

ISO 7870-2:2023-03 (E)

Control charts - Part 2: Shewhart control charts

| Contents | | Page |
|--------------------|--|-------------|
| Foreword | | v |
| Introduction | | vi |
| 1 | Scope | 1 |
| 2 | Normative references | 1 |
| 3 | Terms and definitions | 1 |
| 3.1 | General presence | 1 |
| 3.2 | Symbols | 1 |
| 3.2.1 | For the purposes of this document, the following symbols apply | 1 |
| 4 | Concepts of Shewhart control charts | 3 |
| 4.1 | Shewhart control chart | 3 |
| 4.2 | Control limits | 3 |
| 4.3 | Process in statistical control | 3 |
| 4.4 | Action limits | 4 |
| 4.5 | Warning limits | 4 |
| 4.6 | Type 1 error | 4 |
| 4.7 | Type 2 error | 4 |
| 4.8 | Process not in control | 4 |
| 4.9 | Phase 1 of statistical process control | 5 |
| 4.10 | Phase 2 of control charts | 5 |
| 5 | Types of control charts | 5 |
| 5.1 | Types of Shewhart control charts | 5 |
| 5.2 | Control charts where no pre-specified values of process parameters are given | 5 |
| 5.3 | Control charts with respect to given pre-specified values of process parameters | 6 |
| 5.4 | Types of variables and attribute control charts | 6 |
| 5.4.1 | Variables control charts | 6 |
| 5.4.2 | Attribute control charts | 6 |
| 6 | Variables control charts | 7 |
| 6.1 | Usefulness of variables control charts | 7 |
| 6.2 | Assumption of normality | 7 |
| 6.3 | Pair of control charts | 8 |
| 6.4 | Average, X chart and range, R chart or average, X chart and standard deviation, s chart | 8 |
| 6.5 | Control chart for individuals, X, and moving ranges, Rm | 9 |
| 6.6 | Control charts for medians, X | 10 |
| 7 | Control procedure and interpretation for variables control charts | 11 |
| 7.1 | Underlying principle | 11 |
| 7.2 | Collect preliminary data | 11 |
| 7.3 | Examine s (or R) chart | 11 |
| 7.4 | Homogenization for s (or R) chart | 11 |
| 7.5 | Homogenization for X chart | 12 |
| 7.6 | Ongoing monitoring of process | 12 |
| 8 | Unnatural pattern and tests for assignable causes of variation | 12 |
| 8.1 | Natural pattern | 12 |
| 8.2 | Unnatural patterns | 13 |

| | | |
|---|---|----|
| 8.2.1 | General | 13 |
| 8.2.2 | Lack of control in the average chart only | 13 |
| 8.2.3 | Lack of control in the variation chart only | 13 |
| 8.2.4 | Lack of control in both average and variation charts | 14 |
| 8.2.5 | Depiction of unnatural patterns | 14 |
| 9 | Process control, process capability, and process improvement | 15 |
| 9.1 | Process control | 15 |
| 9.2 | Process capability and improvement | 16 |
| 10 | Attribute control charts | 18 |
| 10.1 | Attribute data | 18 |
| 10.2 | Distributions | 18 |
| 10.3 | Subgroup size | 18 |
| 10.4 | Control chart for fraction nonconforming (p chart) | 19 |
| 11 | Preliminary considerations before starting a control chart | 19 |
| 11.1 | Choice of critical to quality (CTQ) characteristics describing the process to control | 19 |
| 11.2 | Analysis of the process | 19 |
| 11.3 | Choice of rational subgroup | 20 |
| 11.4 | Frequency and size of subgroups | 20 |
| 11.5 | Preliminary data collection | 21 |
| 11.6 | Out of control action plan | 21 |
| 12 | Steps in the construction of control charts | 21 |
| 12.1 | Typical format of a standard control chart form | 21 |
| 12.2 | Determine data collection strategy | 22 |
| 12.3 | Data collection and computation | 23 |
| 12.4 | Plotting X chart and R chart | 23 |
| 13 | Caution with Shewhart control charts | 24 |
| 13.1 | General caution | 24 |
| 13.2 | Correlated data | 26 |
| 13.3 | Use of alternative rules to the three- rule | 26 |
| Annex A (informative) Illustrative examples | | 27 |
| Annex B (informative) Practical notices on the pattern tests for assignable causes of variation | | 46 |
| Bibliography | | 48 |