BS ISO 7870-2:2013

BSI Standards Publication

Control charts

Part 2: Shewhart control charts

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This British Standard is the UK implementation of ISO 7870-2:2013. It supersedes BS 7785:1994, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee SS/4, Statistical Process Management.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Part 2: Shewhart control charts

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7870-2 was prepared by Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 4, *Applications of statistical methods in process management*.

This first edition cancels and replaces ISO 8258:1991, which has been technically revised.

ISO 7870 consists of the following parts, under the general title Control charts:

— *Part 1: General guidelines*

— *Part 2: Shewhart control charts*

— *Part 3: Acceptance control charts*

— *Part 4: Cumulative sum charts*

— *Part 5: Specialized control charts*

EWMA control charts will from the subject of a future Part 6.

Introduction

A traditional approach to manufacturing has been to depend on production to make the product and on quality control to inspect the final product and screen out items not meeting specifications. This strategy of detection is often wasteful and uneconomical because it involves after-the-event inspection when the wasteful production has already occurred. Instead, it is much more effective to institute a strategy of prevention to avoid waste by not producing unusable output in the first place. This can be accomplished by gathering process information and analysing it so that timely action can be taken on the process itself.

Dr. Walter Shewhart in 1924 proposed the control chart as a graphical means of applying the statistical principles of significance to the control of a process. Control chart theory recognizes two kinds of variability. The first kind is random variability due to "chance causes" (also known as "common/*natural/random/inherent/uncontrollable* causes"). This is due to the wide variety of causes that are consistently present and not readily identifiable, each of which constitutes a very small component of the total variability but none of which contributes any significant amount. Nevertheless, the sum of the contributions of all of these unidentifiable random causes is measurable and is assumed to be inherent to the process. The elimination or correction of common causes may well require a decision to allocate resources to fundamentally change the process and system.

The second kind of variability represents a real change in the process. Such a change can be attributed to some identifiable causes that are not an inherent part of the process and which can, at least theoretically, be eliminated. These identifiable causes are referred to as "assignable causes" *(also known as special/unnatural/systematic/controllable causes*) of variation. They may be attributable to such matters as the lack of uniformity in material, a broken tool, workmanship or procedures, the irregular performance of equipment, or environmental changes.

A process is said to be in statistical control, or simply "in control", when the process variability results only from random causes. Once this level of variation is determined, any deviation from this level is assumed to be the result of assignable causes that should be identified and eliminated.

Statistical process control is a methodology for establishing and maintaining a process at an acceptable and stable level so as to ensure conformity of products and services to specified requirements. The major statistical tool used to do this is the control chart, which is a graphical method of presenting and comparing information based on a sequence of observations representing the current state of a process against limits established after consideration of inherent process variability called process capability. The control chart method helps first to evaluate whether or not a process has attained, or continues in, a state of statistical control. When in such a state the process is deemed to be stable and predictable and further analysis as to the ability of the process to satisfy the requirements of the customer can then be conducted. The control chart also can be used to provide a continuous record of a quality characteristic of the process output while process activity is ongoing. Control charts aid in the detection of unnatural patterns of variation in data resulting from repetitive processes and provide criteria for detecting a lack of statistical control. The use of a control chart and its careful analysis leads to a better understanding of the process and will often result in the identification of ways to make valuable improvements.

Control charts —

Part 2:
Shewhart control charts

1 Scope

This International Standard establishes a guide to the use and understanding of the Shewhart control chart approach to the methods for statistical control of a process.

This International Standard is limited to the treatment of statistical process control methods using only the Shewhart system of charts. Some supplementary material that is consistent with the Shewhart approach, such as the use of warning limits, analysis of trend patterns and process capability is briefly introduced. There are, however, several other types of control chart procedures, a general description of which can be found in ISO 7870-1.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534-2, *Statistics — Vocabulary and symbols — Part 2: Applied statistics*

ISO 16269-4, *Statistical interpretation of data — Part 4: Detection and treatment of outliers*

ISO 5479, *Statistical interpretation of data — Tests for departure from the normal distribution*

ISO 22514 (all parts), *Statistical methods in process management — Capability and performance*

3 Terms, definitions and symbols

3.1 General

For the purposes of this document, the terms and definitions given in ISO 3534-2:2006 apply.

3.2 Symbols

NOTE The ISO/IEC Directives makes it necessary to depart from common SPC usage in respect to the differentiation between abbreviated terms and symbols. In ISO standards an abbreviated term and its symbol can differ in appearance in two ways: by font and by layout. To distinguish between abbreviated terms and symbols, abbreviated terms are given in Cambria upright and symbols in Cambria or Greek italics, as applicable. Whereas abbreviated terms can contain multiple letters, symbols consist only of a single letter. For example, the conventional abbreviation of upper control limit, UCL, is valid but its symbol in equations becomes U_{CL}. The reason for this is to avoid misinterpretation of compound letters as an indication of multiplication.

In cases of long established practice where a symbol and/or abbreviated term means different things in different applications, it is necessary to use a field limiter, thus 〈 〉, to distinguish between them. This avoids the alienation of practitioners by the creation of unfamiliar abbreviated terms and symbols in their particular field that are unlike all related texts, operational manuals and dedicated software programs. An example is the abbreviated term ‘R’ and symbol ‘*R*’ which means different things in metrology from that in acceptance sampling and statistical process control. The abbreviated term ‘R’ is differentiated thus:

