

|                             |                                    |                                                                                     |
|-----------------------------|------------------------------------|-------------------------------------------------------------------------------------|
| <b>ETN021</b><br>EN 2025-09 | <b>Measurement System Analysis</b> |  |
|-----------------------------|------------------------------------|-------------------------------------------------------------------------------------|

Content

|     |                                                                           |    |
|-----|---------------------------------------------------------------------------|----|
| 1   | Purpose .....                                                             | 2  |
| 2   | Scope .....                                                               | 2  |
| 3   | Change History .....                                                      | 2  |
| 4   | Applicable Documents .....                                                | 3  |
| 5   | Definition of Terms and Abbreviations .....                               | 3  |
| 6   | Description of the different studies .....                                | 3  |
| 6.1 | Type-1 study (Cg/Cgk study) .....                                         | 3  |
| 6.2 | Type-2 study – ANOVA (tolerance) .....                                    | 4  |
| 6.3 | Type-3 study – ANOVA (tolerance) .....                                    | 6  |
| 6.4 | Study for testing attribute characteristics (discrete data) .....         | 7  |
| 6.5 | Study for unilateral tolerances .....                                     | 8  |
| 6.6 | Assessment of ndc value .....                                             | 8  |
| 7   | Suggestions on how to proceed with unsuitable measurement processes ..... | 9  |
| 7.1 | Step 1: Improve the measurement system .....                              | 9  |
| 7.2 | Step 2: Obtain a more precise measurement system .....                    | 9  |
| 7.3 | Step 3: Tolerance assessment .....                                        | 9  |
|     | Bibliography .....                                                        | 10 |

|                                                                                                                                                                                                                                                                                                                                                             |              |                      |                                  |                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|----------------------------------|--------------------|
| 06                                                                                                                                                                                                                                                                                                                                                          | 500000018668 | 2025-09-25 A.HABERER | 2025-09-26 S.GATZEMEIER          | 2025-09-29 O.THODE |
| DOC-VER.                                                                                                                                                                                                                                                                                                                                                    | CHANGE NO.   | EDITED               | CHECKED                          | RELEASED           |
| <b>TEXT ACCORDING TO ISO 16016</b><br><br>The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design. |              |                      | DOCUMENT NO.                     |                    |
|                                                                                                                                                                                                                                                                                                                                                             |              |                      | <b>100013115_Z25_001_06</b>      |                    |
|                                                                                                                                                                                                                                                                                                                                                             |              |                      | REPLACEMENT FOR DOCUMENT NO<br>- |                    |

## 1 Purpose

Customer satisfaction is the result of an extensive and complex process which depends on various factors. Customer satisfaction can be characterized by a comprehensive profile of different features. The most important criterion is fulfilling the customer's requests, expectations and requirements regarding the products.

In order to verify that the quality requirements of a product have been met, its properties are tested.

The quality of the test methods and used inspection, measuring and test equipment is an essential factor for the reliability of the test results and the decision on the conformity of the products with the quality requirements.

The prerequisite for using an inspection, measuring and test equipment is the knowledge of its capability. The measured values determined using this test method are the basis for the evaluation and shall reflect the true facts in a suitably reliable manner. An unsuitable test method blurs the true facts and does not allow reliable conclusions. In order to determine the capability of an inspection, measuring and test equipment, it is subjected to a measurement system analysis according to AIAG MSA (Cg/Cgk study, Type 2 – ANOVA tolerance and Type 3 – ANOVA tolerance).

Deviations from the specifications according to VDA Volume 5 have not been considered.

Determination of measurement system capability is performed on all workpiece-related inspection, measurement and test systems. For workpiece-unrelated test systems and portable measuring equipment, the measurement system capability is determined on the basis of at least one measuring equipment per measuring equipment group.

Analysis is performed:

- On every new workpiece-related inspection, measuring and test equipment
- On every new measuring equipment group
- After changing the measuring task
- After a change in the inspection, measuring and test equipment
- According to customer requirements

## 2 Scope

This company standard is valid throughout the entire ETO GRUPPE.

The procedures set in this standard reflect the minimum required by the measuring system analyses of the ETO GRUPPE.

In-depth analyses must be applied in case of corresponding customer specifications.

The ETO document Q-008 contains the customer specifications.

## 3 Change History

|         |                                                                                                                                                                                                                                                                       |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2013-03 | Standard subdivision in: <ul style="list-style-type: none"> <li>▪ ETN012 Machine and Process Capability</li> <li>▪ ETN021 Measurement System Analysis (Creation of new company standard)</li> </ul>                                                                   |
| 2014-12 | Complete revision                                                                                                                                                                                                                                                     |
| 2018-06 | Addition ndc-value                                                                                                                                                                                                                                                    |
| 2020-01 | Revision <ul style="list-style-type: none"> <li>▪ Description of the procedures 1, 2 and 3</li> <li>▪ Additionally: evaluation of the number of distinct categories (ndc)</li> <li>▪ Suggestions on how to proceed if the measured values are not adequate</li> </ul> |
| 2024-05 | Correction of errors in the Cg and Cgk formulas and the sample size for discrete data to match German version                                                                                                                                                         |
| 2025-09 | Chapter 4: Documentation of the personnel number of the inspecting person<br>Editorially revised                                                                                                                                                                      |

## 4 Applicable Documents

The following documents are referenced in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

|            |                                                                      |
|------------|----------------------------------------------------------------------|
| MSA (AIAG) | Measurement System Analysis - Description of the different processes |
| Q-008      | Process Capabilities Customer                                        |

## 5 Definition of Terms and Abbreviations

No terms and definitions are listed in this document.

## 6 Description of the different studies

Table 1 Types of study of measurement system analyses

| Types of Study | Objective                                                           | Indices                           |
|----------------|---------------------------------------------------------------------|-----------------------------------|
| Type-1 study   | Systematic error of measurement (bias) and repeatability            | C <sub>g</sub><br>C <sub>gk</sub> |
| Type-2 study   | Gage repeatability and reproducibility (with operator influence)    | %GRR                              |
| Type-3 study   | Gage repeatability and reproducibility (without operator influence) | %GRR                              |

Calculation of the measurement system analyses is based on the evaluation strategies described (e.g. when using the Q-DAS software).

Non-conformance with these calculation methods and the corresponding minimum requirements for the capability indices shall be agreed upon with the customer and the Quality Services department shall be informed about this fact prior to performing the measurement system analysis.

The studies listed in Table 1 are applicable to continuous data.

For the described studies and measurement series, the personnel number of the inspecting person shall be indicated in the protocol. Name information must not be provided due to data protection regulations.

### 6.1 Type-1 study (C<sub>g</sub>/C<sub>gk</sub> study)

Type-1 study serves to evaluate whether the selected measuring equipment is capable for its intended use. For this purpose, a measurement standard is used as measuring object. Evaluation is performed according to the capability indices C<sub>g</sub> and C<sub>gk</sub>.

The workflow of Type-1 study is described in Table 2.

Table 2 Workflow Type-1 study

| Step | Description/Q-DAS Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Evaluate the measurement equipment resolution.</p> <p>The measurement equipment must have a resolution (<b>RE</b>) of %RE ≤ 5% of the characteristic's specified tolerance (<b>RF</b>).</p> <ul style="list-style-type: none"> <li>Calculation:<br/> <math display="block">\%RE = \frac{RE}{RF} \times 100\%</math> </li> <li>Evaluation of results:<br/>           %RE ≤ 5% ► Appropriate resolution<br/>           %RE &gt; 5% ► The measurement equipment is not suitable for the measuring task due to insufficient resolution.         </li> </ul> |

| Step | Description/Q-DAS Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Determine a measurement standard whose value is within the tolerance range of the test characteristic. If needed, the measuring position is marked on the standard. A measurement standard or reference part must be available whose true value is traceable to a national or international measurement standard through calibration and is not subject to changes during the study.                                                                                                                                                                                                                                                                 |
| 3    | Within a short time interval, perform 25 repeat measurements on the measurement standard. During the study, no further adjustments of the measurement equipment are permitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4    | Calculate the average measurement value ( $\bar{X}_g$ ) and the repeatability standard deviation ( $S_g$ ) of the measurement values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5    | Calculate the deviation ( <b>Bi</b> ) of the average measurement value ( $\bar{X}_g$ ) from the reference value ( $X_m$ ):<br><b>Bi</b> = $\bar{X}_g - X_m$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 6    | <p>Configuration:</p> <ul style="list-style-type: none"> <li>Determine the capability index <math>C_g</math>:<br/> <math display="block">C_g = \frac{0.2 \times T}{6 \times S_g}</math> <p>Expected amount of variation: 99.73%</p> </li> <li>Determine the capability index <math>C_{gk}</math>:<br/> <math display="block">C_{gk} = \frac{0.1 \times T -  \bar{X}_g - X_m }{3 \times S_g}</math> </li> <li>Reference value (or reference interval):<br/>Simple standard deviation total variance (TV), established from tolerance</li> <li>Calculation of <math>G_{pp}</math> with unilateral tolerance:<br/><math>G_{pp} = 2U/T</math></li> </ul> |
| 7    | <p>Evaluation of results:</p> <p><b><math>C_g \geq 1.33</math></b>    ► The measuring equipment is capable<br/> <b><math>C_g &lt; 1.33</math></b>    ► The measuring equipment is not capable<br/> <b><math>C_{gk} \geq 1.33</math></b>    ► The measuring equipment is capable<br/> <b><math>C_{gk} &lt; 1.33</math></b>    ► The measuring equipment is not capable</p> <p>The minimum requirements for <b><math>C_g</math></b> and <b><math>C_{gk}</math></b> must be fulfilled</p>                                                                                                                                                               |

## 6.2 Type-2 study – ANOVA (tolerance)

The Type-2 study determines the operator influence.

If a measurement equipment is not subject to operator influence (e.g. automatic parts feed), Type-3 study shall be used.

Precondition for carrying out the Type-2 study is proof of a successful capability using the Type-1 study.

The workflow of Type-2 study is described in Table 3.

Table 3 Workflow Type-2 study

| Step | Description/Q-DAS Configuration                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Specification of the parameters:<br>Number of appraisers ► 3 appraisers<br>Number of measuring objects ► 10 objects<br>Number of measurements per appraiser ► 2 measurement series                                                                                                                                                                                                                                                                        |
| 2    | Numbering and marking of the parts.<br>In order to ensure proper allocation of the measured values, the parts must be numbered.<br>In order to eliminate the influence of the measuring object geometry (i.e. geometrical deviation), the measuring position is marked on the measuring objects.                                                                                                                                                          |
| 3    | The first appraiser measures the characteristics of the measuring objects in the sequence given by the numbering. The measured values are recorded. The first appraiser measures the measuring objects a second time in the same sequence, following the same procedure. The results of the second measurement run must not be affected by the results of the first run.<br>During the study, adjustments of the measurement equipment are not permitted. |
| 4    | Step 3 should be repeated with the other appraisers. The respective measuring results must not be available to the other appraisers during measuring.                                                                                                                                                                                                                                                                                                     |
| 5    | Determine the ranges from the first appraiser's results for each measuring object.                                                                                                                                                                                                                                                                                                                                                                        |
| 6    | Calculate the average $\bar{X}_1$ of the individual results of the first appraiser and the average $\bar{R}_1$ range from the measurement series of the first appraiser.                                                                                                                                                                                                                                                                                  |
| 7    | Repeat steps 5 and 6 for the other appraisers.                                                                                                                                                                                                                                                                                                                                                                                                            |
| 8    | Configuration:<br><ul style="list-style-type: none"> <li>Calculation Method:<br/>Variance analysis ANOVA / expected amount of variation: 99.73%<br/>F-test on the influence of interaction/level: 95%</li> <li>Reference value or reference interval<br/>Simple standard deviation total variance (TV), established from tolerance</li> <li>Calculation of Gpp with unilateral tolerance:<br/><math>G_{pp}=2U/T</math></li> </ul>                         |
| 9    | Calculate the part variation <b>PV</b> .                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10   | Calculate the appraiser variation <b>AV</b> .                                                                                                                                                                                                                                                                                                                                                                                                             |
| 11   | Calculate the equipment variation <b>EV</b> .                                                                                                                                                                                                                                                                                                                                                                                                             |
| 12   | Calculate the gage repeatability and reproducibility <b>%GRR</b> .                                                                                                                                                                                                                                                                                                                                                                                        |
| 13   | Evaluation of results:<br>1. Case: <b>%GRR ≤ 10%</b> ► The measurement system is capable<br>2. Case: <b>%GRR &gt;10% to ≤ 30%</b> ► The measurement system is of limited capability<br>3. Case: <b>%GRR &gt;30%</b> ► The measurement system is not capable                                                                                                                                                                                               |

### 6.3 Type-3 study – ANOVA (tolerance)

The Type-3 study is used for measurement systems which are not subject to operator influence (e.g. automatic parts feed).

Precondition for carrying out the Type-3 study is proof of a successful capability using the Type-1 study.

The workflow of Type-3 study is described in Table 4.

Table 4 Workflow Type-3 study

| Step                                  | Description/Q-DAS Configuration                                                                                                                                                                                                                                                                                                                                                                                                         |                            |                                     |                                       |                                                   |                              |                                         |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------|---------------------------------------|---------------------------------------------------|------------------------------|-----------------------------------------|
| 1                                     | Specification of the parameters:<br>Number of appraisers ► 1 appraiser<br>Number of measuring objects ► 25 objects<br>Number of measurement series ► 2 measurement series                                                                                                                                                                                                                                                               |                            |                                     |                                       |                                                   |                              |                                         |
| 2                                     | Numbering and marking of the parts.<br>In order to ensure proper allocation of the measured values, the parts must be numbered.<br>In order to eliminate the influence of the measuring object geometry (i.e. geometrical deviation), the measuring positions are marked on the measuring objects.                                                                                                                                      |                            |                                     |                                       |                                                   |                              |                                         |
| 3                                     | The operator measures the characteristics of measuring objects in the sequence given by the numbering. The measured values are recorded. The operator measures the measuring objects a second time in the same sequence, following the same procedure. The results of the second measurement run must not be affected by the results of the first run.<br>During the study, adjustments of the measurement equipment are not permitted. |                            |                                     |                                       |                                                   |                              |                                         |
| 4                                     | Determine the range for each measuring object.                                                                                                                                                                                                                                                                                                                                                                                          |                            |                                     |                                       |                                                   |                              |                                         |
| 5                                     | Calculate the average range $\bar{R}$ from the measurement results.                                                                                                                                                                                                                                                                                                                                                                     |                            |                                     |                                       |                                                   |                              |                                         |
| 6                                     | Configuration <ul style="list-style-type: none"> <li>Calculation Method:<br/>Variance analysis ANOVA/expected amount of variation: 99.73%</li> <li>Reference value or reference interval<br/>Simple standard deviation total variance (TV), established from tolerance</li> <li>Calculation of Gpp with unilateral tolerance:<br/><math>G_{pp}=2U/T</math></li> </ul>                                                                   |                            |                                     |                                       |                                                   |                              |                                         |
| 7                                     | Calculate the part variation <b>PV</b> .                                                                                                                                                                                                                                                                                                                                                                                                |                            |                                     |                                       |                                                   |                              |                                         |
| 8                                     | Calculate the equipment variation <b>EV</b> .                                                                                                                                                                                                                                                                                                                                                                                           |                            |                                     |                                       |                                                   |                              |                                         |
| 9                                     | Calculate the gage repeatability and reproducibility <b>%GRR</b> .                                                                                                                                                                                                                                                                                                                                                                      |                            |                                     |                                       |                                                   |                              |                                         |
| 10                                    | Evaluation of results: <table border="0"> <tr> <td>1. Case: <b>%GRR ≤ 10%</b></td> <td>► The measurement system is capable</td> </tr> <tr> <td>2. Case: <b>%GRR &gt;10% to ≤ 30%</b></td> <td>► The measurement system is of limited capability</td> </tr> <tr> <td>3. Case: <b>%GRR &gt;30%</b></td> <td>► The measurement system is not capable</td> </tr> </table>                                                                   | 1. Case: <b>%GRR ≤ 10%</b> | ► The measurement system is capable | 2. Case: <b>%GRR &gt;10% to ≤ 30%</b> | ► The measurement system is of limited capability | 3. Case: <b>%GRR &gt;30%</b> | ► The measurement system is not capable |
| 1. Case: <b>%GRR ≤ 10%</b>            | ► The measurement system is capable                                                                                                                                                                                                                                                                                                                                                                                                     |                            |                                     |                                       |                                                   |                              |                                         |
| 2. Case: <b>%GRR &gt;10% to ≤ 30%</b> | ► The measurement system is of limited capability                                                                                                                                                                                                                                                                                                                                                                                       |                            |                                     |                                       |                                                   |                              |                                         |
| 3. Case: <b>%GRR &gt;30%</b>          | ► The measurement system is not capable                                                                                                                                                                                                                                                                                                                                                                                                 |                            |                                     |                                       |                                                   |                              |                                         |

## 6.4 Study for testing attribute characteristics (discrete data)

The result of attribute test methods is only a "good or bad" statement and/or "good, rework or bad". For this reason, the evaluation procedure used for variable test methods cannot be used.

Examples for measurements of attribute characteristics are, e.g. gauge measurement or parts recognition.

The workflow of the study for testing attribute characteristics is described in Table 5.

Table 5 Workflow of the study for testing attribute characteristics

| Step | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Specification of the parameters:</p> <p>Number of appraisers ► 2 appraisers</p> <p>Number of measuring objects ► 25 objects</p> <p>Number of measurement series ► 2 measurement series</p> <p>Note for the selection of parts: The parts must exhibit spread over the entire scope of application of the gauge in order to be able to distinguish between OK and NOK. Since the limits of the tolerance specifications are examined during attributive testing, these criteria must be checked. It must be ensured that also test specimens meeting the tolerance limits are included in the selection of parts.</p> |
| 2    | Numbering and marking of the parts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3    | Appraiser 1 tests the parts in the sequence given by the numbering. The appraiser documents the result (OK or NOK) such that it can be allocated to the parts. Appraiser 1 repeats the test and documents the result.                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4    | <p>Appraiser 2 performs the test according to step 3.</p> <p>Important:</p> <p>The appraisers must perform the tests independently of each other such that they do not influence each other.</p>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 5    | <p>Evaluation of the results:</p> <p>The test process is capable if all results are in compliance. I.e. the decision as regards the test specimen must be identical in all performed test series.</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |

Source: /1/ Measurement System Capability Reference Manual. Issue 2.1 D/E. Dr. Edgar Dietrich. Q-DAS GmbH

## 6.5 Study for unilateral tolerances

The forms of distribution underlying these cases may be, for instance, binomial distributions. The standard described herein presumes one-sided consideration of the normal distribution. This simplified consideration is made acceptable by the fact that this method produces less favourable results than the calculation of real distribution. This ensures that the measurement task is fulfilled. Based on the given system requirements, mathematically correct calculation bases may be applied. If there are corresponding customer requirements, they must be applied.

When expressing unilateral tolerances, two different situations must be distinguished:

- The upper and lower specification limits are predetermined. These natural tolerances are e.g.: Roundness, true running, positional tolerance, evenness, etc.

It is only reasonable to determine the  $C_{gk}$  value from the tolerance limit.

$$\text{Calculation formula: } C_{gk} = \frac{0.1 \cdot T - \bar{I} \bar{x}_g - x_{mI}}{3 \cdot S_g}$$

- If only one limit (e.g. lower specification limit) is determined (i.e. measured values must be higher than one minimum value), then no determination of  $C_g$  and/or  $C_{gk}$  is possible.

Proof of capability without calculating  $C_g$  and/or  $C_{gk}$ :

In order to ensure that no values are above or below the maximum or minimum values, a distance of  $3S_g$  is required as limit. See Figure 1.

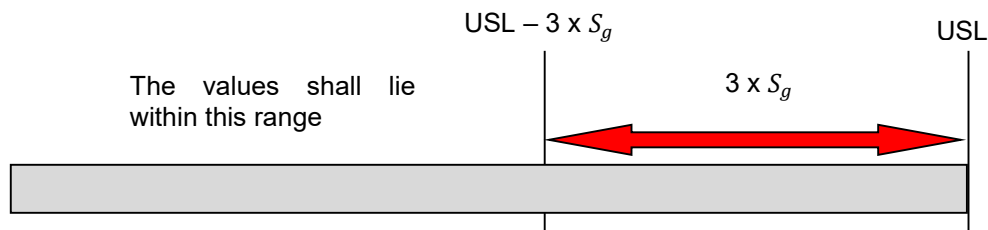


Figure 1 Illustration of the situation regarding an upper specification limit for  $C_g = 1.0$

Source: /2/ *Eignungsnachweis von Prüfprozessen. Dietrich und Schulze. Hanser Verlag*

## 6.6 Assessment of ndc value

For Type-2 and Type-3 study the ndc value is assessed.

Calculation formula:

$$ndc = 1.41 \cdot \frac{PV}{GRR}$$

PV = part variation

GRR = gage repeatability and reproducibility

The value for ndc resulting from this calculation is rounded down to the next integral number and shall be greater than or equal 5.

$$ndc \geq 5$$

If the ndc value is less than 5, the measurement system resolution from the Type-1 study shall be consulted. If the resolution (RE) lies in the range required, i.e.  $\%RE \leq 5\%$  of the tolerance, the reason for the deviating ndc value does not lie in the measurement system. In this case, the ndc value is determined by the variation of the components used and thus allows to assess these components. With the manufacturing process of the components producing a component-specific process variation and the measurement system resolution meeting the requirements, the ndc value shall not be assessed. If, at the same time, the ndc value deviates and the required measurement system resolution is not met, the gage capability is not given.

## 7 Suggestions on how to proceed with unsuitable measurement processes

### 7.1 Step 1: Improve the measurement system

- Measurement error, standards
  - Measuring, clamping, holding forces
  - Measuring locations, definition of positions
  - Receptacles, specimen alignment, measuring probe
  - Sensing element, quality of the measurement standard (surface, form)
- Measurement procedure, strategy
  - Reference element, measurement baseline
  - Measurement speed, filter settings, settling times
  - Multi-point measurements or scanning instead of individual measurements
  - Statistics software
  - Calibration chain
- Environmental conditions
  - Impacts, vibrations
  - Dust, oil mist, draught, humidity
  - Lighting conditions (with optical measurement systems)
  - Temperature fluctuations
  - Electrical interferences
- Specimen
  - Cleanliness
  - Surface condition
  - Geometrical deviations
  - Temperature coefficient
- Operator
  - Briefed, trained
  - Care, handling
  - Cleanliness

### 7.2 Step 2: Obtain a more precise measurement system

- Resolution <5% of the tolerance
- Use linear systems
- Use systems that measure absolute values
- Robust measuring equipment
- Measuring equipment independent of the operator

### 7.3 Step 3: Tolerance assessment

- Check whether the criterion depends on the function
- Deduct the gage repeatability and reproducibility from the tolerance
- Take into consideration process control and capability

ETN021 EN 2025-09  
100013115\_Z25\_001\_06



## Bibliography

VDA Volume 5      Quality Management in the Automotive Industry - Measurement and Inspection Processes - Capability, Planning and Management

/1/ Measurement System Capability Reference Manual. Issue 2.1 D/E. Dr. Edgar Dietrich. Q-DAS GmbH

/2/ Eignungsnachweis von Prüfprozessen. Dietrich und Schulze. Hanser Verlag