

# Keysight Technologies

## Defining Your Calibration Requirement

White Paper

### Introduction

Okay, so you've convinced the accountant that the consequence of not having your test gear calibrated is too risky and also believe you've selected a calibration vendor that meets your organization's initial requirements.

But what steps can be taken when actually placing the order to ensure you get a "proper" calibration? Here's a suggestion.

# How to Take the Uncertainty Out of Buying a Service

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The level of knowledge possessed by purchasers of calibration services varies significantly from company to company. Some organizations employ an experienced metrologist to make calibration purchases while others entrust this complex decision to a non-technical purchasing function. The result of this is that the validity of purchasing decisions varies from exceptionally good to extremely inappropriate.

Extremely inappropriate decisions invariably cost the company more money; either because they are buying unnecessary or unnecessarily detailed calibration or, more commonly, because they are buying insufficient or insufficiently detailed calibration. While the *insufficient* option may be cheaper, it often results in far greater eventual cost to the company through rework and incorrect decisions relating to product quality and customer satisfaction.

To justify *unnecessary* calibration, a detailed knowledge of the precise application of the equipment is required as part of the analysis but adoption of simple measures can enable a purchaser to overcome a tendency to buy inadequate calibration. This is particularly necessary for final test instruments and those responsible for end-product quality. Inputs from some of the most knowledgeable technical buyers in the UK have been used to construct the following purchase order statement which should help the less well-informed calibration purchaser avoid the inadequacy trap:

*Calibration shall be undertaken against full manufacturers' specifications. Where equipment is found to be out of specification, full performance test results, in the as-received condition, must be obtained before any adjustment or repair action is taken. On completion of the calibration work a certificate of calibration is required, signed by your authorized representative, containing a statement confirming that the calibration can be demonstrated to be traceable to National or International standards and stating the item's full compliance with its performance specifications. Full performance test results, taking the form of measured values, are to be supplied. Any omissions from the full calibration are to be notified to us and shall be agreed in writing before a certificate, clearly annotated "Limited Calibration" is issued. A declaration of measurement uncertainty values shall be included with all test results.*

## But What Does it Mean?

This may seem a lengthy statement but it encompasses many of the important points missed by orders which simply require “Calibration”. It is because there is no standard for what is provided under “a calibration” that such an explicit purchase statement is necessary. A breakdown of each element of the statement follows with explanation:

“Calibration shall be undertaken against full manufacturers’ specifications.”

- Requesting that the calibration be to “full manufacturers’ specifications” offers protection from a supplier who may normally test just the simple parameters or those which can be checked without investing in expensive test gear. Where the original manufacturer (or recognized standard) has provided guidance on the tests necessary for high confidence in the product’s overall performance, these recommendations provide some practical distinction between significant and less important aspects of the specification.

“Where equipment is found to be out of specification, full performance test results, in the as-received condition, must be obtained before any adjustment or repair action is taken.”

- Many service providers perform adjustments during the performance test process. Due to the interactivity of circuitry in many complex instruments (adjusting one parameter has a knock-on effect on other parameters) this immediately destroys the history and the “as-received” state of any parameters tested after the first adjustment can never be known. The metrologically correct approach is to fully test every parameter (noting the values which will form the “pre-adjustment data”), then make necessary adjustments and finally perform the tests again to have confidence in the integrity of the whole set of post-adjustment test data.

“On completion of the calibration work a certificate of calibration is required, signed by your authorized representative, containing a statement confirming that the calibration can be demonstrated to be traceable to National or International standards...”

- Clearly a calibration must have a direct and demonstrable traceability path to the appropriate standards.

“...and stating the item’s full compliance with its performance specifications.”

- Test equipment users often assume that having their instrument calibrated means that it now meets specification. However, the international definition allows calibration to be simply a comparison with standards of known accuracy, not necessarily making adjustment. Also, for some applications it is undesirable to alter the product’s characteristics or in other cases adjustment may be impossible. But by making this a specific request the supplier has a clear instruction to restore performance to meet the original manufacturers published specification if possible.

“Full performance test results, taking the form of measured values, are to be supplied.”

- Measured values are more useful than “tick” or check boxes or “pass/fail” indications. They provide greater visibility of what was tested and better confidence that each tested parameter really did fall within the accepted tolerances. Where appropriate, provision of actual figures also enables the user to make measurement corrections.

“Any omissions from the full calibration are to be notified to us and shall be agreed in writing before a certificate, clearly annotated “Limited Calibration” is issued.”

- There is no definition of what should be performed to achieve a “full calibration” so if taken out of context this term is indefinite. However, as part of a statement in which the extent of calibration has been defined (as in the first sentence of this statement) the phrase can be meaningful. In this case, the purchaser has made it clear that reducing the degree of testing to save time or reduce the need for test gear investment is not desirable and that any such compromise should be clearly pointed out before the work is undertaken. To ensure that all users are aware of the limitation, the calibration certificate should disclose any recommended tests that have been omitted which consequently reduce confidence in the product’s overall specification conformity.

“A declaration of measurement uncertainty values shall be included with all test results.”

- In the case of an accredited calibration (e.g. UKAS, DKD, NVLAP, etc.) the uncertainties of measurements for which the laboratory is accredited should be provided. For non-accredited calibration, it is necessary to include remarks affirming the adequacy of measurement accuracy so as to qualify the specification compliance statement. This commonly takes the form of a “test accuracy ratio”, being (simplistically) the ratio of the accuracy of the reference instrument to that of the instrument being tested. Traditionally, a ratio of at least 3-to-1 has been recognized as providing acceptable confidence.

## Conclusions

This all serves to highlight a shortfall in the calibration industry. Without specific demands from the customer, it is left to the service supplier to define how much (or little) of a particular instrument is checked during “a calibration”. By carefully stipulating your calibration requirement on purchase orders it is possible to identify (and eliminate) the suppliers that will not meet your explicit needs. *All calibration is not equal.*

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