Defence and Strategic Goods List

Customs (Prohibited Exports) Regulations

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DEFENCE AND STRATEGIC GOODS LIST
STATEMENTS OF UNDERSTANDING

GENERAL NOTES

1. The object of the controls contained in the Defence and Strategic Goods List should not be defeated by the export of any non-controlled goods (including plants) containing one or more controlled components when the controlled component or components are the principal element of the goods and can feasibly be removed or used for other purposes.

   N.B.: In judging whether the controlled component or components are to be considered the principal element, it is necessary to weigh the factors of quantity, value and technological know-how involved and other special circumstances which might establish the controlled component or components as the principal element of the goods being procured.

2. The control of technology transfer in the Defence and Strategic Goods List is limited to tangible forms.

3. Goods specified in the Defence and Strategic Goods List include both new and used goods.

GENERAL TECHNOLOGY NOTE (PART 1 - MUNITIONS LIST)

1. The export of "technology" which is "required" for the "development", "production" or "use" of items controlled in the Munitions List is controlled according to the provisions in the Munitions List entries. This "technology" remains under control even when applicable to any uncontrolled item.

2. Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those items which are not controlled or whose export has been authorised.

3. Controls do not apply to "technology" "in the public domain", to "basic scientific research" or to the minimum necessary information for patent applications.

NUCLEAR TECHNOLOGY NOTE (PART 2 - NUCLEAR LIST)

(To be read in conjunction with section E of Category 0.)

1. The transfer of "technology" directly associated with any goods in Category 0, will be subject to as great a degree of scrutiny and control as will the goods.

2. "Technology" for the "development", "production" or "use" of goods under control remains under control even when applicable to non-controlled goods.

3. The approval of goods for export also authorizes the export to the same end-user of the minimum "technology" required for the installation, operation, maintenance and repair of the goods.

4. Controls on "technology" transfer do not apply to information "in the public domain" or to "basic scientific research".

GENERAL TECHNOLOGY NOTE (PART 3 - DUAL-USE LIST)

(To be read in conjunction with section E of Categories 1 to 9.)

1. The export of "technology" which is "required" for the "development", "production" or "use" of goods controlled in Categories 1 to 9, is controlled according to the provisions of Categories 1 to 9.

2. "Technology" "required" for the "development", "production" or "use" of goods under control remains under control even when applicable to non-controlled goods.

3. Controls do not apply to that "technology" which is the minimum necessary for the installation , operation, maintenance (checking) and repair of those goods which are not controlled or whose export has been authorised.
   N.B.: This does not release such "technology" specified in 1E002.e. & 1E002.f. and 8E002.a. & 8E002.b.

4. Controls on "technology" transfer do not apply to information "in the public domain", to "basic scientific research" or to the minimum necessary information for patent applications.

GENERAL SOFTWARE NOTE (GSN)

(This note overrides any control within section D of Categories 0 to 9.)

With the exception of Category 5, Part 2 (Information Security) Categories 0 to 9 of this list do not control "software" which is either:

a. Generally available to the public by being:
   1. Sold from stock at retail selling points, without restriction, by means of:
      a. Over-the-counter transactions;
      b. Mail order transactions; or
      c. Telephone order transactions; and
   2. Designed for installation by the user without further substantial support by the supplier; or

b. "In the public domain".

DEFINITIONS OF TERMS USED IN THE DEFENCE AND STRATEGIC GOODS LIST

Category references are given in brackets after the defined term.

"Accuracy" (2 6), usually measured in terms of inaccuracy, means the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value (usually measured in terms of inaccuracy).

"Active flight control systems" (7) are systems that function to prevent undesirable "aircraft" and missile motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventive commands to effect automatic control.

"Active pixel" (6 8) is a minimum (single) element of the solid state array which has a photoelectric transfer function when exposed to light (electromagnetic) radiation.

"Adapted for use in war" (1 ML7) means any modification or selection (such as altering purity, shelf life, virulence, dissemination characteristics, or resistence to UV radiation) designed to increase the effectiveness in producing casualties in humans or animals, degrading equipment or damaging crops or the environment.

"Adaptive control" (2) means a control system that adjusts the response from conditions detected during the operation (ref. ISO 2806-1980).

"Additives" (ML8) means substances used in explosive formulations to improve their properties.

"Aircraft" (10 1 7 9 ML8 ML9 ML10) means a fixed wing, swivel wing, rotary wing (helicopter), tilt rotor or tilt-wing airborne vehicle.
N.B.: See also "civil aircraft".

"Angular position deviation" (2) means the maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position (ref. VDI/VDE 2617, Draft: 'Rotary tables on coordinate measuring machines').

"Asynchronous transfer mode" ("ATM") (5) means a transfer mode in which the information is organised into cells; it is asynchronous in the sense that the recurrence of cells depends on the required or instantaneous bit rate (CCITT recommendation L.113).

"ATM" is equivalent to "Asynchronous transfer mode".

"Automatic target tracking" (6) means a processing technique that automatically determines and provides as output an extrapolated value of the most probable position of the target in real time.

"Basic gate propagation delay time" (3) means the propagation delay time value corresponding to the basic gate used within a "family" of "monolithic integrated circuits". This may be specified, for a given "family", either as the propagation delay time per typical gate or as the typical propagation delay time per gate.
N.B.: "Basic gate propagation delay time" is not to be confused with the input/output delay time of a complex "monolithic integrated circuit".

"Basic scientific research" (GTN NTN) means experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

"Bias" (accelerometer) (7) means an accelerometer output when no acceleration is applied.

"Biocatalysts" (ML7) means enzymes or other biological compounds which bind to and accelerate the degradation of CW agents.
N.B. 'Enzymes' means "biocatalysts" for specific chemical or biochemical reactions.

"Biopolymers" (ML7) means biological macromolecules as follows:
a. Enzymes;
b. Antibodies, monclonal, polyclonal or anti-idiotypic;
c. Specially designed or specially processed receptors;
N.B.1 'Enzymes' means "biocatalysts" for specific chemical or biochemical reactions;
N.B.2 'Anti-idiotypic antibodies' means antibodies whcih bind to the specific antigen binding sites of other anitbodies;
N.B.3 'Monoclonal antibodies' means proteins which bind to one antigenic site and are produced by a single clone of cells;
N.B.4 'Polyclonal antibodies' means a mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;
N.B.5 'Receptors' means biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions.

"Boron equivalent" (BE) is defined as:

$$BE = CF \times \text{Concentration of element Z in ppm}$$

$$\text{where CF is the conversion factor} = \frac{\text{gamma}_Z \times A_B}{\text{gamma}_B \times A_Z}$$

and gamma_B and gamma_Z are the thermal neutron capture cross sections (in barns) for boron and element Z respectively;
and A_B and A_Z are the atomic weights of boron and element Z respectively.

"Camming" (axial displacement) (2) means axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate, at a point next to the circumference of the spindle faceplate (ref. ISO 230/1 1986, paragraph 5.63).

"CE" is equivalent to "computing element".

"CEP" (circle of equal probability) (7) is a measure of accuracy; the radius of the circle centred at the target, at a specific range, in which 50% of the payloads impact.

"Chemical Laser" (6) means a "laser" in which the excited species is produced by the output energy from a chemical reaction.

"Circuit element" means a "laser" in which the excited species is produced by the output energy from a chemical reaction.

"Circulation-controlled anti-torque or circulation controlled direction control systems" (7) are systems that use air blown over aerodynamic surfaces to increase or control the forces generated by the surfaces.

"Civil aircraft" (1 7 9 ML10) means those "aircraft" listed by designation in published airworthiness certification lists by the civil aviation authorities to fly commercial civil internal and external routes or for legitimate civil, private or business use.
N.B.: See also "aircraft".

"Commingled" (1) means filament to filament blending of thermoplastic fibres and reinforcement fibres in order to produce a fibre reinforcement/ "matrix" mix in total fibre form.

"Comminution" (1) means a process to reduce a material to particles by crushing or grinding.

"Common channel signalling" (5) is a signalling method in which a single channel between exchanges conveys, by means of labelled messages, signalling information relating to a multiplicity of circuits or calls and other information such as that used for network management.

"Communications channel controller" (5) means the physical interface which controls the flow of synchronous or asynchronous digital information. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

"Composite" (1 2 6 8 9) means a "matrix" and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes.

"Composite theoretical performance" ("CTP") (3 4) is a measure of computational performance given in millions of theoretical operations per second (Mtops), calculated using the aggregation of "computing elements" ("CE").
N.B.: See Category 4, Technical Note.

"Compound rotary table" (2) means a table allowing the workpiece to rotate and tilt about two non-parallel axes, which can be coordinated simultaneously for "contouring control".

"Computing element" ("CE") (4) means the smallest computational unit that produces an arithmetic or logic result.

"Contouring control" (2) means two or more "numerically controlled" motions operating in accordance with instructions that specify the next required position and the required feed rates to that position. These feed rates are varied in relation to each other so that a desired contour is generated (ref. ISO/DIS 2806 - 1980).

"Critical temperature" (1 3 6) (sometimes referred to as the transition temperature) of a specific "superconductive" material means the temperature at which the material loses all resistance to the flow of direct electrical current.

"Cryptography" (5) means the discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification or prevent its unauthorized use. "Cryptography" is limited to the transformation of information using one or more 'secret parameters' (e.g., crypto variables) or associated key management.
N.B.: 'Secret parameter': a constant or key kept from the knowledge of others or shared only within a group.

"CTP" is equivalent to "composite theoretical performance".

"Data signalling rate" (5) means the rate, as defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, baud and bit per second are not equal. Bits for coding, checking and synchronisation functions are to be included.
N.B.: 1. When determining the "data signalling rate", servicing and administrative channels shall be excluded.
2. It is the maximum one-way rate, i.e., the maximum rate in either transmission or reception.

"Deformable mirrors" (6) (also known as adaptive optic mirrors) means mirrors having:
a. a single continuous optical reflecting surface which is dynamically deformed by the application of individual torques or forces to compensate for distortions in the optical waveform incident upon the mirror; or
b. multiple optical reflecting elements that can be individually and dynamically repositioned by the application of torques or forces to compensate for distortions in the optical waveform incident upon the mirror.

"Depleted uranium" (0) means uranium depleted in the isotope 235 below that occurring in nature.

"Development" (GTN NTN All) is related to all phases prior to serial production, such as: design, design research, design analyses, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

"Diffusion bonding" (1 2 9) means a solid state molecular joining of at least two separate metals into a single piece with a joint strength equivalent to that of the weakest material.

"Digital computer" (4 5) means equipment which can, in the form of one or more discrete variables, perform all of the following:
a. Accept data;
b. Store data or instructions in fixed or alterable (writable) storage devices;
c. Process data by means of a stored sequence of instructions which is modifiable; and
d. Provide output of data.
N.B.: Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"Digital transfer rate" (5) means the total bit rate of the information that is directly transferred on any type of medium.
N.B.: See also "total digital transfer rate".

"Direct-acting hydraulic pressing" (2) means a deformation process which uses a fluid-filled flexible bladder in direct contact with the workpiece.

"Discrete component" means a separately packages "circuit element" with its own external connections.

Drift rate" (gyro) (7) means the time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent input angular displacement per unit time with respect to inertial space.

"Dynamic adaptive routing" (5) means automatic rerouting of traffic based on sensing and analysis of current actual network conditions.
N.B.: This does not include cases of routing decisions taken on predefined information.

"Dynamic signal analysers" (3) means "signal analysers" which use digital sampling and transformation techniques to form a Fourier spectrum display of the given waveform including amplitude and phase information.
N.B.: See also "signal analysers".

"Effective gramme" (0 1) of "special fissile material" or "other fissile material" means:
a. For plutonium isotopes and uranium-233, the isotope weight in grammes;
b. For uranium enriched 1 per cent or greater in the isotope U-235, the element weight in grammes multiplied by the square of its enrichment expressed as a decimal weight fraction;
c. For uranium enriched below 1 per cent in the isotope U-235, the element weight in grammes multiplied by 0.0001;
d. For americium-242m, curium-245 and -247, californium-249 and -251, the isotope weight in grammes multiplied by 10.

"Electronic assembly" (3 4 5) means a number of electronic components (i.e., 'circuit elements', 'discrete components', integrated circuits, etc.) connected together to perform (a) specific function(s), replaceable as an entity and normally capable of being disassembled.
N.B.: 1. 'Circuit element': a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.
2. 'Discrete component': a separately packaged 'circuit element' with its own external connections.

"Electronically steerable phased array antenna" (5 6) means an antenna which forms a beam by means of phase coupling, i.e., the beam direction is controlled by the complex excitation coefficients of the radiating elements and the direction of that beam can be varied in azimuth or in elevation, or both, by application, both in transmission and reception, of an electrical signal.

"End-effectors" (2 ML17) include grippers, 'active tooling units' and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

N.B.: 'Active tooling unit': a device for applying motive power, process energy or sensing to the workpiece.

"Equivalent Density" (6) means the mass of an optic per unit optical area projected onto the optical surface.

"Expert systems" (4 7) mean systems providing results by application of rules to data which are stored independently of the "programme" and capable of any of the following:
a. Modifying automatically the "source code" introduced by the user;
b. Providing knowledge linked to a class of problems in quasi-natural language; or
c. Acquiring the knowledge required for their development (symbolic training).

"Expression Vectors" (ML7) means carriers (e.g., lasmid or virus) used to introduce genetic material into host cells.

"FADEC" is equivalent to "full authority digital engine control".

"Family" (3) means a group of microprocessor or microcomputer microcircuits with:
a. The same architecture;
b. The same basic instruction set; and
c. The same basic technology (e.g., only NMOS or only CMOS).

"Fault tolerance" (4) is the capability of a computer system, after any malfunction of any of its hardware or "software" components, to continue to operate without human intervention, at a given level of service that provides: continuity of operation, data integrity and recovery of service within a given time.

"Fibrous or filamentary materials" (0 1 8) include:
a. Continuous "monofilaments";
b. Continuous "yarns" and "rovings";
c. "Tapes", fabrics, random mats and braids;
d. Chopped fibres, staple fibres and coherent fibre blankets;
e. Whiskers, either monocrystalline or polycrystalline, of any length;
f. Aromatic polyamide pulp.

"Film type integrated circuit" (3) means an array of 'circuit elements' and metallic interconnections formed by deposition of a thick or thin film on an insulating "substrate".
N.B.: 'Circuit element' is a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"First generation image intensifier tubes" (ML15) means electrostacically focused tubes, employing input and output fibre optic or glass face plates, multi-alkali photocathodes (s-20 or S-25), but not microchannel plate amplifiers.

"Fixed" (5) means that the coding or compression algorithm cannot accept externally supplied parameters (e.g., cryptographic or key variables) and cannot be modified by the user.

"Flight control optical sensor array" (7) is a network of distributed optical sensors, using "laser" beams, to provide real-time flight control data for on-board processing.

"Flight path optimization" (7) is a procedure that minimizes deviations from a four-dimensional (space and time) desired trajectory based on maximizing performance or effectiveness for mission tasks.

"Focal plane array" (6) means a linear or two-dimensional planar layer, or combination of planar layers, of individual detector elements, with or without readout electronics, which work in the focal plane.
N.B.: This is not intended to include a stack of single detector elements or any two, three or four element detectors provided time delay and integration is not performed within the element.

"Frequency agility" (frequency hopping) (5) means a form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by discrete steps.

"Frequency switching time" (3 5) means the maximum time (i.e., delay), taken by a signal, when switched from one selected output frequency to another selected output frequency, to reach:
a. A frequency within 100 Hz of the final frequency; or
b. An output level within 1 dB of the final output level.

"Frequency synthesiser" (3) means any kind of frequency source or signal generator, regardless of the actual technique used, providing a multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies.

"Full Authority Digital Engine Control" ("FADEC") (7 9) means an electronic control system for gas turbine or combined cycle engines utilising a digital computer to control the variables required to regulate engine thrust or shaft power output throughout the engine operating range from the beginning of fuel metering to fuel shutoff.

"Gas Atomisation" (1) means a process to reduce a molten stream of metal alloy to droplets of 500 micrometre diameter or less by a high pressure gas stream.

"Gateway" (5) means the function, realised by any combination of equipment and "software", to carry out the conversion of conventions for representing, processing or communicating information used in one system into the corresponding but different conventions used in another system.

"Geographically dispersed" (6) is where each location is distant from any other more than 1,500 m in any direction. Mobile sensors are always considered "geographically dispersed".

"Global interrupt latency time" (4) means the time taken by the computer system to recognize an interrupt due to the event, service the interrupt and perform a context switch to an alternate memory-resident task waiting on the interrupt.

"Guidance set" (7) means systems that integrate the process of measuring and computing a vehicles position and velocity (ie. navigation) with that of computing and sending commands to the vehicles flight control systems to correct the trajectory.

"Hot isostatic densification" (2) means the process of pressurising a casting at temperatures exceeding 375 K (102 C) in a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal force in all directions to reduce or eliminate internal voids in the casting.

"Hybrid computer" (4) means equipment which can perform all of the following:
a. Accept data;
b. Process data, in both analogue and digital representations; and
c. Provide output of data.

"Hybrid integrated circuit" (3) means any combination of integrated circuit(s), or integrated circuit with 'circuit elements' or 'discrete components' connected together to perform (a) specific function(s), and having all of the following characteristics:
a. Containing at least one unencapsulated device;
b. Connected together using typical IC production methods;
c. Replaceable as an entity; and
d. Not normally capable of being disassembled.

N.B.: *1. 'Circuit element': a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.*

2. 'Discrete component': a separately packaged 'circuit element' with its own external connections.

"Image enhancement" (4) means the processing of externally derived information-bearing images by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform). This does not

include algorithms using only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false coloration.

"Immunotoxin" (1) is a conjugate of one cell specific monoclonal antibody and a "toxin" or "sub-unit of toxin", that selectively affects diseased cells.

"In the public domain" (GTN NTN GSN), as it applies herein, means "technology" or "software" which has been made available without restrictions upon its further dissemination (copyright restrictions do not remove "technology" or "software" from being "in the public domain").

"Information security" (5) is all the means and functions ensuring the accessibility, confidentiality or integrity of information or communications, excluding the means and functions intended to safeguard against malfunctions. This includes "cryptography", 'cryptanalysis', protection against compromising emanations and computer security.
N.B.: 'Cryptanalysis': analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text.

"Instantaneous bandwidth" (3 5) means the bandwidth over which output power remains constant within 3 dB without adjustment of other operating parameters.

"Instrumented range" (6) means the specified unambiguous display range of a radar.

"Insulation" (9) is applied to the components of a rocket motor, ie. the case, nozzle, inlets, case closures, and includes cured or semi-cured compounded rubber sheet stock containing an insulating or refractory material. It may also be incorporated as stress relief boots or flaps.

"Integrated Services Digital Network" (ISDN) (5) means a unified end-to-end digital network, in which data originating from all types of communication (e.g., voice, text, data, still and moving pictures) are transmitted from one port (terminal) in the exchange (switch) over one access line to and from the subscriber.

"Interconnected radar sensors" (6) means two or more radar sensors are interconnected when they mutually exchange data in real time.

"Interior lining" (9) is suited for the bond interface between the solid propellant and the case or insulating liner. Usually a liquid polymer based dispersion of refractory or insulating materials, eg carbon filled hydroxyl terminated polybutadiene (HTPB) or other polymer with added curing agents sprayed or screeded over a case interior.

"Intrinsic Magnetic Gradiometer" (6) is a single magnetic field gradient sensing element and associated electronics the output of which is a measure of magnetic field gradient.
N.B.: See also "magnetic gradiometer".

"ISDN" is equivalent to "Integrated Services Digital Network".

"Isolated live cultures" (1) includes live cultures in dormant form and in dried preparations.

"Isostatic presses" (2) mean equipment capable of pressurising a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal pressure in all directions within the cavity upon a workpiece or material.

"Laser" (0 2 3 5 6 9 ML5 ML9) is an assembly of components which produce both spatially and temporally coherent light that is amplified by stimulated emission of radiation.
N.B.: See also: "Chemical laser";
"Q-switched laser";
"Super High Power Laser";
"Transfer laser".

"Linearity" (2) (usually measured in terms of non-linearity) means the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalise and minimise the maximum deviations.

"Local area network" (4) is a data communication system having all of the following characteristics:

a. *Allows* an arbitrary number of independent 'data devices' to communicate directly with each other; and

b. Is confined to a geographical area of moderate size (e.g., office building, plant, campus, warehouse).

N.B.: 'Data device' means equipment capable of transmitting or receiving sequences of digital information.

"Magnetic Gradiometers" (6) are instruments designed to detect the spatial variation of magnetic fields from sources external to the instrument. They consist of multiple "magnetometers" and associated electronics the output of which is a measure of magnetic field gradient.
N.B.: See also "intrinsic magnetic gradiometer".

"Magnetometers" (6) are instruments designed to detect magnetic fields from sources external to the instrument. They consist of a single magnetic field sensing element and associated electronics the output of which is a measure of the magnetic field.

"Main storage" (4) means the primary storage for data or instructions for rapid access by a central processing unit. It consists of the internal storage of a "digital computer" and any hierarchical extension thereto, such as cache storage or non-sequentially accessed extended storage.

"Matrix" (1 2 8 9) means a substantially continuous phase that fills the space between particles, whiskers or fibres.

"Measurement uncertainty" (2) is the characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95 %. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations (ref. ISO 10360-2, or VDI/VDE 2617).

"Mechanical Alloying" (1) means an alloying process resulting from the bonding, fracturing and rebonding of elemental and master alloy powders by mechanical impact. Non-metallic particles may be incorporated in the alloy by addition of the appropriate powders.

"Media access unit" (5) means equipment which contains one or more communication interfaces ("network access controller", "communications channel controller", modem or computer bus) to connect terminal equipment to a network.

"Melt Extraction" (1) means a process to 'solidify rapidly' and extract a ribbon-like alloy product by the insertion of a short segment of a rotating chilled block into a bath of a molten metal alloy.
N.B.: 'Solidify rapidly': solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Melt Spinning" (1) means a process to 'solidify rapidly' a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod-like product.
N.B.: 'Solidify rapidly': solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Microcomputer microcircuit" (3) means a "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing general purpose instructions from an internal storage, on data contained in the internal storage.
N.B.: The internal storage *may be augmented by an external storage.*

"Microprocessor microcircuit" (3) means a "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing a series of general purpose instructions from an external storage.

N.B.: 1. *The "microprocessor microcircuit" normally does not contain integral user-accessible storage, although storage present on-the-chip may be used in performing its logic function.*

2. *This* includes *chip sets which are designed to operate together to provide the function of a "microprocessor microcircuit".*

"Microprogramme" means a sequence of elementary instructions maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction register.

"Microorganisms" (1 2) means bacteria, viruses, mycoplasms, rickettsiae, chlamydiae or fungi, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures.

"Military pyrotechnics" (ML4 ML8) means mixtures of solid or liquid fuels and oxidizers which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce specific time delays, or quantities of heat, noise, smoke, visible light or infrared radiation. Pyrophories are a subclass of pyrotechnics, which contain no oxidizers but ignite spontaneously on contact with air

"Missiles" (1-7,9) means complete rocket systems and unmanned air vehicle systems, capable of delivering at least 500 kg payload to a range of at least 300 km.

"Mixture" (ML7, 1) is defined as a solid, liquid or gaseous product made up of two or more components that do not react together under normal storage conditions

- all ingredients of "mixtures" are expressed in terms of weight.

"Monofilament" (1) or filament is the smallest increment of fibre, usually several micrometres in diameter.

"Monolithic integrated circuit" (3) means a combination of passive or active 'circuit elements' or both which:

a. Are formed by means of diffusion processes, implantation processes or deposition processes in or on a single semiconducting piece of material, a so-called 'chip';
b. Can be considered as indivisibly associated; and
c. Perform the function(s) of a circuit.

N.B.: *'Circuit* element' *is a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.*

"Monospectral imaging sensors" (6) are capable of acquisition of imaging data from one discrete spectral band.

"Multichip integrated circuit" (3) means two or more "monolithic integrated circuits" bonded to a common "substrate".

"Multi-data-stream processing" (4) means the "microprogramme" or equipment architecture technique which permits simultaneous processing of two or more data sequences under the control of one or more instruction sequences by means such as:

a. Single Instruction Multiple Data (SIMD) architectures such as vector or array processors;
b. Multiple Single Instruction Multiple Data (MSIMD) architectures;
c. Multiple Instruction Multiple Data (MIMD) architectures, including those which are tightly coupled, closely coupled or loosely coupled; or
d. Structured arrays of processing elements, including systolic arrays.

N.B.: *"Microprogramme" means a sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.*

"Multilevel security" (5) means a class of system containing information with different sensitivities that simultaneously permits access by users with different security clearances and needs-to-know, but prevents users from obtaining access to information for which they lack authorization.
N.B.: *"Multilevel security" is computer security and not computer reliability which deals with equipment fault prevention or human error prevention in general.*

"Multispectral imaging sensors" (6) are capable of simultaneous or serial acquisition of imaging data from two or more discrete spectral bands. Sensors having more than twenty discrete spectral bands are sometimes referred to as hyperspectral imaging sensors.

"Natural uranium" (0) means uranium containing the mixtures of isotopes occurring in nature.

"Network access controller" (4 5) means a physical interface to a distributed switching network. It uses a common medium which operates throughout at the same "digital transfer rate" using arbitration (e.g., token or carrier sense) for transmission. Independently from any other, it selects data packets or data groups (e.g., IEEE 802) addressed to it. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

"Neural computer" (4) means a computational device designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e., a computational device which is distinguished by its hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data.

"Noise level" (6) means an electrical signal given in terms of power spectral density. The relation between "noise level" expressed in peak-to-peak is given by $S^2_{pp} = 8N_o(f_2-f_1)$, where S_{pp} is the peak-to-peak value of the signal (e.g., nanoteslas), N_o is the power spectral density (e.g., $(\text{nanotesla})^2/\text{Hz}$) and (f_2-f_1) defines the bandwidth of interest.

"Nuclear reactor" (0 ML17) means the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain, come into direct contact with or control the primary coolant of the reactor core.

"Numerical control" (2) means the automatic control of a process performed by a device that makes use of numeric data usually introduced as the operation is in progress (ref. ISO 2382).

"Object code" (4 5 9) means an equipment executable form of a convenient expression of one or more processes ("source code" (source language)) which has been converted by programming system.

"Optical amplification" (5), in optical communications, means an amplification technique that introduces a gain of optical signals that have been generated by a separate optical source, without conversion to electrical signals, i.e., using semiconductor optical amplifiers, optical fibre luminescent amplifiers.

"Optical computer" (4) means a computer designed or modified to use light to represent data and whose computational logic elements are based on directly coupled optical devices.

"Optical fibre preforms" (5 6) means bars, ingots, or rods of glass, plastic or other materials which have been specially processed for use in fabricating optical fibres. The characteristics of the preform determine the basic parameters of the resultant drawn optical fibres.

"Optical integrated circuit" (3) means a "monolithic integrated circuit" or a "hybrid integrated circuit", containing one or more parts designed to function as a photosensor or photoemitter or to perform (an) optical or (an) electro-optical function(s).

"Optical switching" (5) means the routing of or switching of signals in optical form without conversion to electrical signals.

"Other fissile materials" (0) mean *"previously separated" americium-242m, curium-245 and -247,* californium-249 and -251, isotopes of plutonium other than plutonium-238 and -239, and any material containing the foregoing.

"Overall current density" (3) means the total number of ampere-turns in the coil (i.e., the sum of the number of turns multiplied by the maximum current carried by each turn) divided by the total cross-section of the coil (comprising the superconducting filaments, the metallic matrix in which the superconducting filaments are embedded, the encapsulating material, any cooling channels, etc.).

"Participating state" (7 9) is a state participating in the Wassenaar Arrangement.

"Peak power" (6), means energy per pulse in joules divided by the pulse duration in seconds.

"Personalized smart card" (5) means a smart card containing a microcircuit, in accordance with ISO/IEC 7816, which has been programmed by the issuer and cannot be changed by the user.

"Power management" (7) means changing the transmitted power of the altimeter signal so that received power at the "aircraft" altitude is always at the minimum necessary to determine the altitude.

"Precursors" means speciality chemicals used in the manufacture of military expolsives.(ML8).

"Pressure transducers" (2) are devices that convert pressure measurements into an electrical signal.

"Previously separated" (0 1) means the application of any process intended to increase the concentration of the controlled isotope.

"Primary flight control" (7) means an "aircraft" stability or manoeuvering control using force/moment generators, i.e., aerodynamic control surfaces or propulsive thrust vectoring.

"Principal element" (4), as it applies in Category 4, is a "principal element" when its replacement value is more than 35% of the total value of the system of which it is an element. Element value is the price paid for the element by the manufacturer of the system, or by the system integrator. Total value is the normal international selling price to unrelated parties at the point of manufacture or consolidation of shipment.

"Production" (GTN NTN All) means all production phases, such as: construction, production engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

"Production equipment" (9) means tooling, templates, jigs, mandrels, moulds, dies, fixtures, alignment mechanisms, test equipment, other machinery and components therefor, limited to those specially designed or modified for "development" or for one or more phases of "production".

"Production facilities" (9) means equipment and specially designed software therefor integrated into installations for "development" or for one or more phases of "production".

"Programme" (2 4 5 6) means a sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"Pulse compression" (6) means the coding and processing of a radar signal pulse of long time duration to one of short time duration, while maintaining the benefits of high pulse energy.

"Pulse duration" (6) is the duration of a "laser" pulse measured at Full Width Half Intensity (FWHI) levels.

"Q-switched laser" (6) means a "laser" in which the energy is stored in the population inversion or in the optical resonator and subsequently emitted in a pulse.

"Radar frequency agility" (6) means any technique which changes, in a pseudo-random sequence, the carrier frequency of a pulsed radar transmitter between pulses or between groups of pulses by an amount equal to or larger than the pulse bandwidth.

"Radar spread spectrum" (6) means any modulation technique for spreading energy originating from a signal with a relatively narrow frequency band, over a much wider band of frequencies, by using random or pseudo-random coding.

"Real time bandwidth" (3) for "dynamic signal analysers" is the widest frequency range which the analyser can output to display or mass storage without causing any discontinuity in the analysis of the input data. For analysers with more than one channel, the channel configuration yielding the widest "real-time bandwidth" shall be used to make the calculation.

"Real time processing" (2 4 6 7) means the processing of data by a computer system providing a required level of service, as a function of available resources, within a guaranteed response time, regardless of the load of the system, when stimulated by an external event.

"Required" (GTN 1-9), as applied to "technology" or "software", refers to only that portion of "technology" or "software" which is peculiarly responsible for achieving or extending the controlled performance levels, characteristics or functions. Such "required" "technology" or "software" may be shared by different goods.

"Resolution" (2) means the least increment of a measuring device; on digital instruments, the least significant bit (ref. ANSI B-89.1.12).

"Riot control agents" (ML7) means substances produce temporary irritating or disabling physical effects.

"Robot" (2 8 ML17) means a manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use sensors, and has all the following characteristics:

a. Is multifunctional;
b. Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;
c. Incorporates three or more closed or open loop servo-devices which may include stepping motors; and
d. Has "user-accessible programmability" by means of teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention.

N.B.: The above definition does not include the following devices:

1. *Manipulation mechanisms which are only manually/ teleoperator controllable;*
2. *Fixed sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed stops, such as pins or cams. The sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;*
3. *Mechanically controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed, but adjustable stops, such as pins or cams. The sequence of motions and the selection of paths or angles are variable within the fixed programme pattern. Variations or modifications of the programme pattern (e.g., changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;*
4. *Non-servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;*
5. *Stacker cranes defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval.*

"Rotary atomisation" (1) means a process to reduce a stream or pool of molten metal to droplets to a diameter of 500 micrometre or less by centrifugal force.

"Roving" (1) is a bundle (typically 12-120) of approximately parallel 'strands'.
N.B.: 'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

"Run out" (out-of-true running) (2) means radial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle axis at a point on the external or internal revolving surface to be tested (ref. ISO 230/1-1986, paragraph 5.61).

"Scale factor" (gyro or accelerometer) (7) means the ratio of change in output to a change in the input intended to be measured. Scale factor is generally evaluated as the slope of the straight line that can be fitted by the method of least squares to input-output data obtained by varying the input cyclically over the input range.

"SDH" is equivalent to "synchronous digital hierarchy".

"Settling time" (3) means the time required for the output to come within one-half bit of the final value when switching between any two levels of the converter.

"SHPL" is equivalent to "super high power laser".

"Signal analysers" (3) means apparatus capable of measuring and displaying basic properties of the single-frequency components of multi-frequency signals.

"Signal processing" (3 4 5 6) means the processing of externally derived information-bearing signals by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform).

"Software" (GSN All) means a collection of one or more "programmes" or 'microprogrammes' fixed in any tangible medium of expression.
N.B.: 'Microprogramme' means a sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"Solidify rapidly" means a process involving the solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Solvent" (1) is a substance capable of dissolving another substance to form a uniformly dispersed mixture (solution).
- solvents are liquids at standard temperature and pressure (STP);
- in no instance is any CWC or AG listed chemical to be considered a solvent;
- all ingredients of "mixtures" are expressed in terms of weight;
- the solvent component of the "mixture" converts it into a solution.

"Solvent free basis" (1) means when calculating the percentage, by weight, of components in a chemical "mixture", any component of that "mixture" that acts as a "solvent" is excluded from the calculation.

"SONET" is equivalent to "synchronous optical network".

"Source code" (or source language) (4 5 6 7 9) is a convenient expression of one or more processes which may be turned by a programming system into equipment executable form ("object code" (or object language)).

"Spacecraft" (7 9) means active and passive satellites and space probes.

"Space qualified" (3 6 ML15) refers to products designed, manufactured and tested to meet the special electrical, mechanical or environmental requirements for use in the launch and deployment of satellites or high altitude flight systems operating at altitudes of 100 km or higher.

"Special fissile material" (0) means plutonium-239, "uranium enriched in the isotopes 235 or 233", and any material containing the foregoing.

"Specific modulus" (0 1) is Young's modulus in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%.

"Specific tensile strength" (0 1) is ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%.

"Spectral efficiency" (5) is a figure of merit parametrized to characterize the efficiency of transmission system which uses complex modulation schemes such as QAM (quadrature amplitude modulation), Trellis coding, QPSK (Q-phased shift key), etc. It is defined as follows:

$$\text{"Spectral efficiency"} = \frac{\text{"Digital transfer rate"(bits/second)}}{\text{6 dB spectrum bandwidth (Hz)}}$$

"Splat Quenching" (1) means a process to 'solidify rapidly' a molten metal stream impinging upon a chilled block, forming a flake-like product.
N.B.: 'Solidify rapidly': solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Spread spectrum" (5) means the technique whereby energy in a relatively narrow-band communication channel is spread over a much wider energy spectrum.

"Spread spectrum" radar (6) - see "Radar spread spectrum"

"Stability" (7) means the standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

"Stored programme controlled" (2 3 5) means controlled by using instructions stored in an electronic storage which a processor can execute in order to direct the performance of predetermined functions.
N.B.: Equipment may be "stored programme controlled" whether the electronic storage is internal or external to the equipment.

"Substrate" (3) means a sheet of base material with or without an interconnection pattern and on which or within which 'discrete components' or integrated circuits or both can be located.
N.B.: 1. 'Discrete component': a separately packaged 'circuit element' with its own external connections.
2. 'Circuit element': a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"Substrate blanks" (6) means monolithic compounds with dimensions suitable for the production of optical elements such as mirrors or optical windows.

"Sub-unit of toxin" (1) is a structurally and functionally discrete component of a whole "toxin".

"Superalloys" (2 9) means nickel-, cobalt- or iron-base alloys having strengths superior to any alloys in the AISI 300 series at temperatures over 922 K (649°C) under severe environmental and operating conditions.

"Superconductive" (1 3 6 8 ML18 ML20) means materials, i.e., metals, alloys or compounds, which can lose all electrical resistance, i.e., which can attain infinite electrical conductivity and carry very large electrical currents without Joule heating.

N.B.: The "superconductive" state of a material is individually characterised by a "critical temperature", a critical magnetic field, which is a function of temperature, and a critical current density which is, however, a function of both magnetic field and temperature.

"Super High Power Laser" ("SHPL") (6) means a "laser" capable of delivering (the total or any portion of) the output energy exceeding 1 kJ within 50 ms or having an average or CW power exceeding 20 kW.

"Superplastic forming" (1 2) means a deformation process using heat for metals that are normally characterised by low values of elongation (less than 20%) at the breaking point as determined at room temperature by conventional tensile strength testing, in order to achieve elongations during processing which are at least 2 times those values.

"Switch fabric" (5) is that hardware and associated "software" which provides the physical or virtual connection path for in-transit message traffic being switched.

"Synchronous digital hierarchy" ("SDH") (5) means a digital hierarchy providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on different types of media. The format is based on the Synchronous Transport Module (STM) which is defined by CCITT Recommendation G.703, G.707, G.708, G.709 and others yet to be published. The first level rate of "SDH" is 155.52 Mbit/s.

"Synchronous optical network" ("SONET") (5) means a network providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on fibre optics. The format is the North America version of "SDH" and also uses the Synchronous Transport Module (STM). However, it uses the Synchronous Transport Signal (STS) as the basic transport module with a first level rate of 51.81 Mbit/s. The "SONET" standards are being integrated into those of "SDH".

"Systems tracks" (6) means processed, correlated (fusion of radar target data to flight plan position) and updated aircraft flight position report available to the Air Traffic Control centre controllers.

"Systolic array computer" (4) means a computer where the flow and modification of the data is dynamically controllable at the logic gate level by the user.

"Tape" (1) is a material constructed of interlaced or unidirectional "monofilaments", 'strands', "rovings", "tows", or "yarns", etc., usually preimpregnated with resin.
N.B.: 'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

"Tear gases" (ML7) means gases which produce temporary irritating or disabling effects.

"Technology" (GTN NTN All) means specific information necessary for the "development", "production" or "use" of goods. This information takes the form of 'technical data' or 'technical assistance'.
N.B.: 1. 'Technical assistance' may take forms such as instructions, skills, training, working knowledge and consulting services and may involve the transfer of "technical data".
2. 'Technical data' may take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.

"Terminal interface equipment" (4) means equipment at which information enters or leaves the telecommunication system, e.g., telephone, data device, computer, facsimile device.

"Three dimensional Vector Rate" (4) means the number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X-Y-Z coordinate values (whichever produces the maximum rate).

"Tilting spindle" (2) means a tool-holding spindle which alters, during the machining process, the angular position of its centre line with respect to any other axis.

"Time constant" (6) is the time taken from the application of a light stimulus for the current increment to reach a value of 1-1/e times the final value (i.e., 63% of the final value).

"Total control of flight" (7) means an automated control of "aircraft" state variables and flight path to meet mission objectives responding to real time changes in data regarding objectives, hazards or other "aircraft".

"Total digital transfer rate" (5) means the number of bits, including line coding, overhead and so forth per unit time passing between corresponding equipment in a digital transmission system.
N.B.: See also "digital transfer rate".

"Tow" (1) is a bundle of "monofilaments", usually approximately parallel.

"Toxins" (1 2) means toxins in the form of deliberately isolated preparations or mixtures, no matter how produced, other than toxins present as contaminants of other materials such as pathological specimens, crops, foodstuffs or seed stocks of "microorganisms".

"Transfer laser" (6) means a "laser" in which the lasing species is excited through the transfer of energy by collision of a non-lasing atom or molecule with a lasing atom or molecule species.

"Tunable" (6) means the ability of a "laser" to produce a continuous output at all wavelengths over a range of several "laser" transitions. A line selectable "laser" produces discrete wavelengths within one "laser" transition and is not considered "tunable".

"Uranium enriched in the isotopes 235 or 233" (0) means uranium containing the isotopes 235 or 233, or both, in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is more than the ratio of the isotope 235 to the isotope 238 occurring in nature (isotopic ratio 0.72 per cent).

"Use" (GTN NTN All) means operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

"User-accessible programmability" (4 5 6) means the facility allowing a user to insert, modify or replace "programmes" by means other than:
a. A physical change in wiring or interconnections; or
b. The setting of function controls including entry of parameters.

"Vaccine" (1) is a medicinal product which is intended to stimulate a protective immunological response in humans or animals in order to prevent disease.

"Vacuum Atomisation" (1) means a process to reduce a molten stream of metal to droplets of a diameter of 500 micrometre or less by the rapid evolution of a dissolved gas upon exposure to a vacuum.

"Variable geometry airfoils" (7) means the use of trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, the position of which can be controlled in flight.

"Yarn" (1) is a bundle of twisted 'strands'.
N.B.: 'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

ACRONYMS AND ABBREVIATIONS USED IN THE DEFENCE AND STRATEGIC GOODS LIST

An acronym or abbreviation, when used as a defined term, will be found in 'Definitions of Terms used in this List'.

ACRONYM OR ABBREVIATION	MEANING
ABEC	Annular Bearing Engineers Committee
AGMA	American Gear Manufacturers' Association
AHRS	attitude and heading reference systems
AISI	American Iron and Steel Institute
ALU	arithmetic logic unit
ANSI	American National Standards Institute
ASTM	the American Society for Testing and Materials
ATC	air traffic control
CAD	computer-aided-design
CCITT	International Telegraph and Telephone Consultative Committee
CDU	control and display unit
CEP	circular error probable
CNTD	controlled nucleation thermal deposition
CVD	chemical vapour deposition
CW	chemical warfare
CW (for lasers)	continuous wave
DME	distance measuring equipment
DS	directionally solidified
EB-PVD	electron beam physical vapour deposition
ECM	electro-chemical machining
ECR	electron cyclotron resonance
EDM	electrical discharge machines
EEPROMS	electrically erasable programmable read only memory
EIA	Electronic Industries Association
EMC	electromagnetic compatibility
FFT	Fast Fourier Transform
GLONASS	global navigation satellite system
GPS	global positioning system
HBT	hetero-bipolar transistors
HDDR	high density digital recording
HEMT	high electron mobility transistors
ICAO	International Civil Aviation Organisation
IEEE	Institute of Electrical and Electronic Engineers
IFOV	instantaneous-field-of-view
ILS	instrument landing system
IRIG	inter-range instrumentation group
ISAR	inverse synthetic aperture radar
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JIS	Japanese Industrial Standard
JT	Joule-Thomson
LIDAR	light detection and ranging
LRU	line replaceable unit

ACRONYM OR ABBREVIATION	MEANING
MAC	message authentication code
Mach	ratio of speed of an object to speed of sound (after Ernst Mach)
MLS	microwave landing systems
MOCVD	metal organic chemical vapour deposition
MRI	magnetic resonance imaging
MTBF	mean-time-between-failures
Mtops	million theoretical operations per second
MTTF	mean-time-to-failure
NBC	Nuclear, Biological and Chemical
NDT	non-destructive test
PAR	precision approach radar
PIN	personal identification number
ppm	parts per million
PSD	power spectral density
QAM	quadrature-amplitude-modulation
RF	radio frequency
SACMA	Suppliers of Advanced Composite Materials Association
SAR	synthetic aperture radar
SC	single crystal
SLAR	sidelooking airborne radar
SRA	shop replaceable assembly
SRAM	static random access memory
SRM	SACMA Recommended Methods
SSB	single sideband
SSR	secondary surveillance radar
TCSEC	trusted computer system evaluation criteria
TIR	total indicated reading
UV	ultraviolet
UTS	ultimate tensile strength
VOR	very high frequency omni-directional range
YAG	yttrium/aluminum garnet

PART 1 - MUNITIONS LIST

ML1. Arms and automatic weapons with a calibre of 12.7 mm (calibre 0.50 inches) or less and accessories, as follows, and specially designed components therefor:

a. Rifles, carbines, revolvers, pistols, machine pistols and machine guns:
Note *ML1.a. does not control the following:*
1. *Muskets, rifles and carbines manufactured earlier than 1938;*
2. *Reproductions of muskets, rifles and carbines the originals of which were manufactured earlier than 1890;*
3. *Revolvers, pistols and machine guns manufactured earlier than 1890, and their reproductions;*

N.B. For these goods and specially designed components therefor, see Items ML901, ML903 and ML904

b. Smooth-bore weapons specially designed for military use;

c. Weapons using caseless ammunition;

d. Silencers, special gun-mountings, clips and flash suppressers for arms controlled by sub-items ML1.a., ML1.b. or ML1.c.

Technical Note
Smooth-bore weapons specially designed for military use as specified in ML1.b. are those which:
a. Are proof tested at pressures above 1,300 bars;
b. Operate normally and safely at pressures above 1,000 bars; and
c. Are capable of accepting ammunition above 76.2 mm in length (e.g., commercial 12-gauge magnum shot gun shells).
The parameters in this Technical Note are to be measured according to the standards of the Commission Internationale Permanente.

Note 1 *ML1. does not control smooth-bore weapons used for hunting or sporting purposes. These weapons must not be specially designed for military use or of the fully automatic firing type. For these, see Item ML901.*

Note 2 *ML1. does not control firearms specially designed for dummy ammunition and which are incapable of firing any controlled ammunition. For these, see Item ML901.*

Note 3 *ML1. does not control weapons using non-centre fire cased ammunition and which are not of the fully automatic firing type. For these, see Item ML901.*

ML2. Armament or weapons with a calibre greater than 12.7 mm (calibre 0.50 inches), projectors and accessories, as follows, and specially designed components therefor:

a. Guns, howitzers, cannon, mortars, anti-tank weapons, projectile launchers, military flame throwers, recoilless rifles and signature reduction devices therefor;
Note *ML2.a. includes injectors, metering devices, storage tanks and other specially designed components for use with liquid propelling charges for any of the equipment controlled by ML 2.a..*

b. Military smoke, gas and pyrotechnic projectors or generators.
Note *ML 2.b. does not control signal pistols.*

ML3. Ammunition, and specially designed components therefor, for the weapons controlled by ML1., ML2. or ML12.

Note 1 *Specially designed components include:*

a. Metal or plastic fabrications such as primer anvils, bullet cups, cartridge links, rotating bands and munitions metal parts;
b. Safing and arming devices, fuses, sensors and initiation devices ;
c. Power supplies with high one-time operational output;
d. Combustible cases for charges;
e. Submunitions including bomblets, minelets and terminally guided projectiles.

Note 2 *ML3. does not control ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber. For this, and other ammunition not covered by Item ML3, see Item ML902.*

ML4. Bombs, torpedoes, rockets, missiles, and related equipment and accessories, as follows, specially designed for military use, and specially designed components therefor:

a. Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition-charges, demolition-devices and demolition-kits, "military pyrotechnics", cartridges and simulators (i.e. equipment simulating the characteristics of any of these items);
Note *ML4.a. includes:*
1. Smoke grenades, fire bombs, incendiary bombs and explosive devices;
2. Missile rocket nozzles and re-entry vehicle nosetips.

b. Equipment specially designed for the handling, control, activation, powering with one-time operational output, launching, laying, sweeping, discharging, decoying, jamming, detonation or detection of items controlled by ML4.a.
Note *ML 4.b. includes:*
1. Mobile gas liquefying equipment capable of producing 1,000 kg or more per day of gas in liquid form;
2. Buoyant electric conducting cable suitable for sweeping magnetic mines.
Note *ML4.b. does not include detonators or other equipment for the detonation of non-military explosives covered by ML908, For these, see ML909.*

ML5. Fire control, and related alerting and warning equipment, and related systems and countermeasure equipment, as follows, specially designed for military use, and specially designed components and accessories therefor:

a. Weapon sights, bombing computers, gun laying equipment and weapon control systems;

b. Target acquisition, designation, range-finding, surveillance or tracking systems; detection, data fusion, recognition or identification equipment; and sensor integration equipment;

c. Countermeasure equipment for items controlled by ML5.a. and ML5.b.

ML6. Ground vehicles and components therefor specially designed or modified for military use.
Technical Note
For the purposes of ML6. the term ground vehicles includes trailers.

Note 1 *ML6. includes:*

a. Tanks and other military armed vehicles and military vehicles fitted with mountings for arms or equipment for mine laying or the launching of munitions controlled under ML4;

b. Armoured vehicles;

c. Amphibious and deep water fording vehicles;

d. Recovery vehicles and vehicles for towing or transporting ammunition or weapon systems and associated load handling equipment.

Note 2 *Modification of a ground vehicle for military use entails a structural, electrical or mechanical change involving one or more specially designed military components. Such components include:*

a. Pneumatic tyre casings of a kind specially designed to be bullet-proof or to run when deflated;

b. Tyre inflation pressure control systems, operated from inside a moving vehicle;

c. Armoured protection of vital parts, (e.g., fuel tanks or vehicle cabs);

d. Special reinforcements for mountings for weapons.

Note 3 *ML6. does not control civil automobiles or bank trucks having armoured protection.*

ML7. Toxicological agents, "tear gases", related equipment, components, materials and "technology" as follows:

Note *The CAS numbers are shown as examples. They do not cover all the chemicals and mixtures controlled by ML7.*

a. Biological agents and radioactive materials "adapted for use in war" to produce casualties in humans or animals, degrade equipment or damage crops or the environment, and chemical warfare (CW) agents;

b. CW binary precursors and key precursors, as follows:

1. Alkyl (Methyl, Ethyl, n-Propyl or Isopropyl Phosphonyl Difluorides, such as: DF: Methyl Phosphonyldifluoride (CAS 676-99-3);
2. O-Alkyl (H or equal to or less than C_{10}, including cycloalkyl) O-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonite and corresponding alkylated and protonated salts, such as:
   QL: O-Ethyl-2-di-isopropylaminoethyl methylphosphonite (CAS 57856-11-8);
3. Chlorosarin: O-Isopropyl methylphosphonochloridate (CAS 1445-76-7);
4. Chlorosoman: O-Pinakolyl methylphosphonochloridate (CAS 7040-57-5);

c. **"Tear gases" and "riot control agents" including:

1. Bromobenzyl cyanide (CA) (CAS 5798-79-8);
2. o-Chlorobenzylidenemalononitrile (o-Chlorobenzalmalononitrile) (CS) (CAS 2698-41-1);
3. Phenylacyl chloride (w-chloroacetophenone) (CN) (CAS 532-27-4);
4. Dibenz-(b,f)-1,4-oxazephine (CR) (CAS 257-07-8);

d. Equipment specially designed or modified for the dissemination of the materials or agents controlled by ML7.a. and specially designed components therefor;

e. Equipment specially designed for defence against materials controlled by ML7.a. and specially designed components therefor;
Note ML7.e. includes protective clothing.

f. Equipment specially designed for the detection or identification of materials controlled by ML7.a. and specially designed components therefor;

Note *ML7.f. does not control personal radiation monitoring dosimeters.*

N.B.: For civil gas masks and protective equipment see also entry 1A004

ML7. g. "Biopolymers" specially designed or processed for the detection or identification of CW agents controlled by ML7.a., and the cultures of specific cells used to produce them;

h. "Biocatalysts" for the decontamination or degradation of CW agents, and biological systems therefor, as follows:

1. "Biocatalysts" specially designed for the decontamination or degradation of CW agents controlled by ML7.a. resulting from directed laboratory selection or genetic manipulation of biological systems;
2. Biological systems, as follows: "expression vectors", viruses or cultures of cells containing the genetic information specific to the production of "biocatalysts" controlled by ML7.h.1.;

i. "Technology" as follows:

1. "Technology" for the "development", "production" or " use" of toxicological agents, related equipment or components controlled by ML7.a. to ML7.f.;
2. "Technology" for the "development", "production" or "use" of "biopolymers" or cultures of specific cells controlled by ML7.g.;
3. "Technology" exclusively for the incorporation of "biocatalysts", controlled by ML7.h.1., into military carrier substances or military material.

Note 1 *ML7.a. includes the following*

a. CW nerve agents:

1. O-Alkyl (equal to or less than C_{10}, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) - phosphonofluoridates, such as:
Sarin (GB):O-Isopropyl methylphosphonofluoridate (CAS 107-44-8); and
Soman (GD):O-Pinacolyl methylphosphonofluoridate (CAS 96-64-0);

2. O-Alkyl (equal to or less than C_{10}, including cycloalkyl) N,N-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphoramidocyanidates, such as:
Tabun (GA):O-Ethyl N,N-dimethylphosphoramidocyanidate (CAS 77-81-6);

3. O-Alkyl (H or equal to or less than C_{10}, including cycloalkyl) S-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl)-aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonothiolates and corresponding alkylated and protonated salts, such as:
VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (CAS 50782-69-9);

b. CW vesicant agents

1. Sulphur mustards, such as:
2-Chloroethylchloromethylsulphide (CAS 2625-76-5);
Bis(2-chloroethyl) sulphide (CAS 505-60-2);
Bis(2-chloroethylthio) methane (CAS 63869-13-6);
1,2-bis (2-chloroethylthio) ethane (CAS 3563-36-8);
1,3-bis (2-chloroethylthio) -n-propane (CAS 63905-10-2);
1,4-bis (2-chloroethylthio) -n-butane (CAS 142868-93-7)
1,5-bis (2-chloroethylthio) -n-pentane; (CAS 142868-94-8)
Bis (2-chloroethylthiomethyl) ether; (CAS 63918-90-1)
Bis (2-chloroethylthioethyl) ether (CAS 63918-89-8);

2. Lewisites, such as:
2-chlorovinyldichloroarsine (CAS 541-25-3);
Tris (2-chlorovinyl) arsine (CAS 40334-70-1);
Bis (2-chlorovinyl) chloroarsine (CAS 40334-69-8);

3. Nitrogen mustards, such as:
HN1: bis (2-chloroethyl) ethylamine (CAS 538-07-8);

HN2: bis (2-chloroethyl) methylamine (CAS 51-75-2);
HN3: tris (2-chloroethyl) amine (CAS 555-77-1);

c. **CW incapacitating agents such as:*
3-Quinuclindinyl benzilate (BZ) (CAS 6581-06-2);

d. ***CW defoliants such as:*
1. *Butyl 2-chloro-4-fluorophenoxyacetate (LNF);*
2. *2,4,5-trichlorophenoxyacetic acid mixed with 2,4-dichlorophenoxyacetic acid (Agent Orange).*

Note 2 *ML 7.e. includes air conditioning units specially designed or modified for nuclear, biological or chemical filtration.*

Note 3 *ML7.a. and ML7.c. do not control:*
a. *Cyanogen chloride* **(SEE ITEM 1C450a.4)**;
b. *Hydrocyanic acid* **(SEE ITEM 1C450a.5)**;
c. *Chlorine;*
d. *Carbonyl chloride (phosgene)* **(SEE ITEM 1C450a.7)**;
e. *Diphosgene (trichloromethyl-chloroformate);*
f. *Ethyl bromoacetate;*
g. *Xylyl bromide;*
h. *Benzyl bromide;*
i. *Benzyl iodide;*
j. *Bromo acetone;*
k. *Cyanogen bromide;*
l. *Bromo methylethylketone;*
m. *Chloro acetone;*
n. *Ethyl iodoacetate;*
o. *Iodo acetone;*
p. *Chloropicrin* **(SEE ITEM 1C450a.3)**.

Note 4 *The "technology", cultures of cells and biological systems listed in ML7.g., ML7.h.2. and ML7.i.3. are exclusive and these sub-items do not control "technology", cells or biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry.*

Note 5 *ML 7.c. does not control tear gases or riot control agents individually packaged for personal self defence purposes.*

Note 6 *ML 7.d., ML7.e. and ML7.f. control equipment specially designed or modified for military purposes.*

Note 7 *For chemicals listed in ML7 (without asterisks), export permission is required when any mixture contains the listed chemical*

* *Export permission is required when the chemical constitutes more than 10% of a mixture on a "solvent free basis".*

** *Export permission is required when it constitutes more than 25% of a mixture on a "solvent free basis".*

N.B.: SEE ALSO ENTRIES 1A004, 1C350, 1C351, 1C352, 1C353, 1C354 AND 1C450.

ML 8. "Military explosives" and fuels, including propellants, and related substances, as follows:

a. Substances, as follows, and mixtures thereof:
1. Spherical aluminium powder (CAS 7429-90-5) with a particle size of 60 µm or less, manufactured from material with an aluminium content of 99% or more;
2. Metal fuels in particle form whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99 % or more of any of the following:
a. Metals and mixtures thereof:
1. Beryllium (CAS 7440-41-7) in particle sizes of less than 60 µm;

2. Iron powder (CAS 7439-89-6) with particle size of 3 μm or less produced by reduction of iron oxide with hydrogen;

ML8. a. 2. b. Mixtures, which contain any of the following:
1. Zirconium (CAS 7440-67-7), magnesium (CAS 7439-95-4) and alloys of these in particle sizes of less than 60 μm;
2. Boron (CAS 7440-42-8) or boron carbide (CAS 12069-32-8) fuels of 85% purity or higher and particle sizes of less than 60 μm;

3. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;
4. Nitroguanidine (NQ) (CAS 556-88-7);
5. Compounds composed of fluorine and any of the following: other halogens, oxygen, nitrogen;
6. Carboranes; decaborane(CAS 17702-41-9); pentaborane and derivatives thereof;
7. Cyclotetramethylenetetranitramine (CAS 2691-41-0) (HMX); octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine; 1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane; (octogen, octogene);
8. Hexanitrostilbene (HNS) (CAS 20062-22-0);
9. Diaminotrinitrobenzene (DATB) (CAS 1630-08-6);
10. Triaminotrinitrobenzene (TATB) (CAS 3058-38-6);
11. Triaminoguanidinenitrate (TAGN) (CAS 4000-16-2);
12. Titanium subhydride of stoichiometry TiH 0.65-1.68;
13. Dinitroglycoluril (DNGU, DINGU) (CAS 55510-04-8); tetranitroglycoluril (TNGU, SORGUYL) (CAS 55510-03-7);
14. Tetranitrobenzotriazolobenzotriazole (TACOT) (CAS 25243-36-1);
15. Diaminohexanitrobiphenyl (DIPAM) (CAS 17215-44-0);
16. Picrylaminodinitropyridine (PYX) (CAS 38082-89-2);
17. 3-nitro-1,2,4-triazol-5-one (NTO or ONTA) (CAS 932-64-9);
18. Hydrazine (CAS 302-01-2) in concentrations of 70% or more; hydrazine nitrate (CAS 37836-27-4); hydrazine perchlorate (CAS 27978-54-7); unsymmetrical dimethyl hydrazine (CAS 57-14-7); monomethyl (CAS 60-34-4) hydrazine; symmetrical dimethyl hydrazine (CAS 540-73-8);
19. Ammonium perchlorate (CAS 7790-98-9);
20. Cyclotrimethylenetrinitramine (RDX) (CAS 121-82-4) ; cyclonite; T4; hexahydro-1,3,5-trinitro-1,3,5-triazine; 1,3,5-trinitro-1,3,5-triaza-cyclohexane (hexogen, hexogene);
21. Hydroxylammonium nitrate (HAN) (CAS 13465-08-2); hydroxylammonium perchlorate (HAP) (CAS 15588-62-2);
22. 2-(5-cyanotetrazolato) penta amine-cobalt (III) perchlorate (or CP) (CAS 70247-32-4);
23. cis-bis (5-nitrotetrazolato) tetra amine-cobalt (III) perchlorate (or BNCP);
24. 7-Amino-4,6-dinitrobenzofurazane-1-oxide (ADNBF) (CAS 97096-78-1); amino dinitrobenzofuroxan;
25. 5,7-diamino-4,6-dinitrobenzofurazane-1-oxide (CAS 117907-74-1), (CL-14 or diamino dinitrobenzofuroxan);
26. 2,4,6-trinitro-2,4,6-triazacyclohexanone (K-6 or Keto-RDX) (CAS 115029-35-1);
27. 2,4,6,8-tetranitro-2,4,6,8-tetraazabicyclo [3,3,0]-octanone-3 (CAS 130256-72-3) (tetranitrosemiglycouril, K-55 or keto-bicyclic HMX);
28. 1,1,3-trinitroazetidine (TNAZ) (CAS 97645-24-4);
29. 1,4,5,8-tetranitro-1,4,5,8-tetraazadecalin (TNAD) (CAS 135877-16-6);
30. Hexanitrohexaazaisowurtzitane (CAS 135285-90-4) (CL-20 or HNIW); and chlathrates of CL-20;
31. Polynitrocubanes with more than four nitro groups;
32. Ammonium dinitramide (ADN or SR 12) (CAS 140456-78-6);
33. Trinitrophenylmethylnitramine (tetryl) (CAS 479-45-8);

ML 8 b. Explosives and propellants that meet the following performance parameters:
1. Any explosive with a detonation velocity exceeding 8,700 m/s or a detonation pressure exceeding 34 GPa (340 kbar);

2. Other organic explosives not listed in ML8. yielding detonation pressures of 25 GPa (250 kbar) or more that will remain stable at temperatures of 523 K (250°C) or higher for periods of 5 minutes or longer;
3. Any other United Nations (UN) Class 1.1 solid propellant not listed in ML8. with a theoretical specific impulse (under standard conditions) of more than 250 s for non-metallised, or more than 270 s for aluminised compositions;
4. Any UN Class 1.3 solid propellant with a theoretical specific impulse of more than 230 s for non-halogenised, 250 s for non-metallised and 266 s for metallised compositions;
5. Any other gun propellants not listed in ML8. having a force constant of more than 1,200 kJ/kg;
6. Any other explosive, propellant or pyrotechnic not listed in ML8. that can sustain a steady-state burning rate of more than 38 mm/s under standard conditions of 6.89 MPa (68.9 bar) pressure and 294 K (21°C); or
7. Elastomer modified cast double based propellants (EMCDB) with extensibility at maximum stress of more than 5% at 233 K (-40°C);

ML8. c. "Military pyrotechnics";

d. Other substances, as follows:
1. Aircraft fuels specially formulated for military purposes;
2. Military materials containing thickeners for hydrocarbon fuels specially formulated for use in flamethrowers or incendiary munitions, such as metal stearates or palmates (also known as octal) (CAS 637-12-7) and M1, M2, M3 thickeners;
3. Liquid oxidisers comprised of or containing inhibited red fuming nitric acid (IRFNA) (CAS 8007-58-7) or oxygen difluoride;

e. "Additives" and "precursors", as follows:
1. Azidomethylmethyloxetane (AMMO) and its polymers;
2. Basic copper salicylate (CAS 62320-94-9); lead salicylate (CAS 15748-73-9);
3. Bis(2,2-dinitropropyl) formal (CAS 5917-61-3) or Bis(2,2-dinitropropyl) acetal (CAS 5108-69-0);
4. Bis-(2-fluoro-2,2-dinitroethyl) formal (FEFO) (CAS 17003-79-1);
5. Bis-(2-hydroxyethyl) glycolamide (BHEGA) (CAS 17409-41-5);
6. Bis(2-methyl aziridinyl) methylamino phosphine oxide (Methyl BAPO) (CAS 85068-72-0);
7. Bisazidomethyloxetane and its polymers (CAS 17607-20-4);
8. Bischloromethyloxetane (BCMO) (CAS 142173-26-0);
9. Butadienenitrileoxide (BNO);
10. Butanetrioltrinitrate (BTTN) (CAS 6659-60-5);
11. Catocene (CAS 37206-42-1) (2,2-Bis-ethylferrocenyl propane); ferrocene carboxylic acids; N-butyl-ferrocene (CAS 319904-29-7); Butacene (CAS 125856-62-4) and other adducted polymer ferrocene derivatives;
12. Dinitroazetidine-t-butyl salt;
13. Energetic monomers, plasticisers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups;
14. Poly-2,2,3,3,4,4-hexafluoropentane-1,5-diol formal (FPF-1);
15. Poly-2,4,4,5,5,6,6-heptafluoro-2-tri-fluoromethyl-3-oxaheptane-1,7-diol formal (FPF-3);
16. Glycidylazide Polymer (GAP) (CAS 143178-24-9) and its derivatives;
17. Hexabenzylhexaazaisowurtzitane (HBIW) (CAS 124782-15-6);
18. Hydroxyl terminated polybutadiene (HTPB) with a hydroxyl functionality equal to or greater than 2.2 and less than or equal to 2.4, a hydroxyl value of less than 0.77 meq/g, and a viscosity at 30°C of less than 47 poise (CAS 69102-90-5);
19. Superfine iron oxide (Fe_2O_3 hematite) with a specific surface area more than 250 m^2/g and an average particle size of 0.003 µm or less (CAS 1309-37-1);
20. Lead beta-resorcylate (CAS 20936-32-7);

ML8. e. 21. Lead stannate (CAS 12036-31-6), lead maleate (CAS 19136-34-6), lead citrate (CAS 14450-60-3);
22. Lead-copper chelates of beta-resorcylate or salicylates (CAS 68411-07-4);
23. Nitratomethylmethyloxetane or poly (3-Nitratomethyl, 3-methyl oxetane); (Poly-NIMMO) (NMMO) (CAS 84051-81-0);
24. 3-Nitraza-1,5-pentane diisocyanate (CAS 7406-61-9);
25. N-Methyl-p-Nitroaniline (CAS 100-15-2);
26. Organo-metallic coupling agents, specifically:
    a. Neopentyl [diallyl] oxy, tri [dioctyl] phosphato titanate (CAS 103850-22-2); also known as titanium IV, 2,2[bis 2-propenolato-methyl, butanolato, tris (dioctyl) phosphato] (CAS 110438-25-0); or LICA 12 (CAS 103850-22-2);
    b. Titanium IV, [(2-propenolato-1) methyl, n-propanolatomethyl] butanolato-1, tris[dioctyl]pyrophosphate; or KR3538;
    c. Titanium IV, [(2-propenolato-1)methyl, n-propanolatomethyl] butanolato-1, tris(dioctyl)phosphate;
27. Polycyanodifluoroaminoethyleneoxide (PCDE);
28. Polyfunctional aziridine amides with isophthalic, trimesic (BITA or butylene imine trimesamide), isocyanuric or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring;
29. Polyglycidylnitrate or poly (nitratomethyl oxirane); (Poly-GLYN) (PGN) (CAS 27814-48-8);
30. Polynitroorthocarbonates;
31. Propyleneimine, 2-methylaziridine (CAS 75-55-8);
32. Tetraacetyldibenzylhexaazaisowurtzitane (TAIW);
33. Tetraethylenepentaamineacrylonitrile (TEPAN) (CAS 68412-45-3); cyanoethylated polyamine and its salts;
34. Tetraethylenepentaamineacrylonitrileglycidol (TEPANOL) (CAS 68412-46-4); cyanoethylated polyamine adducted with glycidol and its salts;
35. Triphenyl bismuth (TPB) (CAS 603-33-8);
36. Tris-1-(2-methyl)aziridinyl phosphine oxide (MAPO) (CAS 57-39-6); bis(2-methyl aziridinyl) 2-(2-hydroxypropanoxy) propylamino phosphine oxide (BOBBA 8); and other MAPO derivatives;
37. 1,2,3-Tris[1,2-bis(difluoroamino)ethoxy] propane (CAS 53159-39-0); tris vinoxy propane adduct (TVOPA);
38. 1,3,5-trichlorobenzene (CAS 108-70-3);
39. 1,2,4 trihydroxybutane (1,2,4-butanetriol);
40. 1,3,5,7 tetraacetyl-1,3,5,7,-tetraaza cyclo-octane (TAT) (CAS 41378-98-7);
41. 1,4,5,8 Tetraazadecalin (CAS 5409-42-7);
42. Low (less than 10,000) molecular weight, alcohol-functionalised, poly(epichlorohydrin); poly(epichlorohydrindiol) and triol.

Note 1 *The military explosives and fuels containing the metals or alloys listed in ML8.a.1. and ML8.a.2. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.*
N.B.: SEE ALSO ITEM 1C011.

Note 2 *ML 8. does not control boron and boron carbide enriched with boron-10 (20% or more of total boron-10 content).*

Note 3 *Aircraft fuels controlled by ML 8.d.1. are finished products not their constituents.*

Note 4 *ML 8. does not control perforators specially designed for oil well logging.*

Note 5 *ML 8. does not control the following substances when not compounded or mixed with military explosives or powdered metals:*
a. Ammonium picrate;
b. Black powder;

c. Hexanitrodiphenylamine;
d. Difluoroamine (HNF_2);
e. Nitrostarch;
f. Potassium nitrate;
g. Tetranitronaphthalene;
h. Trinitroanisol;
i. Trinitronaphthalene;
j. Trinitroxylene;
k. Fuming nitric acid non-inhibited and not enriched;
l. Acetylene;
m Propane;
n. Liquid oxygen;
o. Hydrogen peroxide in concentrations of less than 85%;
p. Misch metal;
q N-pyrrolidinone; 1-methyl-2-pyrrolidinone;
r. Dioctylmaleate;
s. Ethylhexylacrylate;
t. Triethylaluminium (TEA), trimethylaluminium (TMA), and other pyrophoric metal alkyls and aryls of lithium, sodium, magnesium, zinc and boron;
u. Nitrocellulose;
v. Nitroglycerin (or glyceroltrinitrate, trinitroglycerine) (NG);
w. 2,4,6-trinitrotoluene (TNT);
x. Ethylenediaminedinitrate (EDDN);
y. Pentaerythritoltetranitrate (PETN);
aa. Lead azide, normal and basic lead styphnate, and primary explosives or priming compositions containing azides or azide complexes;
bb. Triethyleneglycoldinitrate (TEGDN);
cc. 2,4,6-trinitroresorcinol (styphnic acid);
dd. Diethyldiphenyl urea; dimethylidiphenyl urea; methylethyldiphenyl urea [Centralites];
ee. N,N-diphenylurea (unsymmetrical diphenylurea);
ff. Methyl-N,N-diphenylurea (methyl unsymmetrical diphenylurea);
gg. Ethyl-N,N-diphenylurea (ethyl unsymmetrical diphenylurea);
hh. 2-Nitrodiphenylamine (2-NDPA);
ii. 4-Nitrodiphenylamine (4-NDPA);
jj. 2,2-dinitropropanol;
kk. Chlorine trifluoride.

N.B.: SEE ALSO ITEM ML908.

ML9. Vessels of war, special naval equipment and accessories, as follows, and components therefor, specially designed for military use:

a. Combatant vessels and vessels (surface or underwater) specially designed or modified for offensive or defensive action, whether or not converted to non-military use, regardless of current state of repair or operating condition, and whether or not they contain weapon delivery systems or armour, and hulls or parts of hulls for such vessels;

b. Engines, as follows:
   1. Diesel engines specially designed for submarines with both of the following characteristics:
      a. A power output of 1.12 MW (1,500 hp.) or more; and
      b. A rotary speed of 700 rpm or more;
   2. Electric motors specially designed for submarines having all of the following characteristics:
      a. A power output of more than 0.75 MW (1,000 hp.);

b. Quick reversing;
c. Liquid cooled; and
d. Totally enclosed;

3. Non-magnetic diesel engines specially designed for military use with a power output of 37.3 kW (50 hp.) or more and with a non-magnetic content in excess of 75% of total mass;

c. Underwater detection devices specially designed for military use and controls thereof;

d. Submarine and torpedo nets;

e. Equipment for guidance and navigation specially designed for military use;

f. Hull penetrators and connectors specially designed for military use that enable interaction with equipment external to a vessel;

Note *ML9.f. includes connectors for vessels which are of the single-conductor, multi-conductor, coaxial or waveguide type, and hull penetrators for vessels, both of which are capable of remaining impervious to leakage from without and of retaining required characteristics at marine depths exceeding 100 m; and fibre-optic connectors and optical hull penetrators specially designed for "laser" beam transmission regardless of depth. It does not include ordinary propulsive shaft and hydrodynamic control-rod hull penetrators.*

g. Silent bearings, with gas or magnetic suspension, active signature or vibration suppression controls, and equipment containing those bearings, specially designed for military use.

ML10. "Aircraft", unmanned airborne vehicles, aero-engines and "aircraft" equipment, related equipment and components, specially designed or modified for military use, as follows:

a. Combat "aircraft" and specially designed components therefor;

b. Other "aircraft" specially designed or modified for military use, including military reconnaissance, assault, military training, transporting and airdropping troops or military equipment, logistics support, and specially designed components therefor;

c. Aero-engines specially designed or modified for military use, and specially designed components therefor;

d. Unmanned airborne vehicles, including remotely piloted air vehicles (RPVs), and autonomous, programmable vehicles specially designed or modified for military use and their launchers, ground support and related equipment for command and control;

e. Airborne equipment, including airborne refuelling equipment, specially designed for use with the "aircraft" controlled by ML10.a. or ML10.b. or the aero-engines controlled by ML10.c., and specially designed components therefor;

f. Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for "aircraft" controlled by ML10.a. or ML10.b., or for aero-engines controlled by ML10.c.;

g. Pressurised breathing equipment and partial pressure suits for use in "aircraft", anti-g suits, military crash helmets and protective masks, liquid oxygen converters used for "aircraft" or missiles, and catapults and cartridge actuated devices for emergency escape of personnel from "aircraft";

h. Parachutes used for combat personnel, cargo dropping or "aircraft" deceleration, as follows:
   1. Parachutes for:
      a. Pin point dropping of rangers;
      b. Dropping of paratroopers;
   2. Cargo parachutes;
   3. Paragliders, drag parachutes, drogue parachutes for stabilisation and attitude control of dropping bodies, (e.g. recovery capsules, ejection seats, bombs);
   4. Drogue parachutes for use with ejection seat systems for deployment and inflation sequence regulation of emergency parachutes;
   5. Recovery parachutes for guided missiles, drones or space vehicles;
   6. Approach parachutes and landing deceleration parachutes;
   7. Other military parachutes;

ML10. i. Automatic piloting systems for parachuted loads; equipment specially designed or modified for military use for controlled opening jumps at any height, including oxygen equipment.

Note 1 *ML10.b. does not control "aircraft" or variants of those "aircraft" specially designed for military use which:*
   a. Are not configured for military use and are not fitted with equipment or attachments specially designed or modified for military use; and
   b. Have been certified for civil use by the civil aviation authority in a participating state.*

Note 2 *ML10.c. does not control:*
   a. Aero-engines designed or modified for military use which have been certified by civil aviation authorities in a participating state for use in "civil aircraft", or specially designed components therefor;*
   b. Reciprocating engines or specially designed components therefor.

Note 3 *The control in ML10.b. and ML10.c. on specially designed components and related equipment for non-military "aircraft" or aero-engines modified for military use applies only to those military components and to military related equipment required for the modification to military use.*

**NB* *As at November 1996, participating states of the Wassenaar Arrangement comprise Argentina, Australia, Austria, Belgium, Bulgaria, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Korea, Romania, the Russian Federation, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom and the United States.*

ML11. Electronic equipment, not controlled elsewhere on the Munitions List, specially designed for military use and specially designed components therefor.

Note *ML11. includes:*

   a. Electronic countermeasure and electronic counter-countermeasure equipment (i.e., equipment designed to introduce extraneous or erroneous signals into radar or radio communication receivers or otherwise hinder the reception, operation or effectiveness of adversary electronic receivers including their countermeasure equipment), including jamming and counter-jamming equipment;
   b. Frequency agile tubes;
   c. Electronic systems or equipment designed either for surveillance and monitoring of the electro-magnetic spectrum for military intelligence or security purposes or for counteracting such surveillance and monitoring;

d. Underwater countermeasures, including acoustic and magnetic jamming and decoy, equipment designed to introduce extraneous or erroneous signals into sonar receivers;
e. Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes;
f. Identification, authentification and keyloader equipment and key management, manufacturing and distribution equipment.

ML12. High velocity kinetic energy weapon systems and related equipment, as follows, and specially designed components therefor:

a. Kinetic energy weapon systems specially designed for destruction or effecting mission-abort of a target;

b. Specially designed test and evaluation facilities and test models, including diagnostic instrumentation and targets, for dynamic testing of kinetic energy projectiles and systems.

N.B. For weapon systems using sub-calibre ammunition or employing solely chemical propulsion, and ammunition therefor, see ML1.to ML4.

Note 1 ML12. includes the following when specially designed for kinetic energy weapon systems:
a. Launch propulsion systems capable of accelerating masses larger than 0.1 g to velocities in excess of 1.6 km/s, in single or rapid fire modes;
b. Prime power generation, electric armour, energy storage, thermal management, conditioning, switching or fuel-handling equipment; and electrical interfaces between power supply, gun and other turret electric drive functions;
c. Target acquisition, tracking, fire control or damage assessment systems;
d. Homing seeker, guidance or divert propulsion (lateral acceleration) systems for projectiles.

Note 2 ML12. controls weapon systems using any of the following methods of propulsion:
a. Electromagnetic;
b. Electrothermal;
c. Plasma;
d. Light gas; or
e. Chemical (when used in combination with any of the above).

Note 3 ML12. does not control "technology" for magnetic induction for continuous propulsion of civil transport devices.

ML13. Armoured or protective equipment and constructions and components, as follows:

a. Armoured plate as follows:
1. Manufactured to comply with a military standard or specification; or
2. Suitable for military use;

b. Constructions of metallic or non-metallic materials or combinations thereof specially designed to provide ballistic protection for military systems;

c. Military helmets;

d. Body armour and flak suits manufactured according to military standards or specifications, or equivalent, and specially designed components therefor.

Note 1 *ML 13.b. includes materials specially designed to form explosive reactive armour or to construct military shelters.*

Note 2 *ML 13.c. does not control conventional steel helmets, neither modified or designed to accept, nor equipped with, any type of accessory device.*

Note 3 *ML 13.d. does not control individual suits of body armour for personal protection and accessories therefor when accompanying their users .*

N.B.: SEE ALSO ITEM 1A005.

ML14. Specialised equipment for military training or for simulating military scenarios and specially designed components and accessories therefor.

Technical Note
The term 'specialised equipment for military training' includes military types of attack trainers, operational flight trainers, radar target trainers, radar target generators, gunnery training devices, anti-submarine warfare trainers, flight simulators (including human-rated centrifuges for pilot/astronaut training), radar trainers, instrument flight trainers, navigation trainers, missile launch trainers, target equipment, drone "aircraft", armament trainers, pilotless "aircraft" trainers and mobile training units.

Note *ML14. includes image generating and interactive environment systems for simulators when specially designed or modified for military use.*

ML15. Imaging or countermeasure equipment, as follows, specially designed for military use, and specially designed components and accessories therefor:

a. Recorders and image processing equipment;
b. Cameras, photographic equipment and film processing equipment;
c. Image intensifier equipment;
d. Infrared or thermal imaging equipment;
e. Imaging radar sensor equipment;
f. Countermeasure or counter-countermeasure equipment for the equipment controlled by sub-items ML15.a. to ML15.e.
Note *ML 15.f. includes equipment designed to degrade the operation or effectiveness of military imaging systems or to minimize such degrading effects.*

Note 1 *The term 'specially designed components' includes the following when specially designed for military use:*
a. Infrared image converter tubes;
b. Image intensifier tubes (other than first generation);
c. Microchannel plates;
d. Low-light-level television camera tubes;
e. Detector arrays (including electronic interconnection or read out systems);
f. Pyroelectric television camera tubes;
g. Cooling systems for imaging systems;
h. Electrically triggered shutters of the photochromic or electro-optical type having a shutter speed of less than 100 µs, except in the case of shutters which are an essential part of a high speed camera;
i. Fibre optic image inverters;
j. Compound semiconductor photocathodes.

Note 2 *ML 15 does not control "first generation image intensifier tubes".*

N.B.: SEE ALSO ENTRIES 6A002.a.2. AND 6A002.b.

ML16. Forgings, castings and other unfinished products the use of which in a controlled product is identifiable by material composition, geometry or function, and which are specially designed for any products controlled by ML1. to ML4., ML6., ML9., ML10., ML 12. or ML19.

ML17. Miscellaneous equipment, materials and libraries, as follows, and specially designed components therefor:

a. Self-contained diving and underwater swimming apparatus, as follows:
   1. Closed or semi-closed circuit (rebreathing) apparatus specially designed for military use (i.e. specially designed to be non magnetic);
   2. Specially designed components for use in the conversion of open-circuit apparatus to military use;
   3. Articles designed exclusively for military use with self-contained diving and underwater swimming apparatus;

b. Construction equipment specially designed for military use;

c. Fittings, coatings and treatments for signature suppression, specially designed for military use;

d. Field engineer equipment specially designed for use in a combat zone;

e. "Robots", "robot" controllers and "robot" "end-effectors", having any of the following characteristics:
   1. Specially designed for military use;
   2. Incorporating means of protecting hydraulic lines against externally induced punctures caused by ballistic fragments (e.g., incorporating self-sealing lines) and designed to use hydraulic fluids with flash points higher than 839 K (566°C); or
   3. Specially designed or rated for operating in an electro-magnetic pulse (EMP) environment;

f. Libraries (parametric technical databases) specially designed for military use with equipment controlled by the Munitions List;

g. Nuclear power generating equipment or propulsion equipment, including "nuclear reactors", specially designed for military use and components therefor specially designed or modified for military use;

h. Equipment and material, coated or treated for signature suppression, specially designed for military use, other than those controlled elsewhere in the Munitions List;

i. Simulators specially designed for military "nuclear reactors";

j. Mobile repair shops specially designed to service military equipment;

k. Field generators specially designed for military use; and

l. Containers specially designed for military use.

Technical Note
For the purpose of ML17., the term 'library' (parametric technical database) means a collection of technical information of a military nature, reference to which may enhance the performance of military equipment or systems.

ML18. Equipment and "technology" for the production of products referred to in the Munitions List, as follows:

a. Specially designed or modified production equipment for the production of products controlled by the Munitions List, and specially designed components therefor;

b. Specially designed environmental test facilities and specially designed equipment therefor, for the certification, qualification or testing of products controlled by the Munitions List;

c. Specific production "technology", even if the equipment with which such "technology" is to be used is not controlled;

d. "Technology" specific to the design of, the assembly of components into, and the operation, maintenance and repair of, complete production installations even if the components themselves are not controlled.

Note 1 *ML 18.a. and ML 18.b. include the following equipment:*

a. Continuous nitrators;

b. Centrifugal testing apparatus or equipment having any of the following characteristics:

1. Driven by a motor or motors having a total rated horsepower of more than 298 kW (400 hp);

2. Capable of carrying a payload of 113 kg or more; or

3. Capable of exerting a centrifugal acceleration of 8 g or more on a payload of 91 kg or more;

c. Dehydration presses;

d. Screw extruders specially designed or modified for military explosive extrusion;

e. Cutting machines for the sizing of extruded propellants;

f. Sweetie barrels (tumblers) 1.85 m or more in diameter and having over 227 kg product capacity;

g. Continuous mixers for solid propellants;

h. Fluid energy mills for grinding or milling the ingredients of military explosives;

i. Equipment to achieve both sphericity and uniform particle size in metal powder listed in ML 8.a.1.;

j. Convection current converters for the conversion of materials listed in ML 8.a.6.

Technical Note

For the purposes of ML 18., the term 'production' includes design, examination, manufacture, testing and checking.

Note 2

a. The term 'products referred to in the Munitions List' includes:

1. Products not controlled if inferior to specified concentrations as follows:

a. hydrazine (see ML 8.a.18.);

b. "Military explosives" (see ML8.);

2. Products not controlled if inferior to technical limits, (i.e., "superconductive" materials not controlled by item 1C005.; "superconductive" electromagnets not controlled by item 3A001.e.3; "superconductive" electrical equipment excluded from control under ML20.b.);

3. Metal fuels and oxidants deposited in laminar form from the vapour phase (see ML8.a.2.);

b. The term 'products referred to in the Munitions List' does not include:

1. Signal pistols (see ML2.b.);

2. The substances excluded from control under Note 3 to ML7.;

3. Personal radiation monitoring dosimeters (see ML7.f.) and masks for protection against specific industrial hazards, see also Parts 2 and 3 of Defence and Strategic Goods List;

4. *Acetylene, propane, liquid oxygen, difluoramine (HNF_2), fuming nitric acid and potassium nitrate powder (see Note 5 to ML 8.);*
5. *Aero-engines excluded from control under ML10.;*
6. *Conventional steel helmets not equipped with, or modified or designed to accept, any type of accessory device (see Note 2 to ML 13.);*
7. *Equipment fitted with industrial machinery, which is not controlled such as coating machinery not elsewhere specified and equipment for the casting of plastics;*
8. *Muskets, rifles and carbines dated earlier than 1938, reproductions of muskets, rifles and carbines dated earlier than 1890, revolvers, pistols and machine guns dated earlier than 1890, and their reproductions;*
(Note 2.b.8. of ML18. does not allow the export of "technology" or equipment capable of producing non-antique small arms, even if used to produce reproductions of antique small arms).

Note 3 *ML 18.d. does not control "technology" for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry (see Note 4 to ML 7.).*

ML19. Directed energy weapon systems (DEW), related or countermeasure equipment and test models, as follows, and specially designed components therefor:

a. "Laser" systems specially designed for destruction or effecting mission-abort of a target;

b. Particle beam systems capable of destruction or effecting mission-abort of a target;

c. High power radio-frequency (RF) systems capable of destruction or effecting mission-abort of a target;

d. Equipment specially designed for the detection or identification of, or defence against, systems controlled by ML19.a. to ML19.c.;

e. Physical test models and related test results for the systems, equipment and components controlled by this Item.

Note 1 *Directed energy weapon systems controlled by ML19 include systems whose capability is derived from the controlled application of:*
a. "Lasers" of sufficient continuous wave or pulsed power to effect destruction similar to the manner of conventional ammunition;
b. Particle accelerators which project a charged or neutral particle beam with destructive power;
c. High pulsed power or high average power radio frequency beam transmitters which produce fields sufficiently intense to disable electronic circuitry at a distant target.

Note 2 *ML19. includes the following when specially designed for directed energy weapon systems:*
a. Prime power generation, energy storage, switching, power conditioning or fuel-handling equipment;
b. Target acquisition or tracking systems;
c. Systems capable of assessing target damage, destruction or mission-abort;
d. Beam-handling, propagation or pointing equipment;
e. Equipment with rapid beam slew capability for rapid multiple target operations;
f. Adaptive optics and phase conjugators;
g. Current injectors for negative hydrogen ion beams;
h. "Space qualified" accelerator components;

i. Negative ion beam funnelling equipment;
j. Equipment for controlling and slewing a high energy ion beam;
k. "Space qualified" foils for neutralising negative hydrogen isotope beams.

ML20. Cryogenic and "superconductive" equipment, as follows, and specially designed components and accessories therefor:

a. Equipment specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications, capable of operating while in motion and of producing or maintaining temperatures below 103 K (- 170°C);
Note ML20.a. includes mobile systems incorporating or employing accessories or components manufactured from non-metallic or non-electrical conductive materials, such as plastics or epoxy-impregnated materials.

b. "Superconductive" electrical equipment (rotating machinery and transformers) specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications, capable of operating while in motion.
Note ML20.b. does not control direct-current hybrid homopolar generators that have single-pole normal metal armatures which rotate in a magnetic field produced by superconducting windings, provided those windings are the only superconducting component in the generator.

ML21. "Software", as follows:

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials controlled by the Munitions List;

b. Specific "software", as follows:
1. "Software" specially designed for:
a. Modelling, simulation or evaluation of military weapon systems;
b. "Development", monitoring, maintenance or up-dating of "software" embedded in military weapon systems;
c. Modelling or simulating military operation scenarios, not controlled by ML14.;
d. Command, Communications, Control and Intelligence (C^3I) applications;
2. "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

ML22. "Technology" according to the General Technology Note (Munitions List) for the "development", "production" or "use" of items controlled in the Munitions List, other than that "technology" controlled in ML7. and ML18.

ML901 Weapons, as follows, and parts and components therefor:

a. rifles, carbines, muskets, pistols, revolvers, shotguns, machine guns and smooth-bore weapons, other than those specified in Item ML1;

b. air weapons.

Note: Item ML901 does not include: nailing or stapling guns; explosive powered fixing tools used in the building industry; flare guns or other signalling devices, designed for emergency or life-saving purposes; line throwers; tranquilliser guns; guns that operate

a captive bolt for the slaughter of animals, devices for the casting of weighted nets; underwater powerheads; fire extinguisher cartridges; paintball markers.

ML902 Ammunition, including projectiles, and specially designed components therefor, for the firearms specified in Item ML901 above.

ML903 Forgings, castings and semi-finished products specially designed for products specified in Item ML901 above.

ML904 Telescopic sights for firearms specified in Item 901.

ML908 Explosive materials and propellants other than explosive materials or propellants specified in Item ML8, but not including those specially designed for toys, novelty goods and display fireworks.

ML909 Apparatus or devices, other than goods specified in Item ML4, for the detonation of explosive detonators or explosives specified in Item ML908.

PART 2, CATEGORY 0 - NUCLEAR MATERIALS, FACILITIES, AND EQUIPMENT

0A Systems, Equipment and Components

0A001 "Nuclear reactors", i.e. reactors capable of operation so as to maintain a controlled, self-sustaining fission chain reaction, and equipment and components specially designed or prepared for use in connection with a "nuclear reactor", including:

a. Pressure vessels, i.e. metal vessels as complete units or parts therefor, which are specially designed or prepared to contain the core of a "nuclear reactor" and are capable of withstanding the operating pressure of the primary coolant, including the top plate for a reactor pressure vessel;

b. Fuel element handling equipment, including reactor fuel charging and discharging machines;

c. Control rods specially designed or prepared for the control of the reaction rate in a "nuclear reactor", including the neutron absorbing part and the support or suspension structures therefor, and control rod guide tubes;

d. Electronic controls for controlling the power levels in "nuclear reactors", including reactor control rod drive mechanisms and radiation detection and measuring instruments to determine neutron flux levels;

e. Pressure tubes specially designed or prepared to contain fuel elements and the primary coolant in a "nuclear reactor" at an operating pressure in excess of 5.1 MPa;

f. Tubes or assemblies of tubes, made from zirconium metal or alloy in which the ratio of hafnium to zirconium is less than 1:500 parts by weight, specially designed or prepared for use in a "nuclear reactor";

g. Coolant pumps specially designed or prepared for circulating the primary coolant of "nuclear reactors";

h. Internal components specially designed or prepared for the operation of a "nuclear reactor", including core support structures, thermal shields, baffles, core grid plates and diffuser plates;

i. Heat exchangers.

0A002 Power generating or propulsion equipment specially designed for use with space, marine or mobile "nuclear reactors".
N.B.: SEE ALSO ML17g.

Note: *0A002 does not apply to conventional power generating equipment which, although designed for use in a particular nuclear station, could in principle be used in conjunction with conventional systems.*

0B Test, Inspection and Production Equipment

0B001 Plant for the separation of isotopes of "natural uranium" and "depleted uranium", "special fissile materials" and "other fissile materials", and specially designed or prepared equipment and components therefor, as follows:

a. Plant specially designed for separating isotopes of "natural uranium" and "depleted uranium", "special fissile materials" and "other fissile materials", as follows:
   1. Gaseous diffusion separation plant;
   2. Gas centrifuge separation plant;
   3. Aerodynamic separation plant;
   4. Chemical exchange separation plant;
   5. Ion-exchange separation plant;
   6. Atomic vapour "laser" isotopic separation plant;
   7. Molecular "laser" isotopic separation plant;
   8. Plasma separation plant;
   9. Electro magnetic separation plant;

b. Equipment and components, specially designed or prepared for gaseous diffusion separation process, as follows:
   1. Bellow valves made of or protected by materials resistant to UF_6 (e.g. aluminium, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel), with a diameter of 40 mm to 1,500 mm;
   2. a. Compressors (positive displacement, centrifugal and axial flowtypes) or gas blowers with a suction volume capacity of 1 m^3/min or more of UF_6, and discharge pressure up to 666.7 kPa, made of or protected by materials resistant to UF_6 (e.g. aluminium, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel);
      b. Rotary shaft seals for compressors or blowers specified in 0B001.b.2.a. and designed for a buffer gas in-leakage rate of less than 1,000 cm^3/min.;
   3. Gaseous diffusion barriers made of porous metallic, polymer or ceramic materials resistant to corrosion by UF_6 with a pore size of 10 to 100 nm, a thickness of 5 mm or less, and, for tubular forms, a diameter of 25 mm or less;
   4. Gaseous diffuser housings made of or protected by materials resistant to corrosion by UF_6;
   5. Heat exchangers made of aluminium, copper, nickel, or alloys containing more than 60 weight percent nickel, or combinations of these metals as clad tubes, designed to operate at sub-atmospheric pressure with a leak rate that limits the pressure rise to less than 10 Pa per hour under a pressure differential of 100 kPa;

c. Equipment and components, specially designed or prepared for gas centrifuge separation process, as follows:
   1. Gas centrifuges;
   2. Complete rotor assemblies consisting of one or more rotor tube cylinders;
   3. Rotor tube cylinders with a thickness of 12 mm or less, a diameter of between 75 mm and 400 mm, made from any of the following high strength-to-density ratio materials:
      a. Maraging steel capable of an ultimate tensile strength of 2,050 MPa or more;
      b. Aluminium alloys capable of an ultimate tensile strength of 460 MPa or more; or
      c. "Fibrous or filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 76.2×10^3 m;
   4. Magnetic suspension bearings consisting of an annular magnet suspended

within a housing made of UF_6 resistant materials (e.g. aluminium, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel) containing a damping medium and having the magnet coupling with a pole piece or second magnet fitted to the top cap of the rotor;

5. Specially prepared bearings comprising a pivot-cup assembly mounted on a damper;
6. Rings or bellows with a wall thickness of 3 mm or less and a diameter of between 75 mm and 400 mm and designed to give local support to a rotor tube or to join a number together, made from any of the following high strength-to-density ratio materials:
   a. Maraging steel capable of an ultimate tensile strength of 2,050 MPa or more;
   b. Aluminium alloys capable of an ultimate tensile strength of 460 MPa or more; or
   c. "Fibrous or filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 76.2×10^3 m;".
7. Baffles of between 75 mm and 400 mm diameter for mounting inside a rotor tube, made from any of the following high strength-to-density ratio materials
   a. Maraging steel capable of an ultimate tensile strength of 2,050 MPa or more;
   b. Aluminium alloys capable of an ultimate tensile strength of 460 MPa or more; or
   c. "Fibrous or filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 76.2×10^3 m;".
8. Top and bottom caps of between 75 mm and 400 mm diameter to fit the ends of a rotor tube, made from any of the following high strength-to-density ratio materials:
   a. Maraging steel capable of an ultimate tensile strength of 2,050 MPa or more; or
   b. Aluminium alloys capable of an ultimate tensile strength of 460 MPa or more;
   c. "Fibrous or filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 76.2×10^3 m.
9. Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores;
10. Ring-shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 to 2,000 Hz and a power range of 50 to 1,000 Volt-Amps;
11. Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having all of the following characteristics, and specially designed components therefor:
    a. Multiphase output of 600 to 2,000 Hz;
    b. Frequency control better than 0.1%;
    c. Harmonic distortion of less than 2%; and
    d. An efficiency greater than 80%;
12. Centrifuge housing/recipients to contain the rotor tube assembly of a gas centrifuge, consisting of a rigid cylinder of wall thickness up to 30 mm with precision machined ends and made of or protected by UF_6 resistant materials;
13. Scoops consisting of tubes of up to 12 mm internal diameter for the extraction of UF_6 gas from within a centrifuge rotor tube by a Pitot tube action, made of or protected by UF_6 resistant materials;

d. Equipment and components, specially designed or prepared for aerodynamic separation process, as follows:

1. Separation nozzles consisting of slit-shaped, curved channels having a radius of curvature less than 1 mm and having a knife-edge contained within the nozzle which separates the gas flowing through the nozzle into two streams;
2. Tangential inlet flow-driven cylindrical or conical tubes, (vortex tubes), made of or protected by UF_6 resistant materials with a diameter of between 0.5 cm and 4 cm and a length to diameter ratio of 20:1 or less and with one or more tangential inlets;
3. Compressors (positive displacement, centrifugal and axial flow types) or gas blowers with a suction volume capacity of 2 m^3/min, made of or protected by materials resistant to UF_6 (e.g., aluminium, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel), and rotary shaft seals therefor;
4. Aerodynamic separation element housings, made of or protected by materials resistant to UF_6 to contain vortex tubes or separation nozzles;
5. Heat exchangers made of aluminium, copper, nickel, or alloy containing more than 60 weight percent nickel, or combinations of these metals as clad tubes, designed to operate at pressures of 600 kPa or less;
6. Bellows valves made of or protected by UF_6 resistant materials with a diameter of 40 to 1,500 mm;
7. Process systems for separating UF_6 from carrier gas (hydrogen or helium) to 1 ppm UF_6 content or less, including:
   a. Cryogenic heat exchangers and cryoseparators capable of temperatures of -120 ^{0}C or less;
   b. Cryogenic refrigeration units capable of temperatures of -120 ^{0}C or less;
   c. Separation nozzle or vortex tube units for the separation of UF_6 from carrier gas;
   d. UF_6 cold traps capable of temperatures of -20 ^{0}C or less;

e. Equipment and components, specially designed or prepared for chemical exchange separation process, as follows:
   1. Fast-exchange liquid-liquid centrifugal contactors with stage residence time of 30 seconds or less and resistant to concentrated hydrochloric acid, (e.g., made of or lined with suitable plastic materials such as fluorocarbon polymers or lined with glass);
   2. Fast-exchange liquid-liquid pulse columns with stage residence time of 30 seconds or less and resistant to concentrated hydrochloric acid,(e.g., made of or lined with suitable plastic materials such as fluorocarbon polymers or lined with glass);
   3. Electrochemical reduction cells designed to reduce uranium from one valence state to another;
   4. Electrochemical reduction cells feed equipment to take U^{+4} from the organic stream and, for those parts in contact with the process stream, made of or protected by suitable materials (e.g., glass, fluorocarbon polymers, polyphenyl sulphate, polyether sulfone and resin-impregnated graphite);
   5. Feed preparation systems for producing high purity uranium chloride solution consisting of dissolution, solvent extraction and/or ion exchange equipment for purification and electrolytic cells for reducing the uranium U^{+6} or U^{+4} to U^{+3};
   6. Uranium oxidation systems for oxidation of U^{+3} to U^{+4};

f. Equipment and components, specially designed or prepared for ion-exchange separation process, as follows:
   1. Fast reacting ion-exchange resins, pellicular or porous macro- reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inactive porous support structure, and other composite structures in any suitable form, including particles or fibres, with diameters of 0.2 mm or less, resistant to concentrated hydrochloric acid and designed to have an exchange rate

half-time of less than 10 seconds and capable of operating at temperatures in the range of 100 °C to 200 °C;

2. Ion exchange columns (cylindrical) with a diameter greater than 1000 mm, made of or protected by materials resistant to concentrated hydrochloric acid (e.g. titanium or fluorocarbon plastics) and capable of operating at temperatures in the range of 100 °C to 200 °C and pressures above 0.7 MPa;
3. Ion exchange reflux systems (chemical or electrochemical oxidation or reduction systems) for regeneration of the chemical reducing or oxidizing agents used in ion exchange enrichment cascades;

g. Equipment and components, specially designed or prepared for atomic vapour "laser" isotopic separation process, as follows:
   1. High power electron beam guns with total power of more than 50 kW and strip or scanning electron beam guns with a delivered power of more than 2.5 kW/cm for use in uranium vaporization systems;
   2. Trough shaped crucibles and cooling equipment made of or protected by materials resistant to heat and corrosion of molten uranium or uranium alloys (e.g., tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof);
      N.B: SEE ALSO ENTRY 2A225.
   3. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium vapour, such as yttria-coated graphite or tantalum;
   4. Separator module housings (cylindrical or rectangular vessels) for containing the uranium metal vapour source, the electron beam gun and the product and tails collectors;
   5. "Lasers" or "laser" systems for the separation of uranium isotopes with a spectrum frequency stabiliser for operation over extended periods of time;
      N.B.: SEE ALSO 6A005 AND 6A205.

h. Equipment and components, specially designed or prepared for molecular "laser" isotopic separation process, as follows:
   1. Supersonic expansion nozzles for cooling mixtures of UF_6 and carrier gas to 150 K or less and made from UF_6 resistant materials;
   2. Uranium fluoride (UF_5) product collectors consisting of filter, impact, or cyclone-type collectors or combinations thereof, and made of UF_5/UF_6 resistant materials (e.g. aluminium, aluminium alloys, nickel or alloys containing 60 weight percent of nickel and UF_6 resistant fully fluorinated hydrocarbon polymers);
   3. Equipment for fluorinating UF_5 to UF_6;
   4. Compressors made of or protected by materials resistant to UF_6 (e.g., aluminium, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel), and rotary shaft seals therefor;
   5. Process systems for separating UF_6 from carrier gas (e.g., nitrogen or argon) including:
      a. Cryogenic heat exchangers and cryoseparators capable of temperatures of -120 °C or less;
      b. Cryogenic refrigeration units capable of temperatures of -120 °C or less;
      c. UF_6 cold traps capable of temperatures of -20 °C or less;
   6. "Lasers" or "laser" systems for the separation of uranium isotopes with a spectrum frequency stabiliser for operation over extended periods of time;
      N.B.: SEE ALSO 6A005 AND 6A205.

i. Equipment and components, specially designed or prepared for plasma separation process, as follows:
   1. Product and tails collectors made of or protected by materials resistant to the heat and corrosion of uranium vapour such as yttria-coated graphite or tantalum;

2. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power;
3. Microwave power sources and antennae for producing or accelerating ions, with an output frequency greater than 30GHz and mean power output greater than 50 kW;
4. Uranium plasma generation systems;
5. Liquid uranium metal handling systems consisting of crucibles, made of or protected by suitable corrosion and heat resistant materials (e.g., tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof), and cooling equipment for the crucibles;
N.B.: SEE ALSO ENTRY 2A225.
6. Separator module housings (cylindrical) for containing the uranium plasma source, radio-frequency drive coil and the product and tails collectors and made of a suitable non-magnetic material (e.g. stainless steel);

j. Equipment and components, specially designed or prepared for electromagnetic separation process, as follows:
1. Ion sources, single or multiple, consisting of a vapour source, ionizer, and beam accelerator made of suitable materials (e.g., graphite, stainless steel, or copper) and capable of providing a total ion beam current of 50 mA or greater;
2. Ion collector plates for collection of enriched or depleted uranium ion beams, consisting of two or more slits and pockets and made of suitable non-magnetic materials (e.g. graphite or stainless steel);
3. Vacuum housings for uranium electromagnetic separators made of non-magnetic materials (e.g. graphite or stainless steel) and designed to operate at pressures of 0.1 Pa or lower;
4. Magnet pole pieces with a diameter greater than 2 m;
5. High voltage power supplies for ion sources, having all of the following characteristics:
a. Capable of continuous operation;
b. Output voltage of 20,000 V or greater;
c. Output current of 1 A or greater;
d. Voltage regulation of better than 0.01% over a period of 8 hours;
N.B.: SEE ALSO 3A227.
6. Magnet power supplies (high power, direct current) having all of the following characteristics:
a. Capable of continuous operation with a current output of 500 A or greater at a voltage of 100 V or greater;
b. Current or voltage regulation better than 0.01% over a period of 8 hours.
N.B.: SEE ALSO 3A226.

0B002 Specially designed or prepared auxiliary systems, equipment and components, as follows, for isotope separation plant specified in 0B001, made of or protected by UF_6 resistant materials:
a. Feed autoclaves, ovens or systems used for passing UF_6 to the enrichment process;
b. Desublimers or cold traps, used to remove UF_6 from the enrichment process for subsequent transfer upon heating;
c. Product and tails stations for transferring UF_6 into containers;
d. Liquefaction or solidification stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid form;
e. Piping systems and header systems specially designed for handling UF_6 within gaseous diffusion, centrifuge or aerodynamic cascades made of or protected by UF_6 resistant materials;
f. 1. Vacuum manifolds or vacuum headers having a suction capacity of 5 m^3/minute or more; or
2. vacuum pumps specially designed for use in UF_6 bearing atmospheres;

g. UF_6 mass spectrometers/ion sources specially designed or prepared for taking on-line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:
   1. Unit resolution for mass of more than 320 amu;
   2. Ion sources constructed of or lined with nichrome or monel, or nickel plated;
   3. Electron bombardment ionization sources; and
   4. Collector system suitable for isotopic analysis.

0B003 Plant for the production of uranium hexafluoride (UF_6) and specially designed or prepared equipment and components therefor, as follows:

a. Plant for the production of UF_6;

b. Equipment and components, as follows, specially designed of prepared for UF_6 production:
   1. Fluorination and hydrofluorination screw and fluid bed reactors and flame towers;
   2. Distillation equipment for the purification of UF_6.

0B004 Plant for the production of heavy water, deuterium or deuterium compounds, and specially designed or prepared equipment and components therefor, as follows:

a. Plant for the production of heavy water, deuterium or deuterium compounds, as follows:
   1. Hydrogen sulphide-water exchange plants;
   2. Ammonia-hydrogen exchange plants;
   3. Hydrogen distillation plants;

b. Equipment and components, as follows, designed for:
   1. Hydrogen sulphide-water exchange process:
      a. Tray exchange towers;
      b. Hydrogen sulphide gas compressors;
   2. Ammonia-hydrogen exchange process:
      a. High-pressure ammonia-hydrogen exchange towers;
      b. High-efficiency stage contactors;
      c. Submersible stage recirculation pumps;
      d. Ammonia crackers designed for pressures of more than 3 MPa;
   3. Hydrogen distillation process:
      a. Hydrogen cryogenic distillation towers and cold boxes designed for operation below 35 K (-238°c);
      b. Turboexpanders or turboexpander-compressor sets designed for operation below 35 K (-238°c);
   4. Heavy water concentration process to reactor grade level (99.75 weight percent deuterium oxide):
      a. Water distillation towers containing specially designed packings;
      b. Ammonia distillation towers containing specially designed packings;
      c. Catalytic burners for conversion of fully enriched deuterium to heavy water;
      d. Infrared absorption analysers capable of on-line hydrogen-deuterium ratio analysis where deuterium concentrations are equal to or more than 90 weight percent.

0B005 Plant specially designed for the fabrication of "nuclear reactor" fuel elements and specially designed equipment therefor.

Note: A plant for the fabrication of "nuclear reactor" fuel elements includes equipment which:

a. Normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;
b. Seals the nuclear materials within the cladding;
c. Checks the integrity of the cladding or the seal; and
d. Checks the finish treatment of the solid fuel.

0B006 Plant for the reprocessing of irradiated "nuclear reactor" fuel elements, and specially designed or prepared equipment and components therefor, including:

a. Fuel element chopping or shredding machines, i.e. remotely operated equipment to cut, chop, shred or shear irradiated "nuclear reactor" fuel assemblies, bundles or rods;

b. Dissolvers, critically safe tanks (e.g. small diameter, annular or slab tanks) specially designed or prepared for the dissolution of irradiated "nuclear reactor" fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded and maintained;

c. Counter-current solvent extractors and ion-exchange processing equipment specially designed or prepared for use in a plant for the reprocessing of irradiated "natural uranium", "depleted uranium" or "special fissile materials" and "other fissile materials";

d. Process control instrumentation specially designed or prepared for monitoring or controlling the reprocessing of irradiated "natural uranium", "depleted uranium" or "special fissile materials" and "other fissile materials";

e. Holding or storage vessels specially designed to be critically safe and resistant to the corrosive effects of nitric acid;

Note: Critically safe tanks may have the following features:
1. Walls or internal structures with a boron equivalent of at least two percent;
2. A maximum diameter or 175 mm for cylindrical vessels; or
3. A maximum width of 75 mm for either a slab or annular vessel.

f. Complete systems specially designed or prepared for the conversion of plutonium nitrate to plutonium oxide;

g. Complete systems specially designed or prepared for the production of plutonium metal.

Note: Plant for the reprocessing of irradiated "nuclear reactor" fuel elements includes equipment and components which normally come into direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

0B008 Equipment for "nuclear reactors":

a. Simulators specially designed for "nuclear reactors";
b. Ultrasonic or eddy current test equipment specially designed for "nuclear reactors".

0B009 Plant for the conversion of uranium and equipment specially designed or prepared therefor, as follows:
a. Systems for the conversion of uranium ore concentrates to UO_3;
b. Systems for the conversion of UO_3 to UF_6;
c. Systems for the conversion of UO_3 to UO_2;
d. Systems for the conversion of UO_2 to UF_4;

e. Systems for the conversion of UF_4 to UF_6;
f. Systems for the conversion of UF_4 to uranium metal;
g. Systems for the conversion of UF_6 to UO_2;
h. Systems for the conversion of UF_6 to UF_4.

0C Materials

0C004 Deuterium, heavy water, deuterated paraffins and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5000.

0C005 Graphite, nuclear-grade, having a purity level of less than 5 parts per million "boron equivalent" and with a density greater than 1.5 g/cm^3.

0C006 Nickel powder or porous nickel metal, specially prepared for the manufacture of gaseous diffusion barriers, as follows:
N.B.: SEE ALSO 1C240.
a. Powder with a nickel purity content of 99.9 weight percent or more and a mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard and a high degree of particle size uniformity; or
b. Porous nickel metal produced from materials specified in 0C006.a.

0C201 Specially prepared compounds or powders, other than nickel, resistant to corrosion by UF_6 (e.g. aluminium oxide and fully fluorinated hydrocarbon polymers), for the manufacture of gaseous diffusion barriers, having a purity of 99.9 weight percent or more and a mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard and a high degree of particle size uniformity.

0D Software

0D001 "Software" specially designed or modified for the "development", "production" or "use" of goods specified in this Category.

0E Technology

0E001 "Technology" according to the Nuclear Technology Note for the "development", "production" or "use" of goods specified in this Category.

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PART 3, CATEGORY 1 - MATERIALS, CHEMICALS, "MICROORGANISMS" & "TOXINS"

1A Systems, Equipment and Components

1A001 Components made from fluorinated compounds, as follows:

a. Seals, gaskets, sealants or fuel bladders specially designed for "aircraft" or aerospace use made from more than 50 % by weight of any of the materials specified in 1C009.b. or 1C009.c.;

b. Piezoelectric polymers and copolymers made from vinylidene fluoride materials specified in 1C009.a.:
   1. In sheet or film form; and
   2. With a thickness exceeding 200 µm;

c. Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers containing at least one vinylether monomer, specially designed for "aircraft", aerospace or missile use.

Note: In 1A001.c., 'missile' means complete rocket systems and unmanned air vehicle systems.

1A002 "Composite" structures or laminates, having any of the following:
N..B: SEE ALSO 1A202, 9A010 and 9A110

a. An organic "matrix" and made from materials specified in 1C010.c., 1C010.d. or 1C010.e.; or

b. A metal or carbon "matrix" and made from:
   1. Carbon "fibrous or filamentary materials" with:
      a. A "specific modulus" exceeding 10.15×10^6 m; and
      b. A "specific tensile" strength exceeding 17.7×10^4 m; or
   2. Materials specified in 1C010.c.

Notes:
1. *1A002 does not control composite structures or laminates made from epoxy resin impregnated carbon "fibrous or filamentary materials" for the repair of aircraft structures or laminates, provided the size does not exceed 1 m^2.*
2. *1A002 does not control finished or semi-finished items specially designed for purely civilian applications as follows:*
   a. *Sporting goods;*
   b. *Automotive industry;*
   c. *Machine tool industry;*
   d. *Medical applications.*

1A003 Manufactures of non-fluorinated polymeric substances specified in 1C008.a.3. in film, sheet, tape or ribbon form with either of the following characteristics :
a. With a thickness exceeding 0.254 mm; or
b. Coated or laminated with carbon, graphite, metals or magnetic substances.

Note: *1A003 does not control manufactures when coated or laminated with copper and designed for the production of electronic printed circuit boards.*

1A004 Protective and detection equipment and components, other than those specified in ML7, as follows:
N.B.: SEE ALSO 2B351 AND 2B352.

a. Gas masks, filter canisters and decontamination equipment therefor designed or modified for defence against biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents and specially designed components therefor;

b. Protective suits, gloves and shoes specially designed or modified for defence against biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents;

c. Nuclear, biological and chemical (NBC) detection systems specially designed or modified for detection or identification of biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents and specially designed components therefor.

Note: *1A004 does not control :*
a. Personal radiation monitoring dosimeters;
b. Equipment limited by design or function to protect against hazards specific to civil industries, such as mining, quarrying, agriculture, pharmaceuticals, medical, veterinary, environmental, waste management, or to the food industry.

1A005 Body armour, and specially designed components therefor, other than those manufactured to military standards or specifications or to their equivalents in performance.
N.B.: SEE ALSO ML13.

Notes: *1. 1A005 does not control individual suits of body armour and accessories therefor, when accompanying their users for his/her own personal protection.*
2. 1A005 does not control body armour designed to provide frontal protection only from both fragment and blast from non-military explosive devices.

1A102 Resaturated pyrolized carbon-carbon materials designed for systems specified in 9A004 or 9A104.

1A202 Composite structures, other than those specified in 1A002, in the form of tubes with an inside diameter of between 75 mm and 400 mm made with any of the "fibrous or filamentary materials" specified in 1C010.a. or b. or 1C210.a. or with carbon prepreg materials specified in 1C210.c.
N.B.: SEE ALSO 9A010 AND 9A110.

1A225 Platinized catalysts specially designed or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of tritium from heavy water or for the production of heavy water.

1A226 Specialized packings for use in separating heavy water from ordinary water and made of phosphor bronze mesh (chemically treated to improve wettability) and designed for use in vacuum distillation towers.

1A227 High-density (lead glass or other) radiation shielding windows greater than 0.09 m^2 on cold area and with a density greater than 3 g/cm^3 and a thickness of 100 mm or greater; and specially designed frames therefor.

1B Test, Inspection and Production Equipment

1B001 Equipment for the production of fibres, prepregs, preforms or "composites" specified in 1A002 or 1C010., as follows, and specially designed components and accessories therefor:
N.B.: SEE ALSO 1B101 AND 1B201.

a. Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, specially designed for the manufacture of "composite" structures or laminates from "fibrous or filamentary materials";

b. Tape-laying or tow-placement machines of which the motions for positioning and laying tape, tows or sheets are coordinated and programmed in two or more axes, specially designed for the manufacture of "composite" airframe or 'missile' structures;

Note: In 1B001.b., 'missile' means complete rocket systems and unmanned air vehicle systems.

c. Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, for weaving, interlacing or braiding fibres to manufacture "composite" structures;

Note: 1B001.c. does not control textile machinery not modified for the above end-uses.

d. Equipment specially designed or adapted for the production of reinforcement fibres, as follows:
   1. Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon, pitch or polycarbosilane) into carbon fibres or silicon carbide fibres, including special equipment to strain the fibre during heating;
   2. Equipment for the chemical vapour deposition of elements or compounds on heated filamentary substrates to manufacture silicon carbide fibres;
   3. Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);
   4. Equipment for converting aluminium containing precursor fibres into alumina fibres by heat treatment;

e. Equipment for producing prepregs specified in 1C010.e. by the hot melt method;

f. Non-destructive inspection equipment capable of inspecting defects three dimensionally, using ultrasonic or X-ray tomography and specially designed for "composite" materials.

1B002 Systems and components therefor, specially designed to avoid contamination and specially designed for producing metal alloys, metal alloy powder or alloyed materials specified in 1C002.a.2., 1C002.b. or 1C002.c.

1B003 Tools, dies, moulds or fixtures, for "superplastic forming" or "diffusion bonding" titanium or aluminium or their alloys, specially designed for the manufacture of:

a. Airframe or aerospace structures;

b. "Aircraft" or aerospace engines; or

c. Specially designed components for those structures or engines.

1B101 Equipment, other than that specified in 1B001, for the "production" of structural composites as follows; and specially designed components and accessories therefor:
N.B.: SEE ALSO 1B201.

Note: Components and accessories specified in 1B101 include moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.

a. Filament winding machines of which the motions for positioning, wrapping and winding fibres can be coordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous or filamentary materials, and coordinating and programming controls;

b. Tape-laying machines of which the motions for positioning and laying tape and sheets can be coordinated and programmed in two or more axes, designed for the manufacture of composite airframe and "missile" structures;

c. Equipment designed or modified for the "production" of "fibrous or filamentary materials" as follows:
1. Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon or polycarbosilane) including special provision to strain the fibre during heating;
2. Equipment for the vapour deposition of elements or compounds on heated filament substrates; and
3. Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);

d. Equipment designed or modified for special fibre surface treatment or for producing prepregs and preforms specified in entry 9A110.

Note: Equipment covered in 1B101.d. includes rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

1B115 Equipment for the "production", handling and acceptance testing of propellants or propellant constituents specified in 1C011a, 1C011b, 1C111 or in ML8, and specially designed components therefor.

Notes:
1. *The only mixers specified in 1B115 are those which have provision for mixing under vacuum in the range of zero to 13.326 kPa and with temperature control capability of the mixing chamber:*
   a. *Batch mixers having a total volumetric capacity of 110 litres or more and at least one mixing/kneading shaft mounted off centre;*
   b. *Continuous mixers having two or more mixing/kneading shafts and capability to open the mixing chamber.*
2. *For equipment specially designed for the production of military goods, see the Munitions List.*
3. *1B115 does not control equipment for the "production", handling and acceptance testing of boron carbide.*

1B116 Specially designed nozzles for producing pyrolitically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,573 K (1,300°C) to 3,173 K (2,900°C) temperature range at pressures of 130 Pa to 20 kPa.

1B201 Filament winding machines, other than those specified in 1B001 or 1B101, in which the motions for positioning, wrapping, and winding fibres are coordinated and programmed in two or more axes, specially designed to fabricate composite structures or laminates from "fibrous or filamentary materials" and capable of winding cylindrical rotors of diameter between 75 mm and 400 mm and lengths of 600 mm or greater and coordinating and programming controls and precision mandrels therefor.

1B225 Electrolytic cells for fluorine production with a production capacity greater than 250g of fluorine per hour.

1B226 Electromagnetic isotope separators, designed for or equipped with,single or multiple ion sources capable of providing a total ion beam current of 50 mA or greater.

Note: *1B226 includes separators:*

a. Capable of enriching stable isotopes;

b. With the ion sources and collectors both in the magnetic field and those configurations in which they are external to the field.

1B227 Ammonia synthesis converters or ammonia synthesis units in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high-pressure exchange column and the synthesized ammonia is returned to said column.

1B228 Hydrogen-cryogenic distillation columns having all of the following characteristics:

a. Designed to operate with internal temperatures of 35 K (-238°C) or less;
b. Designed to operate at an internal pressure of 0.5 to 5 MPa (5 to 50 atmospheres);
c. Constructed of 'fine-grain stainless steels' of the 300 series with low sulphur content or equivalent cryogenic and H_2-compatible materials; and
d. With internal diameters of 1 m or greater and effective lengths of 5 m or greater.

Technical Note:
'Fine-grain stainless steels' in 1B228 are defined to be fine-grain austenitic stainless steels with an ASTM (or equivalent standard) grain size number of 5 or greater.

1B229 Water-hydrogen sulphide exchange tray columns constructed from fine carbon steel with a diameter of 1.8 m or greater, which can operate at a nominal pressure of 2 MPa or greater, and internal contactors therefor.

Notes: *1. For columns which are specially designed or prepared for the production of heavy water see 0B004.*

2. Internal contactors of the columns are segmented trays which have an effective assembled diameter of 1.8 m or greater, are designed to facilitate countercurrent contacting and are constructed of materials

resistant to corrosion by hydrogen sulphide/water mixtures. These may be sieve trays, valve trays, bubble cap trays, or turbogrid trays.

3. *'Fine Carbon steel' in 1B229 is defined to be steel with the austenitic ASTM (or equivalent standard) grain size number of 5 or greater.*
4. *Materials resistant to corrosion by hydrogen sulphide/water mixtures in 1B229 are defined to be stainless steels with a carbon content of 0.03% or less.*

1B230 Pumps circulating solutions of diluted or concentrated potassium amide catalyst in liquid ammonia (KNH_2/NH_3), with all of the following characteristics:

a. Airtight (i.e., hermetically sealed);

b. For concentrated potassium amide solutions (1% or greater), operating pressure of 1.5-60 MPa (15-600 atmospheres); for dilute potassium amide solutions (less than 1%), operating pressure of 20-60 MPa (200-600 atmospheres); and

c. A capacity greater than 8.5 m^3/hr.

1B231 Tritium facilities, plant or equipment, as follows:

a. Facilities or plant for the production, recovery, extraction, concentration, or handling of tritium;
b. Equipment for tritium facilities or plant, as follows:
   1. Hydrogen or helium refrigeration units capable of cooling to 23 K (-250°C) or less, with heat removal capacity greater than 150 watts; or
   2. Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.

1B232 Turboexpanders or turboexpander-compressor sets designed for operation below 35 K (-238°C) and a throughput of hydrogen gas of 1000 kg/hr or greater.

1B233 Lithium isotope separation facilities, plant or equipment, as follows:
a. Facilities or plant for the separation of lithium isotopes;

b. Equipment for the separation of lithium isotopes, as follows:
   1. Packed liquid-liquid exchange columns specially designed for lithium amalgams;
   2. Mercury and/or lithium amalgam pumps;
   3. Lithium amalgam electrolysis cells;
   4. Evaporators for concentrated lithium hydroxide solution.

1C Materials

Technical Note:

Metals and alloys:
Unless provision to the contrary is made, the words 'metals' and 'alloys' in 1C001 to 1C012 cover crude and semi-fabricated forms, as follows:

Crude forms:
Anodes, balls, bars (including notched bars and wire bars), billets, blocks, blooms, brickets, cakes, cathodes, crystals, cubes, dice, grains, granules, ingots, lumps, pellets, pigs, powder, rondelles, shot, slabs, slugs, sponge, sticks;
Semi-fabricated forms (whether or not coated, plated, drilled or punched):

a. *Wrought or worked materials fabricated by rolling, drawing, extruding, forging, impact extruding, pressing, graining, atomising, and grinding, i.e.: angles, channels, circles, discs, dust, flakes, foils and leaf, forging, plate, powder, pressings and stampings, ribbons, rings, rods (including bare welding rods, wire rods, and rolled wire), sections, shapes, sheets, strip, pipe and tubes (including tube rounds, squares, and hollows), drawn or extruded wire;*

b. *Cast material produced by casting in sand, die, metal, plaster or other types of moulds, including high pressure castings, sintered forms, and forms made by powder metallurgy.*

The object of the control should not be defeated by the export of non-listed forms alleged to be finished products but representing in reality crude forms or semi-fabricated forms.

1C001 Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows:
N.B.: SEE ALSO 1C101.

a. Materials for absorbing frequencies exceeding 2×10^8 Hz but less than 3×10^{12} Hz;

Notes: 1. *1C001.a. does not control:*
- a. *Hair type absorbers, constructed of natural or synthetic fibres, with non-magnetic loading to provide absorption;*
- b. *Absorbers having no magnetic loss and whose incident surface is non-planar in shape, including pyramids, cones, wedges and convoluted surfaces;*
- c. *Planar absorbers, having all of the following characteristics:*
  1. *Made from any of the following:*
     - a. *Plastic foam materials (flexible or non-flexible) with carbon-loading, or organic materials, including binders, providing more than 5% echo compared with metal over a bandwidth exceeding ±15% of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 450 K (177° C); or*
     - b. *Ceramic materials providing more than 20% echo compared with metal over a bandwidth exceeding ±15% of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527°C);*

  Technical Note:
  Absorption test samples for 1C001.a. Note: 1.c.1. should be a square at least 5 wavelengths of the centre frequency on a side and positioned in the far field of the radiating element.
  2. *Tensile strength less than 7×10^6 N/m^2; and*
  3. *Compressive strength less than 14×10^6 N/m^2;*
- d. *Planar absorbers made of sintered ferrite, having:*
  1. *A specific gravity exceeding 4.4; and*
  2. *A maximum operating temperature of 548 K (275°C).*

2: *Nothing in 1C001.a. releases magnetic materials to provide absorption when contained in paint.*

b. Materials for absorbing frequencies exceeding 1.5×10^{14} Hz but less than 3.7×10^{14} Hz and not transparent to visible light;

c. Intrinsically conductive polymeric materials with a bulk electrical conductivity exceeding 10,000 S/m (Siemens per metre) or a sheet (surface) resistivity of less than 100 ohms/square, based on any of the following polymers:
   1. Polyaniline;
   2. Polypyrrole;
   3. Polythiophene;
   4. Poly phenylene-vinylene; or
   5. Poly thienylene-vinylene.

   Technical Note:
   Bulk electrical conductivity and sheet (surface) resistivity should be determined using ASTM D-257 or national equivalents.

1C002 Metal alloys, metal alloy powder and alloyed materials, as follows:
N.B.: SEE ALSO 1C202.

Note: 1C002 does not control metal alloys, metal alloy powder and alloyed materials for coating substrates.

a. Metal alloys, as follows:
   1. Nickel or titanium-based alloys in the form of aluminides, as follows, in crude or semi-fabricated forms:
      a. Nickel aluminides containing a minimum of 15 weight percent aluminium, a maximum of 38 weight percent aluminium and at least one additional alloying element ;
      b. Titanium aluminides containing 10 weight percent or more aluminium and at least one additional alloying element ;
   2. Metal alloys, as follows, made from metal alloy powder or particulate material specified in 1C002.b.:
      a. Nickel alloys with:
         1. A stress-rupture life of 10,000 hours or longer at 923 K (650°C) at a stress of 676 MPa; or
         2. A low cycle fatigue life of 10,000 cycles or more at 823 K (550° C) at a maximum stress of 1,095 MPa;
      b. Niobium alloys with:
         1. A stress-rupture life of 10,000 hours or longer at 1,073 K (800°C) at a stress of 400 MPa; or
         2. A low cycle fatigue life of 10,000 cycles or more at 973 K (700°C) at a maximum stress of 700 MPa;
      c. Titanium alloys with:
         1. A stress-rupture life of 10,000 hours or longer at 723 K (450°C) at a stress of 200 MPa; or
         2. A low cycle fatigue life of 10,000 cycles or more at 723 K (450°C) at a maximum stress of 400 MPa;
      d. Aluminium alloys with a tensile strength of:
         1. 240 MPa or more at 473 K (200°C); or
         2. 415 MPa or more at 298 K (25°C);

      e. Magnesium alloys with a tensile strength of 345 MPa or more and a corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G-31 or national equivalents;

   Technical Notes:
   1. *The metal alloys in 1C002.a. are those containing a higher percentage by weight of the stated metal than of any other element.*
   2. *Stress-rupture life should be measured in accordance with ASTM standard E-139 or national equivalents.*
   3. *Low cycle fatigue life should be measured in accordance with ASTM Standard E-606 'Recommended Practice for Constant-Amplitude Low-Cycle*

Fatigue Testing' or national equivalents. Testing should be axial with an average stress ratio equal to 1 and a stress-concentration factor (K_t) equal to 1. The average stress is defined as maximum stress minus minimum stress divided by maximum stress.

b. Metal alloy powder or particulate material for materials specified in 1C002.a., as follows:
   1. Made from any of the following composition systems:
      Technical Note:
      X in the following equals one or more alloying elements.
      a. Nickel alloys (Ni-Al-X, Ni-X-Al) qualified for turbine engine parts or components, i.e. with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100 µm in 10^9 alloy particles;
      b. Niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);
      c. Titanium alloys (Ti-Al-X or Ti-X-Al);
      d. Aluminium alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); or
      e. Magnesium alloys (Mg-Al-X or Mg-X-Al); and
   2. Made in a controlled environment by any of the following processes:
      a. "Vacuum atomisation";
      b. "Gas atomisation";
      c. "Rotary atomisation";
      d. "Splat quenching";
      e. "Melt spinning" and "comminution";
      f. "Melt extraction" and "comminution"; or
      g. "Mechanical alloying";

c. Alloyed materials, in the form of uncomminuted flakes, ribbons or thin rods produced in a controlled environment by "splat quenching", "melt spinning" or "melt extraction", used in the manufacture of metal alloy powder or particulate material specified in 1C002.b.

1C003 Magnetic metals, of all types and of whatever form, having any of the following characteristics:

a. Initial relative permeability of 120,000 or more and a thickness of 0.05 mm or less;
   Technical Note:
   Measurement of initial permeability must be performed on fully annealed materials.

b. Magnetostrictive alloys, having any of the following characteristics:
   1. A saturation magnetostriction of more than 5×10^{-4}; or
   2. A magnetomechanical coupling factor (k) of more than 0.8; or

c. Amorphous or nanocrystalline alloy strips, having all of the following characteristics:
   1. A composition having a minimum of 75 weight percent of iron, cobalt or nickel;
   2. A saturation magnetic induction (B_S) of 1.6 T or more; and
   3. Any of the following:
      a. A strip thickness of 0.02 mm or less; or
      b. An electrical resistivity of 2×10^{-4} ohm cm or more.

Technical Note:

'Nanocrystalline' materials in 1C003.c. are those materials having a crystal grain size of 50 nm or less, as determined by X-ray diffraction.

1C004 Uranium titanium alloys or tungsten alloys with a "matrix" based on iron, nickel or copper, having all of the following:

a. A density exceeding 17.5 g/cm^3;
b. An elastic limit exceeding 1,250 MPa;
c. An ultimate tensile strength exceeding 1,270 MPa; and
d. An elongation exceeding 8%.

1C005 "Superconductive" "composite" conductors in lengths exceeding 100 m or with a mass exceeding 100 g, as follows:

a. Multifilamentary "superconductive" "composite" conductors containing one or more niobium-titanium filaments:
   1. Embedded in a "matrix" other than a copper or copper-based mixed "matrix"; or
   2. Having a cross-section area less than 0.28 x 10^{-4} mm^2 (6 µm in diameter for circular filaments);

b. "Superconductive" "composite" conductors consisting of one or more "superconductive" filaments other than niobium-titanium, having all of the following:
   1. A "critical temperature" at zero magnetic induction exceeding 9.85 K (-263.31°C) but less than 24 K (-249.16°C);
   2. A cross-section area less than 0.28 x 10^{-4} mm^2; and
   3. Remaining in the "superconductive" state at a temperature of 4.2 K (-268.96°C) when exposed to a magnetic field corresponding to a magnetic induction of 12 T.

1C006 Fluids and lubricating materials, as follows:

a. Hydraulic fluids containing, as their principal ingredients, any of the following compounds or materials:
   1. Synthetic hydrocarbon oils or silahydrocarbon oils, having all of the following:
      Note: For the purpose of 1C006.a.1., silahydrocarbon oils contain exclusively silicon, hydrogen and carbon.
      a. A flash point exceeding 477 K (204°C);
      b. A pour point at 239 K (-34°C) or less;
      c. A viscosity index of 75 or more; and
      d. A thermal stability at 616 K (343°C); or

   2. Chlorofluorocarbons, having all of the following:
      Note: For the purpose of 1C006.a.2., chlorofluorocarbons contain exclusively carbon, fluorine and chlorine.
      a. No flash point;
      b. An autogenous ignition temperature exceeding 977 K (704°C);
      c. A pour point at 219 K (-54°C) or less;
      d. A viscosity index of 80 or more; and
      e. A boiling point at 473 K (200°C) or higher;

b. Lubricating materials containing, as their principal ingredients, any of the following compounds or materials:

1. Phenylene or alkylphenylene ethers or thio-ethers, or their mixtures, containing more than two ether or thio-ether functions or mixtures thereof; or
2. Fluorinated silicone fluids with a kinematic viscosity of less than 5,000 mm^2/s (5,000 centistokes) measured at 298 K (25°C);

c. Damping or flotation fluids with a purity exceeding 99.8%, containing less than 25 particles of 200 µm or larger in size per 100 ml and made from at least 85% of any of the following compounds or materials:
   1. Dibromotetrafluoroethane;
   2. Polychlorotrifluoroethylene (oily and waxy modifications only); or
   3. Polybromotrifluoroethylene;

d. Fluorocarbon electronic cooling fluids, having all of the following characteristics:
   1. Containing 85% by weight or more of any of the following, or mixtures thereof:
      a. Monomeric forms of perfluoropolyalkylether-triazines or perfluoroaliphatic-ethers;
      b. Perfluoroalkylamines;
      c. Perfluorocycloalkanes; or
      d. Perfluoroalkanes;
   2. Density at 298 K (25°C) of 1.5 g/ml or more;
   3. In a liquid state at 273 K (0°C); and
   4. Containing 60% or more by weight of fluorine.

Technical Note:
For the purpose of 1C006:

a. *Flash point is determined using the Cleveland Open Cup Method described in ASTM D-92 or national equivalents;*
b. *Pour point is determined using the method described in ASTM D-97 or national equivalents;*
c. *Viscosity index is determined using the method described in ASTM D-2270 or national equivalents;*
d. *Thermal stability is determined by the following test procedure or national equivalents:*
   Twenty ml of the fluid under test is placed in a 46 ml type 317 stainless steel chamber containing one each of 12.5 mm (nominal) diameter balls of M-10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0.75% Sn);
   The chamber is purged with nitrogen, sealed at atmospheric pressure and the temperature raised to and maintained at 644 ± 6 K (371 ± 6°C) for six hours;
   The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:
   1. *The loss in weight of each ball is less than 10 mg/mm^2 of ball surface;*
   2. *The change in original viscosity as determined at 311 K (38°C) is less than 25%; and*
   3. *The total acid or base number is less than 0.40;*
e. *Autogenous ignition temperature is determined using the method described in ASTM E-659 or national equivalents.*

1C007 Ceramic base materials, non-"composite" ceramic materials, ceramic-"matrix" "composite" materials and precursor materials, as follows:
N.B.: SEE ALSO 1C107.

a. Base materials of single or complex borides of titanium having total metallic impurities, excluding intentional additions, of less than 5,000 ppm, an average particle size equal to or less than 5 µm and no more than 10% of the particles larger than 10 µm;

b. Non-"composite" ceramic materials in crude or semi-fabricated form, composed of borides of titanium with a density of 98% or more of the theoretical density;
Note: *1C007.b. does not control abrasives.*

c. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with fibres made from any of the following systems:
1. Si-N;
2. Si-C;
3. Si-Al-O-N; or
4. Si-O-N;

having a specific tensile strength exceeding 12.7×10^3 m;

d. Ceramic-ceramic "composite" materials, with or without a continuous metallic phase, incorporating particles, whiskers or fibres, where carbides or nitrides of silicon, zirconium or boron form the "matrix";

e. Precursor materials (i.e., special purpose polymeric or metallo-organic materials) for producing any phase or phases of the materials specified in 1C007.c., as follows:
1. Polydiorganosilanes (for producing silicon carbide);
2. Polysilazanes (for producing silicon nitride);
3. Polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components);

f. Ceramic-ceramic "composite" materials with an oxide or glass "matrix" reinforced with continuous fibres from any of the following systems:
1. Al_2O_3; or
2. Si-C-N.

Note: *1C007.f. does not control "composites" containing fibres from these systems with a fibre tensile strength of less than 700 MPa at 1,273 K (1,000° C) or fibre tensile creep resistance of more than 1% creep strain at 100 MPa load and 1,273 K (1,000° C) for 100 hours.*

1C008 Non-fluorinated polymeric substances, as follows:

a. 1. Bismaleimides;
2. Aromatic polyamide-imides;
3. Aromatic polyimides;
4. Aromatic polyetherimides having a glass transition temperature (T_g) exceeding 513 K (240° C) determined using the dry method described in ASTM D 3418;

Note: *1C008.a. does not control non-fusible compression moulding powders or moulded forms.*

b. Thermoplastic liquid crystal copolymers having a heat distortion temperature exceeding 523 K (250°C) measured according to ASTM D-648, method A, or national equivalents, with a load of 1.82 N/mm^2 and composed of:
1. Any of the following:
a. Phenylene, biphenylene or naphthalene; or
b. Methyl, tertiary-butyl or phenyl substituted phenylene, biphenylene or naphthalene; and
2. Any of the following acids:
a. Terephthalic acid;
b. 6-hydroxy-2 naphthoic acid; or
c. 4-hydroxybenzoic acid;

c. Polyarylene ether ketones, as follows:
1. Polyether ether ketone (PEEK);

2. Polyether ketone ketone (PEKK);
3. Polyether ketone (PEK);
4. Polyether ketone ether ketone ketone (PEKEKK);

d. Polyarylene ketones;

e. Polyarylene sulphides, where the arylene group is biphenylene, triphenylene or combinations thereof;

f. Polybiphenylenethersulphone.

Technical Note:
The glass transition temperature (Tg) for 1C008 materials is determined using the method described in ASTM D 3418 using the dry method.

1C009 Unprocessed fluorinated compounds, as follows:

a. Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;
b. Fluorinated polyimides containing 10% by weight or more of combined fluorine;
c. Fluorinated phosphazene elastomers containing 30% by weight or more of combined fluorine.

1C010 "Fibrous or filamentary materials" which may be used in organic "matrix", metallic "matrix" or carbon "matrix" "composite" structures or laminates, as follows:
N.B.: SEE ALSO 1C210.

a. Organic "fibrous or filamentary materials", having all of the following:
   1. A specific modulus exceeding 12.7×10^6 m; and
   2. A specific tensile strength exceeding 23.5×10^4 m;
   Note: 1C010.a. does not control polyethylene.

b. Carbon "fibrous or filamentary materials", having all of the following:
   1. A specific modulus exceeding 12.7×10^6 m; and
   2. A specific tensile strength exceeding 23.5×10^4 m;

   Technical Note:
   Properties for materials described in 1C010.b. should be determined using SACMA recommended methods SRM 12 to 17, or national equivalent tow tests, such as Japanese Industrial Standard JIS-R-7601, Paragraph 6.6.2., and based on lot average.
   Note: 1C010.b. does not control fabric made from "fibrous or filamentary materials" for the repair of aircraft structures or laminates, in which the size of individual sheets does not exceed 50 cm x 90 cm.

c. Inorganic "fibrous or filamentary materials", having all of the following:
   1. A specific modulus exceeding 2.54×10^6 m; and
   2. A melting, softening, decomposition or sublimation point exceeding 1,922 K (1,649°C) in an inert environment;
   Note: 1C010.c. does not control:
      1. Discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random mat form, containing 3 weight percent or more silica, with a specific modulus of less than 10×10^6 m;
      2. Molybdenum and molybdenum alloy fibres;
      3. Boron fibres;

4. *Discontinuous ceramic fibres with a melting, softening, decomposition or sublimation point lower than 2,043 K (1,770°C) in an inert environment.*

d. "Fibrous or filamentary materials":
   1. Composed of any of the following:
      a. Polyetherimides specified in 1C008.a.; or
      b. Materials specified in 1C008.b. to 1C008.f.; or
   2. Composed of materials specified in 1C010.d.1.a. or 1C010.d.1.b. and "commingled" with other fibres specified in 1C010.a., 1C010.b. or 1C010.c.;

e. Resin-impregnated or pitch-impregnated fibres (prepregs), metal or carbon-coated fibres (preforms) or "carbon fibre preforms", as follows:
   1. Made from "fibrous or filamentary materials" specified in 1C010.a., 1C010.b. or 1C010.c.;
   2. Made from organic or carbon "fibrous or filamentary materials":
      a. With a "specific tensile strength" exceeding 17.7×10^4 m;
      b. With a "specific modulus" exceeding 10.15×10^6 m;
      c. Not controlled by 1C010.a. or 1C010.b.; and
      d. When impregnated with materials specified in 1C008 or 1C009.b., having a glass transition temperature (T_g) exceeding 383 K (110°C) or with phenolic or epoxy resins, having a glass transition temperature (T_g) equal to or exceeding 418 K (145°C).

Notes: *1C010.e. does not control:*
1. *Epoxy resin "matrix" impregnated carbon "fibrous or filamentary materials" (prepregs) for the repair of aircraft structures or laminates, in which the size of individual sheets of prepreg does not exceed 50 cm x 90 cm;*
2. *Prepregs when impregnated with phenolic or epoxy resins having a glass transition temperature (Tg) less than 433 K (160°C) and a cure temperature lower than the glass transition temperature.*

Technical Note:
The glass transition temperature (Tg) for 1C010.e. materials is determined using the method described in ASTM D 3418 using the dry method. The glass transition temperature for phenolic and epoxy resins is determined using the method described in ASTM D 4065 at a frequency of 1Hz and a heating rate of 2 K (°C) per minute using the dry method.

1C011 Metals and compounds, as follows:
N.B.: SEE ALSO ML8a.1., ML8a.2. and 1C111.

a. Metals in particle sizes of less than 60 µm whether spherical, atomised, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of zirconium, magnesium and alloys of these;
   N.B.: The metals or alloys listed in 1C011.a. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.

b. Boron or boron carbide of 85% purity or higher and a particle size of 60 µm or less;
   N.B.: The metals or alloys listed in 1C011.b. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.

c. Guanidine nitrate.

1C012 Materials for nuclear heat sources, as follows:

a. Plutonium in any form with a plutonium isotopic assay of plutonium-238 of more than 50% by weight;
Note: 1C012.a. does not control:
1. *Shipments with a plutonium content of 1 g or less;*
2. *Shipments of 3 "effective grammes" or less when contained in a sensing component in instruments.*

b. "Previously separated" neptunium-237 in any form.
Note: 1C012.b. does not control shipments with a neptunium-237 content of 1 g or less.

1C101 Materials and devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures, other than those specified in 1C001, usable in "missiles" and their subsystems.

Notes: 1. *1C101 includes:*
a. *Structural materials and coatings specially designed for reduced radar reflectivity;*
b. *Coatings, including paints, specially designed for reduced or tailored reflectivity or emissivity in the microwave, infra red or ultra violet regions of the electromagnetic spectrum.*
2. *1C101 does not include coatings when specially used for the thermal control of satellites.*

1C107 Graphite and ceramic materials, other than those specified in 1C007, as follows:

a. Fine grain recrystallised bulk graphites having a bulk density of 1.72 g/cm^3 or greater, measured at 288 K (15°C), and having a particle size of 100 micrometres or less, pyrolytic or fibrous reinforced graphites, usable for rocket nozzles and reentry vehicle nose tips;

b. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10,000 MHz), also usable for radomes, and bulk machinable silicon-carbide reinforced unfired ceramic, usable for nose tips.

1C111 Propellants and constituent chemicals for propellants, other than those specified in 1C011, as follows:

a. Propulsive substances:

1. Spherical aluminium powder, other than that specified in ML8a, with particles of uniform diameter of less than 500 micrometre and an aluminium content of 97% by weight or greater;
2. Metal fuels, other than that specified in ML8a, in particle sizes of less than 500 micrometres, whether spherical, atomized, spheroidal, flaked or ground, consisting 97% or more by weight of any of the following:
a. Zirconium;
b. Beryllium;
c. Boron;
d. Magnesium; or
e. Alloys of the metals specified by a. to d. above;
3. Liquid oxidisers, the following:
a. Dinitrogen trioxide;
b. Nitrogen dioxide/dinitrogen tetroxide;

c. Dinitrogen pentoxide;

b. Polymeric substances:

1. Carboxy-terminated polybutadiene (CTPB);
2. Hydroxy-terminated polybutadiene (HTPB), other than that specified in the Military Goods Controls;
3. Polybutadiene-acrylic acid (PBAA);
4. Polybutadiene-acrylic acid-acrylonitrile (PBAN);

c. Other propellant additives and agents:

1. Butacene;
2. Triethylene glycol dinitrate (TEGDN);
3. 2-Nitrodiphenylamine;
4. Trimethylolethane trinitrate (TMETN);
5. Diethylene glycol dinitrate (DEGDN).

Note: *For propellants and constituent chemicals for propellants not specified in 1C111, see ML8.*

1C116 Maraging steels (steels generally characterised by high nickel, very low carbon content and the use of substitutional elements or precipitates to produce age-hardening) having an ultimate tensile strength of 1,500 MPa or greater, measured at 293 K (20°C), in the form of sheet, plate or tubing with a wall or plate thickness equal to or less than 5 mm.
N.B.: SEE ALSO 1C216.

1C117 Tungsten, molybdenum and alloys of these metals in the form of uniform spherical or atomized particles of 500 micrometre diameter or less with a purity of 97% or greater for fabrication of rocket motor components, i.e., heat shields, nozzle substrates, nozzle throats and thrust vector control surfaces.

1C202 Alloys, other than those specified in 1C002.a.2.c. or d., as follows:

a. Aluminium 'alloys capable of' an ultimate tensile strength of 460 MPa or more at 293 K (20°C), in the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm;

b. Titanium 'alloys capable of' an ultimate tensile strength of 900 MPa or more at 293 K (20°C) in the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm.

Technical Note:
The phrase 'alloys capable of' encompasses alloys before or after heat treatment.

1C210 'Fibrous or filamentary materials' or prepregs, other than those specified in 1C010.a., b. or e., as follows:

a. Carbon or aramid 'fibrous or filamentary materials' having a "specific modulus" of 12.7×10^6 m or greater or a "specific tensile strength" of 235×10^3 m or greater;
except:
Aramid 'fibrous or filamentary materials' having 0.25 percent or more by weight of an ester based fibre surface modifier;

b. Glass 'fibrous or filamentary materials' having a "specific modulus" of 3.18×10^6 m or greater and a "specific tensile strength" of 76.2×10^3 m or greater; or

c. Thermoset resin impregnated continuous "yarns", "rovings", "tows" or "tapes" with a width no greater than 15 mm (prepregs), made from carbon or glass 'fibrous or filamentary materials' specified in 1C210.a. or b.

Technical Note:
The resin forms the matrix of the composite.

Note: *In 1C210, 'fibrous or filamentary materials' is restricted to continuous "monofilaments", "yarns", "rovings", "tows" or "tapes".*

1C216 Maraging steel, other than that specified in 1C116, capable of an ultimate tensile strength of 2,050 MPa or more, at 293 K (20°C);
except:
Forms in which no linear dimension exceeds 75 mm.

Technical Note:
The phrase 'maraging steel capable of' encompasses maraging steel before or after heat treatment.

1C225 Boron and boron compounds, mixtures and loaded materials in which the boron-10 isotope is more than 20% by weight of the total boron content.

1C226 Tungsten, as follows: parts made of tungsten, tungsten carbide, or tungsten alloys (greater than 90% tungsten) having a mass greater than 20 kg and a hollow cylindrical symmetry (including cylinder segments) with an inside diameter greater than 100 mm but less than 300 mm;
except:
Parts specially designed for use as weights or gamma-ray collimators.

1C227 Calcium (high purity) containing both less than 1,000 parts per million by weight of metallic impurities other than magnesium and less than 10 parts per million of boron.

1C228 Magnesium (high purity) containing both less than 200 parts per million by weight of metallic impurities other than calcium and less than 10 parts per million of boron.

1C229 High purity (99.99% or greater) bismuth with very low silver content (less than 10 parts per million).

1C230 Beryllium metal, alloys containing more than 50% of beryllium by weight, beryllium compounds, or manufactures thereof;
except:
a. Metal windows for X-ray machines, or for bore-hole logging devices;
b. Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits;
c. Beryl (silicate of beryllium and aluminium) in the form of emeralds or aquamarines.

Note: *1C230 includes waste and scrap containing beryllium as defined above.*

1C231 Hafnium metal, alloys and compounds of hafnium containing more than 60% hafnium by weight and manufactures thereof.

1C232 Helium-3 or helium isotopically enriched in the helium-3 isotope, mixtures containing helium-3, or products or devices containing any of the foregoing;
except:
A product or device containing less than 1 g of helium-3.

1C233 Lithium enriched in the 6 isotope (^{6}Li) to greater than 7.5 atom percent, alloys, compounds or mixtures containing lithium enriched in the 6 isotope, or products or devices containing any of the foregoing;
except:
Thermoluminescent dosimeters.

Technical Note:
The natural occurrence of the 6 isotope in lithium is 7.5 atom percent.

1C234 Zirconium with a hafnium content of less than 1 part hafnium to 500 parts zirconium by weight, in the form of metal, alloys containing more than 50% zirconium by weight, or compounds, or manufactures wholly thereof;
except:
Zirconium in the form of foil having a thickness not exceeding 0.10 mm.

Note: 1C234 includes waste and scrap containing zirconium as defined here.

1C235 Tritium, tritium compounds, mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1000, or products or devices containing any of the foregoing;
except:
A product or device containing not more than 1.48×10^{3} GBq (40 Ci) of tritium in any form.

1C236 Alpha-emitting radionuclides having an alpha half-life of 10 days or greater but less than 200 years, compounds or mixtures containing any of these radionuclides with a total alpha activity of 37 GBq/kg (1 Ci/kg) or greater, or products or devices containing any of the foregoing;
except:
A product or device containing less than 3.7 GBq (100 millicuries) of alpha activity.

1C237 Radium-226, radium-226 compounds, mixtures containing radium-226, or products or devices containing any of the foregoing;
except:
a. Medical applicators;
b. A product or device containing not more than 0.37 GBq (10 millicuries) of radium-226 in any form.

1C238 Chlorine trifluoride (ClF_3).

1C239 High explosives, other than those specified in ML8, or substances or mixtures containing more than 2% thereof, with a crystal density greater than 1.8 gm per cm^3 and having a detonation velocity greater than 8,000 m/s.

1C240 Nickel powder or porous nickel metal, other than those specified in 0C006, as follows:

a. Powder with a nickel purity content of 99.0% by weight or greater and a mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard;
<u>except:</u>
Filamentary nickel powders;

b. Porous nickel powder produced from materials specified in 1C240.a.;
<u>except</u>:
Single porous nickel sheets not exceeding 1,000 cm^2 per sheet.

<u>Note:</u> 1C240.b. refers to porous metal formed by compacting and sintering the materials in 1C240.a. to form a metal material with fine pores interconnected throughout the structure.

1C350 Chemicals, which may be used as precursors for toxic chemical agents, as follows:
N.B.: SEE ALSO ML7 AND 1C450.

1. *Thiodiglycol (111-48-8);
2. Phosphorus oxychloride (10025-87-3);
3. *Dimethyl methylphosphonate (756-79-6);
4. **SEE ML7.b.1 FOR**
   ****Methyl phosphonyldifluoride (676-99-3)** ;
5. *Methyl phosphonyl dichloride (676-97-1);
6. Dimethylphosphite (868-85-9);
7. Phosphorus trichloride (7719-12-2);
8. Trimethyl phosphite (121-45-9);
9. Thionyl chloride (7719-09-7);
10. 3-Hydroxy-1-methylpiperidine (3554-74-3);
11. *N,N-Diisopropyl-(beta)-aminoethyl chloride (96-79-7);
12. *N,N-Diisopropyl-(beta)-aminoethane thiol (5842-07-9);
13. *3-Quinuclidinol (1619-34-7);
14. Potassium fluoride (7789-23-3);
15. 2-Chloroethanol (107-07-3);
16. Dimethylamine (124-40-3);
17. *Diethyl ethylphosphonate (78-38-6);
18. *Diethyl-N,N-dimethylphosphoramidate (2404-03-7);
19. Diethyl phosphite (762-04-9);
20. Dimethylamine hydrochloride (506-59-2);
21. *Ethyl phosphinyl dichloride (1498-40-4);
22. *Ethyl phosphonyl dichloride (1066-50-8);
23. **Ethyl phosphonyl difluoride (753-98-0);
24. Hydrogen fluoride (7664-39-3);
25. Methyl benzilate (76-89-1);
26. *Methyl phosphinyl dichloride (676-83-5);
27. *N,N-Diisopropyl-(beta)-amino ethanol (96-80-0);
28. *Pinacolyl alcohol (464-07-3);
29. **SEE ML7.b.2 FOR**
    ****o-Ethyl-2-diisopropylaminoethyl methylphosphonite (57856-11-8);**
30. Triethyl phosphite (122-52-1);
31. *Arsenic trichloride (7784-34-1);
32. *Benzilic acid (76-93-7);

33. *Diethyl methylphosphonite (15715-41-0);
34. *Dimethyl ethylphosphonate (6163-75-3);
35. *Ethyl phosphinyl difluoride (430-78-4);
36. *Methyl phosphinyl difluoride (753-59-3);
37. 3-Quinuclidone (3731-38-2);
38. Phosphorus pentachloride (10026-13-8);
39. Pinacolone (75-97-8);
40. Potassium cyanide (151-50-8);
41. Potassium bifluoride (7789-29-9);
42. Ammonium hydrogen fluoride (1341-49-7);
43. Sodium fluoride (7681-49-4);
44. Sodium bifluoride (1333-83-1);
45. Sodium cyanide (143-33-9);
46. Triethanolamine (102-71-6);
47. Phosphorus pentasulphide (1314-80-3);
48. Di-isopropylamine (108-18-9);
49. Diethylaminoethanol (100-37-8);
50. Sodium sulphide (1313-82-2);
51. Sulphur monochloride (10025-67-9);
52. Sulphur dichloride (10545-99-0);
53. Triethanolamine hydrochloride (637-39-8);
54. *N,N-Diisopropyl-(Beta)-aminoethyl chloride hydrochloride (4261-68-1).
55. *Diethyl methylphosphonate (1683-08-9)
56. *Methylphosphonic acid (993-13-5)
57. *N,N-dimethyl phosphoramidic dichloride (677-43-0)
58. Thiophosphoryl chloride (3982-91-0)
59. Oxalyl chloride (79-37-8)

Note 1: *For chemicals listed in 1C350 (without asterisks), export permission is required when it constitutes more than 25% of a mixture on a "solvent free basis".*

* *Export permission is required when the chemical constitutes more than 10% of a mixture on a "solvent free basis".*

** *Export permission is required when the chemical constitutes more than 0% of a mixture on a "solvent free basis".*

Note 2: *Item 1C350 does not include:*

(a) triethanolamine, as a component of formulations in the following classes of goods, when packaged in containers with a volume not exceeding 6 litres:
- *personal cosmetic products;*
- *photographic developer solutions, or components intended for preparing photographic developer solutions;*
- *cleaning products;*

(b) sodium cyanide, as a component of electroplating formulations, when packaged in containers with a volume not exceeding 6 litres;

(c) potassium cyanide, as a component of electroplating formulations, when packaged in containers with a volume not exceeding 6 litres;

(d) sodium fluoride, as a component of zinc passivating formulations, when packaged in containers with a volume not exceeding 6 litres;

(e) sodium bifluoride, as a component of zinc passivating formulations, when packaged in containers with a volume not exceeding 6 litres.

1C351 Human pathogens, zoonoses and "toxins", as follows:

a. Viruses, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:
   1. Chikungunya virus;
   2. Congo-Crimean haemorrhagic fever virus;
   3. Dengue fever virus;
   4. Eastern equine encephalitis virus;
   5. Ebola virus;
   6. Hantaan virus;
   7. Junin virus;
   8. Lassa fever virus;
   9. Lymphocytic choriomeningitis virus;
   10. Machupo virus;
   11. Marburg virus;
   12. Monkey pox virus;
   13. Rift Valley fever virus;
   14. Tick-borne encephalitis virus (Russian Spring-Summer encephalitis virus);
   15. Variola virus;
   16. Venezuelan equine encephalitis virus;
   17. Western equine encephalitis virus;
   18. White pox;
   19. Yellow fever virus;
   20. Japanese encephalitis virus;

b. Rickettsiae, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:
   1. Coxiella burnetii;
   2. Bartonella quintana (Rochalimaea quintana, Rickettsia quintana);
   3. Rickettsia prowasecki;
   4. Rickettsia rickettsii;

c. Bacteria, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:
   1. Bacillus anthracis;
   2. Brucella abortus;
   3. Brucella melitensis;
   4. Brucella suis;
   5. Chlamydia psittaci;
   6. Clostridium botulinum;
   7. Francisella tularensis;
   8. Burkholderia mallei (Pseudomonas mallei);
   9. Burkholderia pseudomallei (Pseudomonas pseudomallei);
   10. Salmonella typhi;
   11. Shigella dysenteriae;
   12. Vibrio cholerae;
   13. Yersinia pestis;

d. "Toxins", as follows, and "sub-unit of toxins" thereof:
   1. Botulinum toxins;
   2. Clostridium perfringens toxins;
   3. Conotoxin;
   4. Ricin;
   5. Saxitoxin;
   6. Shiga toxin;
   7. Staphylococcus aureus toxins;
   8. Tetrodotoxin;
   9. Verotoxin;
   10. Microcystin (Cyanginosin);
   11. Aflatoxin.

except:
Any goods specified in 1C351 in the form of a "vaccine" or "immunotoxin".

1C352 Animal pathogens, as follows:

a. Viruses, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:
   1. African swine fever virus;
   2. Avian influenza virus, which are:
      a. Uncharacterised; or
      b. Defined in EC Directive 92/40/EC (O.J. L.16 23.1.92 p.19) as having high pathogenicity, as follows:
         1. Type A viruses with an IVPI (intravenous pathogenicity index) in 6 week old chickens of greater than 1.2; or
         2. Type A viruses H5 or H7 subtype for which nucletide sequencing has demonstrated multiple basic amino acids at the cleavage site of haemagglutinin;
   3. Bluetongue virus;
   4. Foot and mouth disease virus;
   5. Goat pox virus;
   6. Porcine herpes virus (Aujeszky's disease);
   7. Swine fever virus (Hog cholera virus);
   8. Lyssa virus;
   9. Newcastle disease virus;
   10. Peste des petits ruminants virus;
   11. Porcine enterovirus type 9 (swine vesicular disease virus);
   12. Rinderpest virus;
   13. Sheep pox virus;
   14. Teschen disease virus;
   15. Vesicular stomatitis virus;

b. Mycoplasma mycoides, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such Mycoplasma mycoides.

except:
Any goods specified in 1C352 in the form of a "vaccine".

1C353 Genetically-modified "microorganisms", as follows:

a. Genetically modified "microorganisms" or genetic elements that contain nucleic acid sequences associated with pathogenicity of organisms specified in 1C351.a. to c. or 1C352 or 1C354;

b. Genetically modified "microorganisms" or genetic elements that contain nucleic acid sequences coding for any of the "toxins" specified in 1C351.d. or "sub-units of toxins" thereof.

1C354 Plant pathogens, as follows:

a. Bacteria, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material which has been deliberately inoculated or contaminated with such cultures, as follows:
   1. Xanthomonas albilineans;

2. Xanthomonas campestris pv. citri including strains referred to as Xanthomonas campestris pv. citri types A,B,C,D,E or otherwise classified as Xanthomonas citri, Xanthomonas campestris pv. aurantifolia or Xanthomonas campestris pv. citrumelo;

b. Fungi, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material which has been deliberately inoculated or contaminated with such cultures, as follows:
1. Colletotrichum coffeanum var. virulans (Colletotrichum kahawae);
2. Cochliobolus miyabeanus (Helminthosporium oryzae);
3. Microcyclus ulei (syn. Dothidella ulei);
4. Puccinia graminis (syn. Puccinia graminis f. sp. tritici);
5. Puccinia striiformis (syn. Puccinia glumarum);
6. Magnaporthe grisea (pyricularia grisea/pyricularia oryzae).

1C450 Toxic chemicals and toxic chemical precursors, as follows:

N.B.: SEE ALSO 1C350, 1C351.d. and ML7.

a. Toxic chemicals, as follows:
1. amiton: O,O-diethyl S-[2-(diethylamino) ethyl] phosphorothiolate (78-53-5);
2. See ML7a for BZ: 3-quinuclidinyl benzilate (6581-06-2);
3. *chloropicrin: trichloronitromethane (76-06-2);
4. *cyanogen chloride (506-77-4);
5. *hydrogen cyanide (74-90-8):
6. PFIB: 1,1,3,3,3-pentafluoro-2-(trifluoromethyl)-1-propene (382-21-8);
7. *phosgene: carbonyl dichloride (75-44-5);

b. Toxic chemicals precursors, as follows:
1. chemicals, other than those specified in ML7 or in 1C350, containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms; *including*:
diphenyl methylphosphonate (7526-26-3);
phosphonic acid, methyl-, methyl 3-(trimethoxysilyl)- propyl ester (67812-17-3);
phosphonic acid, methyl-, monoammonium salt (34255-87-3);
phosphonic acid, methyl-, monomethyl ester, monosodium salt (73750-69-3);
phosphonothioic dichloride, ethyl- (993-43-1);
phosphonic acid, methyl-, bis(3-(trimethoxysilyl)propyl) ester (67812-18-4);
phosphonic acid, methyl-, compd. with (aminoiminomethyl) urea (1:1) (84402-58-4)
phosphonic acid, methyl-, (5-ethyl-2-methyl-1,3,2-dioxaphosphorinan-5-yl) methyl methyl ester, P-oxide) (41203-81-0)
phosphonic acid, methyl-, bis((5-ethyl-2-methyl-1,3,2-dioxaphosphorinan-5-yl) methyl ester, P,P'-dioxide) (42595-45-9).
but not including Fonofos: O-ethyl S-phenyl ethylphosphonothiolothionate (944-22-9);

2. dialkyl [methyl, ethyl or propyl (normal or iso)] N,N-dialkyl [methyl, ethyl or propyl (normal or iso)]-phosphoramidates, *other than* diethyl-N,N-dimethylphosphoramidate which is specified in 1C350;

3. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] phosphoramidic dihalides;
other than N,N-dimethyl phosphoramidic dichloride which is specified in 1C350;

4. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethyl-2-chlorides and corresponding protonated salts,
including N,N-diethylaminoethyl-2-chloride, hydrochloride (869-24-9); and N,N-diethylaminoethyl-2-chloride (96-70-7).
but not including: N,N-diisopropyl-(beta)-aminoethyl chloride or N,N-diisopropyl-(beta)-aminoethyl chloride hydrochloride which are specified in 1C350;

5. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane-2-ols and corresponding protonated salts, other than N,N-diisopropyl-(beta)-aminoethanol which is specified in 1C350; *except*:
   a. N,N-dimethylaminoethanol (108-01-0) and corresponding protonated salts;
   b. N,N-diethylaminoethanol (100-37-8) and corresponding protonated salts;

6. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane-2-thiols and corresponding protonated salts,
including N,N-dimethylaminoethane-2-thiol hydrochloride (13242-44-9);
but not including N,N-diisopropyl-(beta)-aminoethane thiol which is specified in 1C350;

7. *ethyldiethanolamine (139-87-7);

8. *methyldiethanolamine (105-59-9).

Note: *For chemicals listed in 1C450 (without an asterisk), export permission is required when it constitutes more than 10% of a mixture on a "solvent free basis".*
* *Export permission is required when the chemical constitutes more than 25% of a mixture on a "solvent free basis".*

1D Software

1D001 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 1B001 to 1B003.

1D002 "Software" for the "development" of organic "matrix", metal "matrix" or carbon "matrix" laminates or "composites".

1D101 "Software" specially designed for the "use" of goods specified in 1B101.

1D103 "Software" specially designed for analysis of reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures.

1D201 "Software" specially designed for the "use" of goods specified in 1B201.

1E Technology

1E001 "Technology" according to the General Technology Note: for the "development" or "production" of equipment or materials specified in 1A001.b., 1A001.c., 1A002 to 1A005, 1B or 1C.

1E002 Other "technology", as follows:

a. "Technology" for the "development" or "production" of polybenzothiazoles or polybenzoxazoles;

b. "Technology" for the "development" or "production" of fluoroelastomer compounds containing at least one vinylether monomer;

c. "Technology" for the design or "production" of the following base materials or non-"composite" ceramic materials:
   1. Base materials having all of the following characteristics:
      a. Any of the following compositions:
         1. Single or complex oxides of zirconium and complex oxides of silicon or aluminium;
         2. Single nitrides of boron (cubic crystalline forms);
         3. Single or complex carbides of silicon or boron; or
         4. Single or complex nitrides of silicon;
      b. Total metallic impurities, excluding intentional additions, of less than:
         1. 1,000 ppm for single oxides or carbides; or
         2. 5,000 ppm for complex compounds or single nitrides;
         and
      c. Having any of the following:
         1. Average particle size equal to or less than 5 µm and no more than 10% of the particles larger than 10 µm; or
            Note: For zirconia, these limits are 1 µm and 5 µm respectively.
         2. Having all of the following:
            a. Platelets with a length to thickness ratio exceeding 5;
            b. Whiskers with a length to diameter ratio exceeding 10 for diameters less than 2 µm; and
            c. Continuous or chopped fibres less than 10 µm in diameter;

   2. Non-"composite" ceramic materials composed of the materials described in 1E002.c.1;
      Note: 1E002.c.2. does not control technology for the design or production of abrasives.

d. "Technology" for the "production" of aromatic polyamide fibres;

e. "Technology" for the installation, maintenance or repair of materials specified in 1C001;

f. "Technology" for the repair of "composite" structures, laminates or materials specified in 1A002, 1C007.c. or 1C007.d.
   Note: 1E002.f. does not control "technology" for the repair of "civil aircraft" structures using carbon "fibrous or filamentary materials" and epoxy resins, contained in aircraft manufacturers' manuals.

1E101 "Technology" according to the General Technology Note for the "use" of goods specified in 1A102, 1B001, 1B101, 1B115, 1B116, 1C001, 1C101, 1C107, 1C111 to 1C117, 1D101 or 1D103.

1E102 "Technology" according to the General Technology Note for the "development" of "software" specified in 1D001, 1D101 or 1D103.

1E103 "Technology" for the regulation of temperature, pressure or atmosphere

in autoclaves or hydroclaves, when used for the "production" of "composites" or partially processed "composites".

1E104 "Technology" relating to the "production" of pyrolitically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,573 K (1,300°C) to 3,173 K (2,900°C) temperature range at pressures of 130 Pa to 20kPa.

Note: *1E104 includes "technology" for the composition of precursor gases, flow-rates and process control schedules and parameters.*

1E201 "Technology" according to the General Technology Note for the "use" of goods specified in 1A002, 1A202, 1A225 to 1A227, 1B201, 1B225 to 1B233, 1C002.a.2.c. or d., 1C010.b., 1C202, 1C210, 1C216, 1C225 to 1C240 or 1D201.

1E202 "Technology" according to the General Technology Note for the "development" or "production" of goods specified in 1A202 or 1A225 to 1A227.

1E203 "Technology" according to the General Technology Note for the "development" of "software" specified in 1D201.

PART 3, CATEGORY 2 - MATERIALS PROCESSING

2A Systems, Equipment and Components

(For quiet running bearings, see ML9g.)

2A001 Anti-friction bearings and bearing systems, as follows, and components therefor:

Note: *2A001 does not control 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 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 rings, balls or rollers made from monel or beryllium;

Note; *2A001.a. does not control tapered roller bearings.*

b. Other ball bearings and solid 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);

Note: *2A001.b. does not control tapered roller bearings.*

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.

2A225 Crucibles made of materials resistant to liquid actinide metals, as follows:

a. Crucibles with a volume of between 150 ml and 8 litres and made of or coated with any of the following materials having a purity of 98% or greater:
   1. Calcium fluoride (CaF_2);
   2. Calcium zirconate (metazirconate) (Ca_2ZrO_3);
   3. Cerium sulphide (Ce_2S_3);
   4. Erbium oxide (erbia) (Er_2O_3);
   5. Hafnium oxide (hafnia) (HfO_2);
   6. Magnesium oxide (MgO);
   7. Nitrided niobium-titanium-tungsten alloy (approximately 50% Nb, 30%Ti, 20%W);
   8. Yttrium oxide (yttria) (Y_2O_3); or
   9. Zirconium oxide (zirconia) (ZrO_2);

b. Crucibles with a volume of between 50 ml and 2 litres and made of or lined with tantalum, having a purity of 99.9% or greater;

c. Crucibles with a volume of between 50 ml and 2 litres and made of or lined with tantalum (having a purity of 98% or greater) coated with tantalum carbide, nitride or boride (or any combination of these).

2A226 Valves 5 mm or greater in 'nominal size', with a bellows seal, wholly made of or lined with aluminium, aluminium alloy, nickel, or alloy containing 60% or more nickel, either manually or automatically operated.

Note: *For valves with different inlet and outlet diameters, the 'nominal size' above refers to the smallest diameter.*

2B 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.*

   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'.*

3. *For the purposes of 2B001 to 2B009 a "tilting spindle" is counted as a rotary axis.*

4. *Guaranteed positioning accuracy levels instead of individual test protocols may be used for each machine tool model using the agreed ISO test procedure.*

5. *The positioning accuracy of "numerically controlled" machine tools is to be determined and presented in accordance with ISO 230/2.*

2B001 Machine tools, as follows, 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":
N.B.: SEE ALSO 2B201.

a. Machine tools for turning, having all of the following characteristics:
   1. Positioning accuracy with all compensations available of less (better) than 6 µm along any linear axis (overall positioning); and
   2. Two or more axes which can be coordinated simultaneously for "contouring control";

   Note: *2B001.a. does not control turning machines specially designed for the production of contact lenses.*

b. Machine tools for milling, having any of the following characteristics:
   1. a. Positioning accuracy with all compensations available of less (better) than 6 µm along any linear axis (overall positioning); and
      b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";
   2. Five or more axes which can be coordinated simultaneously for "contouring control"; or
   3. A positioning accuracy for jig boring machines, with all compensations available, of less (better) than 4 µm along any linear axis (overall positioning);

c. Machine tools for grinding, having any of the following characteristics:
   1. a. Positioning accuracy with all compensations available of less (better) than 4 µm along any linear axis (overall positioning); and
      b. Three or more axes which can be coordinated simultaneously for "contouring control"; or

2. Five or more axes which can be coordinated simultaneously for "contouring control";

Note: *2B001.c. does not control grinding machines, as follows:*
1. *Cylindrical external, internal, and external-internal grinding machines having all the following characteristics:*
   a. *Limited to cylindrical grinding; and*
   b. *Limited to a maximum workpiece capacity of 150 mm outside diameter or length.*
2. *Machines designed specifically as jig grinders having any of the following characteristics:*
   a. *The c-axis is used to maintain the grinding wheel normal to the work surface; or*
   b. *The a-axis is configured to grind barrel cams.*
3. *Tool or cutter grinding machines shipped as complete systems with "software" specially designed for the production of tools or cutters.*
4. *Crank shaft or cam shaft grinding machines.*
5. *Surface grinders.*

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";

e. Machine tools for removing metals, ceramics or "composites":
   1. By means of:
      a. Water or other liquid jets, including those employing abrasive additives;
      b. Electron beam; or
      c. "Laser" beam; and
   2. Having two or more rotary axes which:
      a. Can be coordinated simultaneously for "contouring control"; and
      b. Have a positioning accuracy of less (better) than 0.003°;

f. Deep-hole-drilling machines and turning machines modified for deep-hole-drilling, having a maximum depth-of-bore capability exceeding 5,000 mm and specially designed components therefor.

2B002 Non-"numerically controlled" machine tools for generating optical quality surfaces, as follows, and specially designed components therefor:

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;

   Technical Note:
   The bidirectional slide positioning repeatability (R) of an axis is the maximum value of the repeatability of positioning at any position along or around the axis determined using the procedure and under the conditions specified in part 2.11 of ISO 230/2: 1988.

b. Fly cutting machines having all 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.

2B003 "Numerically controlled" or manual machine tools, and specially designed components, controls and accessories therefor, specially designed for the shaving, finishing, grinding or honing of hardened (R_C = 40 or more) 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).

2B004 Hot "isostatic presses", having all of the following, and specially designed dies, moulds, components, accessories and controls therefor:
N.B.: SEE ALSO 2B104 and 2B204.

a. A controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; and
b. Any of the following:
   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.

2B005 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 2E003.f., and specially designed automated handling, positioning, manipulation and control components therefor:

a. "Stored programme controlled" chemical vapour deposition (CVD) production equipment having all of the following:
   1. Process modified for one of the following:
      a. Pulsating CVD;
      b. Controlled nucleation thermal decomposition (CNTD); or
      c. Plasma enhanced or plasma assisted CVD; and
   2. Any of the following:
      a. Incorporating high vacuum (equal to or less than 0.01 Pa) rotating seals; or
      b. Incorporating *in situ* coating thickness control;

b. "Stored programme controlled" ion implantation production equipment having beam currents of 5 mA or more;

c. "Stored programme controlled" electron beam physical vapour deposition (EB-PVD) production equipment incorporating all of the following:
   1. Power systems rated for over 80 kW;
   2. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; and
   3. A computer controlled rate monitor operating on the principle of photo-luminescence of the ionised atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;

d. "Stored programme controlled" plasma spraying production equipment having any of the following characteristics:
   1. Operating at reduced pressure controlled atmosphere (equal to or less than 10 kPa measured above and within 300 mm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 0.01 Pa prior to the spraying process; or
   2. Incorporating *in situ* coating thickness control;

e. "Stored programme controlled" sputter deposition production equipment capable of current densities of 0.1 mA/mm^2 or higher at a deposition rate of 15 µm/h or more;

f. "Stored programme controlled" cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;

g. "Stored programme controlled" ion plating production equipment allowing for the *in situ* measurement of any of the following:
   1. Coating thickness on the substrate and rate control; or
   2. Optical characteristics.

Note: *2B005 does not control chemical vapour deposition, cathodic arc, sputter deposition, ion plating or ion implantation equipment specially designed for cutting or machining tools.*

2B006 Dimensional inspection or measuring systems and equipment, as follows:

a. Computer controlled, "numerically controlled" or "stored programme controlled" dimensional inspection machines, having a three dimensional length (volumetric) "measurement uncertainty" equal to or less (better) than (1.7 + L/1,000) µm (L is the measured length in mm) tested according to ISO 10360-2;
   N.B.: SEE ALSO 2B206.

b. Linear and angular displacement measuring instruments, as follows:
   1. Linear measuring instruments having any of the following:
      a. Non-contact type measuring systems with a "resolution" equal to or less (better) than 0.2 µm within a measuring range up to 0.2 mm;
      b. Linear voltage differential transformer systems having all of the following characteristics:
         1. "Linearity" equal to or less (better) than 0.1% within a measuring range up to 5 mm; and
         2. Drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ±1 K; or
      c. Measuring systems having all of the following:
         1. Containing a "laser"; and
         2. Maintaining, for at least 12 hours, over a temperature range of ±1 K around a standard temperature and at a standard pressure, all of the following:
            a. A "resolution" over their full scale of 0.1 µm or less (better); and
            b. A "measurement uncertainty" equal to or less (better) than (0.2 + L/2,000) µm (L is the measured length in mm);

   Note: *2B006.b.1. does not control 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.*

2. Angular measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

Note: 2B006.b.2. does not control optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

c. Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0.5 nm or less (better).

Notes:
1. *Machine tools which can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.*
2. *A machine described in 2B006 is controlled if it exceeds the control threshold anywhere within its operating range.*

2B007 "Robots" having any of the following characteristics and specially designed controllers and "end-effectors" therefor:
N.B.: SEE ALSO 2B207.

a. Capable in real time of full three-dimensional image processing or full three-dimensional scene analysis to generate or modify "programmes" or to generate or modify numerical programme data;

Note: The scene analysis limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (2 1/2 D).

b. Specially designed to comply with national safety standards applicable to explosive munitions environments;

c. Specially designed or rated as radiation-hardened to withstand greater than 5×10^3 Gy (Si) without operational degradation; or

d. Specially designed to operate at altitudes exceeding 30,000 m.

2B008 Assemblies, units or inserts specially designed for machine tools, or for equipment specified in 2B006 or 2B007, as follows:

a. Linear position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an overall "accuracy" less (better) than $(800 + (600 \times L \times 10^{-3}))$ nm (L equals the effective length in mm);

Note: For "laser" systems see also Note to 2B006.b.1.

b. Rotary position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an "accuracy" less (better) than 0.00025°;

Note: For "laser" systems see also Note to 2B006.b.1.

c. "Compound rotary tables" and "tilting spindles", capable of upgrading, according to the manufacturer's specifications, machine tools to or above the levels specified in 2B.

2B009 Spin-forming machines and flow-forming machines, which, according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control and having all of the following:
N.B.: SEE ALSO 2B109 AND 2B209.

a. Two or more controlled axes of which at least two can be coordinated simultaneously for "contouring control"; and

b. A roller force more than 60 kN.

Technical Note:
Machines combining the function of spin-forming and flow-forming are for the purpose of 2B009 regarded as flow-forming machines.

2B104 Equipment and process controls designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

Note: The only "isostatic presses" and furnaces specified in 2B104 are as follows:

a. "Isostatic presses", other than those specified in 2B004, having all the following characteristics:
1. Maximum working pressure of 69 MPa or greater;
2. Designed to achieve and maintain a controlled thermal environment of 873 K (600°C) or greater; and
3. Possessing a chamber cavity with an inside diameter of 254 mm or greater;

b. CVD Furnaces designed or modified for the densification of carbon-carbon composites.

2B109 Flow-forming machines, other than those specified in 2B009, and specially designed components therefor, which:
N.B.: SEE ALSO 2B209.

a. According to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control, even when not equipped with such units; and

b. With more than two axes which can be coordinated simultaneously for "contouring control".

Technical Notes:
1. Machines combining the function of spin-forming and flow-forming are for the purpose of 2B109 regarded as flow-forming machines.
2. 2B109 does not control machines that are not usable in the production of propulsion components and equipment (e.g. motor cases) for systems specified in 9A007.a.

2B116 Vibration test systems, equipment and components therefor, as follows:

a. Vibration test systems employing feedback or closed loop techniques and incorporating a digital controller, capable of vibrating a system at 10 g rms or more over the entire range 20 Hz to 2,000 Hz and imparting forces of 50kN, measured 'bare table', or greater;

b. Digital controllers, combined with specially designed vibration test software, with a "real-time bandwidth" greater than 5 kHz designed for use with vibration test systems specified in 2B116.a.;

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN, measured 'bare table', or greater and usable in vibration test systems specified in 2B116.a.;

d. Test piece support structures and electronic units designed to combine multiple shaker units in a system capable of providing an effective combined force of 50 kN, measured 'bare table', or greater, and usable in vibration systems specified in 2B116.a.

Note: *In 2B116, 'bare table' means a flat table, or surface, with no fixture or fittings.*

2B201 Machine tools, other than those specified in 2B001, as follows, for removing or cutting metals, ceramics or "composites", which, according to the manufacturer's technical specification, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

a. Machine tools for milling, having any of the following characteristics:
   1. "Positioning accuracies" with all compensations available less (better) than 0.006 mm along any linear axis (overall positioning); or
   2. Two or more contouring rotary axes;

   Note: *2B201.a. does not control milling machines having the following characteristics:*
      a. X-axis travel greater than 2m; and
      b. Overall "positioning accuracy" on the x-axis more (worse) than 0.030 mm.

b. Machine tools for grinding, having any of the following characteristics:
   1. "Positioning accuracies" with all compensations available less (better) than 0.004 mm along any linear axis (overall positioning); or
   2. Two or more contouring rotary axes.

   Note: *2B201.b. does not control the following grinding machines:*
      a. Cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:
         1. Limited to cylindrical grinding;
         2. A maximum workpiece outside diameter or length of 150 mm;
         3. Not more than two axes that can be coordinated simultaneously for "contouring control"; and
         4. No contouring c axis;
      b. Jig grinders with axes limited to x, y, c and a where c axis is used to maintain the grinding wheel normal to the work surface , and the a axis is configured to grind barrel cams;
      c. Tool or cutter grinding machines with "software" specially designed for the production of tools or cutters; or
      d. Crankshaft or camshaft grinding machines.

2B204 "Isostatic presses", other than those specified in 2B004 or 2B104, capable of achieving a maximum working pressure of 69 MPa or greater and having a chamber cavity with an inside diameter in excess of 152 mm, and specially designed dies, moulds or controls therefor.

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.

2B206 Dimensional inspection machines, devices or systems, other than those specified in

2B006, as follows:

a. Computer controlled or numericaly controlled dimensional inspection machines having both of the following characteristics:
   1. Two or more axes; and
   2. A one-dimensional length "measurement uncertainty" equal to or less (better) than (1.25 + L/1000) µm tested with a probe of an "accuracy" of less (better) than 0.2 µm (L is the measured length in millimeters) (Ref.:VDI/VDE 2617 Parts 1 and 2);

b. Systems for simultaneously linear-angular inspection of hemishells, having both of the following characteristics:
   1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3.5 µm per 5 mm; and
   2. "Angular position deviation" equal to or less than 0.02°.

Technical Note:

1. *Machine tools that can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.*
2. *A machine specified in 2B206 is controlled if it exceeds the control threshold anywhere within its operating range.*
3. *The probe used in determining the measurement uncertainty of a dimensional inspection system shall be described in VDI/VDE 2617 parts 2, 3 and 4.*

2B207 "Robots" or "end-effectors", other than those specified in 2B007, specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives) and specially designed controllers therefor.

2B209 Flow forming machines, or spin forming machines capable of flow forming functions, other than those specified in 2B009 or 2B109, or mandrels, as follows:

a. 1. Having three or more rollers (active or guiding); and
   2. According to the manufacturer's technical specification can be equipped with "numerical control" units or a computer control;

b. Rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm and 400 mm.

Note: 2B209 includes machines which have only a single roller designed to deform metal plus two auxiliary rollers which support the mandrel, but do not participate directly in the deformation process.

2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations and hot cells, as follows:

a. Having a capability of penetrating 0.6 m or more of hot cell wall (through-the-wall operation); or
b. Having a capability of bridging over the top of a hot cell wall with a thickness of 0.6 m or more (over-the-wall operation).

Note: Remote manipulators provide translation of human operator actions to a remote operating arm and terminal fixture. They may be of 'master/slave' type or operated by joystick or keypad.

2B226 Vacuum or controlled environment (inert gas) induction furnaces capable of operation above 1,123 K (850°C) and having induction coils 600 mm or less in diameter,

and designed for power inputs of 5 kW or more, and power supplies specially designed therefor with a specified power output of 5 kW or more.
N.B: SEE ALSO 3B.

Note: *2B226 does not control furnaces designed for the processing of semiconductor wafers.*

2B227 Vacuum and controlled atmosphere metallurgical melting and casting furnaces as follows; and specially configured computer control and monitoring systems therefor:

a. Arc remelt and casting furnaces with consumable electrode capacities between 1,000 cm^3 and 20,000 cm^3, capable of operating with melting temperatures above 1,973 K (1,700°C);

b. Electron beam melting and plasma atomization and melting furnaces, with a power of 50 kW or greater, capable of operating with melting temperatures above 1,473 K (1,200°C).

2B228 Rotor fabrication and assembly equipment and bellows-forming mandrels and dies, as follows:

a. Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles and end caps, including associated precision mandrels, clamps and shrink fit machines;

b. Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis;

Technical Note:
Normally such equipment will consist of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.

c. Bellows-forming mandrels and dies for producing single-convolution bellows (bellows made of high-strength aluminium alloys, maraging steel or high strength filamentary materials). The bellows have all of the following dimensions:
   1. 75 mm to 400 mm inside diameter;
   2. 12.7 mm or more in length; and
   3. Single convolution depth more than 2 mm.

2B229 Centrifugal multiplane balancing machines, fixed or portable,horizontal or vertical, as follows:

a. Centrifugal balancing machines designed for balancing flexible rotors having a length of 600 mm or more and having all of the following characteristics:
   1. A swing or journal diameter of 75 mm or more;
   2. Mass capability of from 0.9 to 23 kg ; and
   3. Capable of balancing speed of revolution more than 5,000 r.p.m.;

b. Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:
   1. A journal diameter of 75 mm or more;
   2. Mass capability of from 0.9 to 23 kg;
   3. Capable of balancing to a residual imbalance of 0.01 kg mm/kg per plane or better; and
   4. Belt drive type.

2B230 "Pressure transducers" which are capable of measuring absolute pressure at any point in the range 0 to 13 kPa, with pressure sensing elements made of or protected by nickel, nickel alloys with more than 60% nickel by weight, aluminium or aluminium alloys, having any of the following:

a. A full scale of less than 13 kPa and an 'accuracy' of better than ± 1% (full-scale); or
b. A full scale of 13 kPa or greater and an 'accuracy' of better than ± 130 Pa.

Technical Note:
For the purposes of 2B230, 'accuracy' includes non-linearity, hysteresis and repeatability at ambient temperature.

2B231 Vacuum pumps with an input throat size of 380 mm or greater with a pumping speed of 15,000 litres/s or greater and capable of producing an ultimate vacuum better than 13 mPa.

Technical Notes:
1. *The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.*
2. *The pumping speed is determined at the measurement point with nitrogen gas or air.*

2B232 Multistage light gas gun or other high-velocity gun systems (coil, electromagnetic, electrothermal or other advanced systems) capable of accelerating projectiles to 2 km/s or greater.

2B350 Chemical manufacturing facilities and equipment, as follows:

a. Reaction vessels or reactors, with or without agitators, with total internal (geometric) volume greater than 0.1 m^3 (100 litres) and less than 20 m^3 (20,000 litres), where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
   1. Alloys with more than 25% nickel and 20% chromium by weight;
   2. Fluoropolymers;
   3. Glass (including vitrified or enamelled coating or glass lining);
   4. Nickel or alloys with more than 40% nickel by weight;
   5. Tantalum or tantalum alloys;
   6. Titanium or titanium alloys; or
   7. Zirconium or zirconium alloys;

b. Agitators for use in reaction vessels or reactors where all surfaces of the agitator that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
   1. Alloys with more than 25% nickel and 20% chromium by weight;
   2. Fluoropolymers;
   3. Glass (including vitrified or enamelled coatings or glass lining);
   4. Nickel or alloys with more than 40% nickel by weight;
   5. Tantalum or tantalum alloys;
   6. Titanium or titanium alloys; or
   7. Zirconium or zirconium alloys;

c. Storage tanks, containers or receivers with a total internal (geometric) volume greater than 0.1 m^3 (100 litres) where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
   1. Alloys with more than 25% nickel and 20% chromium by weight;
   2. Fluoropolymers;

3. Glass (including vitrified or enamelled coatings or glass lining);
4. Nickel or alloys with more than 40% nickel by weight;
5. Tantalum or tantalum alloys;
6. Titanium or titanium alloys; or
7. Zirconium or zirconium alloys;

d. Heat exchangers or condensers with a heat transfer surface area of less than 20 m^2, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:
1. Alloys with more than 25% nickel and 20% chromium by weight;
2. Fluoropolymers;
3. Glass (including vitrified or enamelled coatings or glass lining);
4. Graphite;
5. Nickel or alloys with more than 40% nickel by weight;
6. Tantalum or tantalum alloys;
7. Titanium or titanium alloys; or
8. Zirconium or zirconium alloys;

e. Distillation or absorption columns of internal diameter greater than 0.1 m, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:
1. Alloys with more than 25% nickel and 20% chromium by weight;
2. Fluoropolymers;
3. Glass (including vitrified or enamelled coatings or glass lining);
4. Graphite;
5. Nickel or alloys with more than 40% nickel by weight;
6. Tantalum or tantalum alloys;
7. Titanium or titanium alloys; or
8. Zirconium or zirconium alloys;

f. Remotely operated filling equipment in which all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:
1. Alloys with more than 25% nickel and 20% chromium by weight; or
2. Nickel or alloys with more than 40% nickel by weight;

g. Multiple seal valves incorporating a leak detection port, bellows-seal valves, non-return (check) valves or diaphragm valves, in which all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
1. Alloys with more than 25% nickel and 20% chromium by weight;
2. Fluoropolymers;
3. Glass (including vitrified or enamelled coatings or glass lining);
4. Nickel or alloys with more than 40% nickel by weight;
5. Tantalum or tantalum alloys;
6. Titanium or titanium alloys; or
7. Zirconium or zirconium alloys;

h. Multi-walled piping incorporating a leak detection port, in which all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
1. Alloys with more than 25% nickel and 20% chromium by weight;
2. Fluoropolymers;
3. Glass (including vitrified or enamelled coatings or glass lining);
4. Graphite;
5. Nickel or alloys with more than 40% nickel by weight;
6. Tantalum or tantalum alloys;
7. Titanium or titanium alloys; or
8. Zirconium or zirconium alloys;

i. Multiple-seal, canned drive, magnetic drive, bellows or diaphragm pumps, with manufacturer's specified maximum flow-rate greater than 0.6 m^3/hour, or vacuum pumps with manufacturer's specified maximum flow-rate greater than 5 m^3/hour (under standard temperature (273 K (0°C)) and pressure (101.3 kPa) conditions), in which all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:
   1. Alloys with more than 25% nickel and 20% chromium by weight;
   2. Ceramics;
   3. Ferrosilicon;
   4. Fluoropolymers;
   5. Glass (including vitrified or enamelled coatings or glass lining);
   6. Graphite;
   7. Nickel or alloys with more than 40% nickel by weight;
   8. Tantalum or tantalum alloys;
   9. Titanium or titanium alloys; or
   10. Zirconium or zirconium alloys;

j. Incinerators designed to destroy chemicals specified in entry 1C350, having specially designed waste supply systems, special handling facilities and an average combustion chamber temperature greater than 1,273 K (1,000°C), in which all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with any of the following materials:
   1. Alloys with more than 25% nickel and 20% chromium by weight;
   2. Ceramics; or
   3. Nickel or alloys with more than 40% nickel by weight.

2B351 Toxic gas monitoring systems, as follows; and dedicated detectors therefor:

a. Designed for continuous operation and usable for the detection of chemical warfare agents, chemicals specified in 1C350 or organic compounds containing phosphorus, sulphur, fluorine or chlorine, at concentrations of less than 0.3 mg/m^3; or
b. Designed for the detection of cholinesterase-inhibiting activity.

2B352 Equipment capable of use in handling biological materials, as follows:

a. Complete biological containment facilities at P3, P4 containment level;
   Technical Note:
   P3 or P4 (BL3, BL4, L3, L4) containment levels are as specified in the WHO Laboratory Biosafety manual (Geneva, 1983).

b. Fermenters capable of cultivation of pathogenic "microorganisms", viruses or capable of toxin production, without the propagation of aerosols, and having a total capacity of 100 litres or more;
   Technical Note:
   Fermenters include bioreactors, chemostats and continuous-flow systems.

c. Centrifugal separators, capable of continuous separation without the propagation of aerosols, having all the following characteristics:
   1. Flow rate exceeding 100 litres per hour;
   2. Components of polished stainless steel or titanium;
   3. Double or multiple sealing joints within the steam containment area; and
   4. Capable of in-situ steam sterilisation in a closed state;
   Technical Note:
   Centrifugal separators include decanters.

d. Cross-flow filtration equipment, capable of continuous separation without the propagation of aerosols, having both of the following characteristics:

1. Equal to or greater than 5 square metres; and
2. Capable of in-situ sterilization;

e. Steam sterilisable freeze drying equipment with a condenser capacity exceeding 50 kg of ice in 24 hours and less than 1,000 kg of ice in 24 hours;

f. Equipment that incorporates or is contained in P3 or P4 containment housing, as follows:
   1. Independently ventilated protective full or half suits;
   2. Biological safety cabinets or isolators, which allow manual operations to be performed within, whilst providing an environment equivalent to Class III biological protection;
      Note: In 2B352.f.2., isolators include flexible isolators, dry boxes, anaerobic chambers and glove boxes.

g. Chambers designed for aerosol challenge testing with "microorganisms" or "toxins" and having a capacity of 1 m^3 or greater.

2C Materials

None.

2D Software

2D001 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 2A001or 2B001 to 2B009.

2D002 "Software" for electronic devices, even when residing in an electronic device or system, enabling such devices or systems to function as a "numerical control" unit, capable of any of the following:

a. Coordinating simultaneously more than 4 axes for "contouring control"; or

b. "Real time processing" of data to modify tool path, feed rate and spindle data, during the machining operation, by any of the following:
   1. Automatic calculation and modification of part program 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 processed by means of a computing model (strategy) to change one or more machining instructions to optimize the process.

Note: 2D002 does not control "software" specially designed or modified for the operation of machine tools not controlled by Category 2.

2D101 "Software" specially designed for the "use" of equipment specified in 2B104, 2B109 or 2B116.
N.B.: SEE ALSO 9D004.

2D201 "Software" specially designed for the "use" of equipment specified in 2B204, 2B206, 2B207, 2B209, 2B227 or 2B229.

2D202 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 2B201.

2E Technology

2E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 2A, 2B or 2D.

2E002 "Technology" according to the General Technology Note for the "production" of equipment specified in 2A or 2B.

2E003 Other "technology", as follows:

a. "Technology" for the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of part programmes;

b. "Technology" for metal-working manufacturing processes, as follows:
   1. "Technology" for the design of tools, dies or fixtures specially designed for any of the following processes:
      a. "Superplastic forming";
      b. "Diffusion bonding"; or
      c. "Direct-acting hydraulic pressing";
   2. Technical data consisting of process methods or parameters as listed below used to control:
      a. "Superplastic forming" of aluminium alloys, titanium alloys or "superalloys":
         1. Surface preparation;
         2. Strain rate;
         3. Temperature;
         4. Pressure;
      b. "Diffusion bonding" of "superalloys" or titanium alloys:
         1. Surface preparation;
         2. Temperature;
         3. Pressure;
      c. "Direct-acting hydraulic pressing" of aluminium alloys or titanium alloys:
         1. Pressure;
         2. Cycle time;
      d. "Hot isostatic densification" of titanium alloys, aluminium alloys or "superalloys":
         1. Temperature;
         2. Pressure;
         3. Cycle time;

c. "Technology" for the "development" or "production" of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;

d. "Technology" for the "development" of generators of machine tool instructions (e.g., part programmes) from design data residing inside "numerical control" units;

e. "Technology for the development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units;

f. "Technology" for the application of inorganic overlay coatings or inorganic surface modification coatings (specified in column 3 of the following table) to non-electronic substrates (specified in column 2 of the following table), by

processes specified in column 1 of the following table and defined in the Technical Note.

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)*	2. Substrate	3. Resultant Coating
A. Chemical Vapour Deposition (CVD)	"Superalloys"	Aluminides for internal passages
	Ceramics and Low-expansion glasses(14)	Silicides Carbides Dielectric layers (15)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Aluminides Alloyed aluminides (2)
	Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
B. Thermal-Evaporation Physical Vapour Deposition (TE-PVD)		
1. Physical Vapour Deposition (PVD): Electron-Beam (EB-PVD)	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
	Ceramics and Low-expansion glasses (14)	Dielectric layers (15)
	Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)

* The numbers in parenthesis refer to the Notes following this Table.

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)	2. Substrate	3. Resultant Coating
B.1. (continued)	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15) Borides
	Sensor window materials (9)	Dielectric layers (15)
	Titanium alloys (13)	Borides Nitrides
B.2. Ion assisted resistive heating Physical Vapour Deposition (Ion Plating)	Ceramics and Low-expansion glasses (14)	Dielectric layers (15)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)	2. Substrate	3. Resultant Coating
B.3. Physical Vapour Deposition: "laser" evaporation	Ceramics and Low-expansion glasses (14)	Silicides Dielectric layers (15)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
B.4. Physical Vapour Deposition: cathodic arc discharge	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5)
	Polymers (11) and Organic "matrix" "composites"	Borides Carbides Nitrides
C. Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
	Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
	Refractory metals and alloys (8)	Silicides Oxides

TABLE - DEPOSITION TECHNIQUES

1.	Coating Process (1)	2. Substrate	3. Resultant Coating
D.	Plasma spraying	"Superalloys"	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel-Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si-Polyester Alloyed aluminides (2)
		Aluminium alloys (6)	MCrAlX (5) Modified zirconia (12) Silicides Mixtures thereof (4)
		Refractory metals and alloys (8)	Aluminides Silicides Carbides
		Corrosion resistant steel (7)	Modified zirconia (12) Mixtures thereof (4)
D.	(continued)	Titanium alloys (13)	Carbides Aluminides Silicides Alloyed aluminides (2) Abradable Nickel-Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si-Polyester Polyester
E.	Slurry Deposition and alloys (8)	Refractory metals	Fused silicides Fused aluminides except for resistance heating elements
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)	2. Substrate	3. Resultant Coating
F. Sputter Deposition	"Superalloys"	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)
	Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectic layers (15)
	Titanium alloys (13)	Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Borides Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
	Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)	2. Substrate	3. Resultant Coating
G. Ion Implantation	High temperature bearing steels	Additions of Chromium, Tantalum or Niobium (Columbium)
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

TABLE - DEPOSITION TECHNIQUES - NOTES

1. The term 'coating process' includes coating repair and refurbishing as well as original coating.

2. The term 'alloyed aluminide coating' includes single or multiple-step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include the multiple use of single-step pack cementation processes to achieve alloyed aluminides.

3. The term 'noble metal modified aluminide' coating includes multiple-step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.

4. Mixtures consist of infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.

5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01 weight percent in various proportions and combinations, except:
   a. CoCrAlY coatings which contain less than 22 weight percent of chromium, less than 7 weight percent of aluminium and less than 2 weight percent of yttrium;
   b. CoCrAlY coatings which contain 22 to 24 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.5 to 0.7 weight percent of yttrium; or
   c. NiCrAlY coatings which contain 21 to 23 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.9 to1.1 weight percent of yttrium.

6. The term 'aluminium alloys' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20°C).

7. The term 'corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.

8. Refractory metals consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. Sensor window materials, as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide and the following metal halides: potassium iodide, potassium fluoride, or sensor window materials of more than 40 mm diameter for thallium bromide and thallium chlorobromide.

10. "Technology" for single-step pack cementation of solid airfoils is not controlled by Category 2.

11. Polymers, as follows: polyimide, polyester, polysulphide, polycarbonates and polyurethanes.

12. Modified zirconia refers to additions of other metal oxides (e.g., calcia, magnesia, yttria, hafnia, rare earth oxides) to zirconia in order to stabilise certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not controlled.

13. Titanium alloys refers to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20°C).

14. Low-expansion glasses refers to glasses which have a coefficient of thermal expansion of $1 \times 10^{-7}\ K^{-1}$ or less measured at 293 K (20°C).

15. Dielectric layers are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal "composite" layers.

16. Cemented tungsten carbide does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickle), titanium carbide/(cobalt, nickle), chromium carbide/nickle-chromium and chromium carbide/nickle.

TABLE - DEPOSITION TECHNIQUES - TECHNICAL NOTE

Processes specified in Column I of the Table are defined as follows:

a. Chemical Vapour Deposition (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, "composite", dielectric or ceramic is deposited upon a heated substrate. Gaseous reactants are decomposed or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloy or compound material-on the substrate. Energy for this decomposition or chemical reaction process may be provided by the heat of the substrate, a glow discharge plasma, or "laser" irradiation.

N.B.1 CVD includes the following processes: directed gas flow out-of-pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.
N.B.2 Pack denotes a substrate immersed in a powder mixture.
N.B.3 The gaseous reactants used in the out-of-pack process are produced using the same basic reactions and parameters as the pack cementation process, except that the substrate to be coated is not in contact with the powder mixture.

b. Thermal Evaporation-Physical Vapour Deposition (TE-PVD) is an overlay coating process conducted in a vacuum with a pressure less than O.1 Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates.

The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process.

The use of ion or electron beams, or plasma to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can be a feature of these processes.

Specific TE-PVD processes are as follows:

1. Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;
2. Resistive Heating PVD employs electrically resistive heating sources capable of producing a controlled and uniform flux of evaporated coating species;
3. "Laser" Evaporation uses either pulsed or continuous wave "laser" beams to heat the material which forms the coating;
4. Cathodic Arc Deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line-of-sight deposition.
   N.B. This definition does not include random cathodic arc deposition with non-biased substrates.

c. Ion Plating is a special modification of a general TE-PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species to be deposited from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.

d. Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:

1. The metallic powders that are to be deposited (usually aluminium, chromium, silicon or combinations thereof);
2. An activator (normally a halide salt); and
3. An inert powder, most frequently alumina.

The substrate and powder mixture is contained within a retort which is heated to between 1,030 K (757^{0}C) and 1,375 K (1,102^{0}C) for sufficient time to deposit the coating.

e. Plasma Spraying is an overlay coating process wherein a gun (spray torch) which produces and controls a plasma accepts powder or wire coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed. Plasma spraying constitutes either low pressure plasma spraying or high velocity plasma spraying carried out under-water.

N.B.1 Low pressure means less than ambient atmospheric pressure.
N.B.2 High velocity refers to nozzle-exit gas velocity exceeding 750 mls calculated at 293 K (20^{0}C) at 0.1 MPa.

f. Slurry Deposition is a surface modification coating or overlay coating process wherein a metallic or ceramic powder with an organic binder is suspended in a liquid and is applied to a substrate by either spraying, dipping or painting, subsequent air or oven drying, and heat treatment to obtain the desired coating.

g. Sputter Deposition is an overlay coating process based on a momentum transfer phenomenon, wherein positive ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on an appropriately positioned substrate.

N.B.1 The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vapourisation of non-metallic coating materials.

N.B.2 Low-energy ion beams (less than 5 keV) can be used to activate the deposition.

h. Ion Implantation is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapour deposition or sputter deposition.

2E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 2B004, 2B104, 2B109, 2B116 or 2D101.

2E201 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 2A225, 2A226, 2B001, 2B006, 2B007.b., 2B007.c., 2B008, 2B009, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B232, 2D201 or 2D202.

2E301 "Technology" required for the "use" of goods specified in 2B350 to 2B352.

2E390 Process "technology", including licences, designed for the manufacture of chemical weapons agents or their precursors, and/or for their disposal, or for whole plants designed for their manufacture

2E391 "Technology", including licences, designed for the manufacture of equipment specified in 2B350 and 2B351.

PART 3, CATEGORY 3 - ELECTRONICS

3A Systems, Equipment and Components

Notes: 1. *The control status of equipment and components described in 3A001 or 3A002, other than those described in 3A001.a.3. to 3A001.a.10. or 3A001.a.12., which are specially designed for or which have the same functional characteristics as other equipment is determined by the control status of the other equipment.*

2. *The control status of integrated circuits described in 3A001.a.3. to 3A001.a.9. or 3A001.a.12. which are unalterably programmed or designed for a specific function for another equipment is determined by the control status of the other equipment.*

N.B.: When the manufacturer or applicant cannot determine the control status of the other equipment, the control status of the integrated circuits is determined in 3A001.a.3. to 3A001.a.9. and 3A001.a.12. If the integrated circuit is a silicon-based "microcomputer microcircuit" or microcontroller microcircuit described in 3A001.a.3. having an operand (data) word length of 8 bit or less, the control status of the integrated circuit is determined in 3A001.a.3.

3A001 Electronic components, as follows:

a. General purpose integrated circuits, as follows:

Notes: 1. *The control status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3A001.a.*

2. *Integrated circuits include the following types:*
"Monolithic integrated circuits";
"Hybrid integrated circuits";
"Multichip integrated circuits";
"Film type integrated circuits", including silicon-on-sapphire integrated circuits;
"Optical integrated circuits".

1. Integrated circuits, designed or rated as radiation hardened to withstand any of the following:
   a. A total dose of 5×10^3 Gy (Si) or higher; or
   b. A dose rate upset of 5×10^6 Gy (Si)/s or higher;

2. "Microprocessor microcircuits", "microcomputer microcircuits", microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analogue-to-digital converters, digital-to-analogue converters, electro-optical or "optical integrated circuits" designed for "signal processing", field programmable gate arrays, field programmable logic arrays, neural network integrated circuits, custom integrated circuits for which either the function is unknown or the control status of the equipment in which the integrated circuit will be used is unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following:
   a. Rated for operation at an ambient temperature above 398 K (125°C);

b. Rated for operation at an ambient temperature below 218 K (-55°C); or
c. Rated for operation over the entire ambient temperature range from 218 K (-55°C) to 398 K (125°C);

Note: *3A001.a.2. does not apply to integrated circuits for civil automobiles or railway train applications.*

3A001 a. 3. "Microprocessor microcircuits", "micro-computer microcircuits" and microcontroller microcircuits, having any of the following characteristics:
Note: *3A001.a.3. includes digital signal processors, digital array processors and digital coprocessors.*

a. A "composite theoretical performance" ("CTP") of 260 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of 32 bit or more;
b. Manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz; or
c. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.5 Mbyte/s;

4. Storage integrated circuits manufactured from a compound semiconductor;

5. Analogue-to-digital and digital-to-analogue converter integrated circuits, as follows:
a. Analogue-to-digital converters having any of the following:
1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time to maximum resolution of less than 10 ns;
2. A resolution of 12 bit with a total conversion time to maximum resolution of less than 200 ns; or
3. A resolution of more than 12 bit with a total conversion time to maximum resolution of less than 2 µs;
b. Digital-to-analogue converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

6. Electro-optical and "optical integrated circuits" designed for "signal processing" having all of the following:
a. One or more than one internal "laser" diode;
b. One or more than one internal light detecting element; and
c. Optical waveguides;

7. Field programmable gate arrays having any of the following:
a. An equivalent usable gate count of more than 30,000 (2 input gates); or
b. A typical "basic gate propagation delay time" of less than 0.4 ns;

8. Field programmable logic arrays having any of the following:
a. An equivalent usable gate count of more than 30,000 (2 input gates); or
b. A toggle frequency exceeding 133 MHz;

9. Neural network integrated circuits;

10. Custom integrated circuits for which the function is unknown, or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:
a. More than 208 terminals;
b. A typical "basic gate propagation delay time" of less than 0.35 ns; or
c. An operating frequency exceeding 3 GHz;

11. Digital integrated circuits, other than those described in 3A001.a.3 to 3A001.a.10. and 3A001.a.12., based upon any compound semiconductor and having any of the following:
    a. An equivalent gate count of more than 300 (2 input gates); or
    b. A toggle frequency exceeding 1.2 GHz;

12. Fast Fourier Transform (FFT) processors having any of the following:
    a. A rated execution time for a 1,024 point complex FFT of less than 1 ms;
    b. A rated execution time for an N-point complex FFT of other than 1,024 points of less than $N \log_2 N$ /10,240 ms, where N is the number of points; or
    c. A butterfly throughput of more than 5.12 MHz;

3A001 b. Microwave or millimetre wave components, as follows:
1. Electronic vacuum tubes and cathodes, as follows:
   Note: 3A001.b.1. does not control tubes designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.
   a. Travelling wave tubes, pulsed or continuous wave, as follows:
      1. Operating at frequencies higher than 31 GHz;
      2. Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;
      3. Coupled cavity tubes, or derivatives thereof, with an "instantaneous bandwidth" of more than 7% or a peak power exceeding 2.5 kW;
      4. Helix tubes, or derivatives thereof, with any of the following characteristics:
         a. An "instantaneous bandwidth" of more than one octave, and average power (expressed in kW) times frequency (expressed in GHz) of more than 0.5;
         b. An "instantaneous bandwidth" of one octave or less, and average power (expressed in kW) times frequency (expressed in GHz) of more than 1; or
         c. Being"space qualified";
   b. Crossed-field amplifier tubes with a gain of more than 17 dB;
   c. Impregnated cathodes designed for electronic tubes, with any of the following:
      1. A turn on time to rated emission of less than 3 seconds; or
      2. Producing a continuous emission current density at rated operating conditions exceeding 5 A/cm^2;
2. Microwave integrated circuits or modules containing "monolithic integrated circuits" operating at frequencies exceeding 3 GHz;
   Note: 3A001.b.2. does not control circuits or modules for equipment designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.
3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;
4. Microwave solid state amplifiers, having any of the following:
   a. Operating frequencies exceeding 10.5 GHz and an "instantaneous bandwidth" of more than half an octave; or
   b. Operating frequencies exceeding 31 GHz;
5. Electronically or magnetically tunable band-pass or band-stop filters having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (f_{max}/f_{min}) in less than 10 µs having any of the following:
   a. A band-pass bandwidth of more than 0.5% of centre frequency; or
   b. A band-stop bandwidth of less than 0.5% of centre frequency;
6. Microwave assemblies capable of operating at frequencies exceeding 31 GHz;

7. Mixers and converters designed to extend the frequency range of equipment described in 3A002.c., 3A002.e. or 3A002.f. beyond the limits stated therein;
8. Microwave power amplifiers containing tubes specified in 3A001.b. and having all of the following:
   a. Operating frequencies above 3 GHz;
   b. An average output power density exceeding 80 W/kg; and
   c. A volume of less than 400 cm^3;

   Note: *3A001.b.8. does not control equipment designed or rated for operation in an ITU allocated band.*

3A001 c. Acoustic wave devices, as follows, and specially designed components therefor:
1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., "signal processing" devices employing elastic waves in materials), having any of the following:
   a. A carrier frequency exceeding 2.5 GHz;
   b. A carrier frequency exceeding 1 GHz, but not exceeding 2.5 GHz, and having any of the following:
      1. A frequency side-lobe rejection exceeding 55 dB;
      2. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;
      3. A bandwidth greater than 250 MHz; or
      4. A dispersive delay of more than 10 μs; or
   c. A carrier frequency of 1 GHz or less, having any of the following:
      1. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;
      2. A dispersive delay of more than 10 μs; or
      3. A frequency side-lobe rejection exceeding 55 dB and a bandwidth greater than 50 MHz;
2. Bulk (volume) acoustic wave devices (i.e., "signal processing" devices employing elastic waves) which permit the direct processing of signals at frequencies exceeding 1 GHz;
3. Acoustic-optic "signal processing" devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

d. Electronic devices and circuits containing components, manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents, with any of the following:
1. Electromagnetic amplification:
   a. At frequencies equal to or less than 31 GHz with a noise figure of less than 0.5 dB; or
   b. At frequencies exceeding 31 GHz;
2. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; or
3. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

e. High energy devices, as follows:
1. Batteries and photovoltaic arrays, as follows:

   Note: *3A001.e.1. does not control batteries with volumes equal to or less than 27 cm^3 (e.g., standard C-cells or R14 batteries).*

   a. Primary cells and batteries having an energy density exceeding 480 Wh/kg and rated for operation in the temperature range from below 243 K (-30°C) to above 343 K (70°C);
   b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current

equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20°C) to above 333 K (60°C);

Technical Note:
Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75% of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

3A001 e. 1. c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m^2 at an operating temperature of 301 K (28°C) under a tungsten illumination of 1 kW/m^2 at 2,800 K (2,527°C);

2. High energy storage capacitors, as follows:
N.B.: SEE ALSO 3A201.a.
a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) having all of the following:
1. A voltage rating equal to or more than 5 kV;
2. An energy density equal to or more than 250 J/kg; and
3. A total energy equal to or more 25 kJ;

b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) having all of the following:
1. A voltage rating equal to or more than 5 kV;
2. An energy density equal to or more than 50 J/kg;
3. A total energy equal to or more than 100 J; and
4. A charge/discharge cycle life equal to or more than 10,000;

3. "Superconductive" electromagnets and solenoids specially designed to be fully charged or discharged in less than one second, having all of the following:
N.B.: SEE ALSO 3A201.b.
a. Energy delivered during the discharge exceeding 10 kJ in the first second;
b. Inner diameter of the current carrying windings of more than 250 mm; and
c. Rated for a magnetic induction of more than 8 T or "overall current density" in the winding of more than 300 A/mm^2;

Note *3A001.e.3. does not control "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.*

f. Rotary input type shaft absolute position encoders having any of the following:
1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; or
2. An accuracy better than ± 2.5 seconds of arc.

3A002 General purpose electronic equipment, as follows:

a. Recording equipment, as follows, and specially designed test tape therefor:
1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module), having any of the following:
a. A bandwidth exceeding 4 MHz per electronic channel or track;
b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; or

c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ± 0.1 μs;

Note: *Analogue magnetic tape recorders specially designed for civilian video purposes are not considered to be instrumentation tape recorders.*

3A002 a. 2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180 Mbit/s;

Note: *3A002.a.2. does not control digital video magnetic tape recorders specially designed for television recording using a signal format standardised or recommended by the CCIR or the IEC for civil television applications.*

3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques, having any of the following:
   a. A maximum digital interface transfer rate exceeding 175 Mbit/s; or
   b. Being "space qualified";

   Note *3A002.a.3. does not control analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.*

4. Equipment, having a maximum digital interface transfer rate exceeding 175 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;
5. Waveform digitisers and transient recorders having all of the following:
   N.B.: SEE ALSO 3A202.
   a. Digitising rates equal to or more than 200 million samples per second and a resolution of 10 bits or more; and
   b. A continuous throughput of 2 Gbit/s or more;

   Technical Note:
   For those instruments with a parallel bus architecture, the continuous throughput rate is the highest word rate multiplied by the number of bits in a word.
   Continuous throughput is the fastest data rate the instrument can output to mass storage without the loss of any information whilst sustaining the sampling rate and analogue-to-digital conversion.

b. "Frequency synthesiser" "electronic assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;

c. "Signal analysers", as follows:
   1. "Signal analysers" capable of analysing frequencies exceeding 31 GHz;
   2. "Dynamic signal analysers" having a "real-time bandwidth" exceeding 25.6 kHz;

      Note: *3A002.c.2. does not control those "dynamic signal analysers" using only constant percentage bandwidth filters.*

      Technical Note:

      Constant percentage bandwidth filters are also known as octave or fractional octave filters.

d. Frequency synthesised signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:
   1. A maximum synthesised frequency exceeding 31 GHz;
   2. A "frequency switching time" from one selected frequency to another of less than 1 ms; or

3. A single sideband (SSB) phase noise better than $-(126 + 20 \log_{10}F - 20 \log_{10}f)$ in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

Note: *3A002.d. does not control equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.*

e. Network analysers with a maximum operating frequency exceeding 40 GHz;

f. Microwave test receivers having all of the following:
   1. A maximum operating frequency exceeding 40 GHz; and
   2. Being capable of measuring amplitude and phase simultaneously;

g. Atomic frequency standards having any of the following:
   1. Long-term stability (aging) less (better) than 1×10^{-11}/month; or
   2. Being "space qualified".

Note: *3A002.g.1. does not control non-"space qualified" rubidium standards.*

3A101 Electronic equipment, devices and components, other than those specified in 3A001, as follows:

a. Analog-to-digital converters, usable in "missiles", designed to meet military specifications for ruggedized equipment;

b. Accelerators capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and systems containing those accelerators.

Note: *3A101.b. above does not specify equipment specially designed for medical purposes.*

3A201 Electronic components, other than those specified in 3A001, as follows;

a. Capacitors with the following characteristics:
   1. Voltage rating greater than 1.4 kV, energy storage greater than 10 J, capacitance greater than 0.5 µF and series inductance less than 50 nH; or
   2. Voltage rating greater than 750 V, capacitance greater than 0.25 µF and series inductance less than 10 nH;

b. Superconducting solenoidal electromagnets with all of the following characteristics:

   1. Capable of creating magnetic fields of more than 2 teslas (20 kilogauss);
   2. With an L/D ratio (length divided by inner diameter) greater than 2;
   3. With an inner diameter of more than 300 mm; and
   4. With a magnetic field uniform to better than 1% over the central 50% of the inner volume;

Note: *3A201.b. does not specify magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. The phrase 'as part of' does not necessarily mean physical part in the same shipment; separate shipments from different sources are allowed, provided the related export documents clearly specify that the shipments are dispatched "as part of" the imaging systems.*

c. Flash X-ray generators or pulsed electron accelerators with peak energy of 500 keV or greater, as follows;
except:
Accelerators that are component parts of devices designed for purposes other than electron beam or X-ray radiation (electron microscopy, for example) and those designed for medical purposes:

1. Having an accelerator peak electron energy of 500 keV or greater but less than 25 MeV and with a figure of merit (K) of 0.25 or greater, where K is defined as:

$$K = 1.7 \times 10^{3} V^{2.65} Q,$$

where V is the peak electron energy in million electron volts and Q is the total accelerated charge in coulombs if the accelerator beam pulse duration is less than or equal to 1 microsecond; if the accelerator beam pulse duration is greater than 1 microsecond, Q is the maximum accelerated charge in 1 microsecond {Q equals the integral of i with respect to t, over the lesser of 1 microsecond or the time duration of the beam pulse (Q = {integral} idt), where i is beam current in amperes and t is time in seconds}; or

2. Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50 MW. {Peak power = (peak potential in volts) x (peak beam current in amperes)}.
Technical Notes:
a. Time duration of the beam pulse - In machines, based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 microsecond or the duration of the bunched beam packet resulting from one microwave modulator pulse.
b. Peak beam current - In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.

3A202 Oscilloscopes and transient recorders other than those specified in 3A002.a.5., as follows; and specially designed components therefor:

a. Non-modular analogue oscilloscopes having a bandwidth of 1 GHz or greater;

b. Modular analogue oscilloscope systems having either of the following characteristics:
1. a mainframe with a bandwidth of 1 GHz or greater; or
2. plug-in modules with an individual bandwidth of 4 GHz or greater;

c. Analogue sampling oscilloscopes for the analysis of recurring phenomena with an effective bandwidth greater than 4 GHz;

d. Digital oscilloscopes and transient recorders, using analogue-to-digital conversion techniques, capable of storing transients by sequentially sampling single-shot inputs at successive intervals of less than 1 ns (greater than 1 giga-sample per second), digitizing to 8 bits or greater resolution and storing 256 or more samples.

Note: Specially designed components specified in this item are the following, for analogue oscilloscopes:
1. Plug-in units;
2. External amplifiers;
3. Pre-amplifiers;
4. Sampling devices;
5. Cathode ray tubes.

Technical Note:
'Bandwidth' is defined as the band of frequencies over which the deflection on the cathode ray tube does not fall below 70.7% of that at the maximum point measured with a constant input voltage to the oscilloscope amplifier.

3A225 Frequency changers (also known as converters or inverters) or generators, other than those specified in 0B001.c.11., having all of the following characteristics:

a. A multiphase output capable of providing a power of 40 W or more;

b. Capable of operating in the frequency range between 600 and 2000 Hz;

c. Total harmonic distortion below 10%; and

d. Frequency control better than 0.1%.

3A226 Direct current high-power supplies, other than those specified in 0B001.j.6., capable of continuously producing,over a time period of 8 hours, 100 V or greater with current output of 500 A or greater and with current or voltage regulation better than 0.1%.

3A227 High-voltage direct current power supplies, other than those specified in 0B001.j.5., capable of continuously producing, over a time period of 8 hours, 20,000 V or greater with current output of 1 A or greater and with current or voltage regulation better than 0.1%.

3A228 Switching devices, as follows:

a. Cold-cathode tubes (including gas krytron tubes and vacuum sprytron tubes), whether gas filled or not, operating similarly to a spark gap, containing three or more electrodes, and having all of the following characteristics:
1. Anode peak voltage rating of 2,500 V or more;
2. Anode peak current rating of 100 A or more; and
3. Anode delay time of 10 microsecond or less;

b. Triggered spark-gaps having an anode delay time of 15 microsecond or less and rated for a peak current of 500 A or more;

c. Modules or assemblies with a fast switching function having all of the following characteristics:
1. Anode peak voltage rating greater than 2,000 V;
2. Anode peak current rating of 500 A or more; and
3. Turn-on time of 1 microsecond or less.

3A229 Firing sets and equivalent high-current pulse generators (for controlled detonators), as follows:
N.B.: SEE ALSO ML4b.

a. Explosive detonator firing sets designed to drive multiple controlled detonators specified in 3A232;

b. Modular electrical pulse generators (pulsers) designed for portable, mobile or ruggedized use (including xenon flash-lamp drivers) having all the following characteristics:
1. Capable of delivering their energy in less than 15 microsecond;
2. Having an output greater than 100 A;

3. Having a rise time of less than 10 microsecond into loads of less than 40 ohms (rise time is the time interval from 10% to 90% current amplitude when driving a resistive load);
4. Enclosed in a dust-tight enclosure;
5. No dimension greater than 254 mm;
6. Weight less than 25 kg; and
7. Specified for use over an extended temperature range 223 K (-50°C) to 373 K (100°C) or specified as suitable for aerospace use.

3A230 High-speed pulse generators with output voltages greater than 6 volts into a less than 55 ohm resistive load, and with pulse transition times less than 500 picoseconds.

Technical Note:
In 3A230, 'pulse transition time' is defined as the time interval between 10% and 90% voltage amplitude.

3A231 Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

3A232 Detonators and multipoint initiation systems, as follows:
N.B.: SEE ALSO ML4b.

a. Electrically driven explosive detonators, the following:
   1. Exploding bridge (EB);
   2. Exploding bridge wire (EBW);
   3. Slapper;
   4. Exploding foil initiators (EFI);

b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over greater than 5,000 mm^2) from a single firing signal (with an initiation timing spread over the surface of less than 2.5 microseconds).

Note: *3A232 does not specify detonators using only primary explosives, such as lead azide.*

Technical Note:
The detonators of concern all utilise a small electrical conductor (bridge, bridge wire or foil) that explosively vapourises when a fast, high-current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (Pentaerythritoltetranitrate). In slapper detonators, the explosive vapourisation of the electrical conductor drives a flyer or slapper across a gap and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by a magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator. Also, the word initiator is sometimes used in place of the word detonator.

3A233 Mass spectrometers, other than those specified in 0B002.g., capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, as follows, and ion sources therefor:

a. Inductively coupled plasma mass spectrometers (ICP/MS);

b. Glow discharge mass spectrometers (GDMS);

c. Thermal ionization mass spectrometers (TIMS);

d. Electron bombardment mass spectrometers which have a source chamber constructed from, lined with or plated with materials resistant to UF_6;

e. Molecular beam mass spectrometers as follows:
   1. Which have a source chamber constructed from, lined with or plated with stainless steel or molybdenum and have a cold trap capable of cooling to 193 K (-80°C) or less; or
   2. Which have a source chamber constructed from, lined with or plated with materials resistant to UF_6; or

f. Mass spectrometers equipped with a microfluorination ion source designed for use with actinides or actinide fluorides.

3B Test, Inspection and Production Equipment

3B001 Equipment for the manufacturing of semiconductor devices or materials, as follows, and specially designed components and accessories therefor:

a. "Stored programme controlled" equipment designed for epitaxial growth, as follows:
   1. Equipment capable of producing a layer thickness uniform to less than ± 2.5% across a distance of 75 mm or more;
   2. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials specified in 3C003 or 3C004;
   3. Molecular beam epitaxial growth equipment using gas sources;

b. "Stored programme controlled" equipment designed for ion implantation, having any of the following:
   1. An accelerating voltage exceeding 200 keV;
   2. Being specially designed and optimised to operate at an accelerating voltage of less than 10 keV;
   3. Direct write capability; or
   4. Being capable of high energy oxygen implant into a heated semiconductor material "substrate";

c. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:
   1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:
      a. Magnetic confinement; or
      b. Electron cyclotron resonance (ECR);
   2. Equipment specially designed for equipment specified in 3B001.e. and having any of the following:
      a. Magnetic confinement; or
      b. ECR;

d. "Stored programme controlled" plasma enhanced CVD equipment, as follows:
   1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:
      a. Magnetic confinement; or
      b. ECR;
   2. Equipment specially designed for equipment specified in 3B001.e. and having any of the following:
      a. Magnetic confinement; or
      b. ECR;

e. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having all of the following:
   1. Interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected; and
   2. Designed to form an integrated system in a vacuum environment for sequential multiple wafer processing;

   Note: 3B001.e. does not control automatic robotic wafer handling systems not designed to operate in a vacuum environment.

f. "Stored programme controlled" lithography equipment, as follows:
   1. Align and expose step and repeat equipment for wafer processing using photo-optical or X-ray methods, having any of the following:
      a. A light source wavelength shorter than 400 nm; or
      b. Capable of producing a pattern with a minimum resolvable feature size of 0.7 µm or less;

         Note: The minimum resolvable feature size is calculated by the following formula:

$$MRF = \frac{(\text{an exposure light source wavelength in } \mu m) \times (\text{Kfactor})}{\text{numerical aperture}}$$

where the K factor = 0.7.
MRF = minimum resolvable feature size.

   2. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, having any of the following:
      a. A spot size smaller than 0.2 µm;
      b. Being capable of producing a pattern with a feature size of less than 1 µm; or
      c. An overlay accuracy of better than ± 0.20 µm (3 sigma);

g. Masks and reticles designed for integrated circuits specified in 3A001;

h. Multi-layer masks with a phase shift layer.

3B002 "Stored programme controlled" test equipment, specially designed for testing finished or unfinished semiconductor devices, as follows, and specially designed components and accessories therefor:

a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;

b. For testing integrated circuits capable of performing functional (truth table) testing at a pattern rate of more than 60 MHz;

   Note: 3B002.b. does not control test equipment specially designed for testing:
   1. *"electronic assemblies" or a class of "electronic assemblies" for home or entertainment applications;*
   2. *Uncontrolled electronic components, "electronic assemblies" or integrated circuits.*

c. For testing microwave integrated circuits at frequencies exceeding 3 GHz;

   Note: 3B002.c. does not control test equipment specially designed for testing microwave integrated circuits for equipment designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.

d. Electron beam systems designed for operation at 3 keV or below, or "laser" beam systems, for the non-contactive probing of powered-up semiconductor devices, having all of the following:
   1. Stroboscopic capability with either beam-blanking or detector strobing; and
   2. An electron spectrometer for voltage measurement with a resolution of less than 0.5 V.

   Note: *3B002.d. does not control scanning electron microscopes,*
   except:
   When specially designed and instrumented for the non-contactive probing of powered-up semiconductor devices.

3C Materials

3C001 Hetero-epitaxial materials consisting of a "substrate" having stacked epitaxially grown multiple layers of any of the following:
a. Silicon;
b. Germanium; or
c. III/V compounds of gallium or indium.

Technical Note:
III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleyev's periodic classification table (e.g., gallium arsenide, gallium-aluminium arsenide, indium phosphide).

3C002 Resist materials, as follows, and "substrates" coated with controlled resists:
a. Positive resists designed for semiconductor lithography specially adjusted (optimised) for use at wavelengths below 370 nm ;
b. All resists designed for use with electron beams or ion beams, with a sensitivity of 0.01 μcoulomb/mm^2 or better;
c. All resists designed for use with X-rays, with a sensitivity of 2.5 mJ/mm^2 or better;
d. All resists optimised for surface imaging technologies, including silylated resists.
   Technical Note:
   Silylation techniques are defined as processes incorporating oxidation of the resist surface to enhance performance for both wet and dry developing.

3C003 Organo-inorganic compounds, as follows:
a. Organo-metallic compounds of aluminium, gallium or indium having a purity (metal basis) better than 99.999%;
b. Organo-arsenic, organo-antimony and organo-phosphorus compounds having a purity (inorganic element basis) better than 99.999%.

Note: *3C003 only controls compounds whose metallic, partly metallic or non-metallic element is directly linked to carbon in the organic part of the molecule.*

3C004 Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in inert gases or hydrogen.

Note: *3C004 does not control hydrides containing 20% molar or more of inert gases or hydrogen.*

3D Software

3D001 "Software" specially designed for the "development" or "production" of equipment specified in 3A001.b. to 3A002.g. or 3B.

3D002 "Software" specially designed for the "use" of "stored programme controlled" equipment specified in 3B.

3D003 Computer-aided-design (CAD) "software" designed for semiconductor devices or integrated circuits, having any of the following:

a. Design rules or circuit verification rules;

b. Simulation of the physically laid out circuits; or

c. Lithographic processing simulators for design.
Technical Note:
A lithographic processing simulator is a "software" package used in the design phase to define the sequence of lithographic, etching and deposition steps for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor material.

Note: *3D003 does not control "software" specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape.*
N.B.: *Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as "technology".*

3D101 "Software" specially designed for the "use" of equipment specified in 3A101.b.

3E Technology

3E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or materials specified in 3A, 3B or 3C;
Note: *3E001 . does not control "technology" for the "development" or "production" of:*
a. Microwave transistors operating at frequencies below 31 GHz;
b. Integrated circuits specified in 3A001.a.3. to 3A001.a.12., having all of the following:
1. Using "technology" of 1 µm or more, and
2. Not incorporating multi-layer structures.
N.B.: The term multi-layer structures in Note b.2. to 3E001 does not include devices incorporating a maximum of two metal layers and two polysilicon layers.

3E002 Other "technology" for the "development" or "production" of:
a. Vacuum microelectronic devices;
b. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices;
c. "Superconductive" electronic devices;
d. Substrates of films of diamond for electronic components.

3E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 3A001.a.1. or 2., 3A101 or 3D101.

3E102 "Technology" according to the General Technology Note for the "development" of "software" specified in 3D101.

3E201 "Technology" according to the General Technology Note for the "use" of equipment specified in 3A001.e.2., 3A001.e.3., 3A201, 3A202, 3A225 to 3A233.

PART 3, CATEGORY 4 - COMPUTERS

Notes: 1. *Computers, related equipment and "software" performing telecommunications or "local area network" functions must also be evaluated against the performance characteristics of Category 5, Part 1 (Telecommunications).*

N.B. 1. Control units which directly interconnect the buses or channels of central processing units, "main storage" or disk controllers are not regarded as telecommunications equipment described in Category 5, Part 1 (Telecommunications).

2. For the control status of "software" specially designed for packet switching, see Item 5D001 (Telecommunications).

2. *Computers, related equipment and "software" performing cryptographic, cryptanalytic, certifiable multi-level security or certifiable user isolation functions, or which limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 5, Part 2 ("Information Security").*

4A Systems, Equipment and Components

4A001 Electronic computers and related equipment, as follows, and "electronic assemblies" and specially designed components therefor:
N.B.: SEE ALSO 4A101.

a. Specially designed to have any of the following characteristics:
   1. Rated for operation at an ambient temperature below 228 K (-45°C) or above 358 K (85°C);
      Note: *4A001.a.1. does not apply to computers specially designed for civil automobile or railway train applications.*

   2. Radiation hardened to exceed any of the following specifications:
      a. Total Dose 5×10^3 Gy (Si);
      b. Dose Rate Upset 5×10^6 Gy (Si)/sec; or
      c. Single Event Upset 1×10^{-7} Error/bit/day;

b. Having characteristics or performing functions exceeding the limits in Category 5, Part 2 ("Information Security").

4A002 "Hybrid computers", as follows, and "electronic assemblies" and specially designed components therefor:
N.B.: SEE ALSO 4A102.

a. Containing "digital computers" specified in 4A003;
b. Containing analogue-to-digital converters having all of the following characteristics:
   1. 32 channels or more; and
   2. A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more.

4A003 "Digital computers", "electronic assemblies", and related equipment therefor, as follows, and specially designed components therefor:

Notes: 1. *4A003 includes the following:*
   a. *Vector processors;*
   b. *Array processors;*
   c. *Digital signal processors;*
   d. *Logic processors;*
   e. *Equipment designed for "image enhancement";*
   f. *Equipment designed for "signal processing".*

2. *The control status of the "digital computers" and related equipment described in 4A003 is determined by the control status of other equipment or systems provided:*
   a. *The "digital computers" or related equipment are essential for the operation of the other equipment or systems;*
   b. *The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; and*
      N.B.: 1. *The control status of "signal processing" or "image enhancement" equipment specially designed for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the "principal element" criterion.*
      2. *For the control status of "digital computers" or related equipment for telecommunications equipment, see Category 5, Part 1 (Telecommunications).*
   c. *The "technology" for the "digital computers" and related equipment is determined by 4E.*

a. Designed or modified for "fault tolerance";

Note: *For the purposes of 4A003.a., "digital computers" and related equipment are not considered to be designed or modified for "fault tolerance" if they utilise any of the following:*
1. *Error detection or correction algorithms in "main storage";*
2. *The interconnection of two "digital computers" so that, if the active central processing unit fails, an idling but mirroring central processing unit can continue the system's functioning;*
3. *The interconnection of two central processing units by data channels or by use of shared storage to permit one central processing unit to perform other work until the second central processing unit fails, at which time the first central processing unit takes over in order to continue the system's functioning; or*
4. *The synchronisation of two central processing units by "software" so that one central processing unit recognises when the other central processing unit fails and recovers tasks from the failing unit.*

b. "Digital computers" having a "composite theoretical performance" ("CTP") exceeding 710 million theoretical operations per second (Mtops);

c. "Electronic assemblies" specially designed or modified to be capable of enhancing performance by aggregation of "computing elements" ("CEs") so that the "CTP" of the aggregation exceeds the limit in 4A003.b.;
Notes: 1. *4A003.c. applies only to "electronic assemblies" and programmable interconnections not exceeding the limit in 4A003.b. when shipped as unintegrated "electronic assemblies". It does not apply to "electronic assemblies" inherently limited by nature of their design for use as related equipment specified in 4A003.d., 4A003.e. or 4A003.f.*

2. *4A003.c. does not control "electronic assemblies" specially designed for a product or family of products whose maximum configuration does not exceed the limit of 4A003.b.*

d. Graphics accelerators and graphics coprocessors exceeding a "three dimensional Vector Rate" of 3,000,000;

e. Equipment performing analogue-to-digital conversions exceeding the limits in 3A001.a.5.;

f. Equipment containing "terminal interface equipment" exceeding the limits in 5A001.b.3.;

Note: *For the purposes of 4A003.f., "terminal interface equipment" includes "local area network" interfaces and other communications interfaces. "Local area network" interfaces are evaluated as "network access controllers".*

g. Equipment specially designed to provide external interconnection of "digital computers" or associated equipment which allows communications at data rates exceeding 80 Mbyte/s.

Note: *4A003.g. does not control internal interconnection equipment (e.g., backplanes, buses) or passive interconnection equipment.*

4A004 Computers, as follows, and specially designed related equipment, "electronic assemblies" and components therefor:
a. "Systolic array computers";
b. "Neural computers";
c. "Optical computers".

4A101 Analogue computers, "digital computers" or digital differential analysers, other than those specified in 4A001.a.1., which are ruggedized and designed or modified for use in systems specified in 9A004 or 9A104.

4A102 "Hybrid computers" specially designed for modelling, simulation or design integration of systems specified in 9A004 or 9A104.

Note: *This control only applies when the equipment is supplied with software specified in 7D103 or 9D103.*

4B Test, Inspection and Production Equipment

None.

4C Materials

None.

4D Software

Note: *The control status of "software" for the "development", "production", or "use" of equipment described in other Categories is dealt with in the appropriate*

Category. The control status of "software" for equipment described in this Category is dealt with herein.

4D001 "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" specified in 4A001 to 4A004, or 4D.

4D002 "Software" specially designed or modified to support "technology" specified in 4E.

4D003 Specific "software", as follows:

a. Operating system "software", "software" development tools and compilers specially designed for "multi-data-stream processing" equipment, in "source code";

b. "Expert systems" or "software" for "expert system" inference engines providing both:
   1. Time dependent rules; and
   2. Primitives to handle the time characteristics of the rules and the facts;

c. "Software" having characteristics or performing functions exceeding the limits in Category 5, Part 2 ("Information Security");

d. Operating systems specially designed for "real time processing" equipment which guarantees a "global interrupt latency time" of less than 20 µs.

4E Technology

4E001 "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 4A or 4D.

TECHNICAL NOTE ON "COMPOSITE THEORETICAL PERFORMANCE" ("CTP")

Abbreviations used in this Technical Note

"CE"	"computing element" (typically an arithmetic logical unit)
FP	floating point
XP	fixed point
t	execution time
XOR	exclusive OR
CPU	central processing unit
TP	theoretical performance (of a single "CE")
"CTP""	composite theoretical performance" (multiple "CEs")
R	effective calculating rate
WL	word length
L	word length adjustment
*	multiply

Execution time 't' is expressed in microseconds, TP and "CTP" are expressed in millions of theoretical operations per second (Mtops) and WL is expressed in bits.

Outline of "CTP" calculation method

"CTP" is a measure of computational performance given in Mtops. In calculating the "CTP" of an aggregation of "CEs" the following three steps are required:

1. Calculate the effective calculating rate R for each "CE";
2. Apply the word length adjustment (L) to the effective calculating rate (R), resulting in a Theoretical Performance (TP) for each "CE";
3. If there is more than one "CE", combine the TPs, resulting in a "CTP" for the aggregation.

Details for these steps are given in the following sections.

Note 1 For aggregations of multiple "CEs" which have both shared and unshared memory subsystems, the calculation of "CTP" is completed hierarchically, in two steps: first, aggregate the groups of "CEs" sharing memory; second, calculate the "CTP" of the groups using the calculation method for multiple "CEs" not sharing memory.

Note 2 "CEs" that are limited to input/output and peripheral functions (e.g., disk drive, communication and video display controllers) are not aggregated into the "CTP" calculation.

The following table shows the method of calculating the Effective Calculating Rate R for each "CE":

Step 1: The effective calculating rate R

For "CEs" Implementing: Note Every "CE" must be evaluated independently.	Effective calculating Rate, R
XP only (R_{xp})	$\frac{1}{3 * (t_{xp\ add})}$ if no add is implemented use: $\frac{1}{(t_{xp\ mult})}$ If neither add nor multiply is implemented use the fastest available arithmetic operation as follows: $\frac{1}{3 * t_{xp}}$ See Notes X & Z
FP only (R_{fp})	$\max \frac{1}{t_{fp\ add}}, \frac{1}{t_{fp\ mult}}$ See Notes X & Y
Both FP and XP (R)	Calculate both R_{xp}, R_{fp}
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3 * t_{log}}$ Where t_{log} is the execute time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation. See Notes X & Z
For special logic processors not using any of the specified arithmetic or logic operations.	R = R' * WL/64 Where R' is the number of results per second, WL is the number of bits upon which the logic operation occurs, and 64 is a factor to normalize to a 64 bit operation.

Note W For a pipelined "CE" capable of executing up to one arithmetic or logic operation every clock cycle after the pipeline is full, a pipelined rate can be established. The effective calculating rate (R) for such a "CE" is the faster of the pipelined rate or non-pipelined execution rate.

Note X For a "CE" which performs multiple operations of a specific type in a single cycle (e.g., two additions per cycle or two identical logic operations per cycle), the execution time t is given by:

$$t = \frac{\text{cycle time}}{\text{the number of identical operations per machine cycle}}$$

"CEs" which perform different types of arithmetic or logic operations in a single machine cycle are to be treated as multiple separate "CEs" performing simultaneously (e.g., a "CE" performing an addition and a multiplication in one cycle is to be treated as two "CEs", the first performing an addition in one cycle and the second performing a multiplication in one cycle).
If a single "CE" has both scalar function and vector function, use the shorter execution time value.

Note Y For the "CE" that does not implement FP add or FP multiply, but that performs FP divide:

$$R_{fp} = \frac{1}{t_{fpdivide}}$$

If the "CE" implements FP reciprocal but not FP add, FP multiply or FP divide, then

$$R_{fp} = \frac{1}{t_{fpreciprocal}}$$

If none of the specified instructions is implemented, the effective FP rate is 0.

Note Z In simple logic operations, a single instruction performs a single logic manipulation of no more than two operands of given lengths.
In complex logic operations, a single instruction performs multiple logic manipulations to produce one or more results from two or more operands.

Rates should be calculated for all supported operand lengths considering both pipelined operations (if supported), and non-pipelined operations using the fastest executing instruction for each operand length based on:

1. Pipelined or register-to-register operations. Exclude extraordinarily short execution times generated for operations on a predetermined operand or operands (for example, multiplication by 0 or 1). If no register-to-register operations are implemented, continue with (2).
2. The faster of register-to-memory or memory-to-register operations; if these also do not exist, then continue with (3).
3. Memory-to-memory.

In each case above, use the shortest execution time certified by the manufacturer.

Step 2: TP for each supported operand length WL

Adjust the effective rate R (or R') by the word length adjustment L as follows:

$$TP = R * L,$$
$$\text{where } L = (1/3 + WL/96)$$

Note The word length WL used in these calculations is the operand length in bits. (If an operation uses operands of different lengths, select the largest word length.)

The combination of a mantissa ALU and an exponent ALU of a floating point processor or unit is considered to be one "CE" with a Word Length (WL) equal to the number of bits in the data representation (typically 32 or 64) for purposes of the "CTP" calculation.

This adjustment is not applied to specialized logic processors which do not use XOR instructions. In this case TP = R.

Select the maximum resulting value of TP for:

Each XP-only "CE" (R_{xp});
Each FP-only "CE" (R_{fp});
Each combined FP and XP "CE" (R);
Each simple logic processor not implementing any of the specified arithmetic operations; and
Each special logic processor not using any of the specified arithmetic or logic operations.

Step 3: "CTP" for aggregations of "CEs", including CPUs

For a CPU with a single "CE",
"CTP" = TP
(for "CEs" performing both fixed and floating point operations
$TP = \max (TP_{fp}, TP_{xp})$

"CTP" for aggregations of multiple "CEs" operating simultaneously is calculated as follows:

Note 1 For aggregations that do not allow all of the "CEs" to run simultaneously, the possible combination of "CEs" that provides the largest "CTP" should be used. The TP of each contributing "CE" is to be calculated at its maximum value theoretically possible before the "CTP" of the combination is derived.

N.B. To determine the possible combinations of simultaneously operating "CEs", generate an instruction sequence that initiates operations in multiple "CEs", beginning with the slowest "CE" (the one needing the largest number of cycles to complete its operation) and ending with the fastest "CE". At each cycle of the sequence, the combination of "CEs" that are in operation during that cycle is a possible combination. The instruction sequence must take into account all hardware and/or architectural constraints on overlapping operations.

Note 2 A single integrated circuit chip or board assembly may contain multiple "CEs".

Note 3 Simultaneous operations are assumed to exist when the computer manufacturer claims concurrent, parallel or simultaneous operation or execution in a manual or brochure for the computer.

Note 4 "CTP" values are not to be aggregated for "CE" combinations (inter)connected by "Local Area Networks", Wide Area Networks, I/O shared connections/devices, I/O controllers and any communication interconnection implemented by software.

Note 5 "CTP" values must be aggregated for multiple "CEs" specially designed to enhance performance by aggregation, operating simultaneously and sharing memory,- or multiple memory/"CE"- combinations operating simultaneously utilising specially designed hardware.
This aggregation does not apply to "electronic assemblies" described by 4A003.d.

$$\text{"CTP"} = TP_1 + C_2 * TP_2 + \ldots + C_n * TP_n,$$

where the TPs are ordered by value, with TP_1 being the highest, TP_2 being the second highest, ..., and TP_n being the lowest. C_i is a coefficient determined by the strength of the interconnection between "CEs", as follows:

For multiple "CEs" operating simultaneously and sharing memory:

$$C_2 = C_3 = C_4 = \ldots = C_n = 0.75$$

Note 1 When the "CTP" calculated by the above method does not exceed 194 Mtops, the following formula may be used to calculate C_i:

$$C_i = \frac{0.75}{\sqrt{m}} \qquad (i = 2, \ldots, n)$$

where m = the number of "CEs" or groups of "CEs" sharing access.

provided:
1. The TP_i of each "CE" or group of "CEs" does not exceed 30 Mtops;
2. The "CEs" or groups of "CEs" share access to main memory (excluding cache memory) over a single channel; and
3. Only one "CE" or group of "CEs" can have use of the channel at any given time.

N.B. This does not apply to items controlled under Category 3.

Note 2 "CEs" share memory if they access a common segment of solid state memory. This memory may include cache memory, main memory or other internal memory. Peripheral memory devices such as disk drives, tape drives or RAM disks are not included.

For Multiple "CEs" or groups of "CEs" not sharing memory, interconnected by one or more data channels:

C_i = $0.75 * k_i$ (i = 2, ... , 32) (see Note below)
= $0.60 * k_i$ (i = 33, ... , 64)
= $0.45 * k_i$ (i = 65, ... , 256)
= $0.30 * k_i$ (i > 256)

The value of C_i is based on the number of "CE"s, not the number of nodes.

where k_i = min (S_i/K_r, 1), and
K_r = normalizing factor of 20 MByte/s.
S_i = sum of the maximum data rates (in units of MByte/s) for all data channels connected to the i^{th} "CE" or group of "CEs" sharing memory.

When calculating a C_i for a group of "CEs", the number of the first "CE" in a group determines the proper limit for C_i. For example, in an aggregation of groups consisting of 3 "CEs" each, the 22nd group will contain $"CE"_{64}$, $"CE"_{65}$ and $"CE"_{66}$. The proper limit for C_i for this group is 0.60.

Aggregation (of "CEs" or groups of "CEs") should be from the fastest-to-slowest; i.e.:

$TP_1 \geq TP_2 \geq .... \geq TP_n$, and

in the case of $TP_i = TP_{i+1}$, from the largest to smallest; i.e.:

$C_i \geq C_{i+1}$

Note The k_i factor is not to be applied to "CEs" 2 to 12 if the TP_i of the "CE" or group of "CEs" is more than 50 Mtops; i.e., C_i for "CEs" 2 to 12 is 0.75.

PART 3, CATEGORY 5 - TELECOMMUNICATIONS AND "INFORMATION SECURITY"

Part 1 - TELECOMMUNICATIONS

Notes:

1. *The control status of components, "lasers", test and "production" equipment, materials and "software" therefor which are specially designed for telecommunications equipment or systems is determined in Category 5, Part 1.*

2. *"Digital computers", related equipment or "software", when essential for the operation and support of telecommunications equipment described in this Category, are regarded as specially designed components, provided they are the standard models customarily supplied by the manufacturer. This includes operation, administration, maintenance, engineering or billing computer systems.*

5A1 Systems, Equipment and Components

5A001 a. Any type of telecommunications equipment having any of the following characteristics, functions or features:

1. Specially designed to withstand transitory electronic effects or electromagnetic pulse effects, both arising from a nuclear explosion;
2. Specially hardened to withstand gamma, neutron or ion radiation; or
3. Specially designed to operate outside the temperature range from 218 K (-55°C) to 397 K (124°C).
   Note: *5A001.a.3. applies only to electronic equipment.*

Note: *5A001.a.2. and 5A001.a.3. do not apply to equipment on board satellites.*

b. Telecommunication transmission equipment and systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

Note: *Telecommunication transmission equipment:*

a. Categorised as follows, or combinations thereof:
1. Radio equipment (e.g., transmitters, receivers and transceivers);
2. Line terminating equipment;
3. Intermediate amplifier equipment;
4. Repeater equipment;
5. Regenerator equipment;
6. Translation encoders (transcoders);
7. Multiplex equipment (statistical mutiplex included);
8. Modulators/demodulators (modems);
9. Transmultiplex equipment (see CCITT Rec. G701);
10. "Stored programme controlled" digital crossconnection equipment;
11. "Gateways" and bridges;
12. "Media access units"; and

b. Designed for use in single or multi-channel communication via any of the following:
1. Wire (line);
2. Coaxial cable;
3. Optical fibre cable;
4. Electromagnetic radiation; or
5. Underwater acoustic wave propagation.

5A001 b. 1. Employing digital techniques, including digital processing of analogue signals, and designed to operate at a "digital transfer rate" at the highest multiplex level exceeding 45 Mbit/s or a "total digital transfer rate" exceeding 90 Mbit/s;

Note: 5A001.b.1. does not control equipment specially designed to be integrated and operated in any satellite system for civil use.

2. Being underwater communications systems having any of the following characteristics:
   a. An acoustic carrier frequency outside the range from 20 kHz to 60 kHz;
   b. Using an electromagnetic carrier frequency below 30 kHz; or
   c. Using electronic beam steering techniques;

3. Being equipment containing any of the following:
   a. "Network access controllers" and their related common medium having a "digital transfer rate" exceeding 156 Mbit/s; or
   b. "Communication channel controllers" with a digital output having a "data signalling rate" exceeding 2.1 Mbit/s per channel;

   Note: If any uncontrolled equipment contains a "network access controller", it cannot have any type of telecommunications interface;
   except:
   Those described in, but not specified in 5A001.b.3.

4. Employing a "laser" and having any of the following characteristics:
   a. A transmission wavelength exceeding 1,000 nm; or
   b. Employing analogue techniques and having a bandwidth exceeding 45 MHz.
      Note: 5A001.b.4.b. does not control commercial TV systems.
   c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);
   d. Employing wavelength division multiplexing techniques; or
   e. Performing "optical amplification";

5. Being radio equipment operating at input or output frequencies exceeding 31 GHz;

   Note: 5A001.b.5. does not specify equipment designed or modified for operation in any ITU allocated band.

6. Being radio equipment employing any of the following:
   a. Quadrature-amplitude-modulation (QAM) techniques above level 4 if the "total digital transfer rate" exceeds 8.5 Mbit/s;
   b. QAM techniques above level 16 if the "total digital transfer rate" is equal to or less than 8.5 Mbit/s; or
   c. Other digital modulation techniques and having a "spectral efficiency" exceeding 3 bit/sec/Hz;

Notes: 1. *5A001.b.6. does not control equipment specially designed to be integrated and operated in any satellite system for civil use.*

2. *5A001.b.6. does not control radio relay equipment for operation in an ITU allocated band:*
   a. 1. *Not exceeding 960 MHz; or*
      2. *With a "total digital transfer rate" not exceeding 8.5 Mbit/s; and*
   b. *Having a "spectral efficiency" not exceeding 4 bit/sec/Hz.*

5A001 b. 7. Being radio equipment operating in the 1.5 MHz to 87.5 MHz band and having any of the following characteristics:
   a. Incorporating adaptive techniques providing more than 15 dB suppression of an interfering signal; or
   b. Having all of the following:
      1. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimise the transmission; and
      2. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the 1.5 MHz to 30 MHz frequency range or 250 W or more in the 30 MHz to 87.5 MHz frequency range, over an "instantaneous bandwidth" of one octave or more and with an output harmonic and distortion content of better than -80 dB;

8. Being radio equipment employing "spread spectrum" or "frequency agility" (frequency hopping) techniques having any of the following characteristics:
   a. User programmable spreading codes; or
   b. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz;
      Note: *5A001.b.8.b. does not control cellular radio equipment operating in civil bands.*

   Note: *5A001.b.8. does not control equipment operating at an output power of 1.0 Watt or less.*

9. Being digitally controlled radio receivers having all of the following:
   a. More than 1,000 channels;
   b. A "frequency switching time" of less than 1 ms;
   c. Automatic searching or scanning of a part of the electromagnetic spectrum; and
   d. Identification of the received signals or the type of transmitter; or

   Note: *5A001.b.9. does not control cellular radio equipment operating in civil bands.*

10. Employing functions of digital "signal processing" to provide voice coding at rates of less than 2,400 bit/s.

c. "Stored programme controlled" switching equipment and related signalling systems, having any of the following characteristics, functions or features, and specially designed components and accessories therefor:
   Note: *Statistical multiplexers with digital input and digital output which provide switching are treated as "stored programme controlled" switches.*

1. "Common channel signalling" operating in either non-associated or quasi-associated mode of operation;

2. "Dynamic adaptive routing";

Note: *5A001.c.2. does not control packet switches or routers with ports or lines not exceeding the limits in 5A001.c.3.*

3. Being packet switches, circuit switches and routers with ports or lines exceeding any of the following:
   a. A "data signalling rate" of 2.1 Mbit/s per channel for a "communications channel controller"; or
      Note: *5A001.c.3.a. does not control multiplexed composite links composed only of communication channels not individually controlled by 5A001.c.3.a.*

   b. A "digital transfer rate" of 156 Mbit/s for a "network access controller" and related common medium;

4. "Optical switching";

5. Employing "Asynchronous Transfer Mode" ("ATM") techniques.

5A001 d. Optical fibre communication cables, optical fibres and accessories, as follows:
1. Optical fibres and optical fibre cables of more than 50 m in length having any of the following characteristics:
   a. Designed for single mode operation; or
   b. For optical fibres, specified by the manufacturer as being capable of withstanding a proof test tensile stress of 2×10^9 N/m^2 or more;
      Technical Note:
      Proof Test: on-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 150 mm in diameter. The ambient temperature is a nominal 293 K (20°C) and relative humidity 40%.
      N.B.: Equivalent national standards may be used for executing the proof test.

2. Optical fibre cables and accessories designed for underwater use.
   Note: *5A001.d.2. does not control standard civil telecommunication cables and accessories.*

   N.B. *For fibre-optic hull penetrators or connectors, see 8A002.c.*

e. "Electronically steerable phased array antennae" operating above 31 GHz.
   Note: *5A001.e. does not control "electronically steerable phased array antennae" for landing systems with instruments meeting ICAO standards covering microwave landing systems (MLS).*

5A101 Telemetering and telecontrol equipment usable for "missiles".

Note: *5A101 does not control equipment specially designed to be used for remote control of model planes, boats or vehicles and having an electric field strength of not more than 200 microvolts per metre at a distance of 500 metres.*

5B1 Test, Inspection and Production Equipment

5B001 a. Equipment and specially designed components or accessories therefor,

specially designed for the "development", "production" or "use" of equipment, materials, functions or features specified in 5A001, 5B001, 5C001, 5D001 or 5E001.

Note: *5B001.a. does not control optical fibres and "optical fibre preform" characterization equipment not using semiconductor "lasers".*

5C1 Materials

5C001 Preforms of glass or of any other material optimised for the manufacture of optical fibres specified in 5A001.d.

5D1 Software

5D001 a. "Software" specially designed or modified for the "development", "production" or "use" of equipment, functions or features specified in 5A001, 5B001 or 5C001.

b. "Software" specially designed or modified to support "technology" specified in 5E001.

c. Specific "software" as follows:

1. "Software", other than in machine-executable form, specially designed or modified for the "use" of digital cellular radio equipment or systems;

2. "Software" specially designed or modified to provide characteristics, functions or features of equipment specified in 5A001 or 5B001;

3. "Software" which provides the capability of recovering "source code" of telecommunications "software" specified in 5A001 or 5B001;

4. "Software", other than in machine-executable form, specially designed for "dynamic adaptive routing".

N.B. *For "software" for "signal processing" see also 4D and 6D.*

5E1 Technology

5E001 a. "Technology" according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, functions or features, materials or "software" specified in 5A001, 5B001, 5C001 or 5D001.

b. Specific "technologies", as follows:

1. "Required" "technology" for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;
2. "Technology" for the "development" or "use" of "laser" communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media;
3. "Technology" for the processing and application of coatings to optical fibre specially designed to make it suitable for underwater use;

4. "Technology" for the "development" of equipment employing "Synchronous Digital Hierarchy" ("SDH") or "Synchronous Optical Network" ("SONET") techniques;
5. "Technology" for the "development" of "switch fabric" exceeding 64,000 bit/s per information channel other than for digital cross connect integrated in the switch;
6. "Technology" for the "development" of centralized network control or "dynamic adaptive routing";
7. "Technology" for the "development" of digital cellular radio systems;
8. "Technology" for the "development" of broadband "Integrated Services Digital Network" ("ISDN");
9. "Technology" for the "development" of QAM techniques, for radio equipment, above level 4;
10. "Technology" for the "development" of "spread spectrum" or "frequency agility" (frequency hopping) techniques.

5E101 "Technology" according to the General Technology Note for the "development", "production" or "use" of equipment specified in 5A101.

Part 2 - "INFORMATION SECURITY"

Note: *The control status of "information security" equipment, "software", systems, application specific "electronic assemblies", modules, integrated circuits, components or functions is determined in Category 5, Part 2 even if they are components or "electronic assemblies" of other equipment.*

Note: *The Minister for Defence Industry, Science and Personnel permits the temporary export by Australian citizens or lawful permanent residents of cryptographic hardware or software products,as listed in Category 5, Part 2 on condition that:*

a. no transfer of hardware, software or technology takes place as a result of the exportation of the cryptographic products;
b. the cryptographic products remain under the control of and in the possession of the exporter;
c. the cryptographic products are not to be reproduced or copied;
d. the cryptographic products must be returned to Australia when the exporter returns to Australia; and
e. the cryptographic products shall not be used for demonstration, marketing or sales of controlled cryptographic products.

The quantity of cryptographic hardware or software products which may be exported under the authority of this permit is limited to one each of any hardware product, and one copy of each software product per exporter, per trip outside of Australia. Records of temporary exports and re-imports under this permit should be maintained by the exporter for a period of 3 years from the date of each temporary export.

If the cryptographic products are lost or stolen while outside of Australia, the exporter shall advise the Strategic Trade Policy and Operation Section of the Department of Defence, in writing, of the incident within 14 calendar days of returning to Australia.

5A2 Systems, Equipment and Components

5A002 a. Systems, equipment, application specific "electronic assemblies", modules and integrated circuits for "information security", as follows, and other specially designed components therefor:

N.B: For the control of global navigation satellite systems receiving equipment containing or employing decryption (i.e. GPS or GLONASS), see 7A005.

1. Designed or modified to use "cryptography" employing digital techniques to ensure "information security";

2. Designed or modified to perform cryptanalytic functions;

3. Designed or modified to use "cryptography" employing analogue techniques to ensure "information security";
   Note: *5A002.a.3. does not control the following:*
   1. *Equipment using "fixed" band scrambling not exceeding 8 bands and in which the transpositions change not more frequently than once every second;*
   2. *Equipment using "fixed" band scrambling exceeding 8 bands and in which the transpositions change not more frequently than once every ten seconds;*
   3. *Equipment using "fixed" frequency inversion and in which the transpositions change not more frequently than once every second;*
   4. *Facsimile equipment;*
   5. *Restricted audience broadcast equipment;*
   6. *Civil television equipment.*

4. Designed or modified to suppress the compromising emanations of information-bearing signals;
   Note: *5A002.a.4. does not control equipment specially designed to suppress emanations for reasons of health and safety.*

5. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" or the hopping code for "frequency agility" systems;

6. Designed or modified to provide certified or certifiable "multilevel security" or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent;

7. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion.

Note: *5A002 does not control:*
- *a. "Personalized smart cards" or specially designed components therefor, with any of the following characteristics:*
  1. *Not capable of message traffic encryption or encryption of user-supplied data or related key management functions therefor; or*
  2. *When restricted for use in equipment or systems excluded from control under entries 1. to 6. of the Note to 5A002.a.3. or under entries b. to h. of this Note;*
- *b. Equipment containing "fixed" data compression or coding techniques;*
- *c. Receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type, without digital encryption and where digital decryption is limited to the video, audio or management functions;*
- *d. Portable or mobile radiotelephones for civil use (e.g., for use with commercial civil cellular radiocommunications systems) that are not capable of end-to-end encryption;*
- *e. Decryption functions specially designed to allow the execution of copy-protected "software", provided the decryption functions are not user-accessible;*
- *f. Access control equipment, such as automatic teller machines, self-service statement printers or point of sale terminals, which protects*

password or personal identification numbers (PIN) or similar data to prevent unauthorized access to facilities but does not allow for encryption of files or text, except as directly related to the password or PIN protection;

g. Data authentication equipment which calculates a Message Authentication Code (MAC) or similar result to ensure no alteration of text has taken place, or to authenticate users, but does not allow for encryption of data, text or other media other than that needed for the authentication;

h. Cryptographic equipment specially designed and limited for use in machines for banking or money transactions, such as automatic teller machines, self-service statement printers or point of sale terminals.

5B2 Test, Inspection and Production Equipment

5B002

a. Equipment specially designed for:

1. The "development" of equipment or functions specified in 5A002, 5B002, 5D002 or 5E002, including measuring or test equipment;
2. The "production" of equipment or functions specified in 5A002, 5B002, 5D002 or 5E002, including measuring, test, repair or production equipment;

b. Measuring equipment specially designed to evaluate and validate the "information security" functions specified in 5A002 or 5D002.

5C2 Materials

None.

5D2 Software

5D002

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" specified in 5A002, 5B002, or 5D002;
b. "Software" specially designed or modified to support "technology" specified in 5E002;
c. Specific "software", as follows:
   1. "Software" having the characteristics, or performing or simulating the functions of the equipment specified in 5A002 or 5B002;
   2. "Software" to certify "software" specified in 5D002.c.1.

Note: *5D002 does not control:*

a. "Software" required for the "use" of equipment excluded from control under the Note to 5A002;

b. "Software" providing any of the functions of equipment excluded from control under the Note to 5A002.

5E2 Technology

5E002 "Technology" according to the General Technology Note for the "development", "production" or "use" of equipment or "software" specified in 5A002, 5B002 or 5D002.

PART 3, CATEGORY 6 - SENSORS AND LASERS

6A Systems, Equipment and Components

6A001 Acoustics:

a. Marine acoustic systems, equipment and specially designed components therefor, as follows:
   1. Active (transmitting or transmitting-and-receiving) systems, equipment and specially designed components therefor, as follows:
      Note: *6A001.a.1. does not control:*
         a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding ± 20°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;
         b. Acoustic beacons, as follows:
            1. Acoustic emergency beacons;
            2. Pingers specially designed for relocating or returning to an underwater position.

   a. Wide-swath bathymetric survey systems designed for sea bed topographic mapping, having all of the following:
      1. Being designed to take measurements at an angle exceeding 20° from the vertical;
      2. Being designed to measure depths exceeding 600 m below the water surface; and
      3. Being designed to provide any of the following:
         a. Incorporation of multiple beams any of which is less than 1.9°; or
         b. Data accuracies of better than 0.3% of water depth across the swath averaged over the individual measurements within the swath;
   b. Object detection or location systems having any of the following:
      1. A transmitting frequency below 10 kHz;
      2. Sound pressure level exceeding 224 dB (reference 1 µPa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;
      3. Sound pressure level exceeding 235 dB (reference 1 µPa at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;
      4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;
      5. Designed to operate with an unambiguous display range exceeding 5,120 m; or
      6. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers with any of the following:
         a. Dynamic compensation for pressure; or
         b. Incorporating other than lead zirconate titanate as the transduction element;
   c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following:

Notes: 1. *The control status of acoustic projectors, including transducers, specially designed for other equipment is determined by the control status of the other equipment.*

2. *6A001.a.1.c. does not control electronic sources which direct the sound vertically only, or mechanical (e.g., air gun or vapour-shock gun) or chemical (e.g., explosive) sources.*

1. An instantaneous radiated acoustic power density exceeding 0.01 mW/mm^2/Hz for devices operating at frequencies below 10 kHz;
2. A continuously radiated acoustic power density exceeding 0.001 mW/mm^2/Hz for devices operating at frequencies below 10 kHz;

Technical Note:
Acoustic power density is obtained by dividing the output acoustic power by the product of the area of the radiating surface and the frequency of operation.

3. Designed to withstand pressure during normal operation at depths exceeding 1,000 m; or
4. Side-lobe suppression exceeding 22 dB;

d. Acoustic systems, equipment and specially designed components for determining the position of surface vessels or underwater vehicles having any of the following:

Note: *6A001.a.1.d. includes:*

a. Equipment using coherent "signal processing" between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle;

b.. Equipment capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

1. Designed to operate at a range exceeding 1,000 m with a positioning accuracy of less than 10 m rms (root mean square) when measured at a range of 1,000 m; or
2. Designed to withstand pressure at depths exceeding 1,000 m;

6A001 a. 2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment and specially designed components therefor, as follows:

a. Hydrophones (transducers) having any of the following characteristics:
   1. Incorporating continuous flexible sensors or assemblies of discrete sensor elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;
   2. Having any of the following sensing elements:
      a. Optical fibres;
      b. Piezoelectric polymers; or
      c. Flexible piezoelectric ceramic materials;
   3. A hydrophone sensitivity better than -180 dB at any depth with no acceleration compensation;
   4. When designed to operate at depths not exceeding 35 m, a hydrophone sensitivity better than - 186 dB with acceleration compensation;
   5. When designed for normal operation at depths exceeding 35 m, a hydrophone sensitivity better than -192 dB with acceleration compensation;

6. When designed for normal operation at depths exceeding 100 m, a hydrophone sensitivity better than -204 dB; or
7. Designed for operation at depths exceeding 1,000 m;

Technical Note:
Hydrophone sensitivity is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 µPa. For example, a hydrophone of -160 dB (reference 1 V per µPa) would yield an output voltage of 10^{-8} V in such a field, while one of -180 dB sensitivity would yield only 10^{-9} V output. Thus, -160 dB is better than -180 dB.

b. Towed acoustic hydrophone arrays having any of the following:
   1. Hydrophone group spacing of less than 12.5 m;
   2. Hydrophone group spacing of 12.5 m to less than 25 m and designed or able to be modified to operate at depths exceeding 35 m;
      Technical Note:
      'Able to be modified' in 6A001.a.2.b.2. means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.
   3. Hydrophone group spacing of 25 m or more and designed to operate at depths exceeding 100 m;
   4. Heading sensors specified in 6A001.a.2.d.;
   5. Longitudinally reinforced array hoses;
   6. An assembled array of less than 40 mm in diameter;
   7. Multiplexed hydrophone group signals designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m; or
   8. Hydrophone characteristics specified in 6A001.a.2.a.;

c. Processing equipment, specially designed for towed acoustic hydrophone arrays, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

d. Heading sensors having all of the following:
   1. An accuracy of better than ± 0.5°; and
   2. Any of the following:
      a. Designed to be incorporated within the array hosing and to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m; or
      b. Designed to be mounted external to the array hosing and having a sensor unit capable of operating with 360° roll at depths exceeding 35 m;

e. Bottom or bay cable systems having any of the following:
   1. Incorporating hydrophones specified in 6A001.a.2.a.;
   2. Incorporating multiplexed hydrophone group signals designed to operate at depths exceeding 35 m or having an adjustable or

removable depth sensing device in order to operate at depths exceeding 35 m; or

3. Processing equipment, specially designed for bottom or bay cable systems, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

b. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m.

6A002 Optical sensors
N.B.: SEE ALSO 6A102.

a. Optical detectors, as follows:
Note: 6A002.a. does not control germanium or silicon photodevices.

1. "Space-qualified" solid-state detectors, as follows:
   a. "Space-qualified" solid-state detectors, having all of the following:
      1. A peak response in the wavelength range exceeding 10 nm but not exceeding 300 nm; and
      2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm;
   b. "Space-qualified" solid-state detectors, having all of the following:
      1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; and
      2. A response "time constant" of 95 ns or less;
   c. "Space-qualified" solid-state detectors having a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

2. Image intensifier tubes and specially designed components therefor, as follows:
   a. Image intensifier tubes having all of the following:
      1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;
      2. A microchannel plate for electron image amplification with a hole pitch (centre-to-centre spacing) of 15 µm or less; and
      3. Photocathodes, as follows:
         a. S-20, S-25 or multialkali photocathodes with a luminous sensitivity exceeding 240 µA/lm;
         b. GaAs or GaInAs photocathodes; or
         c. Other III-V compound semiconductor photocathodes;
            Note: 6A002.a.2.a.3.c. does not control compound semiconductor photocathodes with a maximum radiant sensitivity of 10 mA/W or less.
   b. Specially designed components, as follows:
      1. Microchannel plates having a hole pitch (centre-to-centre spacing) of 15 µm or less;
      2. GaAs or GaInAs photocathodes;
      3. Other III-V compound semiconductor photocathodes;
         Note: 6A002.a.2.b.3. does not control compound semiconductor photocathodes with a maximum radiant sensitivity of 10 mA/W or less.

3. Non-"space-qualified" "focal plane arrays", as follows:

Technical Note:

Linear or two-dimensional multi-element detector arrays are referred to as "focal plane arrays".

Notes: 1. *6A002.a.3. includes photoconductive arrays and photovoltaic arrays.*

2. *6A002.a.3. does not control silicon "focal plane arrays", multi-element (not to exceed 16 elements) encapsulated photoconductive cells or pyroelectric detectors using any of the following:*
   - *a. Lead sulphide;*
   - *b. Triglycine sulphate and variants;*
   - *c. Lead-lanthanum-zirconium titanate and variants;*
   - *d. Lithium tantalate;*
   - *e. Polyvinylidene fluoride and variants;*
   - *f. Strontium barium niobate and variants; or*
   - *g. Lead selenide.*

a. Non-"space-qualified" "focal plane arrays", having all of the following:
   1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; and
   2. A response "time constant" of less than 0.5 ns;

b. Non-"space-qualified" "focal plane arrays", having all of the following:
   1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; and
   2. A response "time constant" of 95 ns or less;

c. Non-"space-qualified" "focal plane arrays", having individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm.

b. "Monospectral imaging sensors" and "multispectral imaging sensors" designed for remote sensing applications, having any of the following:
   1. An Instantaneous-Field-Of-View (IFOV) of less than 200 µrad (microradians); or
   2. Being specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm and having all the following;
      a. Providing output imaging data in digital format; and
      b. Being any of the following:
         1. "Space-qualified"; or
         2. Designed for airborne operation, using other than silicon detectors, and having an IFOV of less than 2.5 mrad (milliradians).

c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:
   1. Image intensifier tubes specified in 6A002.a.2.a. ; or
   2. "Focal plane arrays" specified in 6A002.a.3.

Technical Note:
'Direct view' refers to imaging equipment, operating in the visible or infrared spectrum, that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.

Note: *6A002.c. does not control the following equipment incorporating other than GaAs or GaInAs photocathodes:*
- *a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;*
- *b. Medical equipment;*

c. *Industrial equipment used for inspection, sorting or analysis of the properties of materials;*
d. *Flame detectors for industrial furnaces;*
e. *Equipment specially designed for laboratory use.*

d. Special support components for optical sensors, as follows:
   1. "Space-qualified" cryocoolers;
   2. Non-"space-qualified" cryocoolers, having a cooling source temperature below 218 K (-55°C), as follows:
      a. Closed cycle type with a specified Mean-Time-To-Failure (MTTF), or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours;
      b. Joule-Thomson (JT) self-regulating minicoolers having bore (outside) diameters of less than 8 mm;
   3. Optical sensing fibres specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.

e. "Space qualified" "focal plane arrays" having more than 2,048 elements per array and having a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm.

6A003 Cameras
N.B.: SEE ALSO 6A203.

N.B.: For cameras specially designed or modified for underwater use, see 8A002.d. and 8A002.e.

a. Instrumentation cameras, as follows:
   1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames/s;
      Note: 6A003.a.1. does not control cinema recording cameras for normal civil purposes.
   2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames/s for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;
   3. Mechanical or electronic streak cameras having writing speeds exceeding 10 mm/μs;
   4. Electronic framing cameras having a speed exceeding 1,000,000 frames/s;
   5. Electronic cameras, having all of the following:
      a. An electronic shutter speed (gating capability) of less than 1 μs per full frame; and
      b. A read out time allowing a framing rate of more than 125 full frames per second.

b. Imaging cameras, as follows:
   Note: 6A003.b. does not control television or video cameras specially designed for television broadcasting.

   1. Video cameras incorporating solid state sensors, having any of the following:
      a. More than 4×10^6 "active pixels" per solid state array for monochrome (black and white) cameras;
      b. More than 4×10^6 "active pixels" per solid state array for colour cameras incorporating three solid state arrays; or

c. More than 12×10^6 "active pixels" for solid state array colour cameras incorporating one solid state array;

2. Scanning cameras and scanning camera systems, having all of the following:
   a. Linear detector arrays with more than 8,192 elements per array; and
   b. Mechanical scanning in one direction;
3. Imaging cameras incorporating image intensifiers specified in 6A002.a.2.a.;
4. Imaging cameras incorporating "focal plane arrays" specified in 6A002.a.3.

6A004 Optics

a. Optical mirrors (reflectors), as follows:

1. "Deformable mirrors" having either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;
2. Lightweight monolithic mirrors having an average "equivalent density" of less than 30 kg/m^2 and a total mass exceeding 10 kg;
3. Lightweight "composite" or foam mirror structures having an average "equivalent density" of less than 30 kg/m^2 and a total mass exceeding 2 kg;
4. Beam steering mirrors more than 100 mm in diameter or length of major axis, which maintain a flatness of lambda/2 or better (lambda is equal to 633 nm) having a control bandwidth exceeding 100 Hz.

b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and having any of the following:
   1. Exceeding 100 cm^3 in volume; or
   2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth).

c. "Space-qualified" components for optical systems, as follows:

1. Lightweighted to less than 20% "equivalent density" compared with a solid blank of the same aperture and thickness;
2. Substrates, substrates having surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or having protective films;
3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 m in diameter;
4. Manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than 5×10^{-6} in any coordinate direction.

d. Optical control equipment, as follows:
   1. Specially designed to maintain the surface figure or orientation of the "space-qualified" components specified in 6A004.c.1. or 6A004.c.3.;
   2. Having steering, tracking, stabilisation or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 µrad (microradians) or less;
   3. Gimbals having all of the following:
      a. A maximum slew exceeding 5°;
      b. A bandwidth of 100 Hz or more;
      c. Angular pointing errors of 200 µrad (microradians) or less; and
      d. Having any of the following:

1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 2 rad (radians)/s^2; or
2. Exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0.5 rad (radians)/s^2;

4. Specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more.

6A005 "Lasers", other than those specified in 0B001.g.5. or 0B001.h.6., components and optical equipment, as follows:
N.B.: SEE ALSO 6A205.

Notes:
1. *Pulsed "lasers" include those that run in a continuous wave (CW) mode with pulses superimposed.*
2. *Pulse-excited "lasers" include those that run in a continuously excited mode with pulse excitation superimposed.*
3. *The control status of Raman "lasers" is determined by the parameters of the pumping source "lasers". The pumping source "lasers" can be any of the "lasers" described below.*

a. Gas "lasers", as follows:
1. Excimer "lasers", having any of the following:
a. An output wavelength not exceeding 150 nm and having any of the following:
1. An output energy exceeding 50 mJ per pulse; or
2. An average or CW output power exceeding 1 W;
b. An output wavelength exceeding 150 nm but not exceeding 190 nm and having any of the following:
1. An output energy exceeding 1.5 J per pulse; or
2. An average or CW output power exceeding 120 W;
c. An output wavelength exceeding 190 nm but not exceeding 360 nm and having any of the following:
1. An output energy exceeding 10 J per pulse; or
2. An average or CW output power exceeding 500 W; or
d. An output wavelength exceeding 360 nm and having any of the following:
1. An output energy exceeding 1.5 J per pulse; or
2. An average or CW output power exceeding 30 W;

2. Metal vapour "lasers", as follows:
a. Copper (Cu) "lasers" having an average or CW output power exceeding 20 W;
b. Gold (Au) "lasers" having an average or CW output power exceeding 5 W;
c. Sodium (Na) "lasers" having an output power exceeding 5 W;
d. Barium (Ba) "lasers" having an average or CW output power exceeding 2 W;

3. Carbon monoxide (CO) "lasers" having any of the following:
a. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 5 kW; or
b. An average or CW output power exceeding 5 kW;

4. Carbon dioxide (CO_2) "lasers" having any of the following:
a. A CW output power exceeding 15 kW;
b. A pulsed output having a "pulse duration" exceeding 10 µs and having any of the following:
1. An average output power exceeding 10 kW; or

2. A pulsed "peak power" exceeding 100 kW; or

c. A pulsed output having a "pulse duration" equal to or less than 10 μs; and having any of the following:
1. A pulse energy exceeding 5 J per pulse; or
2. An average output power exceeding 2.5 kW;

5. "Chemical lasers", as follows:
a. Hydrogen Fluoride (HF) "lasers";
b. Deuterium Fluoride (DF) "lasers";
c. "Transfer lasers", as follows:
1. Oxygen Iodine (O_2-I) "lasers";
2. Deuterium Fluoride-Carbon dioxide (DF-CO_2) "lasers";

6. Gas discharge and ion "lasers" (i.e., krypton ion or argon ion "lasers") having any of the following:
a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 50 W; or
b. An average or CW output power exceeding 50 W;

7. Other gas "lasers", having any of the following:
Note: *6A005.a.7. does not control nitrogen "lasers".*
a. An output wavelength not exceeding 150 nm and having any of the following:
1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
2. An average or CW output power exceeding 1 W;
b. An output wavelength exceeding 150 nm but not exceeding 800 nm and having any of the following:
1. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; or
2. An average or CW output power exceeding 30 W;
c. An output wavelength exceeding 800 nm but not exceeding 1,400 nm and having any of the following:
1. An output energy exceeding 0.25 J per pulse and a pulsed "peak power" exceeding 10 W; or
2. An average or CW output power exceeding 10 W; or

d. An output wavelength exceeding 1,400 nm and an average or CW output power exceeding 1 W.

b. Individual, multiple-transverse mode semiconductor "lasers" and arrays of individual semiconductor "lasers", having any of the following:
1. An output energy exceeding 500 μJ per pulse and a pulsed "peak power" exceeding 10 W; or
2. An average or CW output power exceeding 10 W.

Technical Note:
Semiconductor "lasers" are commonly called "laser" diodes.

Notes: *1. 6A005.b. includes semiconductor "lasers" having optical output connectors (e.g. fibre optic pigtails).*
2. The control status of semiconductor "lasers" specially designed for other equipment is determined by the control status of the other equipment.

c. Solid state "lasers", as follows:
1. "Tunable" "lasers" having any of the following:

Note: *6A005.c.1. includes titanium - sapphire(Ti: Al_2O_3), thulium - YAG (Tm: YAG), thulium - YSGG (Tm: YSGG), alexandrite (Cr: $BeAl_2O_4$) and colour centre "lasers".*

a. An output wavelength less than 600 nm and having any of the following:
   1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
   2. An average or CW output power exceeding 1 W;

b. An output wavelength of 600 nm or more but not exceeding 1,400 nm and having any of the following:
   1. An output energy exceeding 1 J per pulse and a pulsed "peak power" exceeding 20 W; or
   2. An average or CW output power exceeding 20 W; or

c. An output wavelength exceeding 1,400 nm and having any of the following:
   1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
   2. An average or CW output power exceeding 1 W;

2. Non-"tunable" "lasers", as follows:
   Note: *6A005.c.2. includes atomic transition solid state "lasers".*
   a. Neodymium glass "lasers", as follows:
      1. "Q-switched lasers" having any of the following:
         a. An output energy exceeding 20 J but not exceeding 50 J per pulse and an average output power exceeding 10 W; or
         b. An output energy exceeding 50 J per pulse;
      2. Non-"Q-switched lasers" having any of the following:
         a. An output energy exceeding 50 J but not exceeding 100 J per pulse and an average output power exceeding 20 W; or
         b. An output energy exceeding 100 J per pulse;

   b. Neodymium-doped (other than glass) "lasers", having an output wavelength exceeding 1,000 nm but not exceeding 1,100 nm, as follows:
      N.B.: *For neodymium-doped (other than glass) "lasers" having an output wavelength not exceeding 1,000 nm or exceeding 1,100 nm, see 6A005.c.2.c.*

      1. Pulse-excited, mode-locked, "Q-switched lasers" having a "pulse duration" of less than 1 ns and having any of the following:
         a. A "peak power" exceeding 5 GW;
         b. An average output power exceeding 10 W; or
         c. A pulsed energy exceeding 0.1 J;
      2. Pulse-excited, "Q-switched lasers" having a pulse duration equal to or more than 1 ns, and having any of the following:
         a. A single-transverse mode output having:
            1. A "peak power" exceeding 100 MW;
            2. An average output power exceeding 20 W; or
            3. A pulsed energy exceeding 2 J; or
         b. A multiple-transverse mode output having:
            1. A "peak power" exceeding 400 MW;
            2. An average output power exceeding 2 kW; or
            3. A pulsed energy exceeding 2 J;

      3. Pulse-excited, non-"Q-switched lasers", having:
         a. A single-transverse mode output having:

1. A "peak power" exceeding 500 kW; or
2. An average output power exceeding 150 W; or

b. A multiple-transverse mode output having:
1. A "peak power" exceeding 1 MW; or
2. An average power exceeding 2 kW;

4. Continuously excited "lasers" having:
a. A single-transverse mode output having:
1. A "peak power" exceeding 500 kW; or
2. An average or CW output power exceeding 150 W; or

b. A multiple-transverse mode output having:
1. A "peak power" exceeding 1 MW; or
2. An average or CW output power exceeding 2 kW;

c. Other non-"tunable" "lasers", having any of the following:
1. A wavelength less than 150 nm and having any of the following:
a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
b. An average or CW output power exceeding 1 W;
2. A wavelength of 150 nm or more but not exceeding 800 nm and having any of the following:
a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; or
b. An average or CW output power exceeding 30 W;

3. A wavelength exceeding 800 nm but not exceeding 1,400 nm, as follows:
a. "Q-switched lasers" having:
1. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 50 W; or
2. An average output power exceeding:
a. 10 W for single-mode "lasers";
b. 30 W for multimode "lasers";

b. Non-"Q-switched lasers" having:
1. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 50 W; or
2. An average or CW output power exceeding 50 W; or

4. A wavelength exceeding 1,400 nm and having any of the following:
a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
b. An average or CW output power exceeding 1 W;

d. Dye and other liquid "lasers", having any of the following:
1. A wavelength less than 150 nm and:
a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
b. An average or CW output power exceeding 1 W;
2. A wavelength of 150 nm or more but not exceeding 800 nm and having any of the following:
a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 20 W;
b. An average or CW output power exceeding 20 W; or
c. A pulsed single longitudinal mode oscillator having an average output power exceeding 1 W and a repetition rate exceeding 1 kHz if the "pulse duration" is less than 100 ns;
3. A wavelength exceeding 800 nm but not exceeding 1,400 nm and having any of the following:
a. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 10 W; or

b. An average or CW output power exceeding 10 W; or

4. A wavelength exceeding 1,400 nm and having any of the following:
   a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
   b. An average or CW output power exceeding 1 W;

e. Components, as follows:
   1. Mirrors cooled either by active cooling or by heat pipe cooling;
      Technical Note:
      Active cooling is a cooling technique for optical components using flowing fluids within the subsurface (nominally less than 1 mm below the optical surface) of the optical component to remove heat from the optic.
   2. Optical mirrors or transmissive or partially transmissive optical or electro-optical components specially designed for use with controlled "lasers";

f. Optical equipment, as follows:

(For shared aperture optical elements, capable of operating in "Super-High Power Laser" ("SHPL") applications, see ML19a.)

   1. Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront having any of the following:
      a. Frame rates equal to or more than 100 Hz and phase discrimination of at least 5% of the beam's wavelength; or
      b. Frame rates equal to or more than 1,000 Hz and phase discrimination of at least 20% of the beam's wavelength;
   2. "Laser" diagnostic equipment capable of measuring "SHPL" system angular beam steering errors of equal to or less than 10 µrad;
   3. Optical equipment and components specially designed for a phased-array "SHPL" system for coherent beam combination to an accuracy of lambda/10 at the designed wavelength, or 0.1 µm, whichever is the smaller;
   4. Projection telescopes specially designed for use with "SHPL" systems.

6A006 "Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers" and compensation systems, and specially designed components therefor, as follows:
Note: 6A006 does not control instruments specially designed for biomagnetic measurements for medical diagnostics.

a. "Magnetometers" using "superconductive", optically pumped or nuclear precession (proton/Overhauser) "technology" having a "noise level" (sensitivity) lower (better) than 0.05 nT rms per square root Hz;

b. Induction coil "magnetometers" having a "noise level" (sensitivity) lower (better) than any of the following:
   1. 0.05 nT rms/square root Hz at frequencies of less than 1 Hz;
   2. 1×10^{-3} nT rms/square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or
   3. 1×10^{-4} nT rms/square root Hz at frequencies exceeding 10 Hz;

c. Fibre optic "magnetometers" having a "noise level" (sensitivity) lower (better) than 1 nT rms per square root Hz;

d. "Magnetic gradiometers" using multiple "magnetometers" specified in 6A006.a., 6A006.b. or 6A006.c.;

e. Fibre optic "intrinsic magnetic gradiometers" having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.3 nT/m rms per square root Hz;

f. "Intrinsic magnetic gradiometers", using "technology" other than fibre-optic "technology", having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.015 nT/m rms per square root Hz;

g. Magnetic compensation systems for magnetic sensors designed for operation on mobile platforms;

h. "Superconductive" electromagnetic sensors, containing components manufactured from "superconductive" materials:
   1. Designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents (including Josephson effect devices or "superconductive" quantum interference devices (SQUIDS));
   2. Designed for sensing electromagnetic field variations at frequencies of 1 kHz or less; and:
   3. Having any of the following characteristics:
      a. Incorporating thin-film SQUIDS with a minimum feature size of less than 2 µm and with associated input and output coupling circuits;
      b. Designed to operate with a magnetic field slew rate exceeding 1×10^6 magnetic flux quanta per second;
      c. Designed to function without magnetic shielding in the earth's ambient magnetic field; or
      d. Having a temperature coefficient less (smaller) than 0.1 magnetic flux quantum/K.

6A007 Gravity meters (gravimeters) and gravity gradiometers, as follows:
N.B.: SEE ALSO 6A107.

a. Gravity meters for ground use having a static accuracy of less (better) than 10 µgal;
   Note: 6A007.a. does not control ground gravity meters of the quartz element (Worden) type.

b. Gravity meters for mobile platforms for ground, marine, submersible, space or airborne use, having all of the following:
   1. A static accuracy of less (better) than 0.7 mgal; and
   2. An in-service (operational) accuracy of less (better) than 0.7 mgal having a time-to-steady-state registration of less than 2 minutes under any combination of attendant corrective compensations and motional influences;

c. Gravity gradiometers.

6A008 Radar systems, equipment and assemblies having any of the following characteristics, and specially designed components therefor:
N.B.: SEE ALSO 6A108.

Note: 6A008 does not control:
   a. Secondary surveillance radar (SSR);
   b. Car radar designed for collision prevention;
   c. Displays or monitors used for air traffic control (ATC) having no more than 12 resolvable elements per mm;
   d. Meteorological (weather) radar.

a. Operating at frequencies from 40 GHz to 230 GHz and having an average output power exceeding 100 mW;

b. Having a tunable bandwidth exceeding ± 6.25% of the centre operating frequency;
   Technical Note:

The centre operating frequency equals one half of the sum of the highest plus the lowest specified operating frequencies.

c. Capable of operating simultaneously on more than two carrier frequencies;

d. Capable of operating in synthetic aperture (SAR), inverse synthetic aperture (ISAR) radar mode, or sidelooking airborne (SLAR) radar mode;

e. Incorporating "electronically steerable phased array antennae";

f. Capable of heightfinding non-cooperative targets;
Note: *6A008.f. does not control precision approach radar (PAR) equipment conforming to ICAO standards.*

g. Specially designed for airborne (balloon or airframe mounted) operation and having Doppler "signal processing" for the detection of moving targets;

h. Employing processing of radar signals using any of the following:
1. "Radar spread spectrum" techniques; or
2. "Radar frequency agility" techniques;

i. Providing ground-based operation with a maximum "instrumented range" exceeding 185 km;
Note: *6A008.i. does not control:*
a. Fishing ground surveillance radar;
b. Ground radar equipment specially designed for enroute air traffic control, provided that all the following conditions are met:
1. It has a maximum "instrumented range" of 500 km or less;
2. It is configured so that radar target data can be transmitted only one way from the radar site to one or more civil ATC centres;
3. It contains no provisions for remote control of the radar scan rate from the enroute ATC centre; and
4. It is to be permanently installed;
c. Weather balloon tracking radars.

j. Being "laser" radar or Light Detection and Ranging (LIDAR) equipment, having any of the following:
1. "Space-qualified"; or
2. Employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 μrad (microradians);
Note: *6A008.j. does not control LIDAR equipment specially designed for surveying or for meteorological observation.*

k. Having "signal processing" sub-systems using "pulse compression", with any of the following:
1. A "pulse compression" ratio exceeding 150; or
2. A pulse width of less than 200 ns; or

l. Having data processing sub-systems with any of the following:
1. "Automatic target tracking" providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage;
Note: *6A008.l.1. does not control conflict alert capability in ATC systems, or marine or harbour radar.*
2. Calculation of target velocity from primary radar having non-periodic (variable) scanning rates;
3. Processing for automatic pattern recognition (feature extraction) and comparison with target characteristic data bases (waveforms or imagery) to identify or classify targets; or

4. Superposition and correlation, or fusion, of target data from two or more "geographically dispersed" and "interconnected radar sensors" to enhance and discriminate targets.
   Note: *6A008.l.4. does not control systems, equipment and assemblies used for marine traffic control.*

6A102 Radiation hardened detectors, other than those specified in 6A002, for use in protecting against nuclear effects (e.g. electromagnetic pulse (EMP), X-rays, combined blast and thermal effects) and usable for "missiles", designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5×10^5 rads (Si).

Technical Note:
In 6A102, a detector is defined as a mechanical, electrical, optical or chemical device that automatically identifies and records, or registers a stimulus such as an environmental change in pressure or temperature, an electrical or electromagnetic signal or radiation from a radioactive material.

6A107 Specially designed components for gravity meters and gravity gradiometers specified in 6A007.b. and c.

6A108 Radar systems and tracking systems, other than those specified in entry 6A008, as follows:

a. Radar and laser radar systems designed or modified for use in systems specified in 9A004 or 9A104;

b. Precision tracking systems, usable for "missiles", as follows:
   1. Tracking systems which use a code translator in conjunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of in-flight position and velocity;
   2. Range instrumentation radars including associated optical/infrared trackers with all of the following capabilities:
      a. Angular resolution better than 3 milliradians (0.5 mils);
      b. Range of 30 km or greater with a range resolution better than 10 m rms;
      c. Velocity resolution better than 3 m/s.

6A202 Photomultiplier tubes with a photocathode area of greater than 20 cm^2 having an anode pulse rise time of less than 1 ns.

6A203 Cameras and components, other than those specified in 6A003, as follows:

a. Mechanical rotating mirror cameras, as follows, and specially designed components therefor:
   1. Framing cameras with recording rates greater than 225,000 frames per second; or
   2. Streak cameras with writing speeds greater than 0.5 mm per microsecond;

   Note: Components of such cameras include their synchronizing electronic units and rotor assemblies consisting of turbines, mirrors and bearings.

b. Electronic streak and framing cameras and tubes, as follows:
   1. Electronic streak cameras capable of 50 ns or less time resolution and streak tubes therefor;
   2. Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;

3. Framing tubes and solid-state imaging devices for use with cameras specified in 6A203.b.2., as follows:
   a. Proximity focused image intensifier tubes having the photocathode deposited on a transparent conductive coating to decrease photocathode sheet resistance;
   b. Gate silicon intensifier target (SIT) videcon tubes, where a fast system allows gating the photoelectrons from the photocathode before they impinge on the SIT plate;
   c. Kerr or pockel cell electro-optical shuttering; or
   d. Other framing tubes and solid-state imaging devices having a fast-image gating time of less than 50 ns specially designed for cameras specified in 6A203.b.2.;

c. Radiation-hardened TV cameras, or lenses therefor, specially designed or rated as radiation hardened to withstand greater than 50×10^3 grays (Silicon) (5×10^6 rad (Silicon)) without operational degradation.

6A205 "Lasers", other than those specified in 0B001.g.5., 0B001.h.6 and 6A005; as follows:

a. Argon ion "lasers" with greater than 40 W average output power operating at wavelengths between 400 nm and 515 nm;

b. Tunable pulsed single-mode dye oscillators capable of an average power output of greater than 1 W, a repetition rate greater than 1 kHz, a pulse less than 100 ns, and a wavelength between 300 nm and 800 nm;

c. Tunable pulsed dye laser amplifiers and oscillators, with an average power output of greater than 30 W, a repetition rate greater than 1 kHz, a pulse width less than 100 ns, and a wavelength between 300 nm and 800 nm;
except:
Single mode oscillators;

d. Pulsed carbon dioxide "lasers" with a repetition rate greater than 250 Hz, an average power output of greater than 500 W, and a pulse of less than 200 ns operating at wavelengths between 9,000 nm and 11,000 nm;

e. Para-hydrogen Raman shifters designed to operate at 16 micrometre output wavelength and at a repetition rate greater than 250 Hz;

f. Pulse -excited, Q-switched Neodymium-doped (other than glass) "lasers", having all of the following:
   1. An output wavelength exceeding 1,000 nm but not exceeding 1,100 nm;
   2. A pulse duration equal to or more than 1 ns; and
   3. A multiple-transverse mode output having an average power exceeding 50 W.

6A225 Velocity interferometers for measuring velocities in excess of 1 km/s during time intervals of less than 10 microsecond (VISARs, Doppler laser interferometers (DLIs), etc.).

6A226 Pressure sensors, as follows:
a. Manganin gauges for pressures greater than 100 kilobars; or
b. Quartz pressure transducers for pressures greater than 100 kilobars.

6B Test, Inspection and Production Equipment

6B004 Optical equipment, as follows:

a. Equipment for measuring absolute reflectance to an accuracy of ± 0.1% of the reflectance value;

b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an "accuracy" of 2 nm or less (better) against the required profile.

Note: 6B004 does not control microscopes.

6B007 Equipment to produce, align and calibrate land-based gravity meters with a static accuracy of better than 0.1 mgal.

6B008 Pulse radar cross-section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefor.
N.B.: SEE ALSO 6B108.

6B108 Systems, other than those specified in 6B008, specially designed for radar cross section measurement usable for "missiles" and other subsystems.

6C Materials

6C002 Optical sensor materials, as follows:

a. Elemental tellurium (Te) of purity levels of 99.9995% or more;

b. Single crystals of cadmium telluride (CdTe), cadmium zinc telluride (CdZnTe) or mercury cadmium telluride (HgCdTe) of any purity level, including epitaxial wafers thereof.

6C004 Optical materials, as follows:

a. Zinc selenide (ZnSe) and zinc sulphide (ZnS) "substrate blanks" produced by the chemical vapour deposition process, having any of the following:
   1. A volume greater than 100 cm^3; or
   2. A diameter greater than 80 mm having a thickness of 20 mm or more;

b. Boules of the following electro-optic materials:
   1. Potassium titanyl arsenate (KTA);
   2. Silver gallium selenide ($AgGaSe_2$);
   3. Thallium arsenic selenide (Tl_3AsSe_3, also known as TAS);

c. Non-linear optical materials, having all of the following:
   1. Third order susceptibility (chi 3) of 10^{-6} m^2/V^2 or more; and
   2. A response time of less than 1 ms;

d. "Substrate blanks" of silicon carbide or beryllium beryllium (Be/Be) deposited materials exceeding 300 mm in diameter or major axis length;

e. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF_4) and hafnium fluoride (HfF_4), having all of the following:
   1. A hydroxyl ion (OH-) concentration of less than 5 ppm;

2. Integrated metallic purity levels of less than 1 ppm; and
3. High homogeneity (index of refraction variance) less than 5×10^{-6};

f. Synthetically produced diamond material with an absorption of less than 10^{-5} cm^{-1} for wavelengths exceeding 200 nm but not exceeding 14,000 nm.

6C005 Synthetic crystalline "laser" host material in unfinished form, as follows:

a. Titanium doped sapphire;
b. Alexandrite.

6D Software

6D001 "Software" specially designed for the "development" or "production" of equipment specified in 6A004, 6A005, 6A008 or 6B008.

6D002 "Software" specially designed for the "use" of equipment specified in 6A002.b., 6A008 or 6B008.

6D003 Other "software", as follows:

a. 1. "Software" specially designed for acoustic beam forming for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;
2. "Source code" for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;
3. "Software" specially designed for bottom or bay cable systems and having beamforming or "source code" for "real time processing" of acoustic data for passive reception;

b. 1. "Software" specially designed for magnetic compensation systems for magnetic sensors designed to operate on mobile platforms;
2. "Software" specially designed for magnetic anomaly detection on mobile platforms;

c. "Software" specially designed to correct motional influences of gravity meters or gravity gradiometers;

d. 1. Air Traffic Control "software" application "programmes" hosted on general purpose computers located at Air Traffic Control centres and capable of any of the following:
a. Processing and displaying more than 150 simultaneous "system tracks"; or
b. Accepting radar target data from more than four primary radars;
2. "Software" for the design or "production" of radomes which:
a. Are specially designed to protect the "electronically steerable phased array antennae" specified in 6A008.e.; and
b. Result in an antenna pattern having an 'average side lobe level' more than 40 dB below the peak of the main beam level.

Technical Note:
'Average side lobe level' in 6D003.d.2.b. is measured over the entire array excluding the angular extent of the main beam and the first two side lobes on either side of the main beam.

6D102 "Software" specially designed for the "use" of goods specified in 6A108.

6D103 "Software" which processes post-flight, recorded data, obtained from the systems specified in 6A108.b., enabling determination of vehicle position throughout its flight path.

6E Technology

6E001 "Technology" according to the General Technology Note for the "development" of equipment, materials or "software" specified in 6A, 6B, 6C or 6D.

6E002 "Technology" according to the General Technology Note for the "production" of equipment or materials specified in 6A, 6B or 6C.

6E003 Other "technology", as follows:

a. 1. Optical surface coating and treatment "technology" "required" to achieve uniformity of 99.5% or better for optical coatings 500 mm or more in diameter or major axis length and with a total loss (absorption and scatter) of less than 5×10^{-3};
N.B.: *See also 2E003.f.*

2. Optical fabrication "technology" using single point diamond turning techniques to produce surface finish accuracies of better than 10 nm rms on non-planar surfaces exceeding 0.5 m^2;

b. "Technology" "required" for the "development", "production" or "use" of specially designed diagnostic instruments or targets in test facilities for "SHPL" testing or testing or evaluation of materials irradiated by "SHPL" beams;

c. "Technology" "required" for the "development" or "production" of fluxgate "magnetometers" or fluxgate "magnetometer" systems, having any of the following:
1. A "noise level" of less than 0.05 nT rms per square root Hz at frequencies of less than 1 Hz; or
2. A "noise level" of less than 1×10^{-3} nT rms per square root Hz at frequencies of 1 Hz or more.

6E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 6A002, 6A007.b. and c., 6A008, 6A102, 6A107, 6A108, 6B108, 6D102 or 6D103.

Note: *6E101 only specifies "technology" for equipment specified in 6A008 when it is designed for airborne applications and is usable in "missiles".*

6E201 "Technology" according to the General Technology Note for the "use" of equipment specified in 6A003, 6A005.a.1.c., 6A005.a.2.a., 6A005.c.1.b., 6A005.c.2.c.2., 6A005.c.2.d.2.b., 6A202, 6A203, 6A205, 6A225 or 6A226.

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PART 3, CATEGORY 7 - NAVIGATION AND AVIONICS

7A Systems, Equipment and Components

N.B.: For automatic pilots for underwater vehicles, see Category 8. For radar, see Category 6.

7A001 Accelerometers designed for use in inertial navigation or guidance systems and having any of the following characteristics, and specially designed components therefor:
N.B.: SEE ALSO 7A101.

a. A "bias" "stability" of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year;
b. A "scale factor" "stability" of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year; or
c. Specified to function at linear acceleration levels exceeding 100 g.

7A002 Gyros having any of the following characteristics, and specially designed components therefor:
N.B.: SEE ALSO 7A102.

a. A "drift rate" "stability", when measured in a 1 g environment over a period of three months and with respect to a fixed calibration value, of:
   1. Less (better) than 0.1° per hour when specified to function at linear acceleration levels below 10 g; or
   2. Less (better) than 0.5° per hour when specified to function at linear acceleration levels from 10 g to 100 g inclusive; or
b. Specified to function at linear acceleration levels exceeding 100 g.

7A003 Inertial navigation systems (gimballed or strapdown) and inertial equipment designed for "aircraft", land vehicle or "spacecraft" for attitude, guidance or control having any of the following characteristics, and specially designed components therefor:
N.B.: SEE ALSO 7A103.

a. Navigation error (free inertial) subsequent to normal alignment of 0.8 nautical mile per hour (50% Circular Error Probable (CEP)) or less (better); or

Note: The parameters of 7A003.a. are applicable with any of the following environmental conditions:
1. *Input random vibration with an overall magnitude of 7.7 g rms in the first half hour and a total test duration of one and one half hour per axis in each of the three perpendicular axes, when the random vibration meets the following:*
   a. *A constant power spectral density (PSD) value of 0.04 g^2/Hz over a frequency interval of 15 to 1,000 Hz; and*
   b. *The PSD attenuates with frequency from 0.04 g^2/Hz to 0.01 g^2/Hz over a frequency interval from 1,000 to 2,000 Hz; or*
2. *A roll and yaw rate of equal to or more than +2.62 radian/s (150 deg/s); or*
3. *According to national standards equivalent to 1. or 2. above.*

b. Specified to function at linear acceleration levels exceeding 10 g.
Note. 7A003 does not control inertial navigation systems which are certified for use on "civil aircraft" by civil authorities of a "participating state".

7A004 Gyro-astro compasses, and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites, with an azimuth accuracy of equal to or less (better) than 5 seconds of arc.
N.B.: SEE ALSO 7A104.

7A005 Global navigation satellite systems (i.e. GPS or GLONASS) receiving equipment having any of the following characteristics, and specially designed components therefor:
N.B.: SEE ALSO 7A105.

a. Employing decryption; or
b. A null-steerable antenna.

7A006 Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive, having any of the following characteristics:
N.B.: SEE ALSO 7A106.

a. "Power management"; or
b. Using phase shift key modulation.

7A007 Direction finding equipment operating at frequencies above 30 MHz and having all of the following characteristics, and specially designed components therefor:
a. "Instantaneous bandwidth" of 1 MHz or more;
b. Parallel processing of more than 100 frequency channels; and
c. Processing rate of more than 1,000 direction finding results per second and per frequency channel.

7A101 Accelerometers, other than those specified in 7A001, with a threshold of 0.05 g or less, or a linearity error within 0.25% of full scale output, or both, which are designed for use in inertial navigation systems or in guidance systems of all types and specially designed components therefor.

Note: 7A101 does not specify accelerometers which are specially designed and developed as MWD(Measurement While Drilling) Sensors for use in downhole well service operations.

7A102 All types of gyros, other than those specified in 7A002, usable in "missiles", with a rated "drift rate" "stability" of less than 0.5° (1 sigma or rms) per hour in a 1 g environment and specially designed components therefor.

7A103 Instrumentation, navigation equipment and systems, other than those specified in 7A003, as follows; and specially designed components therefor:

a. Inertial or other equipment using accelerometers or gyros specified in 7A001, 7A002, 7A101 or 7A102 and systems incorporating such equipment;

Note: 7A103.a. does not specify equipment containing accelerometers specified 7A001 where such accelerometers are specially designed and

developed as MWD (Measurement While Drilling) sensors for use in down-hole well services operations.

b. Integrated flight instrument systems, which include gyrostabilisers or automatic pilots, designed or modified for use in systems specified in 9A004 or 9A104.

7A104 Gyro-astro compasses and other devices, other than those specified in 7A004, which derive position or orientation by means of automatically tracking celestial bodies or satellites and specially designed components therefor.

7A105 Global Positioning Systems (GPS) or similar satellite receivers, other than those specified in 7A005, capable of providing navigation information under the following operational conditions and designed or modified for use in systems specified in 9A004 or 9A104;

a. At speeds in excess of 515 m/s; and

b. At altitudes in excess of 18 km.

7A106 Altimeters, other than those specified in 7A006, of radar or laser radar type, designed or modified for use in systems specified in 9A004 or 9A104.

7A115 Passive sensors for determining bearing to specific electromagnetic source (direction finding equipment) or terrain characteristics, designed or modified for use in systems specified in 9A004 or 9A104.

Note: *7A115 includes sensors for the following equipment:*
a. Terrain contour mapping equipment;
b. Imaging sensor equipment;
c. Interferometer equipment.

7A116 Flight control systems, as follows; designed or modified for systems specified in 9A004 or 9A104:

a. Hydraulic, mechanical, electro-optical, or electro-mechanical flight control systems (including fly-by-wire types);

b. Attitude control equipment.

7A117 "Guidance sets", usable in "missiles", capable of achieving system accuracy of 3.33% or less of the range (e.g., a "CEP" of 10 km or less at a range of 300 km).

7B Test, Inspection and Production Equipment

7B001 Test, calibration or alignment equipment specially designed for equipment specified in 7A.

Note: *7B001 does not control test, calibration or alignment equipment for Maintenance Level I or Maintenance Level II.*

Technical Notes:

1. *Maintenance Level I*

The failure of an inertial navigation unit is detected on the aircraft by indications from the control and display unit (CDU) or by the status message from the corresponding sub-system. By following the manufacturer's manual, the cause of the failure may be localised at the level of the malfunctioning line replaceable unit (LRU). The operator then removes the LRU and replaces it with a spare.

2. *Maintenance Level II*
The defective LRU is sent to the maintenance workshop (the manufacturer's or that of the operator responsible for level II maintenance). At the maintenance workshop, the malfunctioning LRU is tested by various appropriate means to verify and localise the defective shop replaceable assembly (SRA) module responsible for the failure. This SRA is removed and replaced by an operative spare. The defective SRA (or possibly the complete LRU) is then shipped to the manufacturer.
N.B.: Maintenance Level II does not include the removal of controlled accelerometers or gyro sensors from the SRA.

7B002 Equipment, as follows, specially designed to characterize mirrors for ring "laser" gyros:
N.B.: SEE ALSO 7B102.

a. Scatterometers having a measurement accuracy of 10 ppm or less (better);
b. Profilometers having a measurement accuracy of 0.5 nm (5 angstrom) or less (better).

7B003 Equipment specially designed for the "production" of equipment specified in 7A, including:
a. Gyro tuning test stations;
b. Gyro dynamic balance stations;
c. Gyro run-in/motor test stations;
d. Gyro evacuation and fill stations;
e. Centrifuge fixtures for gyro bearings;
f. Accelerometer axis align stations.

7B102 Reflectometers specially designed to characterise mirrors, for "laser" gyros, having a measurement accuracy of 50 ppm or less (better).

7B103 Specially designed "production facilities" for equipment specified in 7A117.

7C Materials

None.

7D Software

7D001 "Software" specially designed or modified for the "development" or "production" of equipment specified in 7A. or 7B.

7D002 "Source code" for the "use" of any inertial navigation equipment or Attitude and Heading Reference Systems (AHRS) including inertial equipment not controlled by 7A003 or 7A004.

Note: *7D002 does not control "source code" for the "use" of gimballed AHRS.*

Technical Note:
AHRS generally differ from inertial navigation systems (INS) in that an AHRS provides attitude and heading information and normally does not provide the acceleration, velocity and position information associated with an INS.

7D003 Other "software", as follows:

a. "Software" specially designed or modified to improve the operational performance or reduce the navigational error of systems to the levels specified in 7A003 or 7A004;

b. "Source code" for hybrid integrated systems which improves the operational performance or reduces the navigational error of systems to the level specified in 7A003 by continuously combining inertial data with any of the following navigation data:
   1. Doppler radar velocity;
   2. Global navigation satellite systems (i.e., GPS or GLONASS) reference data; or
   3. Terrain data from data bases;

c. "Source code" for integrated avionics or mission systems which combine sensor data and employ "expert systems";

d. "Source code" for the "development" of any of the following:
   1. Digital flight management systems for "total control of flight";
   2. Integrated propulsion and flight control systems;
   3. Fly-by-wire or fly-by-light control systems;
   4. Fault-tolerant or self-reconfiguring "active flight control systems";
   5. Airborne automatic direction finding equipment;
   6. Air data systems based on surface static data; or
   7. Raster-type head-up displays or three dimensional displays;

e. Computer-aided-design (CAD) "software" specially designed for the "development" of "active flight control systems", helicopter multi-axis fly-by-wire or fly-by-light controllers or helicopter "circulation controlled anti-torque or circulation-controlled direction control systems" whose "technology" is specified in 7E004.b., 7E004.c.1. or 7E004.c.2.

7D101 "Software" specially designed for the "use" of equipment specified in 7A001 to 7A006, 7A101 to 7A106, 7A115, 7B002, 7B003, 7B102 or 7B103.

7D102 Integration "software" for the equipment specified in 7A003 or 7A103.

7D103 "Software" specially designed for modelling or simulation of the "guidance sets" specified in 7A117 or for their design integration with the systems specified in 9A004 or 9A104.
Note: *"Software" specified in 7D103 remains controlled when combined with specially designed hardware specified in 4A102.*

7E Technology

7E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 7A, 7B or 7D.

7E002 "Technology" according to the General Technology Note for the "production" of equipment specified in 7A or 7B.

7E003 "Technology" according to the General Technology Note for the repair, refurbishing or overhaul of equipment specified in 7A001 to 7A004.

Note: *7E003 does not control maintenance "technology" directly associated with calibration, removal or replacement of damaged or unserviceable LRUs and SRAs of a "civil aircraft" as described in Maintenance Level I or Maintenance Level II.*

N.B.: *See Technical Notes to 7B001.*

7E004 Other "technology", as follows:

a. "Technology" for the "development" or "production" of:
   1. Airborne automatic direction finding equipment operating at frequencies exceeding 5 MHz;
   2. Air data systems based on surface static data only, i.e., which dispense with conventional air data probes;
   3. Raster-type head-up displays or three dimensional displays for "aircraft";
   4. Inertial navigation systems or gyro-astro compasses containing accelerometers or gyros specified in 7A001 or 7A002;
   5. Electric actuators (i.e., electromechanical, electrohydrostatic and integrated actuator package) specially designed for "primary flight control";
   6. "Flight control optical sensor array" specially designed for implementing "active flight control systems";

b. "Development" "technology", as follows, for "active flight control systems" (including fly-by-wire or fly-by-light):
   1. Configuration design for interconnecting multiple microelectronic processing elements (on-board computers) to achieve "real time processing" for control law implementation;
   2. Control law compensation for sensor location or dynamic airframe loads, i.e., compensation for sensor vibration environment or for variation of sensor location from the centre of gravity;
   3. Electronic management of data redundancy or systems redundancy for fault detection, fault tolerance, fault isolation or reconfiguration;
      Note: *7E004.b.3. does not control" technology" for the design of physical redundancy.*
   4. Flight controls which permit inflight reconfiguration of force and moment controls for real time autonomous air vehicle control;
   5. Integration of digital flight control, navigation and propulsion control data into a digital flight management system for "total control of flight";
      Note: *7E004.b.5. does not control:*
         1. *"Development" "technology" for integration of digital flight control, navigation and propulsion control data into a digital flight management system for "flight path optimisation";*
         2. *"Development" "technology" for "aircraft" flight instrument systems integrated solely for VOR, DME, ILS or MLS navigation or approaches.*
   6. Full authority digital flight control or multisensor mission management systems employing "expert systems";

N.B.: For "technology" for Full Authority Digital Engine Control ("FADEC"), see 9E003.a.9.

c. "Technology" for the "development" of helicopter systems, as follows:
   1. Multi-axis fly-by-wire or fly-by-light controllers which combine the functions of at least two of the following into one controlling element:
      a. Collective controls;
      b. Cyclic controls;
      c. Yaw controls;
   2. "Circulation-controlled anti-torque or circulation-controlled directional control systems";
   3. Rotor blades incorporating "variable geometry airfoils" for use in systems using individual blade control.

7E101 "Technology" according to the General Technology Note for the "use" of equipment specified in 7A001 to 7A006, 7A101 to 7A106, 7A115 to 7A117, 7B002, 7B003, 7B102, 7B103, 7D101 to 7D103.

7E102 "Technology" for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards, from external sources, as follows:

a. Design "technology" for shielding systems;

b. Design "technology" for the configuration of hardened electrical circuits and subsystems;

c. Design "technology" for the determination of hardening criteria of a. and b. above.

7E104 "Technology" for the integration of the flight control, guidance, and propulsion data into a flight management system for optimization of rocket system trajectory.

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PART 3, CATEGORY 8 - MARINE

8A Systems, Equipment and Components

8A001 Submersible vehicles and surface vessels, as follows:

Note: *For the control status of equipment for submersible vehicles, see:*
Category 5, Part 2 "Information Security" for encrypted communication equipment;
Category 6 for sensors;
Categories 7 and 8 for navigation equipment;
Category 8A for underwater equipment.

a. Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m;

b. Manned, untethered submersible vehicles, having any of the following:
   1. Designed to 'operate autonomously' and having a lifting capacity of all the following:
      a. 10% or more of their weight in air; and
      b. 15 kN or more;
   2. Designed to operate at depths exceeding 1,000 m; or
   3. Having all of the following:
      a. Designed to carry a crew of 4 or more;
      b. Designed to operate autonomously for 10 hours or more;
      c. Having a 'range' of 25 nautical miles or more; and
      d. Having a length of 21 m or less;

   Technical Notes:
   1. *For the purposes of 8A001.b., 'operate autonomously' means fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.*
   2. *For the purposes of 8A001.b., 'range' means half the maximum distance a submersible vehicle can cover.*

c. Unmanned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m, having any of the following:
   1. Designed for self-propelled manoeuvre using propulsion motors or thrusters specified in 8A002.a.2.; or
   2. Having a fibre optic data link;

d. Unmanned, untethered submersible vehicles, having any of the following:
   1. Designed for deciding a course relative to any geographical reference without real-time human assistance;
   2. Having an acoustic data or command link; or
   3. Having a fibre optic data or command link exceeding 1,000 m;

e. Ocean salvage systems with a lifting capacity exceeding 5 MN for salvaging objects from depths exceeding 250 m and having any of the following:
   1. Dynamic positioning systems capable of position keeping within 20 m of a given point provided by the navigation system; or

2. Seafloor navigation and navigation integration systems for depths exceeding 1,000 m with positioning accuracies to within 10 m of a predetermined point;

f. Surface-effect vehicles (fully skirted variety) having all of the following characteristics:
   1. a maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1.25 m (Sea State 3) or more;
   2. a cushion pressure exceeding 3,830 Pa; and
   3. a light-ship-to-full-load displacement ratio of less than 0.70;

g. Surface-effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3.25 m (Sea State 5) or more;

h. Hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3.25 m (Sea State 5) or more;

i. Small waterplane area vessels having any of the following:
   1. A full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3.25 m (Sea State 5) or more; or
   2. A full load displacement exceeding 1,500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a significant wave height of 4 m (Sea State 6) or more.

Technical Note:
A small waterplane area vessel is defined by the following formula: waterplane area at an operational design draught less than 2 x (displaced volume at the operational design draught)$^{2/3}$.

8A002 Systems and equipment, as follows:

Note: For underwater communications systems, see Category 5, Part 1 - Telecommunications.

a. Systems and equipment, specially designed or modified for submersible vehicles, designed to operate at depths exceeding 1,000 m, as follows:
   1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;
   2. Direct current propulsion motors or thrusters;
   3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;

b. Systems specially designed or modified for the automated control of the motion of equipment for submersible vehicles specified in 8A001 using navigation data and having closed loop servo-controls:
   1. Enabling a vehicle to move within 10 m of a predetermined point in the water column;
   2. Maintaining the position of the vehicle within 10 m of a predetermined point in the water column; or
   3. Maintaining the position of the vehicle within 10 m while following a cable on or under the seabed;

c. Fibre optic hull penetrators or connectors;

d. Underwater vision systems, as follows:
   1. Television systems and television cameras, as follows:

a. Television systems (comprising camera, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 800 lines and specially designed or modified for remote operation with a submersible vehicle;
b. Underwater television cameras having a limiting resolution when measured in air of more than 1,100 lines;
c. Low light level television cameras specially designed or modified for underwater use containing all of the following:
   1. Image intensifier tubes specified in 6A002.a.2.a.; and
   2. More than 150,000 "active pixels" per solid state area array;

Technical Note:
Limiting resolution in television is a measure of horizontal resolution usually expressed in terms of the maximum number of lines per picture height discriminated on a test chart, using IEEE Standard 208/1960 or any equivalent standard.

2. Systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range-gated illuminators or "laser" systems;

e. Photographic still cameras specially designed or modified for underwater use below 150 m having a film format of 35 mm or larger, and having any of the following:
   1. Annotation of the film with data provided by a source external to the camera;
   2. Automatic back focal distance correction; or
   3. Automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000 m;

f. Electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;

g. Light systems, as follows, specially designed or modified for underwater use:
   1. Stroboscopic light systems capable of a light output energy of more than 300 J per flash and a flash rate of more than 5 flashes per second;
   2. Argon arc light systems specially designed for use below 1,000 m;

h. "Robots" specially designed for underwater use, controlled by using a dedicated "stored programme controlled" computer, having any of the following:
   1. Systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; or
   2. The ability to exert a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "fibrous or filamentary" "composite" materials in their structural members;

i. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles, having any of the following:
   1. Systems which control the manipulator using the information from sensors which measure the torque or force applied to an external object, or tactile sense between the manipulator and an external object; or
   2. Controlled by proportional master-slave techniques or by using a dedicated "stored programme controlled" computer, and having 5 degrees of freedom of movement or more;

Note: *Only functions having proportional control using positional feedback or by using a dedicated "stored programme controlled"*

computer are counted when determining the number of degrees of freedom of movement.

j. Air independent power systems, specially designed for underwater use, as follows:
   1. Brayton or Rankine cycle engine air independent power systems having any of the following:
      a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
      b. Systems specially designed to use a monoatomic gas;
      c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; or
      d. Systems specially designed:
         1. To pressurise the products of reaction or for fuel reformation;
         2. To store the products of the reaction; and
         3. To discharge the products of the reaction against a pressure of 100 kPa or more;
   2. Diesel cycle engine air independent systems, having all of the following:
      a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
      b. Systems specially designed to use a monoatomic gas;
      c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; and
      d. Specially designed exhaust systems that do not exhaust continuously the products of combustion;
   3. Fuel cell air independent power systems with an output exceeding 2 kW having any of the following:
      a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; or
      b. Systems specially designed:
         1. To pressurise the products of reaction or for fuel reformation;
         2. To store the products of the reaction; and
         3. To discharge the products of the reaction against a pressure of 100 kPa or more;
   4. Stirling cycle engine air independent power systems, having all of the following:
      a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; and
      b. Specially designed exhaust systems which discharge the products of combustion against a pressure of 100 kPa or more;

k. Skirts, seals and fingers, having any of the following:
   1. Designed for cushion pressures of 3,830 Pa or more, operating in a significant wave height of 1.25 m (Sea State 3) or more and specially designed for surface effect vehicles (fully skirted variety) specified in 8A001.f.; or
   2. Designed for cushion pressures of 6,224 Pa or more, operating in a significant wave height of 3.25 m (Sea State 5) or more and specially designed for surface effect vehicles (rigid sidewalls) specified in 8A001.g.;

l. Lift fans rated at more than 400 kW specially designed for surface effect vehicles specified in 8A001.f. or 8A001.g.;

m. Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels specified in 8A001.h.;

n. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels specified in 8A001.f., 8A001.g., 8A001.h. or 8A001.i.;

o. Propellers, power transmission systems, power generation systems and noise reduction systems, as follows:
   1. Water-screw propeller or power transmission systems, as follows, specially designed for surface effect vehicles (fully skirted or rigid sidewall variety), hydrofoils or small waterplane area vessels specified in 8A001.f., 8A001.g., 8A001.h. or 8A001.i.:
      a. Supercavitating, super-ventilated, partially-submerged or surface piercing propellers rated at more than 7.5 MW;
      b. Contrarotating propeller systems rated at more than 15 MW;
      c. Systems employing pre-swirl or post-swirl techniques for smoothing the flow into a propeller;
      d. Light-weight, high capacity (K factor exceeding 300) reduction gearing;
      e. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 1 MW;
   2. Water-screw propeller, power generation systems or transmission systems designed for use on vessels, as follows:
      a. Controllable-pitch propellers and hub assemblies rated at more than 30 MW;
      b. Internally liquid-cooled electric propulsion engines with a power output exceeding 2.5 MW;
      c. "Superconductive" propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0.1 MW;
      d. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 2 MW;
      e. Ventilated or base-ventilated propeller systems rated at more than 2.5 MW;
   3. Noise reduction systems designed for use on vessels of 1,000 tonnes displacement or more, as follows:
      a. Systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30% of the equipment to be mounted;
      b. Active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source;

p. Pumpjet propulsion systems having a power output exceeding 2.5 MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater-radiated noise;

q. Self-contained, closed or semi-closed circuit (rebreathing) diving and underwater swimming apparatus.

8B Test, Inspection and Production Equipment

8B001 Water tunnels, having a background noise of less than 100 dB (reference 1 µPa, 1 Hz) in the frequency range from 0 to 500 Hz, designed for measuring acoustic fields generated by a hydro-flow around propulsion system models.

8C Materials

8C001 Syntactic foam designed for underwater use, having all of the following:

a. Designed for marine depths exceeding 1,000 m; and

b. A density less than 561 kg/m^3.

Technical Note:
Syntactic foam consists of hollow spheres of plastic or glass embedded in a resin matrix.

8D Software

8D001 "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials specified in 8A, 8B or 8C.

8D002 Specific "software" specially designed or modified for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction.

8E Technology

8E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or materials specified in 8A, 8B or 8C.

8E002 Other "technology", as follows:

a. "Technology" for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;

b. "Technology" for the overhaul or refurbishing of equipment specified in 8A001., 8A002.b., 8A002.j., 8A002.o. or 8A002.p.

PART 3, CATEGORY 9 - PROPULSION SYSTEMS, SPACE VEHICLES AND RELATED EQUIPMENT

9A Systems, Equipment and Components

(For propulsion systems designed or rated against neutron or transient ionizing radiation, see ML12.)

9A001 Aero gas turbine engines incorporating any of the "technologies" specified in 9E003.a., as follows:
N.B.: SEE ALSO 9A101.

a. Not certified for the specific "civil aircraft" for which they are intended;
b. Not certified for civil use by the aviation authorities in a "participating state";
c. Designed to cruise at speeds exceeding Mach 1.2 for more than thirty minutes.

9A002 Marine gas turbine engines with an ISO standard continuous power rating of 24,245 kW or more and a specific fuel consumption not exceeding 0.219 kg/kWh in the power range from 35 to 100%, and specially designed assemblies and components therefor.

Note: *The term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for a ship's electric power generation or propulsion.*

9A003 Specially designed assemblies and components, incorporating any of the "technologies" specified in 9E003.a., for gas turbine engine propulsion systems, as follows:
a. Specified in 9A001;
b. Whose design or production origins are either non-"participating states" or unknown to the manufacturer.

9A004 Space launch vehicles and "spacecraft".
N.B.: SEE ALSO 9A104.

Notes: 1. *9A004 does not control payloads.*
2. *For the control status of products contained in "spacecraft" payloads, see the appropriate Categories.*

9A005 Liquid rocket propulsion systems containing any of the systems or components specified in 9A006 .
N.B.: SEE ALSO 9A105 and 9A119.

9A006 Systems and components specially designed for liquid rocket propulsion systems, as follows:
N.B.: SEE ALSO 9A106 and 9A108.

a. Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30% per year;

b. Cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (-173°C) or less for "aircraft" capable of sustained flight at speeds exceeding Mach 3, launch vehicles or "spacecraft";
c. Slush hydrogen storage or transfer systems;
d. High pressure (exceeding 17.5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;
e. High-pressure (exceeding 10.6 MPa) thrust chambers and nozzles therefor;
f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);
g. Liquid propellant injectors, with individual orifices of 0.381 mm or smaller in diameter (an area of 1.14×10^{-3} cm^2 or smaller for non-circular orifices) specially designed for liquid rocket engines;
h. One-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones with densities exceeding 1.4 g/cm^3 and tensile strengths exceeding 48 MPa.

9A007 Solid rocket propulsion systems with any of the following:
N.B.: SEE ALSO 9A119.

a. Total impulse capacity exceeding 1.1 MNs;
b. Specific impulse of 2.4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;
c. Stage mass fractions exceeding 88% and propellant solid loadings exceeding 86%;
d. Any of the components specified in 9A008 .; or
e. Insulation and propellant bonding systems using direct-bonded motor designs to provide a 'strong mechanical bond' or a barrier to chemical migration between the solid propellant and case insulation material.

Technical Note:
For the purposes of 9A007.e., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

9A008 Components, as follows, specially designed for solid rocket propulsion systems:
N.B.: SEE ALSO 9A108.

a. Insulation and propellant bonding systems using liners to provide a 'strong mechanical bond' or a barrier to chemical migration between the solid propellant and case insulation material;
Technical Note:
For the purposes of 9A008.a., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

b. Filament-wound "composite" motor cases exceeding 0.61 m in diameter or having structural efficiency ratios (PV/W) exceeding 25 km;

Technical Note:
The structural efficiency ratio (PV/W) is the burst pressure (P) multiplied by the vessel volume (V) divided by the total pressure vessel weight (W).

c. Nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0.075 mm/s;

d. Movable nozzle or secondary fluid injection thrust vector control systems capable of any of the following:
1. Omni-axial movement exceeding ± 5°;
2. Angular vector rotations of 20°/s or more; or

3. Angular vector accelerations of $40°/s^2$ or more.

9A009 Hybrid rocket propulsion systems with:
N.B.: SEE ALSO 9A109 and 9A119.

a. Total impulse capacity exceeding 1.1 MNs; or
b. Thrust levels exceeding 220 kN in vacuum exit conditions.

9A010 Specially designed components, systems and structures for launch vehicles, launch vehicle propulsion systems or "spacecraft", as follows:
N.B.: SEE ALSO 1A002 AND 9A110.

a. Components and structures each exceeding 10 kg, specially designed for launch vehicles manufactured using metal "matrix", "composite", organic "composite", ceramic "matrix" or intermetallic reinforced materials specified in 1C007 or 1C010;
Note: The weight cut-off is not relevant for nose cones.

b. Components and structures specially designed for launch vehicle propulsion systems specified in 9A005 to 9A009 manufactured using metal matrix, composite, organic composite, ceramic matrix or intermetallic reinforced materials specified in 1C007 or 1C010;
c. Structural components and isolation systems specially designed to control actively the dynamic response or distortion of "spacecraft" structures;
d. Pulsed liquid rocket engines with thrust-to-weight ratios equal to or more than 1 kN/kg and a response time (the time required to achieve 90% of total rated thrust from start-up) of less than 30 ms.

9A011 Ramjet, scramjet or combined cycle engines and specially designed components therefor.
N.B.: SEE ALSO 9A111 and 9A118.

9A101 Lightweight turbojet and turbofan engines (including turbocompound engines) usable in "missiles", other than those specified in 9A001, as follows;

a. Engines having both of the following characteristics:
   1. Maximum thrust value greater than 1,000 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8,890N (achieved un-installed), and
   2. Specific fuel consumption of 0.13kg/N/hr or less(at sea level static and standard conditions); or
b. Engines designed or modified for use in "missiles".

9A104 Sounding rockets, capable of a range of at least 300 km.
N.B.: SEE ALSO 9A004.

9A105 Liquid propellant rocket engines, as follows:
N.B.: SEE ALSO 9A119.

a. Liquid propellant rocket engines usable in "missiles", other than those specified in 9A005, having a total impulse capacity of 1.1 MNs or greater;

b. Liquid propellant rocket engines usable in missiles, other than those specified in 9A005 or 9A105.a., having a total impulse capacity of 0.841 MNs or greater.

9A106 Systems or components, other than those specified in 9A006, usable in "missiles", as follows, specially designed for liquid rocket propulsion systems:

a. Ablative liners for thrust or combustion chambers;

b. Rocket nozzles;

c. Thrust vector control sub-systems;

Technical Note:
Examples of methods of achieving thrust vector control specified in 9A106.c. are:
1. *Flexible nozzle;*
2. *Fluid or secondary gas injection;*
3. *Movable engine or nozzle;*
4. *Deflection of exhaust gas stream (jet vanes or probes); or*
5. *Thrust tabs.*

d. Liquid and slurry propellant (including oxidisers) control systems, and specially designed components therefor, designed or modified to operate in vibration environments of more than 10 g rms between 20 Hz and 2,000 Hz.

Note: The only servo valves and pumps specified in 9A106.d., are the following:
a. Servo valves designed for flow rates of 24 litres per minute or greater, at an absolute pressure of 7 MPa or greater, that have an actuator response time of less than 100 ms;
b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8,000 r.p.m. or with discharge pressures equal to or greater than 7 MPa.

9A107 Solid propellant rocket engines, usable in missiles, other than those specified in 9A007, having total impulse capacity of 0.841 MNs or greater.
N.B.: SEE ALSO 9A119.

9A108 Components, other than those specified in 9A008, usable in "missiles", as follows, specially designed for solid rocket propulsion systems:

a. Rocket motor cases, "interior lining" and "insulation" therefor;

b. Rocket nozzles;

c. Thrust vector control sub-systems.

Technical Note:
Examples of methods of achieving thrust vector control specified in 9A108.c. are:
1. *Flexible nozzle;*
2. *Fluid or secondary gas injection;*
3. *Movable engine or nozzle;*
4. *Deflection of exhaust gas stream (jet vanes or probes); or*
5. *Thrust tabs.*

9A109 Hybrid rocket motors, usable in "missiles", other than those specified in 9A009, and specially designed components therefor.
N.B.: SEE ALSO 9A119.

9A110 Composite structures, laminates and manufactures thereof, other than those specified in entry 9A010, specially designed for use in the systems specified in entries 9A004 or 9A104 or the subsystems specified in entries 9A005, 9A007, 9A105.a., 9A106 to 9A108, 9A116 or 9A119, and resin impregnated fibre prepregs and metal coated fibre preforms therefor, made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a specific tensile strength greater than 7.62×10^4 m and a specific modulus greater than 3.18×10^6 m.
N.B.: SEE ALSO 1A002, 1C010 and 1C210.

Note: *The only resin impregnated fibre prepregs specified in entry 9A110 are those using resins with a glass transition temperature (T_g), after cure, exceeding 418 K (145°C) as determined by ASTM D4065 or equivalent.*

9A111 Pulse jet engines, usable in "missiles", and specially designed components therefor.
N.B.: SEE ALSO 9A011 and 9A118.

9A115 Launch support equipment, designed or modified for systems specified in 9A004 or 9A104, as follows:

a. Apparatus and devices for handling, control, activation or launching;

b. Vehicles for transport, handling, control, activation or launching.

9A116 Reentry vehicles, usable in "missiles", and equipment designed or modified therefor, as follows:

a. Reentry vehicles;

b. Heat shields and components therefor fabricated of ceramic or ablative materials;

c. Heat sinks and components therefor fabricated of light-weight, high heat capacity materials;

d. Electronic equipment specially designed for reentry vehicles.

9A117 Staging mechanisms, separation mechanisms, and interstages, usable in "missiles".

9A118 Devices to regulate combustion usable in engines, which are usable in "missiles", specified in 9A011 or 9A111.

9A119 Individual rocket stages, usable in missiles, other than those specified in 9A005, 9A007, 9A009, 9A105, 9A107 and 9A109.

9B Test, Inspection and Production Equipment

9B001 Specially designed equipment, tooling and fixtures, as follows, for manufacturing or measuring gas turbine blades, vanes or tip shroud castings:
a. Directional solidification or single crystal casting equipment;
b. Ceramic cores or shells;
c. Ceramic core manufacturing equipment or tools;
d. Ceramic shell wax pattern preparation equipment.

9B002 On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for the "development" of gas turbine engines, assemblies or components incorporating "technologies" specified in 9E003 .a.

9B003 Equipment specially designed for the "production" or test of gas turbine brush seals designed to operate at tip speeds exceeding 335 m/s, and temperatures in excess of 773 K (500°C), and specially designed components or accessories therefor.

9B004 Tools, dies or fixtures for the solid state joining of "superalloy", titanium or intermetallic airfoil-to-disk combinations described in 9E003 .a.3. or 9E003 .a.6. for gas turbines.

9B005 On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with any of the following wind tunnels or devices:
N.B.: SEE ALSO 9B105.

a. Wind tunnels designed for speeds of Mach 1.2 or more,
   except:
   Those specially designed for educational purposes and having a test section size (measured laterally) of less than 250 mm;
   Technical Note:
   Test section size in 9B005.a.means the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test section location.
b. Devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns; or
c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25×10^6.

9B006 Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 µPa) with a rated output of 4 kW or more at a test cell temperature exceeding 1,273 K (1,000°C), and specially designed quartz heaters therefor.
N.B.: SEE ALSO 9B106.

9B007 Equipment specially designed for inspecting the integrity of rocket motors using non-destructive test (NDT) techniques other than planar X-ray or basic physical or chemical analysis.

9B008 Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560°C).

9B009 Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operating at stress levels of 60% of ultimate tensile strength (UTS) or more and metal temperatures of 873 K (600°C) or more.

9B105 Wind tunnels for speeds of Mach 0.9 or more, usable for "missiles" and their subsystems.
N.B.: SEE ALSO 9B005.

9B106 Environmental chambers and anechoic chambers, as follows:

a. Environmental chambers capable of simulating the following flight conditions:
   1. Vibration environments of 10 g rms or greater between 20 Hz and 2,000 Hz and imparting forces of 5 kN or greater; and
   2. Altitudes of 15,000 m or greater; or
   3. Temperature of at least 223 K (-50°C) to 398 K (+ 125°C);

b. Anechoic chambers capable of simulating the following flight conditions:
   1. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to 20 microPa) or with a rated power output of 4 kW or greater; and
   2. Altitudes of 15,000 m or greater; or
   3. Temperature of at least 223 K (-50°C) to 398 K (+ 125°C).

9B115 Specially designed "production equipment" for the systems, sub-systems and components specified in 9A005 to 9A009, 9A011, 9A101, 9A105 to 9A109, 9A111, 9A116 to 9A119.

9B116 Specially designed "production facilities" for the systems, sub-systems, and components specified in 9A004 to 9A009, 9A011, 9A101, 9A104 to 9A109, 9A111, 9A116 to 9A119.

9B117 Test benches and test stands for solid or liquid propellant rockets or rocket motors, having either of the following characteristics:

a. The capacity to handle more than 90 kN of thrust; or

b. Capable of simultaneously measuring the three axial thrust components.

9C Materials

None.

9D Software

9D001 "Software" required for the "development" of equipment or "technology" specified in 9A, 9B or 9E003 .

9D002 "Software" required for the "production" of equipment specified in 9A or 9B.

9D003 "Software" required for the "use" of full authority digital electronic engine controls (FADEC) for propulsion systems specified in 9A or equipment specified in 9B., as follows:

a. "Software" in digital electronic controls for propulsion systems, aerospace test facilities or air breathing aero-engine test facilities;
b. Fault-tolerant "software" used in "FADEC" systems for propulsion systems and associated test facilities.

9D004 Other "software", as follows:

a. 2D or 3D viscous "software" validated with wind tunnel or flight test data required for detailed engine flow modelling;
b. "Software" for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyse data in real time, and capable of feedback control, including the dynamic adjustment of test articles or test conditions, as the test is in progress;

c. "Software" specially designed to control directional solidification or single crystal casting;
d. "Software" in "source code", "object code" or machine code required for the "use" of active compensating systems for rotor blade tip clearance control.
Note: 9D004 .d. does not control "software" embedded in uncontrolled equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.

9D101 "Software" specially designed for the "use" of goods specified in 9B105, 9B106, 9B116 or 9B117.

9D103 "Software" specially designed for modelling, simulation or design integration of the systems specified in 9A004 or 9A104, or the subsystems specified in 9A005, 9A007, 9A105.a., 9A106, 9A108, 9A116 or 9A119.
Note: "Software" specified in 9D103 remains controlled when combined with specially designed hardware specified in 4A102.

9E Technology

Note: "Development" or "production" "technology" specified in 9E001 to 9E003. for gas turbine engines remains controlled when used as "use" "technology" for repair, rebuild and overhaul. Excluded from control are: technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

9E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 9A001.c., 9A004 to 9A011, 9B or 9D.

9E002 "Technology" according to the General Technology Note for the "production" of equipment specified in 9A001.c., 9A004 to 9A011, or 9B.

Note: For "technology" for the repair of controlled structures, laminates or materials, see 1E002.f.

9E003 Other "technology", as follows:

a. "Technology" "required" for the "development" or "production" of any of the following gas turbine engine components or systems:
1. Gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K (1,000°C) at a stress of 200 MPa, based on the average property values;
2. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,813 K (1,540°C) or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;
3. Components manufactured from organic "composite" materials designed to operate above 588 K (315°C), or from metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials controlled by 1A002 or 1C007;
4. Uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050°C) or more;
5. Cooled turbine blades, vanes or tip-shrouds, other than those described in 9E003.a.1., exposed to gas path temperatures of 1,643 K (1,370°C) or more;
6. Airfoil-to-disk blade combinations using solid state joining;

7. Gas turbine engine components using "diffusion bonding" "technology" controlled by 2E003.b.;
8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials controlled by 1C002.b.;
9. "FADEC" for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;
10. Adjustable flow path geometry and associated control systems for:
    a. Gas generator turbines;
    b. Fan or power turbines;
    c. Propelling nozzles;

    Notes: 1. *Adjustable flow path geometry and associated control* systems *in 9E003.a.10. do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.*
    2. *9E003.a.10. does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.*
11. Rotor blade tip clearance control systems employing active compensating casing "technology" limited to a design and development data base; or
12. Wide chord hollow fan blades without part-span support;

b. "Technology" "required" for the "development" or "production" of any of the following:
    1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; or
    2. "Composite" propeller blades or propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. "Technology" "required" for the "development" or "production" of gas turbine engine components using "laser", water jet, ECM or EDM hole drilling processes to produce holes having any of the following sets of characteristics:
    1. All of the following:
        a. Depths more than four times their diameter;
        b. Diameters less than 0.76 mm; and
        c. Incidence angles equal to or less than 25°; or
    2. All of the following:
        a. Depths more than five times their diameter;
        b. Diameters less than 0.4 mm; and
        c. Incidence angles of more than 25°;

    Technical Note:
    For the purposes of 9E003.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

d. "Technology" "required" for any of the following:
    1. The "development" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems; or
    2. The "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems;

e. 1. "Technology" for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:
        a. A box volume of 1.2 m^3 or less;
        b. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; and
        c. A power density of more than 700 kW/m^3 of box volume;

    Technical Note:
    Box volume: the product of three perpendicular dimensions measured in the following way:

Length: *The length of the crankshaft from front flange to flywheel face;*
Width: *The widest of the following:*
a. The outside dimension from valve cover to valve cover;
b. The dimensions of the outside edges of the cylinder heads; or
c. The diameter of the flywheel housing;
Height: *The largest of the following:*
a. The dimension of the crankshaft centre-line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or
b. The diameter of the flywheel housing.

2. "Technology" "required" for the "production" of specially designed components, as follows, for high output diesel engines:
   a. "Technology" "required" for the "production" of engine systems having all of the following components employing ceramics materials controlled by 1C007:
      1. Cylinder liners;
      2. Pistons;
      3. Cylinder heads; and
      4. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);
   b. "Technology" "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:
      1. Operating at pressure ratios of 4:1 or higher;
      2. A mass flow in the range from 30 to 130 kg per minute; and
      3. Variable flow area capability within the compressor or turbine sections;
   c. "Technology" "required" for the "production" of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)), having both of the following:
      1. Injection amount in excess of 230 mm^3 per injection per cylinder; and
      2. Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;
3. "Technology" "required" for the "development" or "production" of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.
   Technical Note:
   High output diesel engines: diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.

9E101 "Technology" according to the General Technology Note for the "development" or "production" of goods specified in 9A101, 9A104 to 9A111 or 9A115 to 9A119.

9E102 "Technology" according to the General Technology Note for the "use" of goods specified in 9A004 to 9A011, 9A101, 9A104 to 9A111, 9A115 to 9A119, 9B105, 9B106, 9B115, 9B116, 9B117, 9D101 or 9D103.

DEFENCE AND STRATEGIC GOODS LIST
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1,2,4 Butanetriol ML8e.45
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1,3,5 Trinitro 1,3,5 triaza cyclohexane ML8a.20
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UF6 auxiliary isotope separation/enrichment equipment 0B002
UF6 cold traps 0B001d.7.d
UF6 cold traps 0B002b
UF6 desublimers 0B002b
UF6 Gaseous diffusion barriers & housing 0B001b.3,4
UF6 liquefaction stations 0B002d
UF6 mass spectrometers/ion sources 0B002g
UF6 piping & header systems 0B002e
UF6 product & tails stations 0B002c
UF6 production plant, equipment & components 0B003
UF6 resistant compounds & powders 0C006
UF6 resistant compounds & powders 0C201
UF6 vacuum pumps 0B002f
Ultrasonic test equipment for nuclear reactors 0B008b
UN Class 1.1 solid propellants ML8b.3
UN Class 1.3 solid propellants ML8b.4
Underwater (propeller) noise reduction software 8D002
Underwater cameras, photographic 8A002d-f
Underwater communication cable 5A001d.3
Underwater communications systems 5A001b.2
Underwater detection devices ML9c
Underwater electronic imaging systems 8A002f
Underwater noise reduction technology 8E002
Underwater optical fibre cables & accessories 5A001d.3
Underwater robots, computer controlled 8A002h
Underwater swimming apparatus 8A002q
Underwater swimming apparatus ML17a
Underwater vehicles, industrial 8A001
Underwater velocity measurement equipment 6A001c
Underwater vision systems 8A002d
Unmanned airborne vehicles & launchers ML10d
Unmanned tethered submersible vehicles 8A001c
Unmanned untethered submersible vehicles 8A001d
Unsymmetrical dimethyl hydrazine ML8a.18
Uranium conversion plant & equipment 0B009
Uranium cooling equipment 0B001g.2
Uranium electromagnetic separator vacuum housings 0B001k.3
Uranium fluoride (UF5) product filter collectors 0B001h.2
Uranium fluoride (UF6) production plant, equipment & components 0B003
Uranium fluoride (vapour product & tails collector systems) 0B001g.3
Uranium hexafluoride (UF6) resistant compounds & powders 0C006
Uranium hexafluoride (UF6) resistant compounds & powders 0C201
Uranium isotopes separation, lasers or laser systems 0B001g.5
Uranium isotopes separation, lasers or laser systems 0B001h.6
Uranium oxidation systems 0B001e.6
Uranium plasma generation systems 0B001i.4
Uranium titanium alloys 1C004
Uranium vapour product & tails collector systems 0B001g.3
Uranium, enriched in Uranium-233 or Uranium-235 0C002
Vacuum furnaces 2B226
Vacuum furnaces 2B227
Vacuum headers 0B002f
Vacuum housings for uranium electromagnetic separators 0B001k.3
Vacuum induction furnace, power supplies 2B226
Vacuum induction furnaces 2B226
Vacuum manifolds 0B002f
Vacuum melting, remelt & casting furnaces 2B227
Vacuum microelectronic device development/production technology 3E002a
Vacuum pumps 0B002f
Vacuum pumps for UF6 bearing atmospheres 0B002f
Vacuum pumps 2B231
Vacuum pumps 2B350i

Vacuum tubes	ML11
Vacuum tubes, industrial electronic	3A228
Vacuum tubes, industrial electronic microwave	3A001b.1
Valve seals	1A001a
Valves, bellows	2B350g
Valves, bellows seal	2A226
Valves, diaphragm	2B350g
Valves, double-seal	2B350g
Valves, electronic (vacuum microwave)	ML11
Valves, gaseous diffusion isotope separation	0B001b.1
Valves, industrial electronic (vacuum - microwave)	3A001b.1
Valves, industrial electronic vacuum	3A228a
Valves, industrial electronic vacuum	3A228b
Valves, multiple seal incorporating a leak detection port	2B350g
Valves, non-return (check)	2B350g
Variola virus	1C351a.15
Vector processors/assemblies	4A003
Vehicles & related equipment/components, military	ML6
Vehicles fitted with mountings for arms	ML6b
Vehicles modified for military use	ML6
Vehicles, space/space craft/rocket launch support	9A115b
Velocity interferometers (VISARs)	6A225
Velocity measurement equipment, underwater	6A001c
Venezuelan equine encephalitis virus	1C351a.16
Ventilated full or half (protective clothing) suits	2B352a.2
Ventilated propellers	8A002o.1.a
Verotoxin	1C351d.9
Vesicular stomatitis virus	1C352a.15
Vessel noise reduction equipment	8A002.o.3
Vessel positioning systems, acoustic	6A001a.1.d
Vessels	ML9
Vessels, marine	8A001
Vibration test equipment production and use software	2D101
Vibration test equipment using digital control techniques	2B116
Vibration test equipment, acoustic	9B006
Vibrio cholerae	1C351c.12
Video cameras incorporating solid state sensors	6A003b.1
Vinylidene fluoride copolymers	1C009a
Vinylidene fluoride copolymers, components of	1A001
Viruses	1C351
Viruses	1C352
Viruses	ML7a
Viruses, animal pathogens	1C352a
Viruses, human pathogens	1C351a
Viscous software, 2D or 3D engine flow modelling	9D004a
Vision systems, underwater	8A002d
Vortex tube units, UF6 separation from carrier gas	0B001d.7.c
Vortex tubes, aerodynamic isotope separation	0B001d.2
VX (O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate)	ML7a
Wafer handling systems, semiconductor	3B001e
Wafer processing, semiconductor manufacture	3B001f
Wafers, comprising multiple epitaxially grown layers	3C001
Wafers, semiconductor with function determined	3A001a
Wall skin friction transducers	9B008
Warning systems/equipment/components	ML5
Warships	ML9
Water distillation towers, heavy	0B004b.4.a
Water jet (pumpjet) propulsion systems	8A002p
Water jet cutting machines (CNC)	2B001e.1.a
Water tunnels, propulsion model acoustic field measurement	8B001
Water-hydrogen sulphide exchange tray columns	1B229
Water-screw propellers	8A002o.1
Wave division multiplex equipment	5A001b.4
Waveform digitisers (Transient recorders)	3A002a.5
Wax pattern preparation equipment, ceramic core	9B001d
Weapon control systems	ML5a
Weapon sights	ML5a
Weapons using caseless ammunition	ML1c
Weapons using caseless ammunition	ML2a
Weapons, other than small arms/firearms	ML2
Weapons, other than small arms/firearms	ML19
Weapons, other than small arms/firearms	ML12
Weapons, other than small arms/firearms	ML4
Weapons, small arms/firearms	ML1
Weapons, small arms/firearms, non-military	ML901
Weaving machines	1B001c
Western equine encephalitis virus	1C351a.17
Wet-spinning equipment for refractory ceramics	1B001d
Wet-spinning equipment for refractory ceramics	1B101d
White pox	1C351a.18
Wide-swath bathymetric survey systems	6A001a.1
Wind tunnel aero-model technology	9E003b.1
Wind tunnel, control systems	9B005
Wind tunnels, usable for missiles	9B105
Windows, glass for nuclear radiation shielding	1A227
Work stations, as computers having a CTP above 260 Mtops	4A003b
X-ray (non planar) inspection equipment, rocket motors	9B007
X-ray equipment, radiographic	3A201c
X-ray equipment, radiographic	3A101b
X-ray generators, flash discharge systems	3A001e.5
X-ray sensitive resist materials	3C002c
Xanthomonas albilineans	1C354a.1
Xanthomonas campestris pv. aurantifolia	1C354a.2
Xanthomonas citri	1C354a.2
Yellow fever virus	1C351a.19
Yttrium oxide (yttria) (Y2O3), crucibles made of or coated with	2A225a.8
Zinc selenide (ZnSe), substrate blanks	6C004a
Zinc sulphide (ZnS), substrate blanks	6C004a
Zirconium fluoride (ZrF4) glass	6C004e
Zirconium metal and alloy powder	1C111a.2
Zirconium metal and alloy tubes & assemblies	0A001f
Zirconium metal, alloy and compounds	1C234
Zirconium metal/alloy powder	ML8a.2.a
Zirconium oxide (zirconia) (ZrO2) made/coated crucibles	2A225a.9
Zoonoses	1C351