AS 3941—1990

Australian Standard®

Quality control—Guide for number nonconforming charts

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Department of Defence

Federal Chamber of Automotive Industries

Federation of Automotive Products Manufacturers

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PREFACE

This Standard was prepared by the Standards Australia Committee on Statistical Quality Procedures at the request of the Quality and Reliability Standards Board.

The need for Australian Standards to cover process control was pointed out to Standards Australia by the Australian Organisation for Quality which was aware that the current Standards used by local industry (that is either British Standards or USA Standards) differed in both matters of definition and emphasis. Standards Australia endorses this view and encourages the application of control charts in both production and service environments.

This Standard is the second in this series, following AS 3940, *Quality control—Guide to the use of control chart methods including Cusum techniques.*

This Standard is based on the British Standard BS 5701—1980, *Guide to number defective charts for quality control,* but has been extensively re-written and enlarged to conform with Australian terminology, practices, and preferences. Recognition is given to the contribution BS 5701 has made in the development of this Standard.

Reference is made also to AS 1057—1985, *Quality assurance and quality control—Glossary of terms,* and AS 3940, *Quality control–Guide to the use of control chart methods including Cusum techniques*.

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FOREWORD

The purpose of this Standard is to provide guidance for the preparation and use of a particular type of traditional chart (Shewhart)—the 'Number Nonconforming Control Chart'. It has been the practice to specify, as a target, a maximum permissible level for non-conformities in output. This has usually been done for a process coming into production with its capability unknown. This helps to maintain attention on the process and encourages action to improve it to the required level. The state of statistical control of the process needs to be assessed in order to direct action at the underlying causes of departure from the state of control. Knowledge of whether or not a process is in statistical control is necessary before process improvement can be undertaken.

This type of chart permits one of the simplest methods of quality control to be introduced into a production process. The product or service is assigned the attribute of being either 'conforming' or 'nonconforming' to a specified quality requirement. Samples of the product or service are regularly taken, and the number of nonconforming items is plotted on a chart.

These data points can be used for the effective control of quality provided that the chart shows preset 'boundaries' such as 'control' and 'warning' limits. These depend on prior knowledge of the 'likely' quality of the process from which knowledge it is possible to select a sample size and a sampling interval, for which an 'average run length' between nonconforming items can be predicted with reasonable confidence.

The term, 'statistical quality control chart', denotes the use of charted results obtained from routine sampling of a process to aid the control of that process. The charted results assist those people controlling the process to make decisions as to whether the process has or has not changed. If control charts are maintained at each stage of the process on those characteristics that define the quality of the process, it then becomes feasible to reduce the overall inspection activity. The prerequisite for using the control chart is that the process is in a state of statistical control; that is, all causes of assignable variation have been eliminated, and the process is only subject to its natural variation. Using the chart as a decision tool, with the process not in this state, will result in resources being consumed on actions which may have only minimal or no effect. Statistical quality control charts may be broadly classified as control charts for variables, or control charts for attributes. Number nonconforming charts considered in this Standard are the most common form of the latter classification.

Number nonconforming control charts have a number of applications not only to manufacturing processes, but also to those processes associated with services or any repetitive task, e.g. control of delivery times of trucks and service vehicles; analysis of typing errors or processing times of invoices; analysis of sales or production volumes.

As its name indicates, this chart describes a process that is producing less than 100% acceptable quality. It describes statistically the stability of the level of nonconforming items in the process. In line with current quality practices, action should be taken to improve the process, and this chart is an important first step. The chart will indicate, once actions have been taken, whether or not a real change has actually occurred, and as such, it becomes an invaluable tool both for management and for people involved in making the change.

The use of this type of chart is usually determined by the nature of the product, for example:

(a) Where it is only possible to describe the outcome of the process as either right or wrong, present or not present (this could apply to such things as ammunition which either fires or does not, or the production of boilers which either leak or do not); or

(b) Where the article is too complex or difficult to measure. (e.g. roughness of textiles, internal screw threads, castings, and the plating and finishing of surfaces).

It may be possible to find a continuous system for measuring (a) and (b) above (e.g. a boiler system would leak at X mL/s, castings can be measured for porosity, plated finish can be measured in terms of adhesion, amount of coverage and thickness), but ultimately the decision to use a number 'nonconforming chart' is made on economic grounds to provide a cheap means of monitoring a process. In some cases, measurement of an appropriate variable may provide better monitoring but at a higher cost.

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SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This Standard describes the simplest method of statistical quality control, i.e. charting the results of the number of nonconforming items in samples taken from a process that produces individual or discrete units of product rather than a bulk commodity or continuous material. This Standard also sets out accepted methods of charting which are easy to use, and which may safely and profitably replace 100 percent inspection or routine examination. They are applicable whenever the quality of work done can be assessed by classifying it as right or wrong.

The guidance given in Sections 2 and 3 should be followed in preparing control charts. The purpose of Section 4 is to guide users in refinements to these methods. It also describes efficient methods, which may be used to reduce the sample sizes and the amount of inspection needed, and to control process quality so that nonconforming items are virtually eliminated. Clause 4.5 provides a fully worked example.

NOTE: No attempt is made to deal at length with the statistical principles underlying these methods, the objective being to show how to use them. They may be employed far more widely than merely for the examination of dimensions. The methods have been used for such processes as making up packages at large mail-order stores, errors in bank statements, reservations and transfers in hotel accommodation, in addition to the more usual manufacturing processes.

1.2 APPLICATION. This Standard is intended as a guide for persons concerned in making decisions on products and processes where the acceptance criteria is defined in terms of whether the product or process is right or wrong. The methods described are concerned solely with the attributes of conformance, no consideration is taken of the degree of nonconformance. It should be noted that the use of number non-conforming charts is restricted in practice to processes of low capability as outlined in the examples given. It should also be noted that this Standard applies to processes which are producing not more than 10 percent of nonconforming items because the Statistical theory used does not apply if this limit is exceeded.

1.3 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS 1057 Quality assurance and quality control—Glossary of terms

AS 3940 Quality Control—Guide to the use of control chart methods including Cusum techniques.

1.4 DEFINITIONS. For the purpose of this Standard, the definitions given in AS 1057 apply.