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Test code for machine tools —

Part 2: Determination of accuracy and repeatability of positioning of numerically controlled axes

AMENDMENT 1

Code d'essai des machines-outils —

Partie 2: Détermination de l'exactitude et de la répétabilité de positionnement des axes à commande numérique

AMENDEMENT 1

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The committee responsible for this document is ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

Test code for machine tools —

Part 2: Determination of accuracy and repeatability of positioning of numerically controlled axes

AMENDMENT 1

Add Annex E after D.3:

Annex E

(informative)

Least increment step

E.1 General

Machine tools are designed to operate over a wide range of feed speeds and travel distances along individual axes of motion. An important aspect of positioning along an individual axis of motion is the resolution of such positioning. This is referred to as least increment step or minimum positioning increment. This capability limits a machine tool's ability to make small corrections in position. These small corrections are necessary for numerical compensations for various sources of positioning errors, such as ballscrew pitch, reversal error, thermal distortions, errors due to geometry, such as straightness, squareness, and parallelism, as well as coordination of axes.

In general, the least increment step may depend on the resolution of the positioning feedback devices, numerical control algorithms, as well as machine construction (e.g. friction, preloads, etc.) and machine condition.

With the least increment step test, the smallest increment at which the machine can position in a specified period of time is determined. This test is typically not included in acceptance testing.

E.2 Test conditions

The test setup and procedure described below applies to all axes of linear motion. However, a similar procedure can be used for axes of rotary motion.

Any instrument having small mechanical or electrical hysteresis (≤20 % of the desired least increment step) and a short measuring range can be used to measure the least positioning increment of the axis. Examples include the following:

— laser interferometer with positioning error optics;

— non-contact displacement sensor such as eddy current or capacitive type;

— high resolution LVDT contact measurement device.

The measuring instrument is mounted such that it measures the displacement between the tool and the workpiece. Any tool or workpiece spindle, if applicable, is locked either through servo control or by external mechanism (bracket, magnet, etc.).

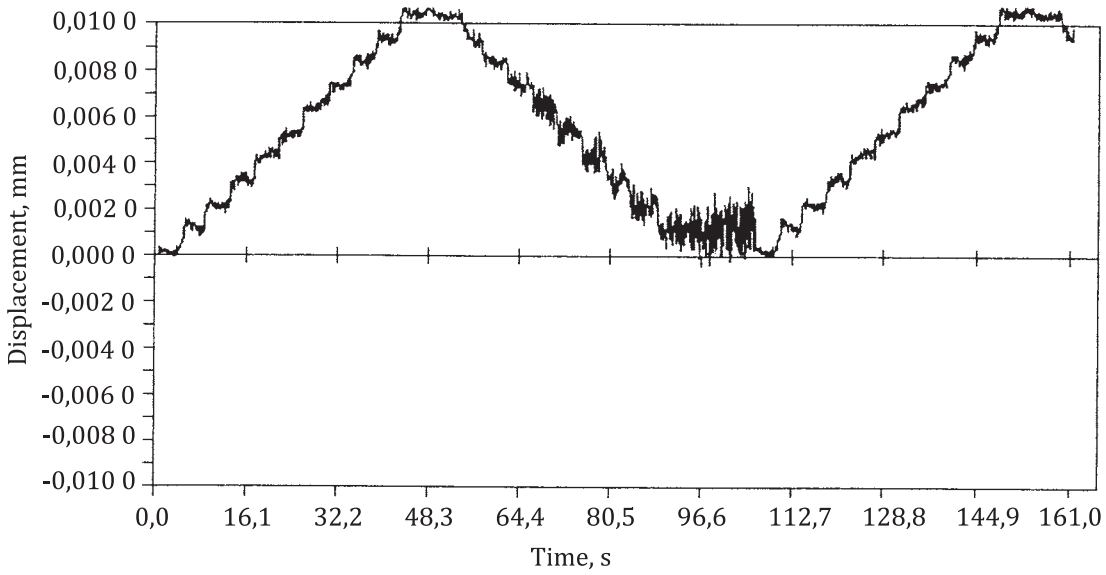
The machine axis is programmed to move in 10 steps, each at the specified positioning resolution, in the positive direction with 5 s dwell time after reaching each target. The same ten steps are repeated in the negative direction and then in the positive direction again.

If no motion is detected after ten steps then the entire test is to be repeated increasing the step size.

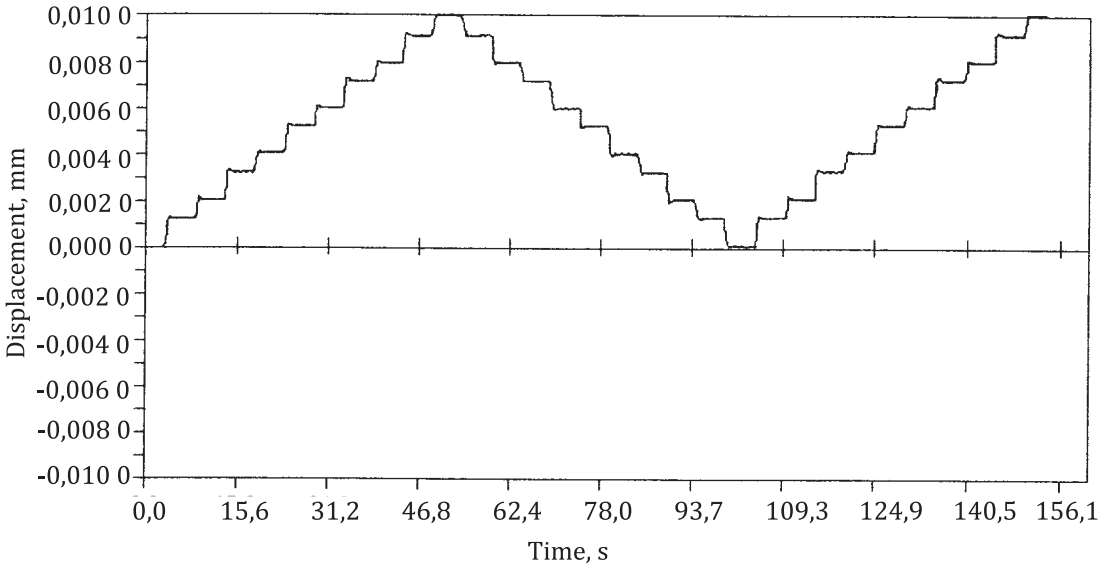
The least increment step is the maximum absolute value of the difference between the commanded and actual positions plus the positioning resolution (i.e. step size applied for this test).

It is known that the size and direction of approach to the first target can affect the results of this test. To achieve a reproducible test, the magnitude and direction of approach should be agreed and reported.

Alternatively, the test may be performed applying a dynamic acquisition mode, e.g. with a laser interferometer. In this case, the entire test (30 steps) is repeated as the step size is gradually increased until the machine axis positions with clearly definable (countable) steps, where extraneous machine motion due to overshoot, settling, reversal error and vibration does not exceed the commanded step. The step size that first satisfies these criteria is the least increment step. Figure E.1 shows sample results from the least increment step tests.



a) Axis not satisfying the criteria of least increment step of 0,001 mm — No clearly definable(countable) steps



b) Axis satisfying the criteria of least increment step of 0,001 mm — Clearly definable (countable) steps

Figure E.1 — Sample least increment step test results

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Price based on 3 pages