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**THE NATIONAL  
SHIPBUILDING  
RESEARCH  
PROGRAM**

**Process Analysis  
Via Accuracy Control**

U.S. DEPARTMENT OF TRANSPORTATION  
Maritime Administration

## FOREWORD

Accuracy per se is not important. Accuracy measurements are needed simply because they are reliable indicators of how work processes are performing. Incessant analyses of accuracy measurements and other relevant variables are means used by the most competitive shipbuilders to *constantly* perfect organization of work. This book, addresses modern industrial principles as successfully applied to shipbuilding by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) of Japan. Some traditional managers will become convinced that high productivity in Japan is not due to superhuman workers or miraculous subsidies. Instead, as this book demonstrates, high productivity comes from appropriately trained workers performing *highly organized work*.

Accuracy Control (A/C) is not quality control nor is it similar. A/C means *regulation* of accuracy as a means for *continuously* improving design details and work methods so as to maximize productivity. Thus, A/C is properly in the realm of operations managers.

Statistical analysis as applied in A/C is based upon the empirically derived observation that there is no such thing as absolute accuracy. No matter how precise people try to be during a specific work process, variations from specified dimensions are always measurable and *normal*. Thus, for shipbuilders accuracy exists only in terms of normally achieved ranges. Learning how to work with ranges of variations is crucial for production control and for achieving specified end-product accuracy in a very competitive market.

A further surprise is that the statistical basis for A/C as a means for controlling work was introduced to the Japanese by an American statistician, W. E. Deming, more than thirty years ago. The importance of his contribution is manifested by the annual TV presentation in Japan of the Deming Award for the most notable contribution to productivity.

One commentator generalized that Deming's theories suggest that traditional managers don't know how to count. The substance of this book suggests further that they also don't know what nor when to count. In shipbuilding, sufficient understanding is dependent upon more college or equivalently educated middle managers as heads of fabrication shops and assembly organizations.

A key feature of A/C as practiced in competitive shipyards is the selection of bright people at critical points in their careers to serve a few years as A/C engineers. Each selectee, having about eight years experience, is on the threshold of really being able to contribute to developing shipbuilding technology. A/C, because it always deals with analytical methods and the entire shipbuilding process, provides opportunities for real performances in a climate that excludes apparent performers. Thus, A/C is excellent for developing and identifying the best *shipbuilding engineers* while they are simultaneously improving productivity. In such shipyards, the terms "shipbuilding engineer" and "shipbuilding manager" are synonymous.

## FOREWORD (Continued)

Because of shrinkage and deformation, A/C is crucial for competitive hull-construction work. This book is limited accordingly. When A/C is perfected for hull construction, similar techniques can be applied elsewhere.

Unlike other A/C publications, this book speaks of "variation" instead of "error". Errors are acts that through ignorance, deficiency or accident cause departures from specified dimensions. They do not normally occur. A/C deals with variations that occur during normal operations.

Further, in this book the word "margin" designates a commitment to rework. "Excess" is used to designate an allowance for accumulated variation that can be predicted with a high degree of probability. Something with excess is finish cut and probably does not require rework. Margins always require rework.

A/C is a scientific procedure which is alien to traditional shipbuilders. Because of its scientific nature, this book is not for a casual reader. Periodic reference to the numerous photographs in Part 6.11 will facilitate understanding.

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Appendix B — Statistical Concepts in Accuracy Control

Appendix C — Variation Merging Equations

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Appendix E — Analysis of Shrinkage in a Double-bottom Floor

Appendix F — Control Charts



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