

ISO 22514-7:2021 (E)

Statistical methods in process management — Capability and performance — Part 7: Capability of measurement processes

Contents

| | |
|-----------|-----------------------------------------------------------------------------------------------------|
| | Foreword |
| | Introduction |
| 1 | Scope |
| 2 | Normative references |
| 3 | Terms and definitions |
| 4 | Symbols and abbreviated terms |
| 4.1 | Symbols |
| 4.2 | Abbreviated terms |
| 5 | Basic principles |
| 5.1 | General |
| 5.2 | Resolution |
| 5.3 | Maximum permissible error known and used |
| 5.3.1 | General |
| 5.3.2 | MPE, maximum permissible deviation of the measuring system — u_{MPE} |
| 5.4 | Capability and performance limits for a measuring system and measurement process |
| 6 | Implementation |
| 6.1 | General |
| 6.2 | Factors that influence the measurement process |
| 6.2.1 | General |
| 6.2.2 | Uncertainty components that belong to the measuring system |
| 6.2.2.1 | Types |
| 6.2.2.2 | Estimation of uncertainty using the maximum permissible error value |
| 6.2.2.3 | Measuring system resolution |
| 6.2.2.4 | Calculation of repeatability, bias and linearity using reference standards or calibrated workpieces |
| 6.2.2.5 | Experimental method |
| 6.2.3 | Additional uncertainty components belonging to the measurement process |
| 6.2.3.1 | General |
| 6.2.3.2 | Determination of uncertainty components from experiments (Type A) |
| 6.2.3.3 | Determination of uncertainty components not included in the experiments (Type B) |
| 6.2.3.4 | Impact of the deviation of workpiece on the measurement result |
| 6.2.3.5 | Resolution |
| 6.2.3.6 | Temperature influence |
| 6.2.3.6.1 | Uncertainty calculation |
| 6.2.3.6.2 | Uncertainty component caused by temperature differences and expansion |
| 6.2.3.6.3 | Uncertainty on the coefficient of expansion |
| 7 | Studies for calculating the uncertainty components |
| 7.1 | Measuring system |
| 7.1.1 | General |
| 7.1.2 | Repeatability and bias based on one reference standard |
| 7.1.2.1 | General |
| 7.1.2.2 | Preconditions |
| 7.1.2.3 | Procedure |
| 7.1.3 | Standard uncertainty from the linearity deviation — u_{LIN} |
| 7.1.3.1 | Applicable methods |

| | |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 7.1.3.2 | Method B |
| 7.1.3.3 | Method A |
| 7.1.3.4 | Linearity evaluation with ANOVA |
| 8 | Calculation of combined uncertainty |
| 8.1 | General |
| 8.2 | Calculation of expanded uncertainty |
| 9 | Capability |
| 9.1 | Performance ratios |
| 9.1.1 | General |
| 9.1.2 | Performance ratio of the measuring system |
| 9.1.3 | Performance ratio of the measurement process |
| 9.2 | Capability indices |
| 9.3 | Capability of a measurement process with one-sided specifications |
| 10 | Capability of the measurement process compared to the capability of the production process |
| 10.1 | Relation between observed process capability and measurement capability ratios |
| 10.2 | Relation between observed process capability and measurement capability |
| 11 | Ongoing review of the measurement process stability |
| 11.1 | Ongoing review of the stability |
| 12 | Capability of attribute measurement processes |
| 12.1 | General |
| 12.2 | Capability calculations without using reference values |
| 12.3 | Capability calculations using reference values |
| 12.3.1 | Calculation of the uncertainty range |
| 12.3.2 | Symbols |
| 12.3.3 | Working steps for determining the uncertainty range |
| 12.4 | Ongoing review |
| Annex A (informative) Examples | |
| A.1 | Example of linearity study with at least three standards |
| A.1.1 | General |
| A.1.2 | Calculation of means and residuals |
| A.1.3 | ANOVA table: |
| A.1.4 | Estimation of uncertainty components |
| A.2 | Experimental determination of the measurement process uncertainty |
| A.3 | Determination of the uncertainty components not taken into account by experiments |
| A.4 | Determination of the combined and expanded uncertainty |
| A.5 | Assessing the capability of the measuring system and measurement process |
| Annex B (informative) Statistical methods used | |
| B.1 | F-test |
| B.2 | ANOVA tables |
| B.3 | Relation between capability of the measurement process and capability of the production process |