HN Metrology Consulting, Inc.

METROLOGY INSIGHT

Volume 3, No. 1

April 2000

I hope you have not tried to contact me unsuccessfully recently. I have moved and my new contact information can be found on page 4. Also note that I now have my own domain on the web: www.HN-Metrology.com.

In this issue of Metrology Insight there are three articles. The first one discusses how to measure the surface finish of short surfaces, the second one looks at quality systems for ISO Guide 25 accreditation and the third covers the new ISO/IEC 17025 standard, which is replacing ISO Guide 25.

Measuring the surface finish of short surfaces is a problem as it is not always possible to measure the surface using the standard filter with default settings. The article goes over the various options available and gives recommendations as to what approach to take.

I have had very good response to the notice in the last issue of Metrology Insight that I have developed an ISO Guide 25 Compatible Model Quality Manual. The article in this issue discusses the requirements for the quality system of an accredited laboratory and how the model quality manual addresses these requirements. Further information and sample sections for download are available at my website.

ISO/IEC 17025 has been anticipated for several years. It was finally published by ISO in December 1999. Much remains the same, but there are still some significant differences from ISO Guide 25.

Measuring Surface Finish on Short Surfaces

Short surfaces represent a special problem when measuring surface finish. Typical examples of short, critical surfaces are O-ring grooves and beveled edges, see figure 1.

Depending on the cut-off filter used, a certain traverse length (measuring length) is required if the measurement is to be carried out under default conditions. The problem arises if the surface is too short to accommodate this traverse length.

ISO 4288:1997, as well as ANSI/ASME B.46.1 (1995), uses a set of tables to determine the appropriate filter for evaluating a surface, when the designer has not explicitly called out which filter is to be used. The tables are based on the surface's Ra or Rz value for non-periodic surfaces (e.g. ground surfaces) or its Rsm value for periodic surfaces (e.g. turned surfaces).

It should be noted that the 1985 edition of ANSI/ASME B.46.1 was different in that it prescribed that a .030" (0.8 mm) cut-off filter always be used, unless otherwise specified. Therefore, significant differences may occur depending on which edition of the standard is used in the evaluation of a surface.

5 is the default number of cut-off lengths in the evaluation length and to allow the cut-off filter to function properly, the traverse length is even longer, typically 6-7 times the cut-off length. This means that to measure a surface using a 0.8 mm (.030") filter, a traverse length of 4.8 mm - 5.6 mm (.180" - .210") is needed. The problem of short surfaces is that they may not be able to accommodate this.

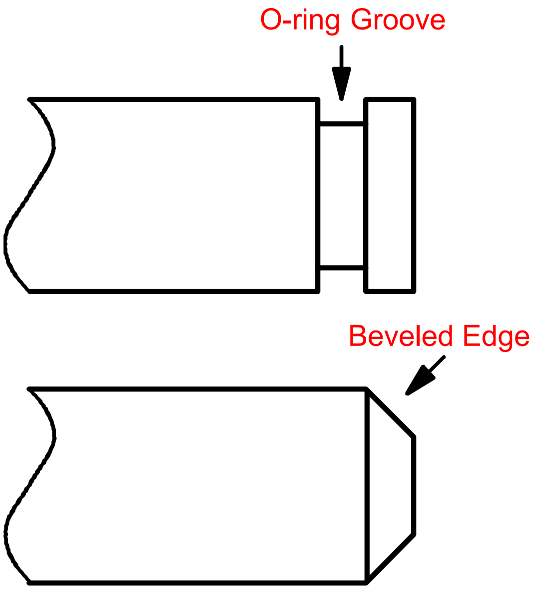

Figure 1: Two examples of short surfaces. O-ring groove (top) and beveled edge (bottom).

A temptingly simple solution is to use a shorter cut-off length. A 0.25 mm (.010") filter, for example, only requires a 1.25 mm - 1.5 mm (.060" - .070") traverse length. However, the measured values of e.g. Ra will change significantly in most cases when the filter setting is changed. Table 1 gives the Ra value for one surface using different cut-off lengths.

Cut-Off	Ra		Rz	
2.5 mm (.100")	2.5 μm	98 μin	11.9 μm	468 μin
0.8 mm (.030")	2.3 μm	91 μin	8.5 μm	334 μin
0.25 mm (.010")	1.7 μm	67 μin	5.1 μm	201 μin

Table 1: *Ra and Rz values for a surface profile as a function of the cut-off value used.*

It is clear that if a given Ra value is taken from an O-ring manufacturer's literature and the O-ring manufacturer has used one filter setting when determining what surfaces the O-rings require and the O-ring groove is subsequently checked with another filter setting, then it is possible that the O-ring will not survive, although the Ra reading is within the prescribed value.

So what is the right approach for measuring short surfaces? First you have to determine what the correct filter setting is. In the situation above, it should be possible to obtain this information from the O-ring manufacturer, otherwise it must be determined using the tables in the standards, or by consultation with the designer.

If it is not possible to accommodate this filter with an evaluation length consisting of 5 cut-off lengths, then the first possibility is to use fewer cut-off lengths in the evaluation length. As a minimum, you obviously need 1 cut-off length in the evaluation length, which translates into a 2-3 cut-off length traversing length to accomodate the filter. In the case of a 0.8 mm (.030") filter, this reduces the traverse length to 1.6 mm - 2.4 mm (.060" - .090").

If this is still not possible, then the next possibility is to turn off the filter and measure the unfiltered profile. ISO 4287:1996 defines parameters with the prefix P on this profile, i.e. Pa is equal to Ra measured on the unfiltered profile, but various instrument manufacturers' terminology varies.

Evaluation Length (Unfiltered)	Ra		Rz	
0.8 mm (.030")	2.4 μm	94 μin	9.1 μm	358 μin

Table 2: *Ra and Rz values for the same surface profile, when only considering 0.8 mm at a time.*

The evaluation length (which in this case is equal to the traversing length) should be set equal to the cut-off length that would have been used if the surface was long enough to accommodate it. In this way, you can make a measurement with the equivalent of a 0.8 mm (.030") filter using a traverse length of only 0.8 mm (.030"). If this can still not be accommodated, then the longest possible unfiltered evaluation length should be used and the results duly annotated.

You should never use a shorter cut-off length than you normally would for a given surface just because it is short. If you reduce the cut-off length, you underestimate the roughness of the surface and may end up with premature product failure.

Designing a Quality System for Accreditation

As announced in the last issue of Metrology Insight, HN Metrology Consulting is offering a Model Quality Manual, that is compatible with ISO Guide 25 "General Requirements for the Competence of Calibration and Testing Laboratories". This is the document that accreditation bodies such as A2LA and NAVLAP use as the basis for issuing accreditation to laboratories. This article explains some of the requirements for laboratories to acheive accreditation and how the Model Quality Manual fits into these requirements.

To achieve accreditation, a calibration or testing laboratory has to show competence in the measuring disciplines within its scope, have access to the standards and equipment necessary to perform the relevant measurements and have a quality system to ensure and document the quality of the measurements performed. One way of viewing the relationship of these requirements is that the ability to perform the measurements is at the core and the quality system is the wrapping around this core that protects its integrity. The focus of this article is on the quality system.

Compared to ISO or QS 9000 registration, the burden of proof for laboratories seeking accreditation can be seen as reversed. In ISO/QS 9000 audits the auditor is looking for non-conformances to the quality system. Consequently, the normal approach is to write the quality documentation as vague and non-committing as possible, as this makes it harder to show that the system is not being followed.

In Guide 25 accreditation assessments, the assessor is trying to establish the competence of the laboratory. Therefore, laboratories are generally more successful during the assessment if they have much more specific and detailed procedures and documentation, since it is impossible to establish the competence of a laboratory if all the documentation is vague and non-specific. Of course, the laboratory has to adhere to all the documentation, so it is important not to be over-enthusiastic and write things into the quality system that are not really done.

ISO Guide 25 has 16 sections, where sections 4-16 establish the requirements. The HN Metrology Consulting Model Quality Manual follows these sections and even the sub-headings, making it easy to establish where the response to each requirement can be found. This makes assessments easier both for the laboratory and the assessor.

The Model Quality Manual itself does not answer many requirements directly, rather it points to the supporting documentation where the responses can be found. This makes it easy to adapt the Model Quality Manual to an existing quality system, as you just have to make it point to an existing document, rather than the boilerplate document that is included with the Model Quality Manual.

For example, there is a generic Quality Manager job description included with the Model Quality Manual. If the laboratory has another job title or job description for the person who has these responsibilities, the Model Quality Manual can easily be edited to point to that document instead.

To make this as easy and flexible as possible, each section of the Model Quality Manual contains a list of all the documents that are referenced in that section, so it is easy to find, for example, all references to the Quality Manager's job description. To further ease the use and adaptability of the Model Quality Manual, all *documents referenced* in the text are italicized and whenever a responsibility or authority is assigned, the **person receiving the assignment** is bolded.

ISO Guide 25, as ISO/QS 9000, has its own special language to identify requirements and to distinguish between requirements and recommendations and it can be somewhat challenging to read this language. Additionally, some of the requirements in ISO Guide 25 are hard to read and interpret. It can be very costly, both in terms of time and expense, to misinterpret the requirements. On one hand, the laboratory may implement an elaborate system that is not required. On the other hand the laboratory may miss a key requirement and have their accreditation held up while they put it in place. As an experienced A2LA lead assessor, I know what the intent of the requirements in the guide is and the Model Quality Manual answers the requirements as they are intended and saves the laboratory from the exposure of misinterpretation of the Guide.

During the next two years ISO 17025 will replace ISO Guide 25 as the governing document for laboratory accreditation. While some of the requirements are changing, the core of what is required for running a competent calibration or testing laboratory will, of course, not change.

As accreditation bodies start assessing to ISO 17025, the HN Metrology Consulting Model Quality Manual will be updated to follow the layout of ISO 17025, as it currently follows ISO Guide 25. This will be the major change as the vast majority of the documents referenced will not need to change.

Go to www.HN-Metrology.com for sample documents from the Model Quality Manual

ISO/IEC 17025 - The replacement for ISO Guide 25

ISO/IEC 17025 was published in December 1999. Accreditation bodies have agreed on a two year implementation period. At present it is up to the individual laboratory whether it wants to be assessed to Guide 25 or to ISO/IEC 17025, but starting January 2002 ISO/IEC 17025 will be the only option.

ISO/IEC 17025 is intended to assure compliance with the relevant sections of ISO 9001 and ISO 9002. Therefore, the new standard will have a more familiar feel to people who are used to working with ISO 900X. It also has a cross-reference table identifying which sections in the standard address which requirements in ISO 9001 and ISO 9002, respectively.

However, one should bear in mind that accreditation assessments are generally much more detail oriented than ISO 900X registration audits. This usually comes as a great shock to laboratories that are already ISO 900X registrered, or otherwise have experience with ISO 900X exclusively. There is no reason to believe that the new standard will change this thoroughness of accreditation assessments.

The requirements in ISO/IEC 17025 are arranged in two sections. One with the management and quality system requirements and one with the technical requirements. This is somewhat cleaner that ISO Guide 25, which was quite repetitious, first requiring a system to handle each quality issue then, in a separate item, requiring that the system is followed.

Most of the specific requirements have not changed all that much, maybe with the one exception: That there is much more emphasis on laboratories understanding their measurement uncertainty. Especially for testing laboratories, this is a new requirement.

However, bearing in mind that the uncertainty quantifies the quality of the measurements making up the test or calibration, this requirement can only help solidify the credibility of tests and calibrations performed by accredited laboratories.

Also, during the process of evaluating their uncertainty, laboratories are likely to find that the uncertainty budget provides them with information that can help them to make their measurements better (less uncertain), cheaper, faster or a combination of the three.

Armed with the uncertainty budget as a tool to understand and optimize their measuring processes, laboratories are likely to be able to offer better service to their customers in terms of the quality of the measurements, the turnaround time and the cost involved in performing a test or calibration.

The caveat for all this is that the customer also has to understand what his exact needs are. If he cannot tell the laboratory how good a test or calibration he needs, then it is impossible for the laboratory to tailor its services to the customer's needs.

In short, I believe that ISO/IEC 17025 is a step towards strengtening of the credibility of accreditations, which is in the interest of all accredited laboratories. Only by maintaining this credibility can the accreditation bodies protect the investment made by the accredited laboratories.

Training from HN Metrology Consulting:

HN Metrology Consulting offers in-house training seminars on metrology, measurement uncertainty and quality assurance for calibration laboratories.

The following 2 day seminars are available at short notice and can be tailored to your specific needs:

- **Managing Measurement Uncertainty**
- **Quality Assurance to ISO Guide 25**

Contact HN Metrology Consulting for more information on these seminars and to request the brochure.

Training offered through the Mitutoyo Institute of Metrology:

The following are very intense 1 day seminars. They cover a lot of material in a very short time.

- **Estimating Measurement Uncertainty**

  This seminar is very popular and has been offered for about a year.

- **Requirements for accreditation: ISO/IEC Guide 25 and ISO/IEC 17025**

  This is a new seminar, which has just become available.

Both seminars are offered nationwide. New seminars are scheduled every month. Call the Mitutoyo Institute of Metrology at (630) 978 6469 for more information, to sign up for a seminar or to check availability in your area.

METROLOGY
INSIGHT

Volume 3, No.1 April 2000

Editor: Henrik S. Nielsen

Published by:

HN Metrology Consulting, Inc.

10219 Coral Reef Way, Indianapolis, IN 46256
Phone: (317) 849 9577
Fax: (317) 849 9578
E-mail: hsnielsen@HN-Metrology.com

Web: http://www.HN-Metrology.com