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Preface

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Measurement Process Qualification

Gage Acceptance and Measurement Uncertainty According to Current Standards

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Preface

Measurement process capability studies gained in importance during the last years. At the end of the 1980s, there were only few company guidelines referring to the significance of gages and only some of them required capability studies. Over the years, new and further guidelines were added. The procedure was more and more refined and its application improved. After the methodology had established itself, more and more requirements were added from quasi-standards, such as the QS-9000 or VDA 6.1 guidelines. From now on, measurement process capability studies have to be conducted regularly in order to obtain the respective QM system certificate.

Today, the field of capability studies also includes the determination of measurement uncertainties that is to be applied in production. As an example, ISO 14253 [29] requires the determination of the measurement uncertainty for measures of length. This uncertainty must be taken into account at the specification limits. Hence, more and more companies are obliged to include the calculation of the measurement uncertainty in their QM system and to administer it in the respective application. In order to facilitate these procedures as much as possible, the German Association of the Automotive Industry (VDA) has already published the “Measurement Process Capability” guideline (VDA 5 [70]). As the title indicates, this guide does not only deal with measuring devices. It is also about all the influencing factors affecting the measuring device.

The second and third edition of our book “Statistical Procedures for Machine and Process Qualification” [13] contains a chapter about “gage capability”. Due to the variety of procedures for measurement process capability studies, we decided to leave out this topic in the fourth edition and to publish this book instead. In order to better define this subject in detail.

Special thanks go to Mr. Ofen (Robert Bosch GmbH, Bamberg) for the long-term cooperation and his professional support. Major parts of the book “Sonderfälle bei der Beurteilung von Messverfahren” (special cases in the evaluation of measurement procedures) [67] are penned by him. Upon his approval, we adopted some passages in this book.

Our thanks also go to Ms. Mesad for the layout and the textual and graphical presentation of this book.

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Weinheim, April 2003

Edgar Dietrich and Alfred Schulze

Preface to the 2nd Edition

The subject this book received a great many response. We received a significant amount of feedback on the first edition including many suggestions and proposals. In particular, our thanks goes to those readers who advised us of some inconsistencies. We acted on these suggestions and the new edition considers that helpful input.

By now, VDA 5 “Measurement Process Capability” has been published. It caused many discussions among experts but also raised many questions. Hence, we expanded on this particular subject and added some sample calculations.

In many conversations and seminars, people have always expressed the wish to have a different procedure for the determination of the “extended measurement uncertainty”. This procedure is to be structured in a similar way as the widely-used “R&R” procedure for the determination of gage capability. So we developed AIO procedure (all-in-one method) for the determination of extended measurement uncertainty. This procedure is based on current draft standards and facilitates the determination of individual standard uncertainties in a step by step proceedure. The final result is the calculated extended measurement uncertainty.

Graduate engineer Michael Radeck supported us in providing new sample calculations. He also edited the “attribute gage” subject. We would like to thank him for his assistance.

Weinheim, Mai 2004

Edgar Dietrich and Alfred Schulze

Preface to the 3rd Edition

The second edition already contained the determination of the measurement uncertainty according to the “Guide to the Uncertainty in Measurement” (GUM [32]) but its application was uncommon in industrial production. However, things have changed lately.

Particularly due to the new ISO 10012:2004 [29] “Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment” standard, this subject has gained in importance. As the standard’s subheading indicates, the measurement uncertainty must be determined for the respective measurement process. The standard says: “The measurement uncertainty must be estimated for every measurement process that is monitored by the measurement system. The Guide to the Expression of Uncertainty in Measurement (GUM) [32] contains the methods to be applied.”

Due to this fact, we decided to deal with measurement uncertainty in more detail in this book.

Since the publication of the second edition in May 2004, further company guidelines about “measurement process capability studies” have been launched. We added the DaimlerChrysler LF05 guideline and the Robert Bosch GmbH booklet 10 in this edition. Both guidelines implemented the procedures and methods for measurement process capability studies that this book describes in theory. Today, companies and suppliers have gained experience in using these methods by applying these guidelines. The practical benefit of the determination of measurement uncertainty is confirmed.

Graduate engineer Stephan Conrad supported us in writing the “Determination of Measurement Uncertainty” chapter. We would like to thank him for his assistance.

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Weinheim, September 2006

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