Measurement Systems Analysis

MSA

Third Edition

MEASUREMENT SYSTEMS ANALYSIS

Reference Manual

Third Edition

First Edition, October 1990 • Second Edition, February 1995; Second Printing, June 1998
Third Edition, March 2002; Second Printing, May 2003

FOREWORD

This Reference Manual was developed by a Measurement Systems Analysis (MSA) Work Group, sanctioned by the DaimlerChrysler Corporation/Ford Motor Company/General Motors Corporation Supplier Quality Requirements Task Force, and under the auspices of the American Society for Quality (ASQ) and the Automotive Industry Action Group (AIAG). The Work Group responsible for this Third Edition were David Benham (DaimlerChrysler Corporation), Michael Down (General Motors Corporation), Peter Cvetkovski (Ford Motor Company), Gregory Gruska (Third Generation, Inc.), Tripp Martin (Federal Mogul) and Steve Stahley (SRS Technical Services).

In the past, Chrysler, Ford, and General Motors each had their own guidelines and formats for ensuring supplier compliance. Differences between these guidelines resulted in additional demands on supplier resources. To improve upon this situation, the Task Force was chartered to standardize the reference manuals, procedures, reporting formats, and technical nomenclature used by Chrysler, Ford, and General Motors.

Accordingly, Chrysler, Ford, and General Motors agreed in 1990 to develop, and, through AIAG, distribute an MSA manual. That first edition was well received by the supplier community, which offered valuable inputs, based on application experience. These inputs have been incorporated into the Second and this Third edition. This manual, which is approved and endorsed by DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation, is a supplemental reference document to QS-9000.

The manual is an introduction to measurement system analysis. ***It is not intended to limit evolution of analysis methods suited to particular processes or commodities.*** While these guidelines are intended to cover normally occurring measurement system situations, there will be questions that arise. These questions should be directed to your customer's Supplier Quality Assurance (SQA) activity. If you are uncertain as to how to contact the appropriate SQA activity, the buyer in your customer's purchasing office can help.

The MSA Work Group gratefully acknowledges: the leadership and commitment of Vice Presidents Tom Sidlik at DaimlerChrysler Corporation, Carlos Mazzorin at Ford Motor Company and Bo Andersson of General Motors Corporation; the assistance of the AIAG in the development, production and distribution of the manual; the guidance of the Task Force principals Hank Gryn (DaimlerChrysler Corporation), Russ Hopkins (Ford Motor Company), and Joe Bransky (General Motors Corporation), in association with ASQ represented by Jackie Parkhurst (General Motors Corporation), and the American Society for Testing and Materials (ASTM *International*). This manual was developed to meet the specific needs of the automotive industry.

March 2002

FOREWORD

This Reference Manual was developed by a Measurement Systems Analysis (MSA) Work Group, sanctioned by the Chrysler/Ford/General Motors Supplier Quality Requirements Task Force, and under the auspices of the Automotive Division of the American Society for Quality Control (ASQC) and the Automotive Industry Action Group (AIAG). The Work Group responsible for this Second Edition were Ray Daugherty (Chrysler), Victor Lowe, Jr. (Ford), Chairperson Michael H. Down (General Motors), and Gregory Gruska (The Third Generation, Inc.).

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Accordingly, Chrysler, Ford, and General Motors agreed in 1990 to develop, and, through AIAG, distribute an MSA manual. That first edition was well received by the supplier community, which offered valuable inputs, based on application experience. These inputs have been incorporated into this second edition. This manual, which is approved and endorsed by Chrysler, Ford and General Motors, should be used by suppliers implementing MSA techniques in their manufacturing processes and in satisfying the requirements of QS9000.

The manual should be considered and introduction to measurement system analysis. It is not intended to limit evolution of analysis methods suited to particular processes or commodities. While these guidelines are intended to cover normally occurring measurement systems situations, there will be questions that arise. These questions should be directed to your customer's Supplier Quality Assurance (SQA) activity. If you are uncertain as to how to contact the appropriate SQA activity, the buyer in your customer's Purchasing office can help.

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February 1995

MSA 3rd Edition Quick Guide

Type of Measurement System	MSA Methods	Chapter
Basic Variable	Range, Average & Range, ANOVA, Bias, Linearity, Control Charts	III
Basic Attribute	Signal Detection, Hypothesis Test Analyses	III
Non-Replicable (e.g., Destructive Tests)	Control Charts	IV
Complex Variable	Range, Average & Range, ANOVA, Bias, Linearity, Control Charts	III, IV
Multiple Systems, Gages or Test Stands	Control Charts, ANOVA, Regression Analysis	III, IV
Continuous Process	Control Charts	III
Miscellaneous	Alternate Approaches	V
Other	White Papers – available at http://www.aiag.org/publications/quality/msa3.html	

NOTE: Regarding the use of the GRR standard deviation

Historically, by convention, a 99% spread has been used to represent the "full" spread of measurement error, represented by a 5.15 multiplying factor (where σ_{GRR} is multiplied by 5.15 to represent a total spread of 99%).

A 99.73% spread is represented by a multiplier of 6, which is $\pm 3\sigma$ and represents the full spread of a "normal" curve.

If the reader chooses to increase the coverage level, or spread, of the total measurement variation to 99.73%, please use 6 as a multiplier in place of 5.15 in the calculations.

Awareness of which multiplying factor is used is crucial to the integrity of the equations and resultant calculations. This is especially important if a comparison is to be made between measurement system variability and the tolerance.