

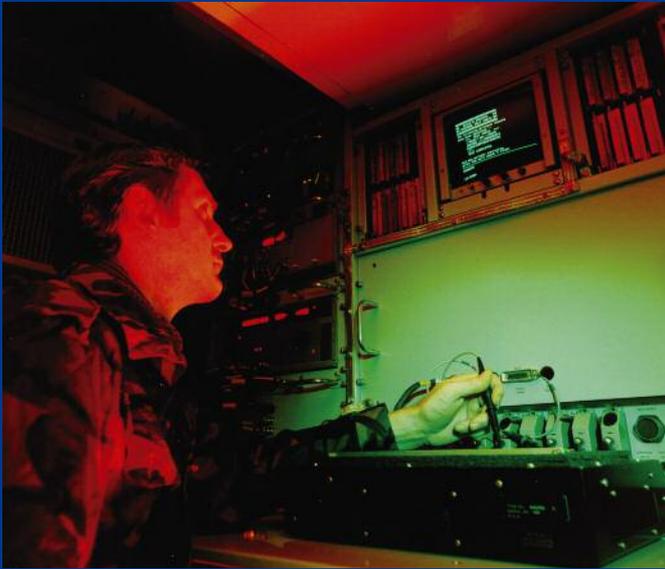
Choosing Calibration

A guide to choosing services and suppliers for the calibration of your test and measurement equipment



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Introduction



This GAMBICA Guide is to assist industry in the selection of calibration services and calibration providers that meet their own specific calibration requirements and to help reduce or eliminate costly re-work, including that resulting from flawed testing and non-compliances raised by clients or quality assessors.

Careful selection of the appropriate calibration service is likely to save you money. This guide sets out how to ensure that you are getting the level of service you require to enable you to be confident in the performance of your products and to enhance the position of your products in the world-wide market place.

GAMBICA is the trade association for the instrumentation, control and automation industry. Member companies of the sector group, Test and Measurement Equipment, provide a wide range of measuring instruments, calibration equipment and calibration services on a world-wide basis.

www.gambica.org.uk

Choosing a calibration service

Calibration and Product Quality

Calibration is not fully regulated – there are no minimum requirements that apply to the technical content of a calibration. This means that it is possible to purchase a calibration from a company that holds established credentials (such as Accreditation) and yet the calibration may not be adequate for the instrument, or for your application. It may be that certain aspects of the instrument are not checked, or that they are checked incorrectly, leading to an instrument that you believe is measuring accurately, but which may not be. Consequently the performance of products and processes evaluated using this equipment may be adversely affected.

A basic definition

To illustrate just one aspect of variation within the calibration industry, the term itself, 'Calibration' does not have a standard, or universally adopted definition. A 'Calibration' could mean any of the following:

- > Measure the instrument's performance and report it in some way
- > Measure its performance, compare the performance to specification, report the performance and whether or not it meets the specification
- > Measure the performance, compare with specification, adjust back to within spec if it is out, report 'post-adjustment' performance
- > Measure the performance, compare with specification, adjust back to within spec if it is out, report 'pre-adjustment' and 'post-adjustment' performance
- > Measure the performance, compare with specification, adjust all parameters to the centre of their specification tolerances, report 'pre-adjustment' and 'post-adjustment' performance.

Another variance is in the term 'Calibration Certificate' which, from some suppliers is a document containing no measurement data, just the details of when and where the instrument was calibrated along with relevant traceability information – the actual measurement data is a separate document. From other suppliers the calibration certificate contains all of the measurement data as well as the details about the calibration.

So it is essential to verify what your expectations are when you request 'calibration' and 'calibration certificate'.



Choosing a calibration service

Questions you need to ask of your own operation in order to make a smart choice

Before embarking on selection of calibration, there are some important facts about your own company's needs and operation that need to be clearly understood. These facts may well differ between departments, and even within a department for different operations.

Why am I getting these instruments calibrated?

The right reason is 'To have confidence that the equipment is measuring correctly.'

If it appears that the only reason is to be able to provide a calibration certificate to an auditor, you are likely to find that instruments have been inadequately calibrated and are making erroneous measurements which can lead to undesirable consequences.

Does every instrument need to be calibrated?

If your Quality Manual states that they should be, then they do need to be to meet audit. Question whether that is necessary for example some instruments do not make measurements that need to be traceable.

How are the instruments used?

If they are used to test products either during manufacture or in final test, to validate designs during R&D, or to validate serviced or repaired equipment, they should be regularly calibrated. However the degree of risk is your decision, and to minimise the risk of an instrument that is not normally used for these purposes being used in place of one that is, it may be preferable to have all instruments calibrated.

Does our Quality Manual contain any statements that would require a specific type of calibration? (e.g. Accredited? ISO 17025 compliant)

If the Manual stipulates that Accredited Calibration must be used at all times, it may be worth checking the reason for this as Accredited Calibration for electronic instruments can be expensive, and may not be necessary. It is also a popular misconception that "Accredited is best."

Check why the Quality Manual requires Accredited Calibration. If it is because your company itself provides an Accredited service (such as EMC testing, or calibration of other companies' equipment) you probably do require Accredited calibration for instruments used for that work. If it is to provide greater confidence in your testing of your own products, it's likely that Accredited Calibration is unnecessary.

When we get a calibration, do we want/ expect that the instrument is adjusted into spec if it is out?

That is your choice but make sure your supplier knows it as they will generally defer to their usual practice (which may be either).

Generally it is preferable to have instruments calibrated and then returned to an 'in-spec' condition so that you can confidently use it without having to make allowances, but there are situations where this is not desired.

Standards laboratories generally prefer that their instruments are not adjusted because the act of adjusting can affect stability, and it destroys long-term performance history characteristics.

If the instrument is reported to be out of spec, do we require the calibration data showing where and by how much?

To provide confidence in the testing done with that instrument prior to the calibration it is necessary to have the 'pre-adjustment' performance data.

Pre-adjustment data that shows where and to what degree the instrument was out allows you to assess the risk to your customers of products they have bought which may be faulty. It allows you to undertake a recall if required rather than letting your customers discover the problem for themselves.

Do we make use of measurement uncertainty data provided during calibration in our own measurement applications?

Are we pushing the measurement limits of these instruments or using them well within their capabilities?

These are related questions. There is always some uncertainty about any measurement. The smaller the uncertainty, the better the measurement.

If you are using an instrument to its measurement limits you should be aware of the uncertainties, and take them into account. By incorporating the uncertainties provided by your calibration supplier into your calculations you can be more confident that your measurements will not be misleading.

If you use the instruments to well within their measurement limits (e.g. use only 4 significant digits in a 6 digit device) it is unlikely that Measurement Uncertainties will have any significant impact on your measurements.

Do we provide a service that is based on measurements that we make using the instruments?

If you are a company whose business is based on measurements you make (such as a testing house or similar) you will need to make due allowances for Measurement Uncertainties.

What are the consequences to our business if instruments are not making valid measurements?

Consequences generally fall into two categories: The cost of unnecessary rework and the cost of poor product performance or quality.

Cost of unnecessary rework: the 'false-fail' scenario. This occurs when a test performed on your product or materials indicates that a fault exists. This results in the product either being scrapped, or being sent for repair. But if the test was wrong, and the product was good, this scrapping or repair investigation will have been unnecessary.

Cost of poor product: the 'false-pass' scenario. This occurs when your product is actually faulty, but the test performed does not expose the fault. This results in the product going into the market-place and the potential cost of a warranty claim, as well as damaged reputation.





What is the cost of the instrument being out of service while it is being calibrated?

This cost occurs when the equipment is a vital part of the testing or manufacturing process and without it production volumes are impacted.

The cost may also be measured in terms of spare equipment being purchased or rented to cover such periods. If the calibration downtime can be as short as possible, this cost will be kept as small as possible.

If the cost and inconvenience of instrument downtime is large, you may benefit from having the calibration performed on your own site. This will usually be more costly, but that extra cost may be small in comparison to the benefits.

Do we manage the calibration periodicity (how often it gets calibrated) for each instrument, rely on the manufacturer's recommendation, or use a standard period (e.g. 1 year)?

Generally the usual method is to rely on the manufacturer's recommendation – with good reason as it is assumed that the statistics gathered by the manufacturer on its product's stability provide sound guidance.

However, such statistics are based on a broad population average, and individual instruments may be better or worse than the average.

By assessing the performance history of your particular instrument you can determine whether it requires more frequent calibration (i.e. it is usually reported to be out-of-spec each time it is calibrated) or less frequent (it has been in-spec for at least three previous consecutive calibrations).

Such management can reduce costs in two ways – reduction of false-pass and false-fail scenarios, and a reduction in the number of calibrations required.



Do we need a hard copy of the calibration data/certificate with every calibration?

Often, the statements about calibration requirements in a Quality Manual were written at a time when the only alternative was to have no data/certificate provided, and being unable to show calibration documentation would certainly have caused problems during quality audits.

Today many suppliers will provide the documentation on disc, by email, or make it available to download on demand from a website. These alternatives to printed copy are both environmentally friendly and convenient, as it takes far less storage space and can make retrieval quicker (especially relevant when multiple locations are involved).

Provided you are able to access the calibration data when it is needed, the way in which it is delivered or stored should not matter.

Is it acceptable to have a 'Limited Calibration'?

A 'Limited calibration' is one in which fewer parameters are tested than would generally be necessary to validate the entire instrument.

This may be at the request of the instrument user, who knows that he will not use the other capabilities of the instrument, or decided by the supplier because they are not able to (or choose not to) calibrate those parameters.

The extent of the testing at the parameters that are tested can also vary. A user can stipulate in-depth testing at certain points where he has a particular need for heightened confidence. Alternatively a supplier may choose to reduce the extent of testing for reasons of economy.

If the degree of testing is adequate for the use of the instrument, and provided it is clearly identified on the instrument that only certain aspects have been calibrated, a limited calibration is perfectly acceptable.

The issue with this situation occurs when the limitation is determined by the supplier, and in particular, when that limitation is not communicated. In this case you would be using an instrument in which some parameters are uncalibrated. These parameters may be the very ones you are using in your application.

“Calibration to the instrument manufacturer's specification”

This is often what companies request when they want a calibration that will ensure that the equipment is operating correctly and within the limits of manufacturer's published performance specification. However it does not ensure that this is what they will get.

A better way to request this would be “Calibration in accordance with the manufacturer's recommended calibration procedure” (assuming one exists). This specifies a service based on the manufacturer's adjustment and calibration procedures, which are usually to be found in the instrument's service manual, and which are produced by the manufacturer during the design process of the instrument.

Different Certification types

There are variations in the Certificate types available, which include:

- a) **Non-Accredited Calibration** – Satisfying the large majority of users, these fall into two main types:
 - I. ISO/IEC 17025 compliant (see ref. 5) certificates can be issued by laboratories that follow the ISO/IEC 17025 process without being externally audited. There may be added value if the provider's quality management system is ISO9001 registered owing to its independent audit. Even though this standard doesn't address attributes of the calibration service, it references ISO10012 for guidance and with which the supplier may also assert that the calibration complies. (see ref. 2)
 - II. Certificates issued by a calibration laboratory whose quality management system, under which the service was provided, is registered to ISO9001.
- b) **Accredited Calibration** – provides ISO/IEC 17025 accredited certificates, which are issued by laboratories which have been externally audited by accreditation organizations such as UKAS, DKD or ALZA. They may include non-accredited measurements for completeness of the calibration report although this should be a small proportion of the overall content and the equipment's main parameters should be covered by the accredited portion.

Traceability of Measurement

A calibration laboratory must establish traceability of its own measuring standards and measuring instruments to the International System (SI) of units, by means of an unbroken chain of calibrations or comparisons linking them to primary standards.

Although it is not a requirement of ISO9001, ISO10012 or ISO/IEC 17025, a calibration laboratory may include a reference to all test equipment used during a calibration, including details of each instrument's current calibration, as an indication of the traceability of measurement.

Choosing a supplier

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Why is there a price difference between you and company X?

There are many reasons that prices differ between suppliers, but on the whole it is reasonable to say that price is directly proportional to confidence. In other words, what you are paying extra for from one company is usually providing additional confidence in your ability to make trustworthy measurements for longer with that instrument. Pricing is generally affected by...

- Amount of tests done during each calibration
- Investment in test instruments
- Differing measurement techniques with different uncertainties of measurement
- Quality of transportation
- Cost of building and business overheads
- Effectiveness of environmental control
- Levels of expertise among staff
- Degree of 'corner-cutting' with procedures
- Whether Data and adjustments etc. are included or charged as extras
- Many of these will be established with the following questions in this table

Can you provide me with an example calibration certificate/data for instrument model X?

An example of the calibration data you would get from this supplier will allow you to check with a technical expert that the calibration covers the important aspects of the instrument for your application. If you have had the instrument calibrated previously you can also check whether the testing is more or less than you have received in the past.

If the supplier is unable to supply example data it is possible that they do not have the necessary capability to calibrate that particular instrument, or they have not calibrated one before. Both situations will put you in danger of delays or inadequate calibration being performed on your instrument.



Can you calibrate to full manufacturers test procedure?

The manufacturer in most cases will have established a series of tests that will provide a good degree of confidence that the instrument is performing correctly. Some suppliers will omit some of the recommended testing.

They may choose to omit tests because they don't have the necessary equipment to do them, or just to save time. But tests omitted can lead to an unreliable calibration and ultimately, to you making bad measurements.

If you have had the instrument calibrated by the manufacturer you will have a reference against which you can compare a sample set of data from the supplier you are assessing. You may be able to request a sample calibration data set from the manufacturer.

Do you have the necessary hardware/software/permissions/ expertise to calibrate and adjust all of my equipment?

This question is related to the one above, but the significance is that many modern instruments can only be adjusted with software from the manufacturer. Some manufacturers do not make this software available to third-parties, or if they do, charge a license fee to use it.

Verify that the supplier you are assessing has the necessary software and license to use it, as well as the required instruments to calibrate your products.

What percentage of my equipment will you calibrate yourself and how much will you subcontract elsewhere?

It is probable that one supplier will not actually have the necessary equipment or knowledge to calibrate everything your company uses. Most calibration suppliers have arrangements with complementary companies to calibrate the items they can't. There is usually a handling charge for doing this.

It is a balance between convenience and cost whether you choose to send it all to one place and pay them to deal with the subcontracting, or deal with many suppliers yourself. By finding out how much they will outsource and what they charge for handling you are in a better position to make the right decision.

Can you repair it if required?

If the instrument is found to have a fault when it is being calibrated, it will need to be repaired. If the calibration company needs to send it somewhere else for repair there will be logistics costs and additional delays to deal with.

For the most important instruments in your test environment it is a good idea to select a calibration supplier that can also repair them. Ensure that they use new (rather than recycled) original manufacturer parts for their repair work.

Can you update/upgrade it if required?

Manufacturers will generally have the latest information about updates and upgrades available for their equipment, and will often offer to carry out reliability and performance updates as part of a calibration.

Check that the supplier you are assessing has information from the manufacturer on updates that are recommended. Check also that they can perform these updates and other instrument upgrades that are available.

Can you tailor the calibration to my specific requirements?

Sometimes an instrument is used in a measurement application which uses just a small proportion of the instrument's measurement capability. It may be preferable to have this aspect very extensively tested, while reducing the tests for the balance of the instrument.

Your supplier may be able to comply. You will need to be explicit in your instructions, and if appropriate, ensure that the instrument is labelled 'Limited Calibration' to alert other users.

What Turnaround Time can you supply (typical)?

Slow turnaround can result in unforeseen costs – rental or purchase of spare instrument, fewer finished goods, missed deadlines... Therefore ensure that the supplier is able to tell you what the turnaround is likely to be.

Check whether the supplier will provide some assurances of the turnaround you will receive, and ask if they have any run-rate data that demonstrates a consistent achievement of these times.

Accreditation

Do you provide full data (pre and post adjustment) in the price quoted?

Pre-adjustment data is taken without making any adjustments. It requires that the supplier runs the instrument through its tests completely, then does any adjustments needed, then runs it through all of the tests again to generate the post-adjustment data.

Check that the supplier will provide this data whenever one of your instruments is found to be out-of-specification (pre-adjustment data is more valuable than post-adjustment data).

Do you provide onsite calibration services?

Onsite calibration can seem disruptive if a large amount of equipment needs to be calibrated in a short period of time, but the savings in downtime, and removal of interruptions for the rest of the year can make it hugely beneficial.

If the supplier offers onsite services ask which instruments they are able to cover. Be wary that some suppliers will not have the same abilities or equipment onsite as they have in their laboratory. Ask to visit another of their customers during their onsite calibration.

How do I keep track of the instrument while it is away for calibration?

Some suppliers provide a web-based application to enable you to check up on progress. This can be much more convenient than having to phone or rely on them phoning you.

Check whether they have a web-based solution, and whether there is a cost or any other restriction to using it. If they don't, find out how they propose to keep you informed of any delays or complications with your work.

Can I access cal data online?

This question is related to the one above. The provision of 'on-demand' calibration data via the web can save time filing and retrieving paperwork, and reduce storage cost and space.

Check whether the supplier has a web-based solution, and whether there is any cost to use it (or indeed cost reduction if paper documents are not required). If none exists, check whether documentation can be supplied by email or on disk if you would prefer not to have paper documents.

How do you transport my equipment? (what steps do you take to avoid damage in transit?)

Some measurement equipment contains fragile components that can change if they experience jarring or shock, altering their measurement characteristics and making the calibration they have just received worthless.

Ask to see the vehicles they would use to transport your instruments, Check that there is adequate cushioning to prevent jarring and physical damage.

Is an accredited laboratory better than a non-accredited one?

An accredited calibration laboratory is one that has demonstrated to an accreditation authority, UKAS in the UK (see ref. 3) that it is technically competent to perform specific measurements. Such a laboratory can issue an accredited calibration certificate only for the measurement parameters for which it holds accreditation. Indeed, within the electronic measurement instrument field the majority of calibration provided by accredited labs is 'non-accredited'.

A non-accredited calibration can be equally fit for purpose, and may well be better (in terms of extent of calibration and measurement uncertainty) than an accredited calibration. So it is important to establish what you require and what the laboratory will provide whether or not you ask for an accredited calibration.

If a laboratory holds accreditation for measurements that are relevant to the instrument to be calibrated, they are able to provide an independently verified calibration (in the form of an accredited calibration) although this is not necessarily a better calibration than could be obtained from a non-accredited laboratory – you would need to assess the content along with the measurement uncertainties to determine which calibration was more suited to your requirements.

Quality Assessors sometimes consider that a non-accredited calibration is inadequate, but this is not at all the case. They are correct in this respect only when your Quality Manual specifically states that your calibration must be accredited.

Assessing whether the calibration meets the need

On receipt of the certificate of calibration ensure that a technically competent person verifies that it meets the calibration requirement, and that the instrument is therefore 'fit for purpose'.

The presence of an accreditation logo on the equipment's certificate of calibration provides evidence of traceability but it may not necessarily affirm the 'fitness for purpose' of the calibration.

Ensure the instrument user in your company is aware of any limitations in the calibration obtained.

General Notes

The International Standard

The International Standard ISO/IEC 17025: 2005 'General requirements for the competence of testing and calibration laboratories' – specifies how laboratories demonstrate that they operate a quality system, are technically competent and able to generate technically valid results. (see ref. 1 & 2)

Multilateral agreements and memorandums of understanding

The acceptance of calibration certificates issued by national metrology institutes and accredited labs in other countries may be covered by memorandums of understanding or by mutual recognition agreements. (see ref. 4).



Contact points for further information

For a list of **GAMBICA** members who offer calibration services for electrical/electronic test and measurement equipment view the **GAMBICA** website: **www.gambica.org.uk**

Contact **NPL** for free independent advice on techniques, practices and standards for measurement, call NPL Helpline on 020 8943 6880, Fax 020 8943 6458 or E-mail **enquiry@npl.co.uk**

For the **National Measurement Partnership (NMP)** Programme managed by the NPL on behalf of the Department of Trade and Industry, for the promotion of good measurement practice call the NMP Helpline on **020 8943 7070**

For information on **UKAS** accreditation including a list of UKAS accredited laboratories contact UKAS on 020 8917 8400, Fax 020 8917 8500 or visit **www.ukas.com**



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References

- 1) ISO/IEC 17025:2005 – supersedes ISO Guide 25 and EN45001 – calibration providers approval to ISO 9000 will claim compliance to ISO 10012 (BS 5780 part 1+2).
- 2) International Electrotechnical Commission (IEC).
- 3) United Kingdom Accreditation Service (UKAS).
- 4) A multilateral recognition agreement came into effect 31/1/2001 between members of the International Laboratory Accreditation Co-operation that supersedes earlier MRA's between the accreditation bodies of individual countries or economic regions. The signatories of this ILAC Arrangement were: Australia, Belgium, Brazil, Canada, People's Republic of China, Czech Republic, Denmark, Finland, France, Germany, Hong Kong China, India, Ireland, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Singapore, South Africa, Spain, Sweden, Switzerland, Chinese Taipei, United Kingdom, United States of America, Vietnam.
- 5) To comply with the ISO/IEC 17025 (section 5.10.4 Calibration Certificates) Measurement uncertainties must be calculated using the internationally agreed methods described in the following documents:
 - Worldwide: ISO/TAG4/WG 1995: ISO Guide to the Expression of Uncertainty in Measurement (GUM)
 - In the UK: UKAS M3003 Edition 2 January 2007: The Expression of Uncertainty and Confidence in Measurement
 - In Europe: EA-4/02 December 1999: Expression of Uncertainty of Measurement in Calibration
 - In the USA: ANSI/NCSL/Z540-2-1997: U.S. Guide to the Expression of Uncertainty in Measurement.

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