The GAMBICA Association Ltd
Rotherwick house
3 Thomas More street
London E1W 1YZ
T +44 (0) 20 7642 8080
E info@gambica.org.uk
W gambica.org.uk

The ins and outs of instrument calibration

How do you know that the electrical testing instrument you purchased some months or years ago is still performing accurately? This is a frequent question asked by accreditation companies during an audit and some end customers when an electrician is testing a building wiring installation.

In these circumstances a "calibration certificate" is usually requested as evidence. But what is involved in acquiring a certificate and does it have any real value?

Calibration Certificate or Certificate of test?

It is common for a new instrument to be shipped with documentation that states the instrument meets the manufacturers specification. This can be a **Certificate of Test** or a **Calibration Certificate** . There is a significant difference between the two:

> **Certificate of Test** : States the instrument was tested during production and passed its stated accuracies. It declares conformity to national standards and should have the serial number on the certificate matching the instrument.
> It does not detail all the measurements and results for individual test modes.
>
> **Calibration Certificate** : This is a far more detailed document with environmental and traceability data referenced to the serial number of the instrument, but most significantly it has all the tests and measured results performed during production or by a separate calibration company and listed against tolerances and uncertainties.

Most organisations that require evidence of an instrument's performance tend to ask for a calibration certificate. Consequently, manufacturers now tend to provide a calibration certificate that was generated in the factory. Unless there is a need for any additional traceability this should be adequate for most purposes.

The benefit is there is often no additional charge for this certificate.
The downside is that if an instrument sits on a distributors shelf for a few months it is losing some of the benefit of including it, see calibration period below.

Some certificates carry a commissioning date, whereby the owner enters the purchase date, and times the calibration period from that date. It is sensible to retain the purchase receipt as evidence for this date. The argument in favour for this is the instrument is highly unlikely to deteriorate whilst in store. This is especially true of modern instrumentation.

Calibration period:

When asked, manufacturers usually recommend a calibration period for their instruments to check all is still OK. This is typically but not always 12 months. However, always contact the manufacturer to be sure if it is not printed in the user guide or other supplied paperwork.
Some working practices or testing companies may have their own calibration periods and traceability.

GAMBICA

But why would an instrument go "out of calibration"?

These days instruments have far fewer components that are subject to drift. Calibration in the production phase adjusts the measurement digitally to allow for manufacturing variation and component tolerances. These digital adjustments or calibration "constants" are stored in the instruments non-volatile memory. Should these constants be corrupted, the instruments accuracy will be seriously affected and a warning that the unit needs to be re-calibrated should be displayed. This is however, a very rare event.

Instruments can also be subject to a wide range of environmental and electrical stresses, such as temperature, water and humidity, or vibration and shock etc. All these can adversely affect the performance of your tester especially over months or years, although modern products are far less susceptible to environmental effects.
Technical failure of the instrument is a more likely cause and it probably needs to be returned to the manufacturer for investigation.
IMPORTANT: Test leads are the most common source of measurement error and should be checked frequently for issues, see TEST LEADS below.

So, what happens during a calibration?

There are two principal calibration phases, production calibration and after-market calibration.

During **production calibration,** the test equipment will adjust the instrument digitally and store the calibration constants internally. A calibration certificate is easy to produce at this stage and is often included with the new instrument.
This is usually done under the same environmentally controlled conditions as the manufacturing.

Once the instrument enters service the owner needs to consider **after-market calibration** .

In most cases the instrument is sent to a calibration company where it is checked against a set of known values (or standards) to ensure the results are still within the manufacturer's tolerances.
This should be done at multiple values for each type of measurement so errors at the middle or extremes of the measurement ranges aren't missed. The results are checked against the manufacturers declared accuracies, such as from a datasheet.
This may also take place in a temperature and humidity-controlled environment to ensure fewer errors are introduced to the measured values and allow for variables in the calibration equipment, called uncertainties.
If all is OK, then a calibration certificate is issued for the instrument.

Occasionally a result may be outside the allowed limits. In this case the calibration constants in the instrument need to be updated. This is only likely to be available from approved repairers or the manufacturer, because the instrument will need to be placed in a special calibration mode and the correct procedures followed to adjust the measured value. Once completed the certificate can be issued.
On older instruments this may require variable components like potentiometers to be adjusted then re-sealed.

The worst-case scenario is the instrument cannot be adjusted adequately, or the calibration company cannot perform the necessary adjustments. In this case the unit is likely to be returned to the manufacturer or authorised repairer for remedial work.

GAMBICA

"What do I do between each calibration"?

It is important to be certain the instrument continues to perform correctly when testing electrical installations. There are various options an owner can use to verify the instrument is still operating correctly. This does NOT replace a calibration but will reduce the risk of potentially passing a non-compliant circuit.

Testing on a Check Box : A Check Box usually consists of a set of known values of low resistances, high resistances, an RCD tripping device, loop impedance additional resistance and access to supply voltage. These allow the user to perform a set of tests on a wide range of test instruments and record the results. By keeping a log of the results, any changes in values become obvious. Likewise, a record is useful should you get asked for evidence your tester is still operating correctly.

Known good circuit : Using a known circuit and/or some basic components such as resistors is a useful quick check to ensure nothing has changed significantly. Circuits can be subject to small changes, but a socket marked for Instrument verification only is unlikely to suffer unnecessary wear and tear. Again, keeping records of the results is very useful.

Basic checks : Even some basic checks can be useful, such as insulation and continuity testing with leads shorted together and open circuit. Checking voltage on a known good supply should always be done regularly and even during a single session.

If available, comparison to a second instrument can be extremely useful to identify early changes or issues.

Frequency of intermediate checks: This ultimately depends on the amount of use the instrument gets, but a recommended starting point would be once a month for a full check of functions. If records show that values may be drifting, more frequent checks can be made.

Record keeping is key to identifying any changes in performance which may go unnoticed in the field. This is especially so if instruments are not in daily use or shared between staff.

It is important to note that test leads are a frequent source of measurement error, as they are consumable items and subject to continuous wear. They should be included in the in-between periods to ensure they are not contributing to errors. These include:

Intermittent breaks in the flexible leads, especially where they exit the probe or connector.

The connectors to the instrument, as the internal "cage" that creates the spring tension can become soft or worn. They may feel loose or very easy to insert.

Poor probe or croc clip contact.

Poor fuse contacts in fused leads

The GAMBICA Association Ltd
Registered in England & Wales No. 1583204

GAMBICA

In summary:

Calibration certificates are considered important in our industry, but instruments are subject to daily stresses, as well as environmental and electrical hazards. A calibration certificate is not a guarantee of continued accurate or safe performance.

Daily and monthly checks are highly advisable to identify issues before they create bigger problems and risk errors when testing installations. Even basic checks of each measurement on a known circuit are useful to identify issues early. Interim checks could also be used to extend periods between calibration dates.

Always keep records of instrument checks and a copy of the original calibration certificate, as not all manufacturers can send copies and if they can, may charge for it. Contact the manufacturer for their recommended calibration period.

The GAMBICA Association Ltd
Registered in England & Wales No. 1583204