NOTE:

1021. does not embargo balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

1021. 1. Ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 7, ABEC 7P, ABEC 7T or ISO Standard Class 4 or better (or national equivalents), and having any of the following characteristics:
   a. Rings, balls or rollers made from monel or beryllium;
   b. Manufactured for use at operating temperatures above 573 K (300°C) either by using special materials or by special heat treatment; *or*
   c. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN;

1021. 2. Other ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 9, ABEC 9P or ISO Standard Class 2 or better (or national equivalents);

1021. 3. Solid tapered roller bearings, having tolerances specified by the manufacturer in accordance with ANSI/AFBMA Class 00 (inch) or Class A (metric) or better (or national equivalents) and having either of the following characteristics:
   a. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN; *or*
   b. Manufactured for use at operating temperatures below 219 K (-54°C) or above 423 K (150°C);

1021. 4. Gas-lubricated foil bearings manufactured for use at operating temperatures of 561 K (288°C) or higher and with a unit load capacity exceeding 1 MPa;

1021. 5. Active magnetic bearing systems;

1021. 6. Fabric-lined self-aligning or fabric-lined journal sliding bearings manufactured for use at operating temperatures below 219 K (-54°C) or above 423 K (150°C).

Technical Notes:

1. DN is the product of the bearing bore diameter in mm and the bearing rotational velocity in rpm.
2. Operating temperatures include those temperatures obtained when a gas turbine engine has stopped after operation.

(For quiet running bearings, see Item 2009. in Munitions List)

1022. TEST, INSPECTION AND PRODUCTION EQUIPMENT

NOTE:

1022. does not embargo measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.

1022. 1. "Numerical control" units, "motion control boards" specially designed for "numerical control" applications on machine tools, machine tools, and specially designed components therefor, as follows:

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.

   N.B.:

   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. Axis nomenclature shall be in accordance with International Standard ISO 841, 'Numerical Control Machines - Axis and Motion Nomenclature'.

1022. 1. a. "Numerical control" units for machine tools, as follows, and specially designed components therefor:

NOTE:

1022.1.a. does not embargo "numerical control" units:

1. Having more than four interpolating axes which can be coordinated simultaneously for "contouring control";
   a. Modified for and incorporated in unembargoed machines; *or*
   b. Specially designed for unembargoed machines.
2. Having two, three or four interpolating axes which can be coordinated simultaneously for "contouring control" and:
   a. Capable of "real time processing" of data to modify, during the machining operation, tool path, feed rate and spindle data by either:
      1. Automatic calculation and modification of part programme data for machining in two or more axes by means of measuring cycles and access to source data; *or*
      2. "Adaptive control" with more than one physical variable measured and processing by means of a computing model (strategy) to change one or more machining instructions to optimize the process;
   b. Capable of receiving directly (on-line) and processing computer aided design (CAD) data for internal preparation of machine instructions; *or*
   c. Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards which would permit an increase above the embargo levels specified in 1022.1., in the number of interpolating axes which can be coordinated simultaneously for "contouring control", even if they do not contain these additional boards;

1022. 1. b. "Motion control boards" specially designed for machine tools and having any of the following characteristics:
   1. Interpolation in more than four axes;
   2. Capable of "real time processing" as described in 1022.1.a.2.a.; *or*
   3. Capable of receiving and processing CAD data as described in 1022.1.a.2.b.;

1022. 1. c. Machine tools, as follows, for removing or cutting metals, ceramics or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:
   1. Machine tools for turning, grinding, milling or any combination thereof which:
      a. Have two or more axes which can be coordinated simultaneously for "contouring control"; *and*
      b. Have any of the following characteristics:
         1. Two or more contouring rotary axes;

            Technical Note:

            The c axis on jig grinders used to maintain grinding wheels normal to the work surface is not considered a contouring rotary axis.
         2. One or more contouring "tilting spindles";

            NOTE:

            1022.1.c.1.b.2. applies to machine tools for grinding or milling only.
         3. "Camming" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

            NOTE:

            1022.1.c.1.b.3. applies to machine tools for turning only.
         4. "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 mm TIR;
         5. The positioning accuracies, with all compensations available, are less (better) than:
            a. 0.001° on any rotary axis; *or*
            b. 1. 0.004 mm along any linear axis (overall positioning) for grinding machines;
               2. 0.006 mm along any linear axis (overall positioning) for turning or milling machines; *or*

            NOTE:

            1022.1.c.1.b.5. does not embargo milling or turning machine tools with a positioning accuracy along one axis, with all compensations available, equal to or more (worse) than 0.005 mm.

            Technical Note:

            The positioning accuracy of "numerically controlled" machine tools is to be determined and presented in accordance with ISO/DIS 230/2, paragraph 2.13, in conjunction with the requirements below: