

Appendix 3 – SCOMET List

8A2 MATERIAL PROCESSING (SYSTEMS, EQUIPMENT AND COMPONENTS)

N.B. For quiet running bearings, see 6A009

8A201 1. Anti-friction bearings and bearing systems, as follows, and components therefor:

Note 8A201 does not apply to balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

- a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4, or better, and having both 'rings' and 'rolling elements' (ISO 5593), made from monel or beryllium;

Note 8A201.a does not apply to tapered roller bearings.

Technical Notes

1. 'Ring' - annular part of a radial rolling bearing incorporating one or more raceways (ISO 5593:1997).
2. 'Rolling element' - ball or roller which rolls between raceways (ISO 5593:1997).

b. (Reserved)

c. Active magnetic bearing systems using any of the following:

1. Materials with flux densities of 2.0 T or greater and yield strengths greater than 414 MPa;
2. All-electromagnetic 3D homopolar bias designs for actuators; or
3. High temperature (450 K (177°C) and above) position sensors.

8B2 MATERIAL PROCESSING (TEST, INSPECTION AND PRODUCTION EQUIPMENT)

Technical Notes

1. Secondary parallel contouring axes, (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the centre line of which is parallel to the primary rotary axis) are not counted in the total number of contouring axes. Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device (e.g., a screw or a rack-and-pinion).
2. For the purposes of 8B201, the number of axes which can be co-ordinated simultaneously for "contouring control" is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative motions within the machine are performed, such as:
 - a. Wheel-dressing systems in grinding machines;
 - b. Parallel rotary axes designed for mounting of separate workpieces;
 - c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.
3. Axis nomenclature shall be in accordance with International Standard ISO 841:2001, Industrial automation systems and integration - Numerical control of machines - Coordinate system and motion nomenclature.
4. For the purposes of 8A2, 8B2, 8C2, 8D2 and 8E2 "tilting spindle" is counted as a rotary axis.
5. 'Stated "unidirectional positioning repeatability"' may be used for each machine tool model as an alternative to individual machine tests, and is determined as follows:
 - a. Select five machines of a model to be evaluated;
 - b. Measure the linear axis repeatability ($R_{\uparrow}, R_{\downarrow}$) according to ISO 230-2:2014 and evaluate "unidirectional positioning repeatability" for each axis of each of the five machines;
 - c. Determine the arithmetic mean value of the "unidirectional positioning repeatability"-values for each axis of all five machines together. These arithmetic mean values of "unidirectional positioning repeatability" (\overline{UPR}) become the stated value of each axis for the model ($\overline{UPR}_x, \overline{UPR}_y, \dots$)
- d. Since 8A2 refers to each linear axis there will be as many 'stated "unidirectional positioning repeatability"'-values as there are linear axes;

Appendix 3 – SCOMET List

- e. If any axis of a machine model not specified by 8B201.a to 8B201.c has a 'stated "unidirectional positioning repeatability" equal to or less than the specified "unidirectional positioning repeatability" of each machine tool model plus 0.7 μm , the builder should be required to reaffirm the accuracy level once every eighteen months.
6. For the purposes of 8B2, measurement uncertainty for the "unidirectional positioning repeatability" of machine tools, as defined in the International Standard ISO 230-2:2014, shall not be considered.
7. For the purpose of 8B2, the measurement of axes shall be made according to test procedures in 5.3.2. of ISO 230-2:2014. Tests for axes longer than 2 meters shall be made over 2 m segments. Axes longer than 4 m require multiple tests (e.g., two tests for axes longer than 4 m and up to 8 m, three tests for axes longer than 8 m and up to 12 m), each over 2 m segments and distributed in equal intervals over the axis length. Test segments are equally spaced along the full axis length, with any excess length equally divided at the beginning, in between, and at the end of the test segments. The smallest "unidirectional positioning repeatability"-value of all test segments is to be reported.
- ✓ 8B201 1. Machine tools and any combination thereof, for removing (or cutting) metals, ceramics or "composites", which, according to the manufacturer's technical specification, can be equipped with electronic devices for "numerical control", as follows:
- Note 1 8B201 does not apply to special purpose machine tools limited to the manufacture of gears. For such machines, see 8B203.
- Note 2 8B201 does not apply to special purpose machine tools limited to the manufacture of any of the following:
- Crank shafts or cam shafts;
 - Tools or cutters;
 - Extruder worms;
 - Engraved or faceted jewellery parts; or
 - Dental prostheses;
- Note 3 A machine tool having at least two of the three turning, milling or grinding capabilities (e.g., a turning machine with milling capability), must be evaluated against each applicable entry 8B201.a, b. or c.
- N.B. For optical finishing machines, see 8B202.
- 8B201 a. Machine tools for turning having two or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
- "Unidirectional positioning repeatability" equal to or less (better) than 0.9 μm along one or more linear axis with a travel length less than 1.0 m; or
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.1 μm along one or more linear axis with a travel length equal to or greater than 1.0 m;
- Note 1 8B201.a does not apply to turning machines specially designed for producing contact lenses, having all of the following:
- Machine controller limited to using ophthalmic based "software" for part programming data input; and
 - No vacuum chucking.
- Note 2 8B201.a does not apply to bar machines (Swissturn), limited to machining only bar feed thru, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm.
- 8B201 b. Machine tools for milling having any of the following:
- Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control" having any of the following:
 - "Unidirectional positioning repeatability" equal to or less (better) than 0.9 μm along one or more linear axis with a travel length less than 1.0 m; or
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.1 μm along one or more linear axis with a travel length equal to or greater than 1.0 m;

Appendix 3 – SCOMET List

2. Five or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
- "Unidirectional positioning repeatability" equal to or less (better) than 0.9 μm along one or more linear axis with a travel length less than 1.0 m;
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.4 μm along one or more linear axis with a travel length equal to or greater than 1 m and less than 4 m; or
 - "Unidirectional positioning repeatability" equal to or less (better) than 6.0 μm along one or more linear axis with a travel length equal to or greater than 4 m; or
- 8B201 b. 3. A "unidirectional positioning repeatability" for jig boring machines, equal to or less (better) than 1.1 μm along one or more linear axis; or
- 8B201 b. 4. Fly cutting machines having all of the following:
- Spindle "run-out" and "camming" less (better) than 0.0004 mm TIR; and
 - Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over 300 mm of travel;
- 8B201 c. Machine tools for grinding having any of the following:
- Having all of the following:
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.1 μm along one or more linear axis; and
 - Three or more axes which can be coordinated simultaneously for "contouring control"; or
 - Five or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.1 μm along one or more linear axis with a travel length less than 1 m;
 - "Unidirectional positioning repeatability" equal to or less (better) than 1.4 μm along one or more linear axis with a travel length equal to or greater than 1 m and less than 4 m; or
 - "Unidirectional positioning repeatability" equal to or less (better) than 6.0 μm along one or more linear axis with a travel length equal to or greater than 4 m.
- Note* 8B201.c does not apply to grinding machines as follows:
- Cylindrical external, internal, and external-internal grinding machines, having all of the following:
 - Limited to cylindrical grinding; and
 - Limited to a maximum workpiece capacity of 150 mm outside diameter or length.
 - Machines designed specifically as jig grinders that do not have a z-axis or a w-axis, with a "unidirectional positioning repeatability" less (better) than 1.1 μm .
 - Surface grinders.
- 8B201 d. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";
- 8B201 e. Machine tools for removing metals, ceramics or "composites", having all of the following:
- Removing material by means of any of the following:
 - Water or other liquid jets, including those employing abrasive additives;
 - Electron beam; or
 - "Laser" beam; and
 - At least two rotary axes having all of the following:
 - Can be coordinated simultaneously for "contouring control"; and
 - A positioning "accuracy" of less (better) than 0.003°;
- 8B201 f. Deep-hole-drilling machines and turning machines modified for deep-hole-drilling, having a maximum depth-of-bore capability exceeding 5 m.
- 8B202 Numerically controlled optical finishing machine tools equipped for selective material removal to produce non-spherical optical surfaces having all of the following characteristics: