



Standard Practice for Machine/Process Capability Study Procedure¹

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1. Scope *

1.1 This practice covers provision of a proper method for determining process capability for new or existing machine processes. It is recommended that available statistical software be used for the calculation of the descriptive statistics required for decision making when using this practice. Where software is not available, Section 8 and Tables 1 and 2 are provided for manual calculations.

2. Referenced Documents

2.1 ASTM Standards:

F 1469 Guide for Conducting a Repeatability and Reproducibility Study on Test Equipment for Nondestructive Testing²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *bilateral specifications*—specifications that have both upper and lower values.

3.1.2 C_p —an index that indicates the variability of the process with respect to tolerance.

3.1.3 C_{pk} —an index of process variability and centering. This is a widely-used index which considers the process mean, range, and its relation to the specification nominal.

3.1.4 *inspection plan*—a set of instructions defining product characteristics, specifications, frequency of inspection, acceptance criteria, and methods of inspection for product at a specified operation.

3.1.5 *process parameters*—combination of people, equipment, materials, methods, and environment that produce output.

3.1.6 *unilateral specifications*—specifications that have only upper or lower values.

3.1.7 σ —an estimate of the standard deviation of a process characteristic.

4. Summary of Practice

4.1 A machine/process capability (MPC) study is conducted

to provide a level of confidence in the ability of a machine/process to meet engineering specification requirements. This is accomplished through statistical process control techniques as defined in this practice.

4.2 For new equipment purchases, the purchaser's manufacturing engineering department, or equivalent discipline, shall have primary responsibility for ensuring that the requirements of this practice are met. The purchaser's quality assurance department shall be available to assist on an as-requested basis.

4.3 New machines/processes will not be accepted for use in production with C_p values less than 1.67. If a manufacturing process must be conditionally accepted, a process improvement/product control plan shall be developed.

4.3.1 The machine/process control plan shall identify specific process improvement activities, which will be implemented to make the process more capable as well as an interim inspection plan to ensure that nonconforming product is not shipped to a customer.

4.4 Product Specifications:

4.4.1 Prior to any MPC study, the product specifications (nominal dimension and tolerances) must be identified, and an appropriate method of variables type inspection selected.

4.4.2 This practice is limited to bilateral specifications whose distributions can be expected to approximate a normal curve. This practice should not be applied to unilateral specifications (flatness, concentricity, minimum tensile, maximum hardness, etc.).

4.5 Gage Capability Analysis:

4.5.1 All gaging systems used to evaluate product involved in the study must have documentation for a gage repeatability and reproducibility study in accordance with Guide F 1469 before the machine/capability study is conducted.

4.5.1.1 Gaging systems which consume $\leq 10\%$ of the applicable product tolerance are considered acceptable.

4.5.1.2 Gaging systems which consume over 10 to 30 % of the applicable product tolerance are generally considered to be unacceptable. However, users of this guide may authorize their use depending on factors such as the criticality of the specification in question, the cost of alternative gaging systems, and so forth.

4.5.1.3 Gaging systems which consume more than 30 % of the product tolerance are unacceptable and must not be used.

4.5.2 All gaging systems must be certified as accurate using

¹ This practice is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.93 on Quality Assurance Provisions for Fasteners.

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² *Annual Book of ASTM Standards*, Vol 01.08.