

1. c. 1. b. 6. a. A positioning accuracy less (better) than 0.007 mm; **and**
- b. A slide motion from rest for all slides within 20% of a motion command input for inputs of less than 0.5 µm;

Technical Note

Minimum increment of motion test (slide motion from rest):
The test is conducted only if the machine tool is equipped with a control unit the minimum increment of which is less (better) than 0.5 µm.

Prepare the machine for testing in accordance with ISO 230/2 paragraphs 3.1, 3.2, 3.3.

Conduct the test on each axis (slide) of the machine tool as follows:

- a. Move the axis over at least 50% of the maximum travel in plus and minus directions twice at maximum feed rate, rapid traverse rate or jog control;
- b. Wait at least 10 seconds;
- c. With manual data input, input the minimum programmable increment of the control unit;
- d. Measure the axis movement;
- e. Clear the control unit with the servo null, reset or whatever clears any signal (voltage) in the servo loop;
- f. Repeat steps 2 to 5 five times, twice in the same direction of the axis travel and three times in the opposite direction of travel for a total of six test points;
- g. If the axis movement is between 80% and 120% of the minimum programmable input for four of the six test points, the machine is embargoed.

For rotary axes, the measurement is taken 200 mm from the centre of rotation.

Notes

1. 1022.1.c.1. does not embargo cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:
 - a. Not centreless (shoe-type) grinding machines;
 - b. Limited to cylindrical grinding;
 - c. A maximum workpiece capacity of 150 mm outside diameter or length;
 - d. Only two axes which can be coordinated simultaneously for "contouring control"; **and**
 - e. No contouring c axis.
2. 1022.1.c.1. does not embargo machines designed specifically as jig grinders having both of the following characteristics:
 - a. Axes limited to x, y, c and a, where the c axis is used to maintain the grinding wheel normal to the work surface and the a axis is configured to grind barrel cams; **and**
 - b. A spindle "run out" not less (not better) than 0.0006 mm.
3. 1022.1.c.1. does not embargo tool or cutter grinding machines having all of the following characteristics:
 - a. Shipped as a complete system with "software" specially designed for the production of tools or cutters;
 - b. No more than two rotary axes which can be coordinated simultaneously for "contouring control";
 - c. "Run out" (out-of-true running) in one revolution of the spindle not less (not better) than 0.0006 mm TIR; **and**
 - d. The positioning accuracies, with all compensations available, are not less (not better) than:
 1. 0.004 mm along any linear axis for overall positioning; **or**
 2. 0.001° on any rotary axis.
1. c. 2. Electrical discharge machines (EDM) of the wire feed type which have five or more axes which can be coordinated simultaneously for "contouring control";
3. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";
4. Machine tools for removing metals, ceramics or composites:
 - a. By means of:

1. Water or other liquid jets, including those employing abrasive additives;
2. Electron beam; **or**
3. "Laser" beam; **and**
- b. Having two or more rotary axes which:
 1. Can be coordinated simultaneously for "contouring control"; **and**
 2. Have a positioning accuracy of less (better) than 0.003°;

Technical Note

Machines capable of being simultaneously coordinated for "contouring control", in two or more rotary axes or one or more tilting spindles, remain embargoed regardless of the number of simultaneously coordinated contouring axes that can be controlled by the "numerical control" unit attached to the machine.

2. Non-"numerically controlled" machine tools for generating optical quality surfaces, as follows:
 - a. Turning machines using a single point cutting tool and having all of the following characteristics:
 1. Slide positioning accuracy less (better) than 0.0005 mm per 300 mm of travel;
 2. Bidirectional slide positioning repeatability less (better) than 0.00025 mm per 300 mm of travel;
 3. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR;
 4. Angular deviation of the slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel; **and**
 5. Slide perpendicularity less (better) than 0.001 mm per 300 mm of travel;
 - b. Fly cutting machines having both of the following characteristics:
 1. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR; **and**
 2. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel;
 3. "Numerically controlled" or manual machine tools specially designed for cutting, finishing, grinding or honing either of the following classes of bevel or parallel axis hardened ($R_c = 40$ or more) gears, and specially designed components, controls and accessories therefor:
 - a. Hardened bevel gears finished to a quality of better than AGMA 13 (equivalent to ISO 1328 class 4); **or**
 - b. Hardened spur, helical and double-helical gears with a pitch diameter exceeding 1,250 mm and a face width of 15% of pitch diameter or larger finished to a quality of AGMA 14 or better (equivalent to ISO 1328 class 3);
 4. Hot "isostatic presses", as follows, and specially designed dies, moulds, components, accessories and controls therefor:
 - a. Having a controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; **and**
 - b. Having:
 1. A maximum working pressure exceeding 207 MPa;
 2. A controlled thermal environment exceeding 1,773 K (1,500°C); **or**
 3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products;

Technical Note

The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.

5. Equipment specially designed for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications, as follows, for non-electronic substrates, by processes shown in the Table and associated Notes following 1025.3.d, and specially designed automated handling, positioning, manipulation and control components therefor:
 - a. "Stored programme controlled" chemical vapour deposition (CVD) production equipment with both of the following:
 1. Process modified for one of the following: