This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

ANSI/ASQC B1-1996, ANSI/ASQC B2-1996, and ANSI/ASQC B3-1996

AMERICAN NATIONAL STANDARD

Guide for Quality Control Charts
Control Chart Method of Analyzing Data
Control Chart Method of Controlling Quality During Production

AMERICAN SOCIETY FOR QUALITY
611 EAST WISCONSIN AVENUE
MILWAUKEE, WISCONSIN 53202

This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

AMERICAN NATIONAL STANDARD

Guide for Quality Control Charts
Control Chart Method of Analyzing Data
Control Chart Method of Controlling Quality During Production

[Reaffirmation of ANSI/ASQC B1-1985, ANSI/ASQC B2-1985, and ANSI/ASQC B3-1985]

Prepared by
American Society for Quality Standards Committee
for
American National Standards Committee Z-1 on Quality Assurance

An American National Standard Approved on February 26, 1996

American National Standard: An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he or she has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions.

Caution Notice: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

©1996 by ASQ
All rights reserved. No part of this book may be reproduced in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

ASQ Mission: To facilitate continuous improvement and increase customer satisfaction by identifying, communicating, and promoting the use of quality principles, concepts, and technologies; and thereby be recognized throughout the world as the leading authority on, and champion for, quality.

10 9 8 7 6 5 4 3

Printed in the United States of America

Printed on acid-free paper

Published by:

American Society for Quality

Quality Press
611 East Wisconsin Avenue
Milwaukee, Wisconsin 53201-3005
800-248-1946
Web site http://www.asq.org

This is a preview of ANSI/ASQC B1-1996. Click here to purchase the full version from the ANSI store.

Contents

This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

Foreword

(This Foreword is not a part of American National Standard ANSI/ASQC B1-1996, *Guide for Quality Control Charts,* nor of American National Standard ANSI/ASQC B2-1996, *Control Chart Method of Analyzing Data,* nor of ANSI/ASQC B3-1996, *Control Chart Method of Controlling Quality During Production.*)

Upon request by the War Department, the American Standards Association, in December, 1940, initiated a project on the application of statistical methods to the quality control of materials and manufactured products. Since, due to the national emergency, there was an urgent need for the prompt development of standards in this field, the ASA Defense Emergency Procedure (later called the War Emergency Procedure) was applied to this project, and the following Emergency Technical Committee (later, War Committee) was appointed to develop such standards:

H. F. Dodge, Bell Telephone Laboratories, Inc., Chairman
A. G. Ashcroft, Alexander Smith and Sons Carpet Company
W. Edwards Deming, Bureau of the Census
Leslie E. Simon, Ordnance Department, U.S. Army
R. E. Wareham, General Electric Company
John Gaillard, American Standards Association, Secretary

This committee developed these three standards. Drafts were submitted for criticism and comment to a number of key individuals in groups having a substantial interest in the subject of the standards. All of the comments were carefully reviewed by the committee and a number of changes were made in accordance with suggestions received. The revised drafts of Z1.1 and Z1.2 were unanimously approved by the Emergency Technical Committee and received ASA approval as American Defense Emergency Standards (later, War Standards) on May 27, 1941. Z1.3 was first approved in 1942.

In November, 1952, the ASA invited the American Society for Quality Control (ASQC) to accept the proprietary sponsorship for the three standards which had been developed by the War Committee. The invitation was accepted by ASQC in February, 1953, and the standards were turned over to the ASQC Standards Committee who assigned the designations ASQC B1, ASQC B2, and ASQC B3 to the standards which were later to become ANSI standards Z1.1, Z1.2 and Z1.3 respectively. The personnel of the committee at that time was as follows:

Irving W. Burr, Purdue University
W. Edwards Deming, Consultant in Statistical Surveys, New York University
Harold F. Dodge, Bell Telephone Laboratories, Inc. (retired) and Rutgers, The State University of New Jersey, Chairman
Eugene L. Grant, Stanford University
Ralph E. Wareham, Consultant in Quality Control

One of the duties of the ASQC as Proprietary Sponsor was the establishment of a national consensus on approval of the standards by industry. In August, 1956, a canvass of industry was instituted in which organizations believed to have a substantial interest in the subject of quality control were contacted. This canvass resulted in all but three of the organizations interested approving the standards as circulated by ASQC. After further review by the Standards Committee of ASQC, in the light of comments received in the course of the canvass, ASQC felt that the basic criticisms had been covered by making minor modifications and bringing the appendixes up to date, and accordingly submitted the standards to ASA for approval as American Standards. In the course of considering the submittal for a recommendation on approval, the Miscellaneous Standards Board, which had jurisdiction over this work, requested that those organizations which had objected be contacted again to ascertain their present feelings in the matter. This was done with the result that the organizations involved announced that they now approved the standards.

Accordingly, after receiving a favorable recommendation from the Miscellaneous Standards Board, the American Standards Association approved the standards as American Standards on November 21, 1958.

This is a preview of "ANSI/ASQC B1-B3-1996". Click here to purchase the full version from the ANSI store.

In 1981, the ANSI Z1 Statistical Methods Subcommittee recommended to the ASQC Standards Committee that the standards Z1.1, *Guide for Quality Control,* Z1.2, *Control Chart Method of Analyzing Data,* and Z1.3, *Control Chart Method of Controlling Quality During Production* can be updated to include more modern terminology and symbols in keeping with the American National Standard ANSI/ASQC A1-1978, *Definitions, Symbols, Formulas and Tables for Control Charts* and other publications such as the ASTM STP15D, *ASTM Manual on Presentation of Data and Control Chart Analysis.*

The task was assigned to the ASQC Statistics Division which formed a writing committee that completed the task of updating these standards. The writing committee combined the three standards, Z1.1, Z1.2, and Z1.3 under one cover as had been done previously with Z1.1 and Z1.2, because all three documents are concerned with the statistical quality control charts.

The significant changes are: (1) the redefinition of the sample standard deviation to be $s = \sqrt{\Sigma(X - \overline{X})^2 / (n - 1)}$; (2) the use of the words nonconforming and nonconformities to replace defectives and defects respectively; (3) the use of a subscript (0) to replace the prime symbol (') e.g. p_0 used in place of p', for designating a standard value, and (4) the amplification of the material on Warning Limits.

The redifinition of the sample standard deviation also required changing many factors used in control chart work (c_4 in place of c_2; A_3 in place of A_1; B_5 and B_6 in place of B_1 and B_2 respectively; E_3 in place of E_1). Table 6 *Factors for Computing Control Chart Lines* and the Table A2 in the Appendix now use the updated factors.

The above changes required many changes in these standards. This document is a reaffirmation of the 1985 version.

Scope

The scope of this document is intended to cover the Shewhart statistical quality control charts which are in general use in the United States manufacturing and service industries.

Writing Committee

The following individuals were members of the writing committee for the 1985 revision of ANSI Z1.1, Z1.2, and Z1.3 1958:

Sherman L. Babcock, Chairman
Hardy M. Cook, Jr.
Acheson J. Duncan
C. Allen Mannon
Harrison M. Wadsworth, Jr.
Oswald Willner

Suggestions for improvement of this standard will be welcome. They should be sent to the Standards Administrator, American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.

ANSI/ASQC B1-1996
Guide for Quality Control Charts

1. SCOPE

1.1 This standard is intended as a guide for handling problems concerning the economic control of quality of materials, manufactured products, services, etc. It has particular reference to methods of collecting, arranging, and analyzing inspection and test records in a manner designed to detect lack of uniformity of quality.

For the sake of simplicity, the term *product* will be used hereafter, whether the object whose quality is being considered is a material, a semi-finished or finished product, or a service. Thus the words "manufacturer, purchaser, production process, etc." should be interpreted broadly to cover many fields of interest.

2. THE CONTROL CHART

2.1 It is recommended that the control chart be used for handling quality control problems, for example, for controlling quality during manufacture, for presenting the essential information of the quality records, as an aid in judging how well the quality is controlled, for continuing quality improvement, and as an indicator as to when action should be taken to prevent quality problems from occurring.

2.2 The control chart is a graphical record of quality. On it are placed a pair of *control limits.* These limits are of assistance in judging the significance of variations of product quality around the general level, particularly with a view to the more important function of exercising purposeful control over the quality. Moreover, they are placed such that a plotted point falling outside them during manufacture may be taken as an indication of a cause of variation that should be investigated.

3. SPECIFICATION LIMITS

3.1 Before the nature of control limits is explained, it may be well to visualize the nature of *specification limits.* These are the limits given in the product specification to define the extreme permissible values of a quality characteristic, to ensure correct performance of the *individual unit* of product. Specification limits are used by the manufacturer in his own plant, or by the purchaser when receiving a consignment, as a basis for checking the quality of each individual unit inspected.

A typical example of specification limits are the minimum and maximum limits for the diameter of a shaft.

4. CONTROL LIMITS

4.1 The control limits on a control chart are different from specification limits. They are used, not for checking the quality of each unit of the product, but as a basis for judging the significance of the quality variations from sample to sample, from lot to lot, or from time to time. They supply a criterion for deciding whether a production process is being disturbed by causes of variation that should be investigated.

Control limits apply to some measure of the *collective quality* of a group of units, this measure to be computed from observations made on the individual units in the group.

Quality measures commonly used are (1) the *average* of the observed values of the individual units under consideration, and (2) some measure of the dispersion of the observed values around their average, such as the *standard deviation* or the *range.* Where individual units are tested or examined primarily to determine whether they do or do not conform to a specified requirement or set of requirements, the quality measure *fraction nonconforming* is commonly used.

5. VARIATION OF QUALITY—ASSIGNABLE CAUSES

5.1 The quality of a product as measured from sample to sample, or from lot to lot, shows variations that are attributable to numerous causes. A variation can be classed in one of two ways: (1) as a variation that merits no investigation; (2) as a significant variation, indicative of an *assignable cause* (cause of trouble), which should be identified and corrected if practicable. The control limits effect this classification in an economic manner.

5.2 The control chart can only indicate when and where the trouble has occurred; the identification and elimination of the trouble is an engineering problem. An assignable cause of variation may be attributable to lack of uniformity in materials or in workmanship, or to irregular performance of manufacturing equipment or testing equipment. The removal of such causes decreases the variability of quality.