



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Statistical methods in monitoring process capability and
performance - Part 6: Process capability statistics for
characteristics following a multivariate normal distribution**

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Foreword

The plan of GB/T 40681 "Statistical Methods for Monitoring Production Process Capability and Performance" is divided into the following 8 parts.

- Part 1.General principles and concepts;
- Part 2.Process capability and performance of time-dependent process models;
- Part 3.Research on machine performance of discrete product measurement data;
- Part 4.Process capability estimation and performance measurement;
- Part 5.Process capability and performance estimation of counting characteristics;
- Part 6.Multivariate normal process capability analysis;
- Part 7.Measuring process capability;

---Part 8.Equipment performance analysis of multi-state production process.

This part is Part 6 of GB/T 40681.

This section was drafted in accordance with the rules given in GB/T 1.1-2009.

This part uses the redrafting method to modify and adopt ISO 22514-6.2013 "Statistical Methods Capability and Performance in Process Management No. 6

Part. Analysis of Multivariate Normal Process Capability.

The technical differences between this part and ISO 22514-6.2013 and the reasons are as follows.

---Modified the description of the scope of application;

--- The term 3.4 "process capability" is changed to the definition of the corresponding term in GB/T 3358.2-2009 and Note 2 is deleted to maintain the current

Consistent with national standards;

---Change the term 3.6 "process performance" to the definition of the corresponding term in GB/T 3358.2-2009 and delete the note to the original definition to ensure

Be consistent with current national standards;

--- Modify the F distribution in 7.2.2 to the chi-square distribution, which is more accurate;

--- Modify the estimated formula of D in 7.4.2 to $D^{\wedge}= 1$

$n-1$

$(x-\mu_0)TS-1(x$

$-\mu_0).$

This section has made the following editorial changes.

---Revised the standard name to "Statistical Methods for Production Process Capability and Performance Monitoring Part 6.Multivariate Normal Process Capability Analysis";

--- Correct the meaning of $x_{t1}, x_{t2}, \dots, x_{td}$ in 7.4.2 to "the length of the semi-ellipse axis";

--- Correct $\{x|(x-\mu)^T \cdot -1(x-\mu)=c^2\}$ in A.1 of Appendix A to $\{x|(x-\mu)^T \text{sum}-1(x-\mu)= c^2\}$;

---Add the equal sign "=" after the covariance matrix sumA and sumB in Appendix C;

---Modified the right picture of Figure C.1 in Appendix C;

---Revised references.

This part is proposed and managed by the National Standardization Technical Committee for the Application of Statistical Methods (SAC/TC21).

Drafting organizations of this section. Beijing University of Technology, China National Institute of Standardization, Inner Mongolia Mengniu Dairy (Group) Co., Ltd., Shanxi Hu Chemical Group Jinxing Chemical Co., Ltd., Huzhou Rongke Building Material Technology Co., Ltd., Huzhou Mingfeng Enterprise Management Consulting Co., Ltd., China Machinery Productivity Promotion Center, Zhongtong Bus Holding Co., Ltd., Liaocheng Zhuoqun Auto Parts Co., Ltd.

Introduction

Due to the complexity of production methods and the increased quality requirements for products and production processes, in many cases, univariate processes are used.

Process analysis is not enough to meet the requirements of process management. Therefore, it is particularly necessary to carry out process analysis based on the characteristics of multiple products. For example, in production

During the process, the process capability is developed for the geometric tolerances, dynamic changes (such as imbalance), material correlation characteristics or other process characteristics that can be collected

analyze.

The purpose of this section is to give different calculation methods for process performance and process capability index in the case of multiple processes or multiple product characteristics.

Definition.

Drawing on the methods in ISO 22514-2, this section provides the calculation formulas for the multivariate process performance and process capability index as a corresponding list.

The generalization of the variable index, these formulas take the process dispersion and process position into consideration at the same time. The index in this section is actually one-dimensional

Based on the classic C_p and C_{pk} indices. Appendix A gives a detailed explanation of the expansion from the univariate case to the multiple case.

The possible application examples of this section are the two-dimensional or three-dimensional position of the product, the imbalance (see Appendix B) or some related quantities of the chemical product.

The dispersion of the measurement result depends on the dispersion of the product realization process and the accuracy of the measurement process. It is assumed in this section that the

The capability of the measurement system has been verified before the product realizes the process capability analysis.

The calculation methods described in this section should be used to guide clear decisions, especially in the following situations.

---The limit of the process capability index is set for the continuous multi-product characteristics, which can be used as a part of the contract between the customer and the supplier;

---Comparison of production methods or supplier process capabilities;

---Production process license;

---In the event of complaints or harmful incidents, carry out problem analysis and make decisions.

Note. The product realization process includes the manufacturing process, product assembly process and service process.

Statistical methods for production process capability and performance monitoring

Part 6. Multivariate Normal Process Capability Analysis

1 Scope

This part of GB/T 40681 provides for the calculation process or product when it is necessary to consider a family of interrelated single variables.

Statistical methods for the performance and capabilities of product characteristics.

This section is applicable to the process capability and performance estimation of the multivariate normal process in the common production process.

Note. For the sake of simplicity, the methods provided in this section are mostly described with the bivariate normal process as an example.

For the different methods provided, this section does not evaluate the possible applications of each method in different situations. The user can be based on

Choose a more appropriate method for the actual situation.

2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version is applicable to this

document. For undated reference documents, the latest version (including all amendments) is applicable to this document.