifications.

Table 2.4.3

Capacity	Maximum resolution	Use
0 to 5000 grams	1 gram	IOM Rudder, IOM fin/ballast, IOM boat, 6M & A Class nominal sail weights
5000 to 10000 grams	5 grams	10R boat
10000 to 20000 grams	20 grams	6M boat, A Class boat

Corner Error – a simple quality test

A simple quality test for any weighing equipment is to place an object, weighing approximately 80% of the range, in the centre of the pan. Note the reading. In turn place the object at the four corners of the pan and note any variation. A variation of more than one display step/scale interval indicates a problem with the weighing equipment which should be rejected and not used until repaired.

Low cost weighing equipment

Low cost weighing equipment is attractive but not recommended for serious weighing as the quality is not high enough to give repeatable readings, have fine enough resolution, have corner error less than one display step, and be reliable and precise enough for our job. See Appendix 2 - Models of weighing equipment, calibration weights & their sources.

Standard of Calibration Weights - also known as Test Weights, Check Weights
Calibration weights are specially designed cast iron or stainless steel weights used to calibrate weighing equipment. Test weights are manufactured and compared in the laboratory to a certain degree of accuracy against a known standard.

> *There are many different standards of calibration weights that are used for different applications. See Appendix 3 - Maximum permitted variation of calibration weights.*

M1 Class Calibration Weights: The most widely used calibration weight. These weights are used to calibrate weighing equipment where the highest precision is not necessary. For trade use Class III weighing equipment is required to be checked with M1 weights for reference and calibration.

Appropriate class of Calibration Weight for our purposes
For our purposes, due to the rounding of weights prescribed by the 10R, 6M and A Class class rules, with Class III weighing equipment the following is relevant:

IOM equipment, 6M & A Class nominal sail weights
M1, or better if available, is the correct choice.

10R boats, 6M boats, A Class boats
M3, or better if available, is the correct choice.

It should be noted that calibration weights themselves, unless kept in perfect condition, will eventually need to be re-calibrated externally to remain of value.

Certification/independent calibration of weighing equipment
External calibration of weighing equipment ensures it meets the required standard, either at the point of supply, or at a later date. It does not guarantee that the equipment will continue to be accurate and it is not an alternative to having calibration weights.
The repeated use of appropriate calibration weights is the only means by which the measurer and the owner can remain confident that the measured weights are accurate.

2.5 Templates, go no-go gauges & related tools

Templates, go no-go gauges and related items are often used to establish that equipment is compliant with class rules. These are effectively tools for checking compliance with length restrictions in one, two and even three dimensions at a time. As such they are replacements for length measurement tools and should be subject to the same standards of precision. Generally, in reality, they are not made by processes that can achieve the same high precision that is possible for steel rules and tapes. Nevertheless their accuracy must be checked carefully with appropriate length and, where appropriate angle, measurement tools to ensure they will correctly discriminate between compliant and non-compliant equipment.

Where the tools may go out of shape, shrink or expand, they should be checked carefully before use. For example, length restriction gauges made of timber and sail measurement grids on film may be subject to change of size with atmospheric conditions.

To guard against such changes:
Timber tools should be coated with varnish, resin or paint and stored in stable conditions.
Sail measurement gauges should be made of Mylar/Polyester film and never of paper.

Examples of templates & go no-go gauges

65 Class
Length restriction gauge
Depth restriction gauge
Sail corner/edge extension gauge
Sail measurement grid

36"
Hull & appendages measurement box

IOM
Leech stiffening zone template

Marblehead
Length restriction gauge
Depth restriction gauge
Upper & lower leech profile gauge
Sail foot roach gauge

Ten Rater
Waterline measurement gauge
Draught measurement gauge
Sail corner/edge extension gauge (same as Marblehead upper & lower leech profile gauge)
Sail measurement grid

A Class
None

2.6 Dry measurement equipment, flotation tanks

Such equipment is basically similar in concept to templates and go no-go gauges but different in that it is used to determine dimensions essential for rating calculation and certification control.

The exceptions are the flotation tanks that are used to test compliance at events of IOM and 10 Rater boats under Section C of their class rules. Such tanks are not equipment that is

used for certification control of IOM and 10 Rater but they may be essential for owners to establish that their boats are in compliance with the class rules before they take part in an event. For these classes they may also be essential for owners to remain confident that their boats are in compliance with the class rules after they have undertaken repairs or other alternations to their equipment.

In contrast to the IOM and Ten Rater classes, where flotation is not required for certification, the certification of 6 Metre and A Class boats requires flotation and the use of properly prepared equipment to enable precise and repeatable measurements to be taken. Again, in contrast to the IOM and Ten Rater classes where a tank is required to test compliance at an event, compliance with class rules at an event under Section C of the A Class rules does not require flotation but the use of linear measurement and gauges. Where the technical committee/protest committee finds an A Class boat does not comply with the permitted tolerances, flotation may then be required. See A Class Rules.

In common with templates, go no-go gauges and related items, these are effectively tools for measuring length in one, two, or three, dimensions at the same time. As such they are replacements for length measurement tools and should be subject to the same standards of precision. Generally, in reality, they are not made by processes that can achieve the same high precision that is possible for steel rules and tapes. Nevertheless their accuracy must be checked carefully with appropriate length and, where appropriate angle, measurement tools to ensure they will correctly discriminate between compliant and non-compliant equipment.

2.7 Related aids for measurement

Other aids that are useful to have at hand during the measurement process are:

Masking tape	for the temporary extension of sail corners where there is no well defined measurement point
Permanent marker	for the signing and dating of sails required as part of the certification process – avoid fine line pens and colours other than black unless of the metallic ink variety
Set square	see below

An alternative to the preferred method of folding the **sail leech** to find the **half**, **quarter** and **three-quarter leech points**, is to divide the expected **leech length** into half and rounding to a convenient number. Mark a point on the **leech** that distance from the **head point** and another mark the same distance from the **clew point**. A point midway between those points will be the **half leech point**. Repeat the process to find the **quarter** and **three quarter leech points**.

Another alternative to the preferred method is to find these points by setting a long straight edge from (first) the **clew point** to **head point**, finding the middle of that length, and setting

an edge of the square at that point. The **half leech point** is where the edge of the square crosses the **leech**.

The process is repeated with the straight edge passing through the **half leech point** and each of the **head point** and **clew point** (in turn) and repeating the division process.

These processes are prone to error – a suitable flat surface is required, the straight edge may not be truly straight, the divisions may be in error – hence folding the **sail** is the preferred method.

2.8 Computer hardware and software

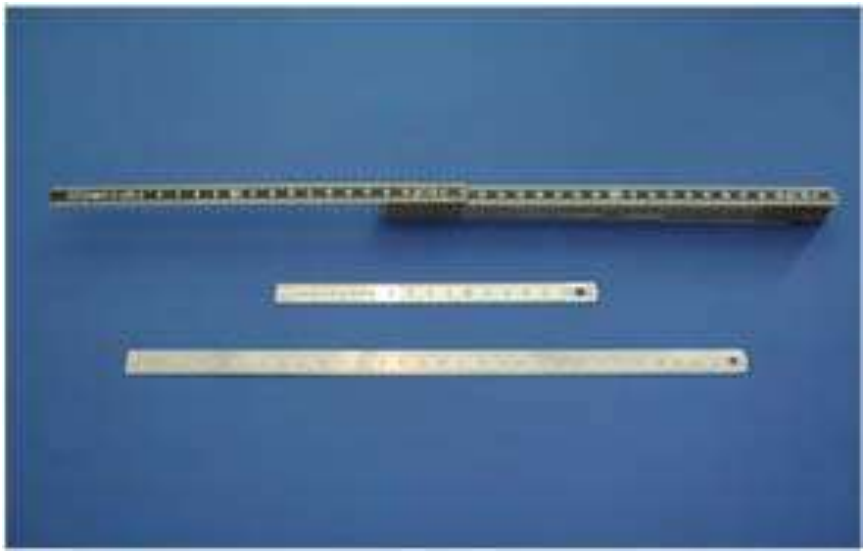
Access to class rules, interpretations, Q&As, and other measurement related documentation including this training material, requires access to a pc. Most classes use certification documentation that has to be used on a computer capable of running an operation system for Microsoft software.

The Terms of Reference for Class Measurer require the candidate to be able to receive and send e mails, access information by Internet, and use Excel, Word and Power Point. The Application form also includes this requirement.

3 TAKING MEASUREMENTS

Measurer shall be able to use the measuring equipment to take accurate measurements

3.1 Testing straightness



Straight edge
Class rules requiring hull surfaces to be tested for hollows normally state over what length(s) the test is to be made. Steel rules of length equal to the prescribed test length are appropriate tools for this task.

Testing with a straight edge
When held against a surface with fair curvature the edge will rock smoothly. When held against a surface with a flat, or hollow, the edge will not rock. On close inspection light from a source behind the rule will be visible between the edge of the rule and the hull surface. If the amount of hollow needs to be established a series of drill bits in 0.1 mm increments provide a handy set of go-no-go gauges. Drill bits are normally 0.05 mm less than the nominal diameter i.e a 2.0 mm drill will normally be about 1.95 mm diameter.

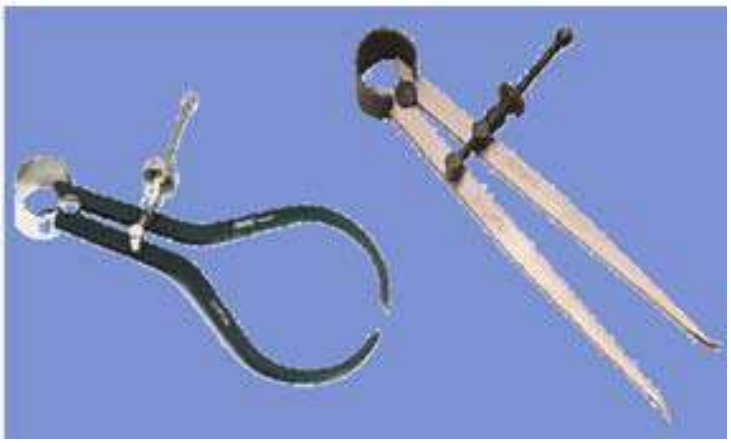
The IOM class rules require the headsail leech not to extend aft of a straight line between aft head point and clew point. The mainsail leech is also tested between batten pocket points. The longest headsail leech is 1255 mm – if a straight edge is not available at this length then a light line, or elastic line, can be stretched over a flat surface to establish a straight line.

3.2 Measuring Length

Callipers - Verniers

Vernier callipers are used for measuring items such as the diameter of wire, the thickness of small parts or the cross section of spars. Inside or outside callipers may help to transfer figures where you cannot reach directly with a Vernier.

Inside and outside callipers



Electronic/digital Verniers can be quite inexpensive but may lack repeatability, may be less robust, and rely on batteries to work.

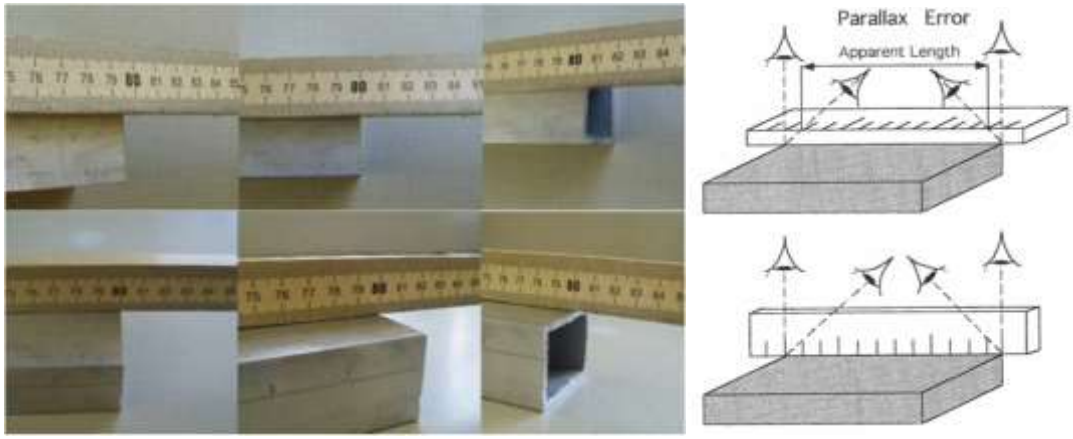
The traditional type with a dial gauge, as shown below, is preferred.

End error – Zero error
If the end of the tape or rule is damaged there may be an error in the measurement. It is good practice to check that the length of the tape or rule over its first 100 mm is correct. Some measuring tapes have sliding hooks at their end, to facilitate inside and outside measurements. These are legal for all Classes of tape, but they are likely to create an end error. Some precision tapes have their zero datum offset from the end of the tape. A bent tape (e.g. by stepping on it) will also give wrong readings.

A standard procedure to avoid any end error is to place the 100 mm mark (for example) at one end of the length measurement and subtract that dimension from the reading before recording. Use of 100 mm, or 200 mm say , is safer than using 10 mm as any difference between the recorded dimension and the true dimension is more likely to be obvious.

Parallax Error
This is a misreading of a scale which is not contiguous (next to) with the object being measured when the line of sight is not perpendicular to the scale. Parallax errors can be eliminated by placing the scale adjacent to the object being measured.

Figure *Examples of the parallax error when sighting a non-contiguous scale*



Note that the lower photos show a consistent reading whereas the upper photos show how the reading changes with viewpoint. The scale in the lower photos is contiguous with the surface it is measuring.

3.3 Measuring weight

Weighing equipment set up
The weighing equipment should be levelled and set up on a firm base in an area free from vibration caused by passing traffic. Good quality weighing equipment incorporates a spirit level enabling a quick visual check to be made. However, use of a traditional spirit level of length equal to the width of the scale pan is preferred. Suspended floors transmit vibration from people moving about and will induce vibrations large enough to introduce reading errors. If a solid floor is not available, place the weighing equipment on a pile made of several concrete patio slabs and prohibit the presence of non-essential personnel. Avoid placing the weighing equipment where there will be any influence from wind.

Some weighing equipment incorporates a locking mechanism designed to protect the weighing apparatus when being moved. Ensure this is properly freed for use and re-engaged afterwards to protect the weighing equipment from shock loads.

Zero indication – 'no load' reading
The reading of the weighing equipment shall show zero when no load is applied. If the weighing equipment does not read zero, and cannot be reset to zero, it is not suitable for use for measurement.

Weighing equipment calibration
Calibration is the comparison between the reading of the weighing equipment against a calibration weight in order to establish the weighing equipment error.

Adjustment of the weighing equipment is normally done so that the reading is zero with no load and equal to the nominal value of the calibration weight when loaded with a calibration weight that itself is close to the maximum range of the weighing equipment.

For our purposes it is good practice to ensure the weighing equipment has a zero reading with no load and then use the appropriate calibration weight to check the reading at approximately the expected weight to be determined*.

Note: if a framework is to be used to support the boat equipment on the weighing equipment, this will add to the weight to be determined.

*Thus, for an IOM the weighing equipment would be calibrated at:
Zero and 2500 grams (2000 and 500 grams) for checking fin/ballast
Zero and 2 x 2000 grams for checking the boat.

Zero, 2000 grams and 2 x 2000 grams is less satisfactory but acceptable.

*In the case of other classes where the boat weight will vary, the weighing equipment would be calibrated at:
Zero and one or more calibration weights near the typical boat weights.

Calibration in practice – MYA procedure

A MYA approved weighing equipment calibration spreadsheet shall be used for scale calibration.

Weighing equipment properties

There are a number of problems with weighing equipment that a measurer should know how to avoid.

Weighing equipment has a given accuracy that is achieved only if the scale is operated within the temperature range stated by the manufacturer. The error can be significant if the weighing equipment is operated outside the temperature range, with some hulls weighed in hot sunny conditions at noon, while others are weighed in the cool evening. It is preferable to weigh indoors, or at least keep the weighing equipment in the shade.

Although most electronic weighing equipment has stabilized power supplies, with battery powered weighing equipment it is nevertheless good practice to use fresh batteries or ensure that they are always fully charged. Mains powered weighing equipment is preferred.

The electronics used in weighing equipment is often nonlinear over the first and last 20% of the range so weighing equipment should preferably not be used over these ranges. Instead obtain and use weighing equipment with a smaller range or larger range, as appropriate, so that the measurement is not towards the end of the weighing equipment's range. Choosing weighing equipment with range 125% of the weight to be measured will give the best resolution at the working load.

Weighing equipment may be damaged easily by overloads. Shock loads can be significant, typically two or three times the actual load, and weighing equipment with a range or overload rating twice the intended load is recommended if the necessary resolution can be achieved. Great care should always be taken when loading the weighing equipment to avoid shock loads beyond the range of the weighing equipment.

Regular use of the calibration weight(s) will detect problems caused by the above.

How to clean calibration weights

Weights should be dusted routinely before use using a clean, soft-haired, brush. But they should not be more extensively cleaned unless it is absolutely necessary. More extensive cleaning may adjust the weight to the extent the weight loses its value as a calibration weight. See below.

How to store calibration weights

Calibration weights should be stored in individual boxes to protect them from moisture, dust and damage.

Avoidance of exposure to moisture is particularly important. Calibration weights are typically made of cast iron which is subject to rusting in a damp atmosphere. Initially this increases the weight and then, when the rust is removed, reduces the weight.

3.4 Using templates, go no-go gauges & related tools

Whereas the use of rules and tapes generally requires a judgement about the dimension of the target, use of a template or go no-go gauge requires no judgement other than whether the target fits or does not fit. The important criterion then is the method of application of the tool.

Sail measurement grids (65 and 10R classes)
The correct placement of the sail on the grid is of primary concern. This involves two stages:

- the establishment of the clew point, tack point and head point for measurement purposes, if they are not clearly defined by the sail edges, using the methods prescribed in the class rules
- avoidance of parallax error when placing the measurement points on the grid lines

Sail corner/edge extension gauge (65, 10R classes)
Where the sail clew is not clearly defined, the edges of the sails nearby are each extended (as prescribed by the class rules) using the edge of the gauge. The intersection of the extended lines determines the location of the clew point. Adding a piece of paper, card or sail film to the sail corner using masking tape allows a pen or pencil to trace the extended lines and provide a virtual sail measurement point for the duration of the measurement exercise.

Length restriction gauge (65, M classes)
The boat is placed on the gauge and checked to see that the ends of the boat clear the gauge. The same gauge may be used to check that the rig and rudder do not extend beyond the ends of the boat.

Depth restriction gauges (65, M, 10R classes)
The boat is placed on the gauge (transverse for 65 and M, longitudinal for 10R) and checked to see that the lowest part of the appendages clears the gauge.

Upper & lower leech gauges, leech stiffening zone template, sail foot roach gauge (IOM, M classes)
The tools are placed over the sail and compliance is established by judging whether the sail part extends beyond the tool edge.

Examples of templates, go no-go gauges & related tools

65 Class
Length restriction gauge
Depth restriction gauge
Sail corner/edge extension gauge
Sail measurement grid

36”
Hull & appendages measurement box

IOM
Leech stiffening zone template

Marblehead
Length restriction gauge
Depth restriction gauge
Upper & lower leech profile gauge
Sail foot roach gauge

Ten Rater
Waterline measurement gauge
Draught measurement gauge
Sail corner/edge extension gauge (same as Marblehead Upper & lower leech profile gauge)
Sail measurement grid

3.5 Using dry measurement equipment, flotation tanks

36”
The correct use of the measurement box for certification control and event inspection is to be described in the class specific appendix.

IOM
The correct use of the flotation tank used to check draught, hull depth and length for event inspection* is to be described in the class specific appendix.

M
The correct use of the hull length restriction gauge used at initial certification control and event inspection and the draught restriction gauge used at event inspection* is to be described in the class specific appendix.

Ten Rater
The correct use of the flotation tank used to check that the waterline endings fall within the waterline length limit marks for event inspection* is to be described in the class specific appendix.

6M & A Classes
The correct use of the flotation tank and dry measurement equipment used to take accurate measurements for initial certification control is to be described in the class specific appendix.

* These checks are not required at initial certification control but may be requested by the builder or owner for their own satisfaction.

4 Assessment

Measurer shall be able to satisfactorily perform tasks relevant to the class(es) he has applied to measure.

4.1 Assessment

The measurement assessment shall include examples of unusual features such as matters which have been the subject of a Q & A, as well as a standard configuration.

The measurer shall know what is the correct response when an item of equipment appears not to comply with the class rules, and when he is doubtful that an item appears not to comply with the class rules.

5 Links

Useful links

IMCA	International Marblehead Class Association	http://www.marbleheadclass.org/
IRSA	International Radio Sailing Association	https://www.radiosailing.org/
IOMICA	International One Metre International Class Association	https://www.iomclass.org/
ITCA	International Ten Rater Class Association	http://www.tenrater.org/
MYA	Model Yachting Association	https://www.mya-uk.org.uk/
RYA	Royal Yachting Association	https://www.rya.org.uk/
WS	World Sailing	https://www.sailing.org/

Appendices CLASS SPECIFIC ISSUES

Measurer to know the issues specific to his class – see separate documents.

Appendix 1

Adapted text relating to approved scales.

What is NAWI?
Firstly, we should start with the basics. The NAWI directive is what tells us what should and shouldn't be approved. NAWI stands for Non Automatic Weighing Instrument and essentially means a weighing scale that has human interaction at some point along its process.

The NAWI directive tells us that certain weighing scales do not require an approval. This would cover items for use at home, for instance a kitchen scale or a bathroom scale. Even scales used in Gyms do not need to be approved. Whether the gym chooses to use trade approved scales is entirely up to them, but trading standards would not have any control over this.

On an industrial level, scales that are used for internal processes are also not required to be approved. If, however, you are charging or buying by weight and you are declaring a weight for this purpose then your scales need to be checked and verified by a qualified person, organisation or company, in other words Trade Approved.

Different Classes
There are 4 separate classes that govern this directive. Classes I & II would normally be used for a very high accuracy scale, as an example this could be used for weighing precious metals at a jewellers.

Class III is what most approvals fall under in the U.K. and would be used for the following applications:-

- retail and industrial weighing machines
- supermarket checkout weighing systems
- weighbridges
- laboratory and pharmaceutical balances and medical weighing machines

Class IIII is generally used in medical environments where a patient's weight needs to be checked or monitored, but at no stage can medication be prescribed based on weight given by a Class IIII approved scale, this would need to be done on a class III machine.
In short, if you are prescribing by weight, selling by weight or even buying by weight then your scales should be class III approved at the very least. If, however, you are shipping parcels on a courier, doing a stock take or even weighing your pet dog then your scales do not need to be approved.

Are Approved Scales More Accurate?
Not necessarily. A scale being approved means that it has been checked and verified to fall within a certain set of parameters. These parameters are very strict so in theory you are buying an item where quality is a necessity. A non approved scale might be just as accurate,

but unless it has been through those same strict tests, sealed and verified then it cannot be used for trading from.

Labelling and Marks

Approved scales will generally have a green M on them and a CE mark. This does not make them approved, though, and simply means they could be should all criteria be met. To be approved your scale will also require the relevant paperwork as well as a tamperproof seal on the instrument to stop the calibration being affected without a re-verification being completed along with other identifying labels and marks.

Don't be Fooled!

Do not get taken in by cheaper scales for sale on the internet. Scales offered for around £40 to £50 are probably not approved and therefore you cannot legally trade by the weight given on them. Should trading standards pay you a visit they will either fine you or shut you down for using illegal scales. It is a false economy to think that anything less than the correct tool for the job will do.

Advice

When in doubt, seek advice. Your local Trading Standards office will always offer assistance and information for free as will we. If you have any questions at all then please ask. Calibration certificates can only be issued at the place the scales are located. The certificate is only valid at the place of issue.

Appendix 2

Models of weighing equipment, calibration weights & their sources

This list can only be provisional in nature as model numbers, their specification and price will vary over time.
NB Prices are, or are likely to be, excluding VAT and carriage.

Scales

5 & 6 kg (IOM)

code	capacity kg	resolution g	accuracy g	price	source
AFR-EJ5	6	1	2	£50	ATP
AFWS-6	6	0.2	0.6	£99	ATP
AFHB-6000	6	0.1	0.2	£99	ATP
JWN-6KG	6	0.5	?	£75	Marsden
JWE-6KG	6	0.2	?	£115	Marsden

** Any model marked with asterisks below is also acceptable

10 kg (10R)

AECB-10K	10	5	20	£96	ATP

15 kg (6M)

AFWS-15**	15	0.5	1.5	£99	ATP
B-200	15	5	?	£95	Marsden
B-250	15	2	?	£105	Marsden
JWN-15KG**	15	1	?	£75	Marsden
JWE-15KG**	15	0.5	?	£115	Marsden

20 kg (A)

AFGL-3001	30	1	3	£75	ATP
AFCS-30	30	10	20	£99	ATP
390301**	20	1	?	Euro 40.79	R & G
JWN-30KG	30	2	?	£75	Marsden
JWE-30KG**	30	1	?	£115	Marsden

Calibration weights

Code	size	use	standard	price	source
AM1-100	100 grams	IOM	M1	£11.75	ATP
AM1-5KG	5 kg	IOM/10R	M1	£45.10	ATP
AM1-10KG	10 kg	6M/A	M1	£74	ATP
AM3-10KG	10 kg	6M/A	M3	£74	ATP
M1IRON100	100 grams	IOM	M1	£11	S&B
M1IRON5K	5 kg	IOM/10R	M1	£35	S&B
M1IRON10K	10 kg	6M/A	M1	£46	S&B
M3IRON10K	10 kg	6M/A	M3	£39	S&B

Sources

ATP Instruments, UK	https://www.atp-instrumentation.co.uk/
R & G Composites, Germany	https://shop1.r-g.de/4DCGI/ezshop
Scales & Balances, UK	https://www.scalesandbalances.co.uk/index.html

Appendix 3

Maximum permitted variation of calibration weights

The maximum permitted variation is quoted in milligrams (0.001 gram) and may be positive or negative. Quoted figures are from OIML source.

Nominal Weight	F1	F2	M1	M2	M3
100 grams	0.5	1.6	5	16	
1 kg	5	16	50	160	
2 kg	10	30	100	300	
5kg	25	80	250	800	2500
10 kg	50	160	500	1600	5000
20 kg	100	300	1000	3000	10000

The following reference (Janice Uttley source) indicates UK Stamped calibration weights are approximately to the same standard as M2 weights.

	UK Stamped	M1 mg	M2 mg	M3 mg
20 KG	3,200 mg	1,000	3,000	10,000
10 KG	1600 mg	500	1.600	5,000
5 KG	800 mg	250	800	2,500
2 KG	400 mg	100	300	1,000
1 KG	200 mg	50	160	500
500 g	100 mg	25	80	250
200g	50 mg	10	30	100
100g	30 mg	5	16	50

Appendix 4

Sources of equipment (not weighing equipment)

Manufacturers of high quality tools	Moore & Wright Mitutoyo
Calipers, rules, tapes	Cutwel Ltd Axminster Tools, UK Machine DRO

Mail order tape supplier
https://www.thetapestore.co.uk/tapes-rules/tape-measures/tape-accuracy/class-1-tape-measures