

Defence and Strategic Goods List

made under paragraph 112 (2A) (aa) of the

Customs Act 1901

**Compilation No. 1**

**Compilation date:** 17 October 2006

**Includes amendments up to:** Defence and Strategic Goods List Amendment 2006

**Registered:** 10 April 2015

**About this compilation**

**This compilation**

This is a compilation of the *Defence and Strategic Goods List* that shows the text of the law as amended and in force on 17 October 2006 (the ***compilation date***).

This compilation was prepared on 8 April 2015.

The notes at the end of this compilation (the ***endnotes***) include information about amending laws and the amendment history of provisions of the compiled law.

**Uncommenced amendments**

The effect of uncommenced amendments is not shown in the text of the compiled law. Any uncommenced amendments affecting the law are accessible on ComLaw (www.comlaw.gov.au). The details of amendments made up to, but not commenced at, the compilation date are underlined in the endnotes. For more information on any uncommenced amendments, see the series page on ComLaw for the compiled law.

**Application, saving and transitional provisions for provisions and amendments**

If the operation of a provision or amendment of the compiled law is affected by an application, saving or transitional provision that is not included in this compilation, details are included in the endnotes.

**Modifications**

If the compiled law is modified by another law, the compiled law operates as modified but the modification does not amend the text of the law. Accordingly, this compilation does not show the text of the compiled law as modified. For more information on any modifications, see the series page on ComLaw for the compiled law.

**Self‑repealing provisions**

If a provision of the compiled law has been repealed in accordance with a provision of the law, details are included in the endnotes.



**DEFENCE AND STRATEGIC GOODS LIST**

### November 1996

**PREFACE**

The Defence and Strategic Goods List (DSGL) is identified in regulation 13E of the *Customs (Prohibited Exports) Regulations 1958* as the document titled ‘Defence and Strategic Goods List’:

(a)   formulated and published for the purpose of paragraph 112 (2A) (aa) of the *Customs Act 1901* by the Minister for Defence; and

(b)   dated November 1996;

as amended by the Minister for Defence and in force from time to time*.*

Goods included in the list may not be exported from Australia unless a licence or permission has been granted by the Minister or an authorised person and that licence or permission is produced to a Collector of Customs before exportation: regulation 13E of the *Customs (Prohibited Exports) Regulations 1958*.

The DSGL was first published in 1996 when the *Customs (Prohibited Exports) Regulations* were consolidated and revised as a result of an Australian National Audit Office review of the Defence export control activity.

The DSGL includes equipment, assemblies and components, associated test, inspection and production equipment, materials, software and technology and is divided into two parts.

***PART 1*** covers defence and related goods ‑ those goods and technologies designed or adapted for use by armed forces or goods that are inherently lethal. These goods include:

• *Military Goods* – those goods or technology that is designed or adapted for military purposes including parts and accessories thereof.

• *Non Military Lethal Goods (NMLG)* – that equipment that is inherently lethal, incapacitating or destructive such as non‑military firearms, non‑military ammunition and commercial explosives and initiators.

***PART 2*** covers those goods that have a dual use. Dual‑use goods comprise equipment and technologies developed to meet commercial needs but which may be used either as military components or for the development or production of military systems or weapons of mass destruction. This part is further subdivided into and is made up of the following 10 categories:

• *Category 0* – Nuclear Materials;

• *Category 1* – Materials, Chemicals, Microorganisms and Toxins;

• *Category 2* – Materials Processing;

• *Category 3* – Electronics;

• *Category 4* – Computers;

• *Category 5* – Telecommunications and Information Security;

• *Category 6* – Sensors and Lasers;

• *Category 7* – Navigation and Avionics;

• *Category 8* – Marine;

• *Category 9* – Propulsion Systems, Space Vehicles and Related Equipment.

The DSGL is amended from time to time to reflect changes in the various multilateral non‑proliferation and export control regimes of which Australia is a member.

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**NOTES**

## GENERAL NOTES

1. The Notes, Technical Notes and Nota Bene (N.B.) appearing in the Defence and Strategic Goods List form an integral part of the control text.

2. 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 plant) 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*.

1. Goods specified in the Defence and Strategic Goods List include both new and used goods.
2. Terms in "quotations" are defined terms. Refer to the 'Definitions of Terms' section of the Defence and Strategic Goods List. Words and terms appearing under 'Definitions of Terms', if used in their undefined forms, take their common or dictionary meanings.

### PART 1 ‑ MUNITIONS LIST

**ML 8**

Specially formulated pharmaceutical products containing ML8 materials are not controlled.

**ML 10**

Absence of items from the Munitions List and absence of configuration for military use would mean that an aircraft would not be considered military.

### PART 2 ‑ DUAL‑USE GOODS AND TECHNOLOGIES

**General Technology Note**

The transfer of "technology" according to the General Technology Note, for "production" or "development" of items on this list shall be treated with vigilance.

**General Technology Note**

Controls on intangible "technology" are to be exercised as far as the scope of legislation† will allow.

**General Software Note**

The transfer of "software", for "production" or "development" of items on this list shall be treated with vigilance.

**Medical equipment**

Equipment specially designed for medical end‑use that incorporates an item controlled in the Dual‑Use List is not controlled.

**Category 6**

The control text contained in 6A002.a. Nota Bene, 6A002.a.3. Nota Bene, 6A002.a.3.c. Nota Bene, 6A002.a.3.f., 6A003.b.4. and 6A003.b.4. Notes 1, 2 and 3 is valid until 05 December 2007.

**Category 9**

"Development" or "production" "technology" controlled by 9E 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.

*† Australia’s export control legislation on the intangible transfers of “software” and “technology” is the* *Weapons of Mass Destruction (Prevention of Proliferation) Act 1995.* *The object of this Act is to ensure that goods are not supplied or exported, and services are not provided, in circumstances where the goods will or may be used in, or the services will or may assist a Weapons of Mass Destruction (WMD) program.*

*A WMD program means a plan or program for the development, production, acquisition or stockpiling of nuclear, biological or chemical weapons or missiles capable of delivering such weapons.*

*The provision of services includes doing anything that confers a benefit on, grants a right or privilege to, provides a facility for, or otherwise assists, someone.*

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**DEFINITIONS OF TERMS**

Definitions of terms between 'single quotation marks' are given in a Technical Note to the relevant item.

Definitions of terms between "double quotation marks" are as follows:

N.B.: 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.

"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 resistance to UV radiation) designed to increase the effectiveness in producing casualties in humans or animals, degrading equipment or damaging crops or the environment.

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

"Aircraft" (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".

"All compensations available" (2) means after all feasible measures available to the manufacturer to minimise all systematic positioning errors for the particular machine‑tool model are considered.

"Allocated by the ITU" (3 5) means the allocation of frequency bands according to the current edition of the ITU Radio Regulations for primary, permitted and secondary services.

N.B.: Additional and alternative allocations are not included.

"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').

"Asymmetric algorithm " (5) means a cryptographic algorithm using different, mathematically‑related keys for encryption and decryption.

N.B.: A common use of "asymmetric algorithms" is key management.

"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 in a "monolithic integrated circuit". For a 'family' of "monolithic integrated circuits", this may be specified either as the propagation delay time per typical gate within the given 'family' or as the typical propagation delay time per gate within the given 'family'.

Technical Notes:

1. "Basic gate propagation delay time" is not to be confused with the input/output delay time of a complex "monolithic integrated circuit".

2. 'Family' consists of all integrated circuits to which all of the following are applied as their manufacturing methodology and specifications except their respective functions:

a. The common hardware and software architecture;

b. The common design and process technology; and

c. The common basic characteristics.

"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 ML22) means enzymes or other biological compounds which bind to and accelerate the degradation of CW agents.

*Technical Note:*

*‘Enzymes’ means “biocatalysts” for specific chemical or biochemical reactions.*

"Biopolymers" (ML7 ML22) means biological macromolecules as follows:

a. Enzymes for specific chemical or biochemical reactions;

b. Antibodies, monoclonal, polyclonal or anti‑idiotypic;

c. Specially designed or specially processed receptors;

*Technical Notes:*

*1*. *'Anti‑idiotypic antibodies' means antibodies which bind to the specific antigen binding sites of other antibodies;*

*2*. *‘Monoclonal antibodies’ means proteins which bind to one antigenic site and are produced by a single clone of cells;*

*3*. *‘Polyclonal antibodies’ means a mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;*

*4*. *‘Receptors’ means biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions.*

"Camming" (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 (Reference: ISO 230/1 1986, paragraph 5.63).

"Carbon fibre preforms" (1) means an ordered arrangement of uncoated or coated fibres intended to constitute a framework of a part before the "matrix" is introduced to form a "composite".

"CE" (4) is equivalent to "computing element".

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

"Chemical mixture" (1) means a solid, liquid or gaseous product made up of two or more components which do not react together under the conditions under which the mixture is stored.

"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" (4) 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 unauthorised use. "Cryptography" is limited to the transformation of information using one or more 'secret parameters' (e.g., crypto variables) or associated key management.

Technical Note:

'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‑Based Referenced Navigation" ("DBRN") (7) Systems means systems which use various sources of previously measured geo‑mapping data integrated to provide accurate navigation information under dynamic conditions. Data sources include bathymetric maps, stellar maps, gravity maps, magnetic maps or 3‑D digital terrain maps.

"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.

*Note: When determining the "data signalling rate", servicing and administrative channels shall be excluded.*

*Technical Note:*

*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.

Technical Note:

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.

"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 gram" (1) of "special fissile material" means:

a. For plutonium isotopes and uranium‑233, the isotope weight in grams;

b. For uranium enriched 1 per cent or greater in the isotope uranium‑235, the element weight in grams multiplied by the square of its enrichment expressed as a decimal weight fraction;

c. For uranium enriched below 1 per cent in the isotope uranium‑235, the element weight in grams multiplied by 0.0001

"Electronic assembly" (2 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.

Technical Notes:

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) means grippers, 'active tooling units' and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

Technical Note:

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

"Energetic materials" (ML 4 ML8 ML908 ML909) mean substances or mixtures that react chemically to release energy required for their intended application. "Explosives", "pyrotechnics" and "propellants" are subclasses of energetic materials.

"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 "program" 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).

"Explosives" (ML8 ML18 ML909) mean solid, liquid or gaseous substances or mixtures of substances which, in their application as primary, booster, or main charges in warheads, demolition and other applications, are required to detonate.

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

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

"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 2 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".

Technical Note:

'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 electrostatically 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 optimisation" (7) is a procedure that minimises deviations from a four‑dimensional (space and time) desired trajectory based on maximising 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.

Note: This definition does not 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.

"Fractional bandwidth" (3) means the "instantaneous bandwidth" divided by the centre frequency, expressed as a percentage.

"Frequency hopping" (5) means a form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by a random or pseudo‑random sequence of 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.

"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".

"Guidance set" (7) means systems that integrate the process of measuring and computing a vehicle’s position and velocity (i.e. navigation) with that of computing and sending commands to the vehicle’s 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.

Technical Notes:

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.

"Information security" (4 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.

Technical Note:

'Cryptanalysis' is the analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text (ISO 7498‑2‑1988 (E), paragraph 3.3.18).

"Instantaneous bandwidth" (3 5 7) 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 radar.

"Insulation" (9) is applied to the components of a rocket motor, i.e. 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.

"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, e.g. carbon filled hydroxyl terminated polybutadiene (HTPB) or other polymer with added curing agents sprayed or screeded over a case interior.

"In the public domain" (GTN NTN GSN ML22), 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").

"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".

"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 7 8 9 ML5 ML9 ML19) 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".

"Lighter‑than‑air vehicles" (ML10) mean balloons and airships that rely on hot air or on lighter‑than‑air gases such as helium or hydrogen for their lift.

"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).

Technical Note:

'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.

"Materials resistant to corrosion by UF6" (0) may be copper, stainless steel, aluminium, aluminium oxide, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel and UF6‑ resistant fluorinated hydrocarbon polymers, as appropriate for the type of separation process.

"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.

"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/s.

"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/s.

"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.

Technical Note:

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.

Technical Note:

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.

Note: This definition includes chip sets which are designed to operate together to provide the function of a "microprocessor microcircuit".

"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.

"Microprogram" 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.

"Missiles" (1 3 6 7 9) means complete rocket systems and unmanned aerial vehicle systems, capable of delivering at least 500 kg payload to a range of at least 300 km.

"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.

Technical Note:

'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 "microprogram" 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.

"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.

Technical Note:

"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) 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 = 8No(f2‑f1), where Spp is the peak‑to‑peak value of the signal (e.g., nanoteslas), No is the power spectral density (e.g., (nanotesla)2/Hz) and (f2‑f1) 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" (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 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.

"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. (See www.wassenaar.org)

"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 which has been programmed for a specific application and cannot be reprogrammed for any other application 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" (ML8) means specialty chemicals used in the manufacture of military explosives.

"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" (1 7 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" (7 9) means equipment and specially designed software therefor integrated into installations for "development" or for one or more phases of "production".

"Program" (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.

"Propellants" (ML8) Substances or mixtures that react chemically to produce large volumes of hot gases at controlled rates to perform mechanical work.

"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.

"Pyrotechnic(s)" (ML4 ML8 ML909) 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. Pyrophorics are a subclass of pyrotechnics, which contain no oxidizers but ignite spontaneously on contact with air.

"Quantum cryptography" (5) means a family of techniques for the establishment of a shared key for "cryptography" by measuring the quantum‑mechanical properties of a physical system (including those physical properties explicitly governed by quantum optics, quantum field theory, or quantum electrodynamics).

"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" (2 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" (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 5 6 9 ML22), 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) mean substances which, under the expected conditions of use for riot control purposes, rapidly produce in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure. (Tear gases are a subset of "riot control agents".)

"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.

Note: 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 program 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 program 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 program pattern. Variations or modifications of the program 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 program 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'.

Technical Note:

'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

"Run‑out" (2) (out‑of‑true running) 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 (Reference: 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.

"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" (6) is equivalent to "super high power laser".

"Signal analysers" (3) mean 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 "programs" or "microprograms" fixed in any tangible medium of expression.

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

"Source code" (or source language) (4 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) 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‑233, "uranium enriched in the isotopes 235 or 233", and any material containing the foregoing.

"Specific modulus" (0 1 9) is Young's modulus in pascals, equivalent to N/m2 divided by specific weight in N/m3, measured at a temperature of (296 + 2) K ((23 + 2)oC) and a relative humidity of (50 + 5)%.

"Specific tensile strength" (0 1 9) is ultimate tensile strength in pascals, equivalent to N/m2 divided by specific weight in N/m3, measured at a temperature of (296 + 2) K ((23 + 2)oC) and a relative humidity of (50 + 5)%.

"Splat Quenching" (1) means a process to "solidify rapidly" a molten metal stream impinging upon a chilled block, forming a flake‑like product.

"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.

"States (not) Party to the Chemical Weapon Convention" (1) are those states for which the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons has (not) entered into force. (See www.opcw.org)

"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.

Technical Notes:

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) mean nickel‑, cobalt‑ or iron‑base alloys having strengths superior to any alloys in the AISI 300 series at temperatures over 922 K (649oC) 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.

Technical Note:

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.

"Symmetric algorithm " (5) means a cryptographic algorithm using an identical key for both encryption and decryption.

Technical Note:

A common use of "symmetric algorithms" is confidentiality of data.

"System 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.

Technical Note:

'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

"Technology" (GTN NTN All) means specific information necessary for the "development", "production" or "use" of a product. The information takes the form of technical data or technical assistance. Controlled "technology" for the Dual‑Use List is defined in the General Technology Note and in the Dual‑Use List. Controlled “technology” for the Munitions List is specified in ML22.

*Technical Notes:*

*1*. *'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.*

*2*. *'Technical assistance' may take forms such as instruction, skills, training, working knowledge, consulting services. 'Technical assistance' may involve transfer of 'technical data'.*

"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".

"Unmanned aerial vehicle" ("UAV") (9) means any "aircraft" capable of initiating flight and sustaining controlled flight and navigation without any human presence on board.

"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 1 2 4 5 6 7 8 9 ML21 ML22) 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 "programs" 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 in a pharmaceutical formulation licensed by, or having marketing or clinical trial authorisation from, the regulatory authorities of either the country of manufacture or of use, which is intended to stimulate a protective immunological response in humans or animals in order to prevent disease in those to whom or to which it is administered.

"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'.

Technical Note:

'Strand' is a bundle of "monofilaments" (typically over 200) arranged approximately parallel.

**ACRONYMS AND ABBREVIATIONS**

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

| **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 |
| ASNO | Australian Safeguards and Non‑proliferation Office |
| ASTM | the American Society for Testing and Materials |
| ATC | air traffic control |
| AVLIS | atomic vapour laser isotope separation |
| C3I | command, communications, control & intelligence |
| CAD | computer‑aided‑design |
| CAS | Chemical Abstracts Service |
| CCITT | International Telegraph and Telephone Consultative Committee |
| CDU | control and display unit |
| CEP | circular error probable |
| CNTD | controlled nucleation thermal deposition |
| CRISLA | chemical reaction by isotope selective laser activation. |
| CVD | chemical vapour deposition |
| CW | chemical warfare |
| CW (for lasers) | continuous wave |
| DEW | directed energy weapon systems |
| DME | distance measuring equipment |
| DS | directionally solidified |
| EB‑PVD | electron beam physical vapour deposition |
| EBU | European Broadcasting Union |
| 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 |
| EMCDB | elastomer modified cast double based propellants |
| 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 |
| IEC | International Electro‑technical Commission |
| 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 |
| MAC | message authentication code |
| Mach | ratio of speed of an object to speed of sound (after Ernst Mach) |
| MLIS | molecular laser isotopic separation |
| MLS | microwave landing systems |
| MOCVD | metal organic chemical vapour deposition |
| MPEG | Moving Picture Experts Group (ISO/IEC JTC1/SC29/WG11) |
| 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 |
| RPV | remotely piloted air vehicle |
| SACMA | Suppliers of Advanced Composite Materials Association |
| SAR | synthetic aperture radar |
| SC | single crystal |
| SLAR | sidelooking airborne radar |
| SMPTE | Society of Motion Picture and Television Engineers |
| 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 |
| UAV | unmanned aerial vehicle |
| UTS | ultimate tensile strength |
| UV | ultraviolet |
| VOR | very high frequency omni‑directional range |
| YAG | yttrium/aluminium garnet |

**PART 1 ‑ MUNITIONS LIST**

*Note 1 Terms in "quotations" are defined terms. Refer to the 'Definitions of Terms’ section.*

*Note 2 Chemicals are listed by name and CAS number. Chemicals of the same structural formula (including hydrates) are controlled regardless of name or CAS number. CAS numbers are shown to assist in identifying whether a particular chemical or mixture is controlled, irrespective of nomenclature. CAS numbers cannot be used as unique identifiers because some forms of the listed chemical have different CAS numbers, and mixtures containing a listed chemical may also have different CAS numbers.*

ML1. Smooth‑bore weapons with a calibre of less than 20 mm, other 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;

1. 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, as follows:

1. Smooth‑bore weapons specially designed for military use;

2. Other smooth‑bore weapons, as follows:

1. a. Of the fully automatic type;

b. Of the semi‑automatic or pump‑action type;

c. Weapons using caseless ammunition;

d. Silencers, special gun‑mountings, clips, weapons sights and flash suppressors for arms controlled by sub‑items ML1.a., ML1.b. or ML1.c.

*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*.

*Note 4 ML1*.*d. does not control optical weapon sights without electronic image processing, with a magnification of 4 times or less, provided they are not specially designed or modified for military use.*

ML2. Smooth‑bore weapons with a calibre of 20 mm or more, other weapons or armament 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 ML2.a.

b. Military smoke, gas and pyrotechnic projectors or generators.

Note ML2.b. does not control signal pistols.

c. Weapons sights.

ML3. Ammunition and fuze setting devices, as follows, and specially designed components therefor:

1. Ammunition for the weapons controlled by ML1., ML2. or ML12.;

b. Fuze setting devices specially designed for ammunition controlled by ML3.a.

*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, fuzes, 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*.*a. 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*.

*Note 3 ML3*.*a. does not control cartridges specially designed for any of the following purposes:*

*a. Signalling;*

*b. Bird scaring; or*

*c. Lighting of gas flares at oil wells.*

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

*N.B. For guidance and navigation equipment, see ML11, Note 7*.

a. Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition‑charges, demolition‑devices and demolition‑kits, "pyrotechnic" devices, 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 1 ML4.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 2 ML4.b. does not include detonators or other equipment for the detonation of non‑military explosives covered by ML908. For these, see ML909.

*Technical Note*

*Hand‑held devices, limited by design solely to the detection of metal objects and incapable of distinguishing between mines and other metal objects, are not considered to be specially designed for the detection of items controlled by ML4*.*a.*

ML5. Fire control, and related alerting and warning equipment, and related systems, test and alignment 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. or ML5.b.

d. Field test or alignment equipment, specially designed for items controlled by ML5.a. or ML5.b.

ML6. Ground vehicles and components, as follows:

*N.B. For guidance and navigation equipment, see ML11, Note 7*.

1. Ground vehicles and components therefor, specially designed or modified for military use;

*Technical Note*

*For the purposes of ML6*.*a. the term ground vehicles includes trailers.*

1. All wheel‑drive vehicles capable of off‑road use which have been manufactured or fitted with materials to provide ballistic protection to level III (NIJ 0108.01, September 1985, or comparable national standard) or better.

*N.B. See also ML13*.*a.*

*Note 1 ML6*.*a. 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 controlled by ML6*.*a. 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 or mountings for weapons;*

*e. Black‑out lighting.*

*Note 3 ML6*. *does not control civil automobiles or trucks designed or modified for transporting money or valuables, having armoured or ballistic protection.*

ML7. Chemical or biological toxic agents, "riot control agents", radioactive materials, related equipment, components, and materials, as follows:

1. Biological agentsand radioactive materials "adapted for use in war" to produce casualties in humans or animals, degrade equipment or damage crops or the environment;
2. Chemical warfare (CW) agents including:

1.CW nerve agents:

a. O‑Alkyl (equal to or less than C10, 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);

b. O‑Alkyl (equal to or less than C10, 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);

c. O‑Alkyl (H or equal to or less than C10, 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);

2. CW vesicant agents:

a. Sulphur mustards, such as:

1. 2‑Chloroethylchloromethylsulphide (CAS 2625‑76‑5);

2. Bis(2‑chloroethyl) sulphide (CAS 505‑60‑2);

3. Bis(2‑chloroethylthio) methane (CAS 63869‑13‑6);

4. 1,2‑bis (2‑chloroethylthio) ethane (CAS 3563‑36‑8);

5. 1,3‑bis (2‑chloroethylthio) ‑n‑propane (CAS 63905‑10‑2);

6. 1,4‑bis (2‑chloroethylthio) ‑n‑butane (CAS 142868‑93‑7);

7. 1,5‑bis (2‑chloroethylthio) ‑n‑pentane (CAS 142868‑94‑8);

8. Bis (2‑chloroethylthiomethyl) ether (CAS 63918‑90‑1);

9. Bis (2‑chloroethylthioethyl) ether (CAS 63918‑89‑8);

b. Lewisites, such as:

1. 2‑chlorovinyldichloroarsine (CAS 541‑25‑3);

2. Tris (2‑chlorovinyl) arsine (CAS 40334‑70‑1);

3. Bis (2‑chlorovinyl) chloroarsine (CAS 40334‑69‑8);

c. Nitrogen mustards, such as:

1. HN1: bis (2‑chloroethyl) ethylamine (CAS 538‑07‑8);

2. HN2: bis (2‑chloroethyl) methylamine (CAS 51‑75‑2);

3. HN3: tris (2‑chloroethyl) amine (CAS 555‑77‑1);

3. CW incapacitating agents, such as:

a. 3‑Quinuclidinyl benzilate (BZ) (CAS 6581‑06‑2);

Note 1: For exports to "States not Party to the Chemical Weapons Convention", ML7 does not control "chemical mixtures" containing 3‑Quinuclindinyl benzilate (BZ) in which BZ does not constitute more than 1% by the weight of the mixture.

Note 2: For exports to "States Party to the Chemical Weapons Convention", ML7 does not control "chemical mixtures" containing 3‑Quinuclindinyl benzilate (BZ) in which BZ does not constitute more than 30% by the weight of the mixture.

4. CW defoliants, such as:

a. Butyl 2‑chloro‑4‑fluorophenoxyacetate (LNF);

b. 2,4,5‑trichlorophenoxyacetic acid mixed with

2,4‑dichlorophenoxyacetic acid (Agent Orange).

1. CW binary precursorsand 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 C10, including cycloalkyl) O‑2‑dialkyl (Methyl, Ethyl, n‑Propyl or Isopropyl) aminoethyl alkyl (Methyl, Ethyl, n‑Propyl or Isopropyl) phosphonites 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‑Pinacolyl methylphosphonochloridate

(CAS 7040‑57‑5);

d. "Riot control agents", active constituent chemicals and combinations thereof, including:

1. ‑Bromobenzeneacetonitrile, (Bromobenzyl cyanide) (CA)

(CAS 5798‑79‑8);

2. [(2‑chlorophenyl) methylene] propanedinitrile,

(o‑Chlorobenzylidenemalononitrile) (CS) (CAS 2698‑41‑1);

3. 2‑Chloro‑1‑phenylethanone, Phenylacyl chloride

(ω‑chloroacetophenone) (CN) (CAS 532‑27‑4);

4. Dibenz‑(b,f)‑1,4‑oxazephine, (CR) (CAS 257‑07‑8);

5. 10‑Chloro‑5,10‑dihydrophenarsazine, (Phenarsazine chloride), (Adamsite), (DM) (CAS 578‑94‑9);

6. N‑Nonanoylmorpholine, (MPA) (CAS 5299‑64‑9);

*Note 1 ML7*.*d. does not control "riot control agents" individually packaged for personal self defence purposes.*

*Note 2 ML7*.*d. does not control active constituent chemicals, and combinations thereof identified and packaged for food production or medical purposes.*

e. Equipment specially designed or modified for military use,for the dissemination of any of the following and specially designed components therefor:

1. Materials or agents controlled by ML7.a., ML7.b. or d.; or

2. CW made up of precursors controlled by ML7.c.

f. Protective and decontamination equipment, specially designed components therefor, and specially formulated chemical mixtures, as follows:

1. Equipment, specially designed or modified for military use, for defence against materials controlled by ML7.a., ML7.b. or d. and specially designed components therefor;

2. Equipment, specially designed or modified for military use,for the decontamination of objects contaminated with materials controlled by ML7.a. or ML7.b. and specially designed components therefor;

3. Chemical mixtures specially developed/formulated for the decontamination of objects contaminated with materials controlled by ML7.a. or ML7.b.;

*Note ML7*.*f.1. includes:*

*a. Air conditioning units specially designed or modified for nuclear, biological or chemical filtration;*

*b. Protective clothing.*

*N.B. For civil gas masks, protective and decontamination equipment see also entry 1A004*.

g. Equipment, specially designed or modified for military use, for the detection or identification of materials controlled by ML7.a., ML7.b. or d. and specially designed components therefor;

Note ML7.g. does not control personal radiation monitoring dosimeters.

*N.B. See also entry 1A004*.

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

i. "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.b. 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.i.1.;

Note 1 ML7.b. and ML7.d. do not control:

a. Cyanogen chloride (CAS 506‑77‑4);

b. Hydrocyanic acid (CAS 74‑90‑8);

c. Chlorine (CAS 7782‑50‑5);

d. Carbonyl chloride (phosgene) (CAS 75‑44‑5);

e. Diphosgene (trichloromethyl‑chloroformate) (CAS 503‑38‑8);

f. Deleted

g. Xylyl bromide, ortho: (CAS 89‑92‑9), meta: (CAS 620‑13‑3), para: (CAS 104‑81‑4);

h. Benzyl bromide (CAS 100‑39‑0);

i. Benzyl iodide (CAS 620‑05‑3);

j. Bromo acetone (CAS 598‑31‑2);

k. Cyanogen bromide (CAS 506‑68‑3);

l. Bromo methylethylketone (CAS 816‑40‑0);

m. Chloro acetone (CAS 78‑95‑5);

n. Ethyl iodoacetate (CAS 623‑48‑3);

o. Iodo acetone (CAS 3019‑04‑3);

p. Chloropicrin (CAS 76‑06‑2).

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

*Note 3 The export of chemicals listed in ML7*.*b.1 and b.2, ML7.c.1, c.2, c.3 and c.4 in any concentration requires permission and prior consultation with ASNO.*

*Note 4 ML7 does not control "chemical mixtures" containing one or more of the chemicals specified in entries ML7*.*b.4, ML7.d.1, d.2, d.3, d.4, d.5 and d.6 in which no individually specified chemical constitutes more than 30% by the weight of the mixture.*

*N.B. See also entries 1A004, 1C350, 1C351, 1C352, 1C353, 1C354 and 1C450*.

ML8. "Energetic materials", and related substances, as follows:

*N.B. See also entry 1C011*.

*Technical Notes*

*1*. *For the purposes of this entry, mixture refers to a composition of two or more substances with at least one substance being listed in the ML8 sub‑items.*

*2*. *Any substance listed in the ML8 sub‑items is controlled by this list, even when utilized in an application other than that indicated. (e.g., TAGN is predominantly used as an explosive but can also be used either as a fuel or an oxidizer.)*

a. "Explosives", as follows, and mixtures thereof:

1. ADNBF (aminodinitrobenzofuroxan or 7‑amino‑4,6‑dinitrobenzofurazane‑1‑oxide) (CAS 97096‑78‑1);

2. BNCP (cis‑bis (5‑nitrotetrazolato) tetra amine‑cobalt (III) perchlorate) (CAS 117412‑28‑9);

3. CL‑14 (diamino dinitrobenzofuroxan or 5,7‑diamino‑4,6‑dinitrobenzofurazane‑1‑oxide ) (CAS 117907‑74‑1);

4. CL‑20 (HNIW or Hexanitrohexaazaisowurtzitane) (CAS 135285‑90‑4); chlathrates of CL‑20 (see also ML8.g.3. and g.4. for its "precursors");

5. CP (2‑(5‑cyanotetrazolato) penta amine‑cobalt (III) perchlorate)

(CAS 70247‑32‑4);

6. DADE (1,1‑diamino‑2,2‑dinitroethylene, FOX7);

7. DATB (diaminotrinitrobenzene) (CAS 1630‑08‑6);

8. DDFP (1,4‑dinitrodifurazanopiperazine);

9. DDPO (2,6‑diamino‑3,5‑dinitropyrazine‑1‑oxide, PZO) (CAS 194486‑77‑6);

10. DIPAM (3,3′‑diamino‑2,2′,4,4′,6,6′‑hexanitrobiphenyl or dipicramide) (CAS 17215‑44‑0);

11. DNGU (DINGU or dinitroglycoluril) (CAS 55510‑04‑8);

12. Furazans, as follows:

a. DAAOF (diaminoazoxyfurazan);

b. DAAzF (diaminoazofurazan) (CAS 78644‑90‑3);

13. HMX and derivatives (see also ML8.g.5. for its "precursors"), as follows:

a. HMX (Cyclotetramethylenetetranitramine, octahydro‑1,3,5,7‑tetranitro‑1,3,5,7‑tetrazine, 1,3,5,7‑tetranitro‑1,3,5,7‑tetraza‑cyclooctane, octogen or octogene) (CAS 2691‑41‑0);

b. difluoroaminated analogs of HMX;

c. K‑55 (2,4,6,8‑tetranitro‑2,4,6,8‑tetraazabicyclo [3,3,0]‑octanone‑3, tetranitrosemiglycouril or keto‑bicyclic HMX) (CAS 130256‑72‑3);

14. HNAD (hexanitroadamantane) (CAS 143850‑71‑9);

15. HNS (hexanitrostilbene) (CAS 20062‑22‑0);

16. Imidazoles, as follows:

a. BNNII (Octahydro‑2,5‑bis(nitroimino)imidazo [4,5‑d]imidazole);

b. DNI (2,4‑dinitroimidazole) (CAS 5213‑49‑0);

c. FDIA (1‑fluoro‑2,4‑dinitroimidazole);

d. NTDNIA (N‑(2‑nitrotriazolo)‑2,4‑dinitroimidazole);

e. PTIA (1‑picryl‑2,4,5‑trinitroimidazole);

1. NTNMH (1‑(2‑nitrotriazolo)‑2‑dinitromethylene hydrazine);
2. NTO (ONTA or 3‑nitro‑1,2,4‑triazol‑5‑one) (CAS 932‑64‑9);

19. Polynitrocubanes with more than four nitro groups;

20. PYX (2,6‑Bis(picrylamino)‑3,5‑dinitropyridine) (CAS 38082‑89‑2);

21. RDX and derivatives, as follows:

a. RDX (cyclotrimethylenetrinitramine, cyclonite, T4, hexahydro‑1,3,5‑trinitro‑1,3,5‑triazine, 1,3,5‑trinitro‑1,3,5‑triaza‑cyclohexane, hexogen or hexogene) (CAS 121‑82‑4);

b. Keto‑RDX (K‑6 or 2,4,6‑trinitro‑2,4,6‑triazacyclohexanone)

(CAS 115029‑35‑1);

22. TAGN (triaminoguanidinenitrate) (CAS 4000‑16‑2);

23. TATB (triaminotrinitrobenzene) (CAS 3058‑38‑6) (see also ML8.g.7 for its "precursors");

24. TEDDZ (3,3,7,7‑tetrabis(difluoroamine) octahydro‑1,5‑dinitro‑1,5‑diazocine);

25. Tetrazoles, as follows:

a. NTAT (nitrotriazol aminotetrazole);

b. NTNT (1‑N‑(2‑nitrotriazolo)‑4‑nitrotetrazole);

26. Tetryl (trinitrophenylmethylnitramine) (CAS 479‑45‑8);

27. TNAD (1,4,5,8‑tetranitro‑1,4,5,8‑tetraazadecalin) (CAS 135877‑16‑6)

(see also ML8.g.6. for its "precursors");

28. TNAZ (1,3,3‑trinitroazetidine) (CAS 97645‑24‑4)

(see also ML8.g.2. for its "precursors");

29. TNGU (SORGUYL or tetranitroglycoluril) (CAS 55510‑03‑7);

30. TNP (1,4,5,8‑tetranitro‑pyridazino[4,5‑d]pyridazine) (CAS 229176‑04‑9);

31. Triazines, as follows:

a. DNAM (2‑oxy‑4,6‑dinitroamino‑s‑triazine) (CAS 19899‑80‑0);

b. NNHT (2‑nitroimino‑5‑nitro‑hexahydro‑1,3,5‑triazine) (CAS 130400‑13‑4);

32. Triazoles, as follows:

a. 5‑azido‑2‑nitrotriazole;

b. ADHTDN (4‑amino‑3,5‑dihydrazino‑1,2,4‑triazole dinitramide)

(CAS 1614‑08‑0);

c. ADNT (1‑amino‑3,5‑dinitro‑1,2,4‑triazole);

d. BDNTA ([bis‑dinitrotriazole]amine);

e. DBT (3,3′‑dinitro‑5,5‑bi‑1,2,4‑triazole) (CAS 30003‑46‑4);

f. DNBT (dinitrobistriazole) (CAS 70890‑46‑9);

g. NTDNA (2‑nitrotriazole 5‑dinitramide) (CAS 75393‑84‑9);

h. NTDNT (1‑N‑(2‑nitrotriazolo) 3,5‑dinitrotriazole);

i. PDNT (1‑picryl‑3,5‑dinitrotriazole);

j. TACOT (tetranitrobenzotriazolobenzotriazole) (CAS 25243‑36‑1);

33. Any explosive not listed elsewhere in ML8.a. with a detonation velocity exceeding 8,700 m/s at maximum density or a detonation pressure exceeding 34 GPa (340 kbar);

34. Other organic explosives not listed elsewhere in ML8.a. yielding detonation pressures of 25 GPa (250 kbar) or more that will remain stable at temperatures of 523K (250oC) or higher for periods of 5 minutes or longer.

b. "Propellants", as follows:

1. Any United Nations (UN) Class 1.1 solid "propellant" with a theoretical specific impulse (under standard conditions) of more than 250 seconds for non‑metallized, or more than 270 seconds for aluminized compositions;

2. Any UN Class 1.3 solid "propellant" with a theoretical specific impulse (under standard conditions) of more than 230 seconds for non‑halogenized, 250 seconds for non‑metallized compositions and 266 seconds for metallized compositions;

3. "Propellants" having a force constant of more than 1,200 kJ/kg;

4. "Propellants" that can sustain a steady‑state linear burning rate of more than 38 mm/s under standard conditions (as measured in the form of an inhibited single strand) of 6.89 MPa (68.9 bar) pressure and 294K (21oC);

5. Elastomer modified cast double base (EMCDB) "propellants" with extensibility at maximum stress of more than 5% at 233K (‑40oC);

6. Any "propellant" containing substances listed in ML8.a.

c. "Pyrotechnics", fuels and related substances, as follows, and mixtures thereof:

1. Aircraft fuels specially formulated for military purposes;

2. Alane (aluminium hydride) (CAS 7784‑21‑6);

3. Carboranes; decaborane (CAS 17702‑41‑9); pentaboranes (CAS 19624‑22‑7 and 18433‑84‑6) and their derivatives;

4. Hydrazine and derivatives, as follows (see also ML8.d.8. and d.9. for oxidising hydrazine derivatives):

a. Hydrazine (CAS 302‑01‑2) in concentrations of 70% or more;

b. Monomethyl hydrazine (CAS 60‑34‑4);

c. Symmetrical dimethyl hydrazine (CAS 540‑73‑8);

d. Unsymmetrical dimethyl hydrazine (CAS 57‑14‑7);

5. 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, as follows:

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;

b. Mixtures, which contain any of the following:

1. Zirconium (CAS 7440‑67‑7), magnesium (CAS 7439‑95‑4) or 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;

6. Military materials containing thickeners for hydrocarbon fuels specially formulated for use in flame throwers or incendiary munitions, such as metal stearates or palmates (e.g. octal (CAS 637‑12‑7)) and M1, M2, and M3 thickeners;

7. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;

8. 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;

9. Titanium subhydride (TiHn) of stoichiometry equivalent to n= 0.65‑1.68.

*Note 1 Aircraft fuels controlled by ML8*.*c.1. are finished products not their constituents.*

*Note 2 ML8*.*c.4.a. does not control hydrazine mixtures specially formulated for corrosion control.*

*Note 3 Explosives and fuels containing the metals or alloys listed in ML8*.*c.5. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium, or beryllium.*

*Note 4 ML8*.*c.5.b.2. does not control boron and boron carbide enriched with boron‑10 (20% or more of total boron‑10 content.)*

d. Oxidizers, as follows, and mixtures thereof:

1. ADN (ammonium dinitramide or SR 12) (CAS 140456‑78‑6);

2. AP (ammonium perchlorate) (CAS 7790‑98‑9);

3. Compounds composed of fluorine and any of the following:

a. Other halogens;

b. Oxygen; or

c. Nitrogen;

*Note 1 ML8*.*d.3 does not control chlorine trifluoride.*

*Note 2 ML8*.*d.3 does not control nitrogen trifluoride in its gaseous state.*

4. DNAD (1,3‑dinitro‑1,3‑diazetidine) (CAS 78246‑06‑7);

5. HAN (hydroxylammonium nitrate) (CAS 13465‑08‑2);

6. HAP (hydroxylammonium perchlorate) (CAS 15588‑62‑2);

7. HNF (hydrazinium nitroformate) (CAS 20773‑28‑8);

8. Hydrazine nitrate (CAS 37836‑27‑4);

9. Hydrazine perchlorate (CAS 27978‑54‑7);

10. Liquid oxidisers comprised of or containing inhibited red fuming nitric acid (IRFNA) (CAS 8007‑58‑7);

*Note ML8*.*d.10 does not control non‑inhibited fuming nitric acid.*

e. Binders, plasticizers, monomers, polymers, as follows:

1. AMMO (azidomethylmethyloxetane and its polymers) (CAS 90683‑29‑7) (see also ML8.g.1. for its "precursors");

2. BAMO (bisazidomethyloxetane and its polymers) (CAS 17607‑20‑4)

(see also ML8.g.1. for its "precursors");

3. BDNPA (bis (2,2‑dinitropropyl)acetal) (CAS 5108‑69‑0);

4. BDNPF (bis (2,2‑dinitropropyl)formal) (CAS 5917‑61‑3);

5. BTTN (butanetrioltrinitrate) (CAS 6659‑60‑5)

(see also ML8.g.8. for its "precursors");

6. Energetic monomers, plasticizers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups specially formulated for military use;

7. FAMAO (3‑difluoroaminomethyl‑3‑azidomethyl oxetane) and its polymers;

8. FEFO (bis‑(2‑fluoro‑2,2‑dinitroethyl) formal) (CAS 17003‑79‑1);

9. FPF‑1 (poly‑2,2,3,3,4,4‑hexafluoropentane‑1,5‑diol formal) (CAS 376‑90‑9);

10. FPF‑3 (poly‑2,4,4,5,5,6,6‑heptafluoro‑2‑tri‑fluoromethyl‑3‑oxaheptane‑1,7‑diol formal);

11. GAP (glycidylazide polymer) (CAS 143178‑24‑9) and its derivatives;

12. HTPB (hydroxyl terminated polybutadiene) 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);

13. Low (less then 10,000) molecular weight, alcohol functionalised, poly(epichlorohydrin); poly(epichlorohydrindiol) and triol;

14. NENAs (nitratoethylnitramine compounds) (CAS 17096‑47‑8, 85068‑73‑1, 82486‑83‑7, 82486‑82‑6 and 85954‑06‑9);

15. PGN (poly‑GLYN, polyglycidylnitrate or poly(nitratomethyl oxirane)

(CAS 27814‑48‑8);

16. Poly‑NIMMO (poly nitratomethylmethyloxetane) or poly‑NMMO

(poly[3‑Nitratomethyl‑3‑methyloxetane]) (CAS 84051‑81‑0);

17. Polynitroorthocarbonates;

18. TVOPA (1,2,3‑tris[1,2‑bis(difluoroamino)ethoxy] propane or tris vinoxy propane adduct) (CAS 53159‑39‑0).

f. "Additives", as follows:

1. Basic copper salicylate (CAS 62320‑94‑9);

2. BHEGA (*b*is‑(2‑hydroxyethyl) glycolamide) (CAS 17409‑41‑5);

3. BNO (butadienenitrileoxide) (CAS 9003‑18‑3);

4. Ferrocene derivatives, as follows:

a. Butacene (CAS 125856‑62‑4);

b. Catocene (2,2‑bis‑ethylferrocenyl propane) (CAS 37206‑42‑1);

c. Ferrocene carboxylic acids;

d. n‑butyl‑ferrocene (CAS 31904‑29‑7);

e. Other adducted polymer ferrocene derivatives;

5. Lead beta‑resorcylate (CAS 20936‑32‑7);

6. Lead citrate (CAS 14450‑60‑3);

7. Lead‑copper chelates of beta‑resorcylate or salicylates (CAS 68411‑07‑4);

8. Lead maleate (CAS 19136‑34‑6);

9. Lead salicylate (CAS 15748‑73‑9);

10. Lead stannate (CAS 12036‑31‑6);

11. MAPO (tris‑1‑(2‑methyl)aziridinyl phosphine oxide) (CAS 57‑39‑6); BOBBA 8 (bis(2‑methyl aziridinyl) 2‑(2‑hydroxypropanoxy) propylamino phosphine oxide); and other MAPO derivatives;

12. Methyl BAPO (bis(2‑methyl aziridinyl) methylamino phosphine oxide) (CAS 85068‑72‑0);

13. N‑methyl‑p‑nitroaniline (CAS 100‑15‑2);

14. 3‑Nitraza‑1,5‑pentane diisocyanate (CAS 7406‑61‑9);

15. Organo‑metallic coupling agents, as follows:

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;

1. Titanium IV, [(2‑propenolato‑1)methyl, n‑propanolatomethyl] butanolato‑1, tris(dioctyl)phosphate;

16. Polycyanodifluoroaminoethyleneoxide;

17. 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;

18. Propyleneimine (2‑methylaziridine) (CAS 75‑55‑8);

19. Superfine iron oxide (Fe2O3) with a specific surface area more than 250 m2/g and an average particle size of 3.0 nm or less;

20. TEPAN (tetraethylenepentaamineacrylonitrile) (CAS 68412‑45‑3); cyanoethylated polyamines and their salts;

21. TEPANOL (tetraethylenepentaamineacrylonitrileglycidol) (CAS 68412‑46‑4); cyanoethylated polyamines adducted with glycidol and their salts;

22. TPB (triphenyl bismuth) (CAS 603‑33‑8).

g. "Precursors", as follows:

N.B. In ML8.g. the references are to controlled “Energetic Materials” manufactured from these substances.

1. BCMO (bischloromethyloxetane) (CAS 142173‑26‑0)

(see also ML8.e.1. and e.2.);

2. Dinitroazetidine‑t‑butyl salt (CAS 125735‑38‑8) (see also ML8.a.28.);

3. HBIW (hexabenzylhexaazaisowurtzitane) (CAS 124782‑15‑6)

(see also ML8.a.4.);

4. TAIW (tetraacetyldibenzylhexaazaisowurtzitane) (see also ML8.a.4.);

5. TAT (1,3,5,7 tetraacetyl‑1,3,5,7,‑tetraaza cyclo‑octane) (CAS 41378‑98‑7) (see also ML8.a.13.);

6. 1,4,5,8‑tetraazadecalin (CAS 5409‑42‑7) (see also ML8.a.27.);

7. 1,3,5‑trichlorobenzene (CAS 108‑70‑3) (see also ML8.a.23.);

8. 1,2,4‑trihydroxybutane (1,2,4‑butanetriol) (CAS 3068‑00‑6)

(see also ML8.e.5.).

*Note 5 For charges and devices see ML4*.

*Note 6 ML8*. *does not control the following substances unless they are compounded or mixed with the “energetic material” mentioned in ML8.a. or powdered metals in ML8.c.:*

*a. Ammonium picrate;*

*b. Black powder;*

*c. Hexanitrodiphenylamine;*

*d. Difluoroamine;*

*e. Nitrostarch;*

*f. Potassium nitrate;*

*g. Tetranitronaphthalene;*

*h. Trinitroanisol;*

*i. Trinitronaphthalene;*

*j. Trinitroxylene;*

*k. N‑pyrrolidinone; 1‑methyl‑2‑pyrrolidinone;*

*l. Dioctylmaleate;*

*m. Ethylhexylacrylate;*

*n. Triethylaluminium (TEA), trimethylaluminium (TMA), and otlher pyrophoric metal alkyls and aryls of lithium, sodium, magnesium, zinc or boron;*

*o. Nitrocellulose;*

*p. Nitroglycerin (or glyceroltrinitrate, trinitroglycerine) (NG);*

*q. 2,4,6‑trinitrotoluene (TNT);*

*r. Ethylenediaminedinitrate (EDDN);*

*s. Pentaerythritoltetranitrate (PETN);*

*t. Lead azide, normal and basic lead styphnate, and primary explosives or priming compositions containing azides or azide complexes;*

*u. Triethyleneglycoldinitrate (TEGDN);*

*v. 2,4,6‑trinitroresorcinol (styphnic acid);*

*w. Diethyldiphenyl urea; dimethylidiphenyl urea; methylethyldiphenyl urea [Centralites];*

*x. N,N‑diphenylurea (unsymmetrical diphenylurea);*

*y. Methyl‑N,N‑diphenylurea (methyl unsymmetrical diphenylurea);*

*z. Ethyl‑N,N‑diphenylurea (ethyl unsymmetrical diphenylurea);*

*aa. 2‑Nitrodiphenylamine (2‑NDPA);*

*bb. 4‑Nitrodiphenylamine (4‑NDPA);*

*cc. 2,2‑dinitropropanol;*

*dd. Nitroguanidine (see entry 1C011*.*d).*

*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:

N.B. For guidance and navigation equipment, see ML11, Note 7.

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. Deleted;

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", "lighter‑than‑air vehicles", unmanned airborne vehicles, aero‑engines and "aircraft" equipment, related equipment and components, specially designed or modified for military use, as follows:

N.B. For guidance and navigation equipment, see ML11, Note 7.

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

b. Other "aircraft" and "lighter‑than‑air vehicles" 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. Unmanned airborne vehicles and related equipment, specially designed or modified for military use, as follows, and specially designed components therefor:

1. Unmanned airborne vehicles including remotely piloted air vehicles (RPVs), autonomous programmable vehicles and "lighter‑than‑air vehicles";

2. Associated launchers and ground support equipment;

3. Related equipment for command and control.

d. Aero‑engines specially designed or modified for military use, and specially designed components therefor;

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.d., 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.d.;

1. Military crash helmets and protective masks and specially designed components therefor, pressurised breathing equipment and partial pressure suits for use in "aircraft", anti‑g suits, liquid oxygen converters used for "aircraft" or missiles, and catapults and cartridge actuated devices for emergency escape of personnel from "aircraft";

h. Parachutes and related equipment, used for combat personnel, cargo dropping or "aircraft" deceleration, as follows, and specially designed components therefor:

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;

8. Equipment specially designed for high altitude parachutists (e.g., suits, special helmets, breathing systems, navigation equipment);

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*.*d. 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, except those specially designed for unmanned airborne vehicles.*

*Note 3 The control in* *ML10*.*b. and ML10.d. 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.*

*\*N.B. In June 2006, the Participating States of the Wassenaar Arrangement are:*

[*Argentina*](http://www.wassenaar.org/participants/contacts.html)*,* [*Australia*](http://www.wassenaar.org/participants/contacts.html#Australia)*,* [*Austria*](http://www.wassenaar.org/participants/contacts.html#Austria)*,* [*Belgium*](http://www.wassenaar.org/participants/contacts.html#Belgium)*,* [*Bulgaria*](http://www.wassenaar.org/participants/contacts.html#Bulgaria)*,* [*Canada*](http://www.wassenaar.org/participants/contacts.html#Canada)*,* [*Croatia*](http://www.wassenaar.org/participants/contacts.html#Croatia)*,* [*Czech Republic*](http://www.wassenaar.org/participants/contacts.html#Czech_Republic)*,* [*Denmark*](http://www.wassenaar.org/participants/contacts.html#Denmark)*,* [*Estonia*](http://www.wassenaar.org/participants/contacts.html#Estonia)*,* [*Finland*](http://www.wassenaar.org/participants/contacts.html#Finland)*,* [*France*](http://www.wassenaar.org/participants/contacts.html#France)*,* [*Germany*](http://www.wassenaar.org/participants/contacts.html#Germany)*,* [*Greece*](http://www.wassenaar.org/participants/contacts.html#Greece)*,* [*Hungary*](http://www.wassenaar.org/participants/contacts.html#Hungary)*,* [*Ireland*](http://www.wassenaar.org/participants/contacts.html#Ireland)*,* [*Italy*](http://www.wassenaar.org/participants/contacts.html#Italy)*,* [*Japan*](http://www.wassenaar.org/participants/contacts.html#Japan)*,* [*Latvia*](http://www.wassenaar.org/participants/contacts.html#Latvia)*,* [*Lithuania*](http://www.wassenaar.org/participants/contacts.html#Lithuania)*,* [*Luxembourg*](http://www.wassenaar.org/participants/contacts.html#Luxembourg)*,* [*Malta*](http://www.wassenaar.org/participants/contacts.html#Malta)*,* [*Netherlands*](http://www.wassenaar.org/participants/contacts.html#Netherlands)*,* [*New Zealand*](http://www.wassenaar.org/participants/contacts.html#New_Zealand)*,* [*Norway*](http://www.wassenaar.org/participants/contacts.html#Norway)*,* [*Poland*](http://www.wassenaar.org/participants/contacts.html#Poland)*,* [*Portugal*](http://www.wassenaar.org/participants/contacts.html#Portugal)*,* [*Republic of Korea*](http://www.wassenaar.org/participants/contacts.html#Korea)*,* [*Romania*](http://www.wassenaar.org/participants/contacts.html#Romania)*,* [*Russian Federation*](http://www.wassenaar.org/participants/contacts.html#Russia)*,* [*Slovakia*](http://www.wassenaar.org/participants/contacts.html#Slovakia)*,* [*Slovenia*](http://www.wassenaar.org/participants/contacts.html#Slovenia)*, South Africa,* [*Spain*](http://www.wassenaar.org/participants/contacts.html#Spain)*,* [*Sweden*](http://www.wassenaar.org/participants/contacts.html#Sweden)*,* [*Switzerland*](http://www.wassenaar.org/participants/contacts.html#Swiss)*,* [*Turkey*](http://www.wassenaar.org/participants/contacts.html#Turkey)*,* [*Ukraine*](http://www.wassenaar.org/participants/contacts.html#Ukraine)*,* [*United Kingdom*](http://www.wassenaar.org/participants/contacts.html#UK) *and* [*United States*](http://www.wassenaar.org/participants/contacts.html#USA)*.*

ML11. Electronic equipment, not controlled elsewhere on the Munitions List as follows, and specially designed components therefor:

a. Electronic equipment specially designed for military use.

*Note ML11*.*a. includes:*

*1*. *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;*

*2*. *Frequency agile tubes;*

*3*. *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;*

*4*. *Underwater countermeasures, including acoustic and magnetic jamming and decoy, equipment designed to introduce extraneous or erroneous signals into sonar receivers;*

*5*. *Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes;*

*6*. *Identification, authentification and keyloader equipment and key management, manufacturing and distribution equipment;*

1. *Guidance and navigation equipment.*

b. Global Navigation Satellite Systems(GNSS) jamming 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:*

1. *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).*

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, and specially designed components therefor;

c. Military helmets;

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

*N.B. For "fibrous or filamentary materials” used in the manufacture of body armour, see entry 1C010*.

*Note 1 ML13*.*b. includes materials specially designed to form explosive reactive armour or to construct military shelters.*

*Note 2 ML13*.*c. does not control conventional steel helmets, neither modified or designed to accept, nor equipped with any type of accessory device.*

*Note 3 ML13*.*d. does not control body armour or protective garments when accompanying their user for the user’s own personal protection.*

*N.B.*  *See also entry 1A005*.

ML14. Specialised equipment for military training or for simulating military scenarios, simulators specially designed for training in the use of any firearm or weapon controlled by ML1. or ML2., 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, mobile training units and training equipment* *for* *ground military operations.*

*Note 1 ML14*. *includes image generating and interactive environment systems for simulators when specially designed or modified for military use.*

*Note 2 ML14*. *does not control equipment specially designed for training in the use of hunting or sporting weapons.*

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 ML15.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 ML15 does not control "first generation image intensifier tubes" or equipment specially designed to incorporate "first generation image intensifier tubes".*

*N.B. For the status of weapons sights incorporating "first generation image intensifer tubes" see entries ML1*.*d, ML2.c and ML5.a.*

*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., ML12. 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 nonmagnetic);

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 or modified to service military equipment;

k. Field generators specially designed or modified for military use;

l. Containers specially designed or modified for military use;

m. Ferries, other than those controlled elsewhere in the Munitions List, bridges and pontoons, specially designed for military use;

1. Test models specially designed for the "development" of items controlled by ML4., ML6., ML9. or ML10.;
2. Laser protection equipment (e.g., eye and sensor protection) specially designed for military use.

*Technical Notes*

*1*. *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.*

*2*. *For the purpose of ML17, ‘modified’ means any structural, electrical, mechanical, or other change that provides a non‑military item with military capabilities equivalent to an item which is specially designed for military use.*

ML18. Equipment 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.

*Technical Note*

*For the purposes of ML18*.*, the term 'production' includes design, examination, manufacture, testing and checking.*

*Note 1 ML18*.*a. and ML18.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 ML8*.*c.8.;*

*j. Convection current converters for the conversion of materials listed in ML8*.*c.3.*

*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 ML8*.*c.4.);*

*b. "Explosives" (see ML8*.*);*

*2*. *Products not controlled if inferior to technical limits, (i.e., "superconductive" materials not controlled by 1C005.; "superconductive" electromagnets not controlled by 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.c.5.);*

*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.g.) and masks for protection against specific industrial hazards, see also Part 2 of the Defence and Strategic Goods List;*

*4*. *Difluoroamine and potassium nitrate powder (see Note 6 to ML8.);*

*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 ML13.);*

*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 3 Note 2*.*b.8. of ML18. does not release from controls production equipment for non‑antique small arms, even if used to produce reproductions of antique small arms.*

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.

f. Continuous wave or pulsed "laser" systems specially designed to cause permanent blindness to unenhanced vision, i.e., to the naked eye or to the eye with corrective eyesight devices.

*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 (C3I) or Command, Communications, Control, Computer and Intelligence (C4I) applications;

2. "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

3. "Software", not controlled by ML21.a., b.1. or b.2., specially designed or modified to enable equipment not controlled by the Munitions List to perform the military functions of equipment controlled by ML5., ML7.g., ML9.c., ML9.e., ML10.e., ML11., ML14., ML15., ML17.i., or ML18.

ML22. "Technology" as follows:

a. "Technology", other than specified in ML22.b, which is “required” for the "development", "production" or "use" of items controlled in the Munitions List.

b. "Technology" as follows:

1. "Technology" "required" for the design of, the assembly of components into, and the operation, maintenance and repair of complete production installations for items controlled in the Munitions List, even if the components of such production installations are not controlled;

2. "Technology" "required" for the "development" and "production" of small arms even if used to produce reproductions of antique small arms;

3. "Technology" "required" for the "development", "production" or "use" of toxicological agents, related equipment or components controlled by ML7.a. to ML7.g.;

4. "Technology" "required" for the "development", "production" or "use" of "biopolymers" or cultures of specific cells controlled by ML7.h.;

5. "Technology" "required" exclusively for the incorporation of "biocatalysts", controlled by ML7.i.1., into military carrier substances or military material.

*Note 1 "Technology" “required” for the "development", "production" or "use" of items controlled in the Munitions List remains under control even when applicable to any uncontrolled item.*

*Note 2 ML22 does not control "technology" as follows:*

*a. 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;*

*b. Which is "in the public domain", "basic scientific research" or the minimum necessary information for patent applications;*

*c. For magnetic induction for continuous propulsion of civil transport devices.*

ML901. Weapons, as follows, and specially designed components therefor:

1. rifles, carbines, muskets, pistols, revolvers, shotguns, machine guns and smooth‑bore weapons, not controlled in Item ML1; and
2. air weapons.

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

ML903. Deleted.

ML904. Accessories, including telescopic sights, for the weapons specified in Item ML901.

ML908. "Energetic materials" other than "energetic materials" specified in Item ML8, but excluding those specially formulated for toys, novelty goods and fireworks.

ML909. Apparatus or devices, other than specified in Item ML4, for the initiation of detonators or "energetic materials" specified in Item ML908.

*Note: Items ML901 to ML909 do not include nailing or stapling guns, explosive powered fixing tools, starting pistols, 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, air bag and life raft inflation gas generators, thermal welding charges and associated ignition tapes, oil well perforator charges, oil well gas flare igniters, bird‑fright cartridges, bomb disposal disruptor cartridges or any other cartridges or "explosive"/"pyrotechnic" charges specially designed for use with the items listed in this Note.*

*Technical Note:*

*Specially designed components for the products controlled by ML901 and ML902 include forgings, castings and other unfinished products the use of which in a controlled product is identifiable by material composition, geometry or function.*

**PART 2 – DUAL‑USE LIST**

*Note 1 Terms in "quotations" are defined terms. Refer to the 'Definitions of Terms’ section.*

*Note 2 Chemicals are listed by name and CAS number. Chemicals of the same structural formula (including hydrates) are controlled regardless of name or CAS number. CAS numbers are shown to assist in identifying whether a particular chemical or mixture is controlled, irrespective of nomenclature. CAS numbers cannot be used as unique identifiers because some forms of the listed chemical have different CAS numbers, and mixtures containing a listed chemical may also have different CAS numbers*.

**NUCLEAR TECHNOLOGY NOTE (NTN)**

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

1. The "technology" directly associated with any goods controlled in Category 0 is controlled according to the provisions of Category 0.

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 (GTN)**

(To be read in conjunction with section E of Categories 0 to 9.)

1. The export of "technology" which is "required" for the "development", "production" or "use" of goods controlled in Categories 0 to 9, is controlled according to the provisions of Categories 0 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., 8E002.a. and 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.)

Categories 0 to 9 of this list do not control "software" which is either:

1. Generally available to the public by being:

a. Sold from stock at retail selling points, without restriction, by means of:

1. Over‑the‑counter transactions;

2. Mail order transactions;

3. Electronic transactions; or

4. Telephone order transactions; and

b. Designed for installation by the user without further substantial support by the supplier; or

*N.B. Entry a. of the General Software Note does not release "software" specified in Category 5 – Part 2 ("Information Security").*

2. "In the public domain".

**CATEGORY 0 ‑ NUCLEAR MATERIALS, FACILITIES, AND EQUIPMENT**

0A Systems, Equipment and Components

0A001 "Nuclear reactors" and specially designed or prepared equipment and components therefor, as follows:

a. "Nuclear reactors" capable of operation so as to maintain a controlled self‑sustaining fission chain reaction;

b. Metal vessels, or major shop‑fabricated parts therefor, specially designed or prepared to contain the core of a "nuclear reactor", including the reactor vessel head for a reactor pressure vessel;

c. Manipulative equipment specially designed or prepared for inserting or removing fuel in a "nuclear reactor";

d. Control rods specially designed or prepared for the control of the fission process in a "nuclear reactor", support or suspension structures therefor, rod drive mechanisms and rod guide tubes;

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. Zirconium metal and alloys in the form of tubes or assemblies of tubes 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. 'Nuclear reactor internals' specially designed or prepared for use in a "nuclear reactor", including support columns for the core, fuel channels, thermal shields, baffles, core grid plates, and diffuser plates;

Note: In 0A001.h. 'nuclear reactor internals' means any major structure within a reactor vessel which has one or more functions such as supporting the core, maintaining fuel alignment, directing primary coolant flow, providing radiation shields for the reactor vessel, and guiding in‑core instrumentation.

i. Heat exchangers (steam generators) specially designed or prepared for use in the primary coolant circuit of a "nuclear reactor";

j. Neutron detection and measuring instruments specially designed or prepared for determining neutron flux levels within the core of a "nuclear reactor".

0B Test, Inspection and Production Equipment

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

a. Plant specially designed for separating isotopes of "natural uranium", "depleted uranium", and "special fissile materials", as follows:

1. Gas centrifuge separation plant;

2. Gaseous diffusion separation plant;

3. Aerodynamic separation plant;

4. Chemical exchange separation plant;

5. Ion‑exchange separation plant;

6. Atomic vapour "laser" isotope separation (AVLIS) plant;

7. Molecular "laser" isotope separation (MLIS) plant;

8. Plasma separation plant;

9. Electro magnetic separation plant;

b. Gas centrifuges and assemblies and components, specially designed or prepared for gas centrifuge separation process, as follows:

Note: In 0B001.b. 'high strength‑to‑density ratio material' means any of the following:

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 x 106 m and a "specific tensile strength" greater than 76.2 x 103 m;

1. Gas centrifuges;

2. Complete rotor assemblies;

3. Rotor tube cylinders with a wall thickness of 12 mm or less, a diameter of between 75 mm and 400 mm, made from 'high strength‑to‑density ratio materials';

4. 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 'high strength‑to‑density ratio materials';

5. Baffles of between 75 mm and 400 mm diameter for mounting inside a rotor tube, made from 'high strength‑to‑density ratio materials'.

6. Top or bottom caps of between 75 mm and 400 mm diameter to fit the ends of a rotor tube, made from 'high strength‑to‑density ratio materials';

7. Magnetic suspension bearings consisting of an annular magnet suspended within a housing made of or protected by "materials resistant to corrosion by UF6" containing a damping medium and having the magnet coupling with a pole piece or second magnet fitted to the top cap of the rotor;

8. Specially prepared bearings comprising a pivot‑cup assembly mounted on a damper;

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. 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 "materials resistant to corrosion by UF6";

12. Scoops consisting of tubes of up to 12 mm internal diameter for the extraction of UF6 gas from within a centrifuge rotor tube by a Pitot tube action, made of or protected by "materials resistant to corrosion by UF6";

13. 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%;

c. Equipment and components, specially designed or prepared for gaseous diffusion separation process, as follows:

1. Gaseous diffusion barriers made of porous metallic, polymer or ceramic "materials resistant to corrosion by UF6" 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;

2. Gaseous diffuser housings made of or protected by "materials resistant to corrosion by UF6";

3. Compressors (positive displacement, centrifugal and axial flow types) or gas blowers with a suction volume capacity of 1 m3/min or more of UF6, and discharge pressure up to 666.7 kPa, made of or protected by "materials resistant to corrosion by UF6";

4. Rotary shaft seals for compressors or blowers specified in 0B001.c.3. and designed for a buffer gas in‑leakage rate of less than 1,000 cm3/min.;

5. Heat exchangers made of aluminium, copper, nickel, or alloys containing more than 60 per cent 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;

6. Bellow valves made of or protected by "materials resistant to corrosion by UF6", with a diameter of 40 mm to 1,500 mm;

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, resistant to corrosion by UF6, 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 "materials resistant to corrosion by UF6" 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 m3/min or more, made of or protected by "materials resistant to corrosion by UF6", and rotary shaft seals therefor;

4. Heat exchangers made of or protected by "materials resistant to corrosion by UF6";

5. Aerodynamic separation element housings, made of or protected by "materials resistant to corrosion by UF6" to contain vortex tubes or separation nozzles;

6. Bellows valves made of or protected by "materials resistant to corrosion by UF6", with a diameter of 40 to 1,500 mm;

7. Process systems for separating UF6 from carrier gas (hydrogen or helium) to 1 ppm UF6 content or less, including:

a. Cryogenic heat exchangers and cryoseparators capable of temperatures of 153K (‑120°C) or less;

b. Cryogenic refrigeration units capable of temperatures of 153 K (‑120°C) or less;

c. Separation nozzle or vortex tube units for the separation of UF6 from carrier gas;

d. UF6 cold traps capable of temperatures of 253 K (‑20°C) or less;

e. Equipment and components, specially designed or prepared for chemical exchange separation process, as follows:

1. 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 protected by suitable plastic materials such as fluorocarbon polymers or glass);

2. 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 protected by suitable plastic materials such as fluorocarbon polymers or glass);

3. Electrochemical reduction cells resistant to concentrated hydrochloric acid solutions, for reduction of 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 373 K (100oC) to 473 K (200oC);

2. Ion exchange columns (cylindrical) with a diameter greater than 1,000 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 373 K (100oC) to 473 K (200oC) 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" isotope separation process (AVLIS), as follows:

1. High power strip or scanning electron beam guns with a delivered power of more than 2.5 kW/cm for use in uranium vaporization systems;

2. Liquid uranium metal handling systems for molten uranium or uranium alloys, 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 2A225.**

3. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium metal vapour or liquid, 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" isotope separation process (MLIS) or chemical reaction by isotope selective laser activation (CRISLA), as follows:

1. Supersonic expansion nozzles for cooling mixtures of UF6 and carrier gas to 150 K (‑123°C) or less and made from "materials resistant to corrosion by UF6";

2. Uranium pentafluoride (UF5) product collectors consisting of filter, impact, or cyclone‑type collectors or combinations thereof, and made of "materials resistant to corrosion by UF5/UF6";

3. Compressors made of or protected by "materials resistant to corrosion by UF6", and rotary shaft seals therefor;

4. Equipment for fluorinating UF5 (solid) to UF6 (gas);

5. Process systems for separating UF6 from carrier gas (e.g. nitrogen or argon) including:

a. Cryogenic heat exchangers and cryoseparators capable of temperatures of 153 K (‑120°C) or less;

1. Cryogenic refrigeration units capable of temperatures of 153 K (‑120°C) or less;

c. UF6 cold traps capable of temperatures of 253 K (‑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. Microwave power sources and antennae for producing or accelerating ions, with an output frequency greater than 30 GHz and mean power output greater than 50 kW;

2. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power;

3. Uranium plasma generation systems;

4. Liquid metal handling systems for molten uranium or uranium alloys, 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 2A225.**

5. 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;

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, ioniser, and beam accelerator made of suitable non‑magnetic 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. 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; and

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; and

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 "materials resistant to corrosion by UF6":

a. Feed autoclaves, ovens or systems used for passing UF6 to the enrichment process;

b. Desublimers or cold traps, used to remove UF6 from the enrichment process for subsequent transfer upon heating;

c. Product and tails stations for transferring UF6 into containers;

d. Liquefaction or solidification stations used to remove UF6 from the enrichment process by compressing, cooling and converting UF6 to a liquid or solid form;

e. Piping systems and header systems specially designed for handling UF6 within gaseous diffusion, centrifuge or aerodynamic cascades;

f. 1. Vacuum manifolds or vacuum headers having a suction capacity of 5 m3/minute or more; or

2. Vacuum pumps specially designed for use in UF6 bearing atmospheres;

g. UF6 mass spectrometers/ion sources specially designed or prepared for taking on‑line samples of feed, product or tails from UF6 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 ionisation sources; and

4. Collector system suitable for isotopic analysis.

0B003 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 UO3;

b. Systems for the conversion of UO3 to UF6;

c. Systems for the conversion of UO3 to UO2;

d. Systems for the conversion of UO2 to UF4;

e. Systems for the conversion of UF4 to UF6;

f. Systems for the conversion of UF4 to uranium metal;

g. Systems for the conversion of UF6 to UO2;

h. Systems for the conversion of UF6 to UF4;

i. Systems for the conversion of UO2 to UCl4.

0B004 Plant for the production or concentration of heavy water, deuterium and 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. Water‑hydrogen sulphide exchange plants;

2. Ammonia‑hydrogen exchange plants;

b. Equipment and components, as follows:

1. Water‑hydrogen sulphide exchange towers fabricated from fine carbon steel (e.g. ASTM A516) with diameters of 6 m to 9 m, capable of operating at pressures greater than or equal to 2 MPa and with a corrosion allowance of 6 mm or greater;

2. Single stage, low head (i.e. 0.2 MPa) centrifugal blowers or compressors for hydrogen sulphide gas circulation (i.e. gas containing more than 70% H2S) with a throughput capacity greater than or equal to 56 m3/second when operating at pressures greater than or equal to 1.8 MPa suction and having seals designed for wet H2S service;

3. Ammonia‑hydrogen exchange towers greater than or equal to 35 m in height with diameters of 1.5 m to 2.5 m capable of operating at pressures greater than 15 MPa;

4. Tower internals, including stage contactors, and stage pumps, including those which are submersible, for heavy water production utilizing the ammonia‑hydrogen exchange process;

5. Ammonia crackers with operating pressures greater than or equal to 3 MPa for heavy water production utilizing the ammonia‑hydrogen exchange process;

6. Infrared absorption analysers capable of on‑line hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%;

7. Catalytic burners for the conversion of enriched deuterium gas into heavy water utilizing the ammonia‑hydrogen exchange process;

8. Complete heavy water upgrade systems, or columns therefor, for the upgrade of heavy water to reactor‑grade deuterium concentration.

0B005 Plant specially designed for the fabrication of "nuclear reactor" fuel elements and specially designed or prepared 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; or

d. Checks the finish treatment of the sealed fuel.

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

Note: 0B006 includes:

a. Plant for the reprocessing of irradiated "nuclear reactor" fuel elements including 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;

b. 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;

c. 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;

d. 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";

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

Note: Holding or storage vessels may have the following features:

1. Walls or internal structures with a boron equivalent (calculated for all constituent elements as defined in the note to 0C004)of at least two per cent;

2. A maximum diameter of 175 mm for cylindrical vessels; or

3. A maximum width of 75 mm for either a slab or annular vessel.

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

0B007 Plant for the conversion of plutonium and equipment specially designed or prepared therefor, as follows:

a. Systems for the conversion of plutonium nitrate to oxide;

b. Systems for plutonium metal production.

0C Materials

0C003 Deuterium, heavy water (deuterium oxide) and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5,000.

0C004 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/cm3.

N.B.: SEE ALSO 1C107

Note 1: 0C004 does not control the following:

a. Manufactures of graphite having a mass less than 1 kg, other than those specially designed or prepared for use in a nuclear reactor;

b. Graphite powder.

Note 2: In 0C004, 'boron equivalent' (BE) is defined as the sum of BEz for impurities (excluding BEcarbon since carbon is not considered an impurity) including boron, where:

BEz (ppm) = CF x concentration of element Z in ppm;

*σZ AB*

*where CF is the conversion factor = ‑‑‑‑‑‑‑*

*σB AZ*

and σB and σZ  are the thermal neutron capture cross sections (in barns) for naturally occurring boron and element Z respectively; and AB and AZ are the atomic masses of naturally occurring boron and element Z respectively.

0C005 Specially prepared compounds or powders for the manufacture of gaseous diffusion barriers, resistant to corrosion by UF6 (e.g. nickel or alloy containing 60 weight per cent or more nickel, aluminium oxide and fully fluorinated hydrocarbon polymers), having a purity of 99.9 weight per cent 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.

**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 weightof 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 group as a constitutional unit, specially designed for "aircraft", aerospace or 'missile' use.

Note: In 1A001.c., 'missile' means complete rocket systems and unmanned aerial 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 x 106 m; and

b. A "specific tensile strength" exceeding 17.7 x 104 m; or

2. Materials specified in 1C010.c.

Note 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 m2.

Note 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 anddesigned for the production of electronic printed circuit boards.

1A004 Protective and detection equipment and components, not controlled 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.

*N.B.: For "fibrous or filamentary materials" used in the manufacture of body armour, see 1C010*.

Note 1: 1A005 does not control body armour or protective garments when accompanying their user for the user’s own personal protection.

Note 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 components designed for space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

1A202 Composite structures, not controlled in 1A002, in the form of tubes and having both of the following characteristics:

N.B.: SEE ALSO 9A010 AND 9A110.

a. An inside diameter of between 75 mm and 400 mm; and

b. 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.

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 which may be used in separating heavy water from ordinary water, having both of the following characteristics:

a. Made of phosphor bronze mesh chemically treated to improve wettability; and

b. Designed to be used in vacuum distillation towers.

1A227 High‑density (lead glass or other) radiation shielding windows, having all of the following characteristics, and specially designed frames therefor:

a. A 'cold area' greater than 0.09 m2;

b. A density greater than 3 g/cm3; and

c. A thickness of 100 mm or greater.

Technical Note:

In 1A227 the term 'cold area' means the viewing area of the window exposed to the lowest level of radiation in the design application.

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 aerial 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;

Technical Note:

For the purposes of 1B001.c. the technique of interlacing includes knitting.

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 Equipment for producing metal alloys, metal alloy powder or alloyed materials,

specially designed to avoid contamination and specially designed for use in one

of the processes specified in 1C002.c.2.

N.B.: SEE ALSO 1B102.

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;

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 9C110.

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

1B102 Metal powder "production equipment", other than that specified in 1B002, and

components as follows:

**N.B.: SEE ALSO 1B115.b.**

a. Metal powder "production equipment" usable for the "production", in a controlled environment, of spherical or atomised materials specified in 1C011.a., 1C011.b., 1C111.a.1., 1C111.a.2. or in ML8.a.

b. Specially designed components for "production equipment" specified in 1B002 or 1B102.a.

Note: 1B102 includes:

a. Plasma generators (high frequency arc‑jet) usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon‑water environment;

b. Electroburst equipment usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon‑water environment;

c. Equipment usable for the "production" of spherical aluminium powders by powdering a melt in an inert medium (e.g. nitrogen).

1B115 Equipment, other than that specified in 1B002 or 1B102, for the production of propellant and propellant constituents, as follows, and specially designed components therefor:

a. "Production equipment" for the "production", handling or acceptance testing of liquid propellants or propellant constituents specified in 1C011.a., 1C011.b., 1C111 or in ML8;

b. "Production equipment" for the "production", handling, mixing, curing, casting, pressing, machining, extruding or acceptance testing of solid propellants or propellant constituents specified in 1C011.a., 1C011.b., 1C111 or in ML8.

Note: 1B115.b. does not control batch mixers, continuous mixers or fluid energy mills. For the control of batch mixers, continuous mixers and fluid energy mills see 1B117, 1B118 and 1B119.

Note 1: For equipment specially designed for the production of military goods, see the Munitions List.

Note 2: 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 (1,300oC) to 3,173 K (2,900oC) temperature range at pressures of 130 Pa to 20 kPa.

1B117 Batch mixers with provision for mixing under vacuum in the range of zero to

13.326 kPa and with temperature control capability of the mixing chamber and having all of the following, and specially designed components therefor:

a. A total volumetric capacity of 110 litres or more; and

b. At least one mixing/kneading shaft mounted off centre.

1B118 Continuous mixers with provision for mixing under vacuum in the range of zero to 13.326 kPa and with a temperature control capability of the mixing chamber having any of the following, and specially designed components therefor:

a. Two or more mixing/kneading shafts; or

b. A single rotating shaft which oscillates and having kneading teeth/pins on the shaft as well as inside the casing of the mixing chamber.

1B119 Fluid energy mills usable for grinding or milling substances specified in 1C011.a., 1C011.b., 1C111 or in the Munitions List, and specially designed components therefor.

1B201 Filament winding machines, not controlled in 1B001 or 1B101, and related equipment, as follows:

a. Filament winding machines having all of the following characteristics:

1. Having motions for positioning, wrapping, and winding fibres coordinated and programmed in two or more axes;

2. Specially designed to fabricate composite structures or laminates from "fibrous or filamentary materials"; and

3. Capable of winding cylindrical rotors of diameter between 75 and 400 mm and lengths of 600 mm or greater;

b. Coordinating and programming controls for the filament winding machines specified in 1B201.a.;

c. Precision mandrels for the filament winding machines specified in 1B201.a.

1B225 Electrolytic cells for fluorine production with an output capacity greater than 250 g 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 for operation with internal temperatures of 35 K (‑238°C) or less;

b. Designed for operation at an internal pressure of 0.5 to 5 MPa;

c. Constructed of either:

1. Stainless steel of the 300 series with low sulphur content and with an austenitic ASTM (or equivalent standard) grain size number of 5 or greater; or

2. Equivalent materials which are both cryogenic and H2‑compatible; and

d. With internal diameters of 1 m or greater and effective lengths of 5 m or greater.

1B229 Water‑hydrogen sulphide exchange tray columns and 'internal contactors', as follows:

N.B.: For columns which are specially designed or prepared for the production of heavy water see 0B004.

a. Water‑hydrogen sulphide exchange tray columns, having all of the following characteristics:

1. Can operate at pressures of 2 MPa or greater;

2. Constructed of carbon steel having an austenitic ASTM (or equivalent standard) grain size number of 5 or greater; and

3. With a diameter of 1.8 m or greater;

b. 'Internal contactors' for the water‑hydrogen sulphide exchange tray columns specified in 1B229.a.

Technical Note:

'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 stainless steels with a carbon content of 0.03% or less. These may be sieve trays, valve trays, bubble cap trays, or turbogrid trays.

1B230 Pumps capable of circulating solutions of concentrated or dilute potassium amide catalyst in liquid ammonia (KNH2/NH3), having all of the following characteristics:

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

b. A capacity greater than 8.5 m3/h; and

c. Either of the following characteristics:

1. For concentrated potassium amide solutions (1% or greater), an operating pressure of 1.5 to 60 MPa; or

2. For dilute potassium amide solutions (less than 1%), an operating pressure of 20 to 60 MPa.

1B231 Tritium facilities or plants, and equipment therefor, as follows:

a. Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium;

b. Equipment for tritium facilities or plants, 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 W;

2. Hydrogen isotope storage or purification systems using metal hydrides as the storage or purification medium.

1B232 Turboexpanders or turboexpander‑compressor sets having both of the following

characteristics:

a. Designed for operation with an outlet temperature of 35 K (‑238°C) or less; and

b. Designed for a throughput of hydrogen gas of 1000 kg/h or greater.

1B233 Lithium isotope separation facilities or plants, and equipment therefor, as follows:

a. Facilities or plants 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 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 x 108 Hz but less than 3 x 1012 Hz;

Note 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 x 106 N/m2; and

3. Compressive strength less than 14 x 106 N/m2;

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).

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

b. Materials for absorbing frequencies exceeding 1.5 x 1014 Hz but less than 3.7 x 1014 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 andalloyed materials for coating substrates.

Technical Notes:

1. The metal alloys in 1C002 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 (Kt) equal to 1. The average stress is defined as maximum stress minus minimum stress divided by maximum stress.

a. Aluminides, as follows:

1. Nickel aluminides containing a minimum of 15 weight percent aluminium, a maximum of 38 weight percent aluminium and at least one additional alloying element;

2. Titanium aluminides containing 10 weight percent or more aluminium and at least one additional alloying element;

b. Metal alloys, as follows, made from material specified in 1C002.c.:

1. Nickel alloys with:

1. A stress‑rupture life of 10,000 hours or longer at 923 K (650°C) at a stress of 676MPa; or

b. A low cycle fatigue life of 10,000 cycles or more at 823 K (550° C) at a maximum stress of 1,095MPa;

2. Niobium alloys with:

a. A stress‑rupture life of 10,000 hours or longer at 1,073 K (800°C) at a stress of 400 MPa; or

b. A low cycle fatigue life of 10,000 cycles or more at 973 K (700°C) at a maximum stress of 700 MPa;

3. Titanium alloys with:

a. A stress‑rupture life of 10,000 hours or longer at 723 K (450°C) at a stress of 200 MPa; or

b. A low cycle fatigue life of 10,000 cycles or more at 723 K (450°C) at a maximum stress of 400 MPa;

4. Aluminium alloys with a tensile strength of:

a. 240 MPa or more at 473 K (200°C); or

b. 415 MPa or more at 298 K (25°C);

1. Magnesium alloys with:

a. A tensile strength of 345 MPa or more; and

b. 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;

c. Metal alloy powder or particulate material for material, having all of the following characteristics:

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 109 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);

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"; and

3. Capable of forming materials specified in 1C002.a. or 1C002.b.

d. Alloyed materials having all of the following characteristics:

1. Made from any of the composition systems specified in 1C002.c.1.;

2. In the form of uncomminuted flakes, ribbons or thin rods; and

3. Produced in a controlled environment by any of the following:

a. "Splat quenching";

b. "Melt spinning"; or

c. Melt extraction".

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 x 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 (Bs) 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 x 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/cm3;

b. An elastic limit exceeding 880 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. Havinga cross‑section area less than 0.28 x 10‑4 mm2 (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 mm2; and

3. Remainingin 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 silahydrocarbon oils, having all of the following:

Technical 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:

Technical 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 mm2/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/mm2 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 having all of the following:

1. Made from any of the following materials:

a. Si‑N;

b. Si‑C;

c. Si‑Al‑O‑N; or

d. Si‑O‑N; and

2. Having a specific tensile strength exceeding 12.7 x 103m;

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 anyof the following systems:

1. Al2O3; 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 (Tg) 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 ISO 75‑3 (2004), or national equivalents, with a load of 1.82 N/mm2 and composed of:

1. Anyof 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. Deleted;

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 having a glass transition temperature (Tg) exceeding 513 K (240°C).

Technical Note:

The glass transition temperature (Tg) for 1C008 materials is determined using the method described in ISO 11357‑2 (1999) or national equivalents.

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 weightor more of combined fluorine;

c. Fluorinated phosphazene elastomers containing 30% by weightor 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 x 106 m; and

2. A "specific tensile strength" exceeding 23.5  x 104 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 x 106 m; and

2. A "specific tensile strength" exceeding 23.5 x 104 m;

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.

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.

c. Inorganic "fibrous or filamentary materials", having all of the following:

1. A "specific modulus" exceeding 2.54 x 106 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 x 106 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 x 104 m;

b. With a "specific modulus" exceeding 10.15 x 106 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 (Tg) exceeding 383 K (110°C) or with phenolic or epoxy resins, having a glass transition temperature (Tg) equal to or exceeding 418 K (145°C).

Notes: 1C010.e. does not control:

a. 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;

b. 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 ML8.a.1., ML8.a.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;

Technical Note:

The natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.

Note: 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;

Note: 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;

d. Nitroguanidine (NQ) (CAS 556‑88‑7).

1C012 Materials as follows:

Technical Note:

These materials are typically used for nuclear heat sources.

a. Plutonium in any form with a plutonium isotopic assay of plutonium‑238 ofmore than 50% by weight;

Note: 1C012.a. does not control:

a. Shipments with a plutonium content of 1 g or less;

b. Shipments of 3"effective grams" 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, not controlled

in 1C001, usable in 'missiles', "missile" subsystems or unmanned aerial vehicles specified in 9A012.

Note 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, infrared or ultra violet regions of the electromagnetic spectrum.

Note 2: 1C101 does not include coatings when specially used for the thermal control of satellites.

Technical Note:

In 1C101 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

1C102 Resaturated pyrolized carbon‑carbon materials designed for space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

1C107 Graphite and ceramic materials, not controlled in 1C007, as follows:

1. Fine grain graphites with a bulk density of 1.72 g/cm3 or greater, measured at 288 K (15°C), and having a grain size of 100 µm or less, usable for rocket nozzles and re‑entry vehicle nose tips, which can be machined to any of the following products:

1. Cylinders having a diameter of 120 mm or greater and a length of 50 mm or greater;

2. Tubes having an inner diameter of 65 mm or greater and a wall thickness of 25 mm or greater and a length of 50 mm or greater; or

3. Blocks having a size of 120 mm x 120 mm x 50 mm or greater;

N.B.: See also 0C004

b. Pyrolytic or fibrous reinforced graphites, usable for "missile" nozzles and re‑entry vehicle nose tips;

N.B.: See also 0C004

c. Ceramic composite materials (dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz) usable for "missile" radomes;

d. Bulk machinable silicon‑carbide reinforced unfired ceramic, usable for "missile" nose tips.

1C111 Propellants and constituent chemicals for propellants, not controlled in 1C011, as follows:

a. Propulsive substances:

1. Spherical aluminium powder, other than that specified in ML8.a., with particles of uniform diameter of less than 200 µm and an aluminium content of 97% by weight or more, if at least 10% of the total weight is made up of particles of less than 63 µm, according to ISO 2591:1988 or national equivalents;

Technical Note:

A particle size of 63 µm (ISO R‑565) corresponds to 250 mesh (Tyler) or 230 mesh (ASTM standard E‑11).

2. Metal fuels, other than that specified in ML8.a., in particle sizes of less than 60 µm, whether spherical, atomized, spheroidal, flaked or ground, consisting 97% by weight or more of any of the following:

a. Zirconium;

b. Beryllium;

c. Magnesium; or

d. Alloys of the metals specified by a. to c. above;

Technical Note:

The natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.

3. Liquid oxidiser substances as follows:

a. Dinitrogen trioxide;

b. Nitrogen dioxide/dinitrogen tetroxide;

c. Dinitrogen pentoxide;

d. Mixed Oxides of Nitrogen (MON);

Technical Note:

Mixed Oxides of Nitrogen (MON) are solutions of Nitric Oxide (NO) in Dinitrogen Tetroxide/Nitrogen Dioxide (N2O4/NO2 ) that can be used in missile systems. There are a range of compositions that can be denoted as MONi or MONij, where i and j are integers representing the percentage of Nitric Oxide in the mixture (e.g., MON3 contains 3% Nitric Oxide, MON25 25% Nitric Oxide. An upper limit is MON40, 40% by weight).

e. **SEE ML8.d.10. FOR Inhibited Red Fuming Nitric Acid (IRFNA);**

f. **SEE ML8.d.3. AND 1C238 FOR**

**Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen;**

4. Hydrazine derivatives usable as rocket fuel substances, not controlled in ML8;

b. Polymeric substances:

1. Carboxy‑terminated polybutadiene (CTPB);

2. Hydroxy‑terminated polybutadiene (HTPB), other than that specified in ML8.e.22.;

3. Polybutadiene‑acrylic acid (PBAA);

4. Polybutadiene‑acrylic acid‑acrylonitrile (PBAN);

c. Other propellant additives and agents:

**1. SEE ML8.c.3. FOR Carboranes, decaboranes, pentaboranes and derivatives thereof;**

2. Triethylene glycol dinitrate (TEGDN);

3. 2‑Nitrodiphenylamine;

4. Trimethylolethane trinitrate (TMETN);

5. Diethylene glycol dinitrate (DEGDN);

6. Ferrocene derivatives as follows:

**a. See ML8.f.4.b. for catocene;**

b. Ethyl ferrocene;

c. Propyl ferrocene;

**d. See ML8.f.4.d. for n‑butyl ferrocene;**

e. Pentyl ferrocene;

f. Dicyclopentyl ferrocene;

g. Dicyclohexyl ferrocene;

h. Diethyl ferrocene;

i. Dipropyl ferrocene;

j. Dibutyl ferrocene;

k. Dihexyl ferrocene;

l. Acetyl ferrocenes;

**m. See ML8.f.4.c. for ferrocene Carboxylic acids;**

1. **See ML8.f.4.a. for butacene;**

o. Other ferrocene derivatives usable as rocket propellant burning rate modifiers, not controlled in ML8.f.4.e.

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 "missile" motor components, i.e., heat shields, nozzle substrates, nozzle throats and thrust vector control surfaces.

1C118 Titanium‑stabilised duplex stainless steel (Ti‑DSS) having all of the following:

a. Having all of the following characteristics:

1. Containing 17.0 ‑ 23.0 weight percent chromium and 4.5 ‑ 7.0 weight percent nickel;

2. Having a titanium content of greater than 0.10 weight percent; and

3. A ferritic‑austenitic microstructure (also referred to as a two‑phase microstructure ) of which at least 10 percent is austenite by volume (according to ASTM E‑1181‑87 or national equivalents); and

b. Having any of the following forms:

1. Ingots or bars having a size of 100 mm or more in each dimension;

2. Sheets having a width of 600 mm or more and a thickness of 3 mm or less; or

3. Tubes having an outer diameter of 600 mm or more and a wall thickness of 3 mm or less.

1C202 Alloys, not controlled in 1C002.b.3. or .b.4., as follows:

a. Aluminium alloys having both of the following characteristics:

1. 'Capable of' an ultimate tensile strength of 460 MPa or more at 293 K (20°C); and

2. In the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm;

b. Titanium alloys having both of the following characteristics:

1. 'Capable of' an ultimate tensile strength of 900 MPa or more at 293 K (20°C); and

2. 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, not controlled in 1C010.a., b. or e., as follows:

a. Carbon or aramid 'fibrous or filamentary materials' having either of the following characteristics:

1. A "specific modulus" of 12.7 x 106 m or greater; or

2. A "specific tensile strength" of 235 x 103 m or greater;

Note: 1C210.a. does not control 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 both of the following characteristics:

1. A "specific modulus" of 3.18 x 106 m or greater; and

2. A "specific tensile strength" of 76.2 x 103 m or greater;

c. Thermoset resin impregnated continuous "yarns", "rovings", "tows" or "tapes" with a width of 15 mm or less (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 (20oC).

Note: 1C216 does not control forms in which all linear dimensions are 75 mm or less.

Technical Note:

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

1C225 Boron enriched in the boron‑10 (10B) isotope to greater than its natural isotopic

abundance, as follows: elemental boron, compounds, mixtures containing boron, manufactures thereof, waste or scrap of any of the foregoing.

Note: In 1C225 mixtures containing boron include boron loaded materials.

Technical Note:

The natural isotopic abundance of boron‑10 is approximately 18.5 weight per cent (20 atom per cent).

1C226 Tungsten, tungsten carbide, and alloys containing more than 90% tungsten by weight, having both of the following characteristics:

a. In forms with a hollow cylindrical symmetry (including cylinder segments) with an inside diameter between 100 mm and 300 mm; and

b. A mass greater than 20 kg.

Note: 1C226 does not control manufactures specially designed as weights or gamma‑ray collimators.

1C227 Calcium having both of the following characteristics:

a. Containing less than 1,000 parts per million by weight of metallic impurities other than magnesium; and

b. Containing less than 10 parts per million by weight of boron.

1C228 Magnesium having both of the following characteristics:

a. Containing less than 200 parts per million by weight of metallic impurities other than calcium; and

b. Containing less than 10 parts per million by weight of boron.

1C229 Bismuth having both of the following characteristics:

a. A purity of 99.99% or greater by weight; and

b. Containing less than 10 parts per million by weight of silver.

1C230 Beryllium metal, alloys containing more than 50% beryllium by weight, beryllium compounds, manufactures thereof, and waste or scrap of any of the foregoing.

Note: 1C230 does not control the following:

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.

1C231 Hafnium metal, alloys containing more than 60% hafnium by weight, hafnium compounds containing more than 60% hafnium by weight, manufactures thereof, and waste or scrap of any of the foregoing.

1C232 Helium‑3 (3He), mixtures containing helium‑3, and products or devices containing any of the foregoing.

Note: 1C232 does not control a product or device containing less than 1 g of helium‑3.

1C233 Lithium enriched in the lithium‑6 (6Li) isotope to greater than its natural isotopic

abundance, and products or devices containing enriched lithium, as follows: elemental lithium, alloys, compounds, mixtures containing lithium, manufactures thereof, waste or scrap of any of the foregoing.

Note: 1C233 does not control thermoluminescent dosimeters.

Technical Note:

The natural isotopic abundance of lithium‑6 is approximately 6.5 weight per cent (7.5 atom per cent).

1C234 Zirconium with a hafnium content of less than 1 part hafnium to 500 parts zirconium by weight, as follows: metal, alloys containing more than 50% zirconium by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing.

Note: 1C234 does not control zirconium in the form of foil having a thickness of 0.10 mm or less.

1C235 Tritium, tritium compounds, mixtures containing tritium in which the ratio of tritium to hydrogen atoms exceeds 1 part in 1000, and products or devices containing any of the foregoing.

Note: 1C235 does not control a product or device containing less than 1.48 x 103 GBq (40 Ci) of tritium.

1C236 Alpha‑emitting radionuclides having an alpha half‑life of 10 days or greater but less than 200 years, in the following forms:

a. Elemental;

b. Compounds having a total alpha activity of 37 GBq/kg (1 Ci/kg) or greater;

c. Mixtures having a total alpha activity of 37 GBq/kg (1 Ci/kg) or greater;

d. Products or devices containing any of the foregoing.

Note: 1C236 does not control a product or device containing less than 3.7 GBq (100 millicuries) of alpha activity.

1C237 Radium‑226 (226Ra), radium‑226 alloys, radium‑226 compounds, mixtures containing radium‑226, manufactures therof, and products or devices containing any of the foregoing.

Note: 1C237 does not control the following:

a. Medical applicators;

b. A product or device containing less than 0.37 GBq (10 millicuries) of radium‑226.

1C238 Chlorine trifluoride (ClF3).

1C239 High explosives, not controlled in ML8, or substances or mixtures containing more than 2% by weight thereof, with a crystal density greater than 1.8 g/cm3 and having a detonation velocity greater than 8,000 m/s.

1C240 Nickel powder and porous nickel metal, not controlled in 0C005, as

follows:

a. Nickel powder having both of the following characteristics:

1. A nickel purity content of 99.0% or greater by weight; and

2. A mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard;

b. Porous nickel metal produced from materials specified in 1C240.a.

Note: 1C240 does not control the following:

a. Filamentary nickel powders;

b. Single porous nickel sheets with an area of 1,000 cm2 per sheet or less.

*Technical Note:*

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, and "chemical mixtures" containing one or more thereof:

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 phosphonyl difluoride (676‑99‑3)**;

5. Methyl phosphonyl dichloride (676‑97‑1);

6. Dimethyl phosphite (DMP) (868‑85‑9);

7. Phosphorus trichloride (7719‑12‑2);

8. Trimethyl phosphite (TMP) (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. **SEE ML7.b.1. FOR 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 methyl phosphonite (QL) (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 or ammonium bifluoride (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);

1. N,N‑Diisopropyl‑(Beta)‑aminoethyl chloride hydrochloride (4261‑68‑1);
2. Methylphosphonic acid (993‑13‑5);
3. Diethyl methylphosphonate (683‑08‑9);
4. N,N‑Dimethylaminophosphoryl dichloride or N,N‑dimethyl phosphoramidic dichloride (677‑43‑0);
5. Triisopropyl phosphite (116‑17‑6);
6. Ethyldiethanolamine (139‑87‑7);
7. O,O‑Diethyl phosphorothioate (2465‑65‑8);
8. O,O‑Diethyl phosphorodithioate (298‑06‑6);
9. Sodium hexafluorosilicate (16893‑85‑9);
10. Methylphosphonothioic dichloride (676‑98‑2);
11. Thiophosphoryl chloride (3982‑91‑0);
12. Oxalyl chloride (79‑37‑8).

Note 1: For exports to "States not Party to the Chemical Weapons Convention", 1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C350.1, .3, .5, .11, .12, .13, .17, .18, .21, .22, .26, .27, .28, .31, .32, .33, .34, .35, .36, .54, .55, .56, .57 and .63 in which no individually specified chemical constitutes more than 10% by the weight of the mixture.

Note 2: For exports to "States Party to the Chemical Weapons Convention", 1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C350.1, .3, .5, .11, .12, .13, .17, .18, .21, .22, .26, .27, .28, .31, .32, .33, .34, .35, .36, .54, .55, .56, .57 and .63 in which no individually specified chemical constitutes more than 30% by the weight of the mixture.

Note 3: 1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C350 .2, .6, .7, .8, .9, .10, .14, .15, .16, .19, .20, .24, .25, .30, .37, .38, .39, .40, .41, .42, .43, .44, .45, .46, .47, .48, .49, .50, .51, .52, .53, .58, .59, .60, .61, .62, .64 and .65 in which no individually specified chemical constitutes more than 30% by the weight of the mixture.

Note 4: 1C350 does not control products identified as consumer goods packaged for retail sale for personal use or packaged for individual use.

*N.B.: This exemption does not apply to chemicals 1C350*.*4, .23 and .29 (see Note 5 of ML7).*

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;

21. Kyasanur Forest virus;

22. Louping ill virus;

23. Murray Valley encephalitis virus;

24. Omsk haemorrhagic fever virus;

25. Oropouche virus;

26. Powassan virus;

27. Rocio virus;

28. St Louis encephalitis virus;

29. Hendra virus (Equine morbillivirus);

30. South American haemorrhagic fever (Sabia, Flexal, Guanarito);

31. Pulmonary & renal syndrome‑haemorrhagic fever viruses

(Seoul, Dobrava, Puumala, Sin Nombre);

32. Nipah 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;

1. 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;

14. Clostridium perfringens epsilon toxin producing types;

15. Enterohaemorrhagic Escherichia coli, serotype O157 and other verotoxin producing serotypes.

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. Aflatoxins;

12. Abrin;

13. Cholera toxin;

14. Diacetoxyscirpenol toxin;

15. T‑2 toxin;

16. HT‑2 toxin;

17. Modeccin;

18. Volkensin;

19. Viscum album Lectin 1 (Viscumin).

Note: 1C351.d. does not control botulinum toxins or conotoxins in product form meeting all of the following criteria:

1. Are pharmaceutical formulations designed for human administration in the treatment of medical conditions;

2. Are pre‑packaged for distribution as medical products;

3. Are authorised by a state authority to be marketed as medical products.

Note: 1C351 does not control "vaccines" or "immunotoxins".

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;

1. Lumpy skin disease virus;
2. African horse sickness 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.

Note: 1C352 does not control "vaccines".

1C353 Genetic elements and genetically modified organisms, as follows:

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

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

Technical Notes:

1. Genetic elements include, inter alia, chromosomes, genomes, plasmids, transposons and vectors whether genetically modified or unmodified.
2. Nucleic acid sequences associated with the pathogenicity of any of the micro‑organisms specified in 1C351.a. to c. or 1C352 or 1C354 means any sequence specific to the specified micro‑organism that:

a. In itself or through its transcribed or translated products represents a significant hazard to human, animal or plant health; or

b. Is known to enhance the ability of a specified micro‑organism, or any other organism into which it may be inserted or otherwise integrated, to cause serious harm to humans, animals or plant health.

Note: 1C353 does not apply to nucleic acid sequences associated with the pathogenicity of enterohaemorrhagic Escherichia coli, serotype O157 and other verotoxin producing strains, other than those coding for the verotoxin, or for its sub‑units.

1C354 Plant pathogens, as follows:

a. Viruses, 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. Potato Andean latent tymovirus;
2. Potato spindle tuber viroid;

b. 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;

1. Xanthomonas oryzae pv. Oryzae (Pseudomonas campestris pv. Oryzae);
2. Clavibacter michiganensis subsp. Sepedonicus (Corynebacterium michiganensis subsp. Sepedonicum or Corynebacterium Sepedonicum);
3. Ralstonia solanacearum Races 2 and 3 (Pseudomonas solanacearum Races 2 and 3 or Burkholderia solanacearum Races 2 and 3);

c. 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, and "chemical mixtures" containing one or more thereof:

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

a. Toxic chemicals, as follows:

1. Amiton: O,O‑Diethyl S‑[2‑(diethylamino)ethyl] phosphorothiolate (78‑53‑5) and corresponding alkylated or protonated salts;

2. PFIB: 1,1,3,3,3‑Pentafluoro‑2‑(trifluoromethyl)‑1‑propene (382‑21‑8);

3. **SEE ML7.a.3. FOR BZ: 3‑Quinuclidinyl benzilate (6581‑06‑2);**

4. Phosgene: Carbonyl dichloride (75‑44‑5);

5. Cyanogen chloride (506‑77‑4);

6. Hydrogen cyanide (74‑90‑8);

1. Chloropicrin: Trichloronitromethane (76‑06‑2);

Note 1: For exports to "States not Party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C450.a.1. and .a.2. in which no individually specified chemical constitutes more than 1% by the weight of the mixture.

Note 2: For exports to "States Party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C450.a.1. and .a.2. in which no individually specified chemical constitutes more than 30% by the weight of the mixture.

Note 3: 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C450.a.4., .a.5., .a.6. and .a.7. in which no individually specified chemical constitutes more than 30% by the weight of the mixture.

b. Toxic chemical precursors, as follows:

1. Chemicals, not controlled in the Munitions List 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:

a. diphenyl methylphosphonate (7526‑26‑3);

b. phosphonic acid, methyl‑, methyl 3‑(trimethoxysilyl)‑ propyl ester (67812‑17‑3);

c. phosphonic acid, methyl‑, monoammonium salt (34255‑87‑3);

d. phosphonic acid, methyl‑, monomethyl ester, monosodium salt (73750‑69‑3);

e. phosphonothioic dichloride, ethyl‑ (993‑43‑1);

f. phosphonic acid, methyl‑, bis(3‑(trimethoxysilyl)propyl) ester (67812‑18‑4);

g. phosphonic acid, methyl‑, compd. with (aminoiminomethyl) urea (1:1) (84402‑58‑4);

h. phosphonic acid, methyl‑, (5‑ethyl‑2‑methyl‑1,3,2‑dioxaphosphorinan‑5‑yl) methyl methyl ester, P‑oxide)   
(41203‑81‑0);

i. phosphonic acid, methyl‑, bis((5‑ethyl‑2‑methyl‑1,3,2‑dioxaphosphorinan‑5‑yl) methyl ester, P,P’‑dioxide) (42595‑45‑9).

Note: 1C450.b.1. does not control Fonofos: O‑Ethyl S‑phenyl ethylphosphonothiolothionate (944‑22‑9);

2. N,N‑Dialkyl [methyl, ethyl or propyl (normal or iso)] phosphoramidic dihalides, other than N,N‑dimethyl phosphoramidic dichloride (677‑43‑0) which is specified in 1C350;

3. 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 (2404‑03‑7) which is specified in 1C350;

4. N,N‑Dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethyl‑2‑chlorides and corresponding protonated salts, other than N,N‑Diisopropyl‑(beta)‑aminoethyl chloride (96‑79‑7) or N,N‑Diisopropyl‑(beta)‑aminoethyl chloride hydrochloride (4261‑68‑1) which are specified in 1C350;

1. N,N‑Dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane‑2‑ols and corresponding protonated salts, other than N,N‑Diisopropyl‑(beta)‑aminoethanol (96‑80‑0) and N,N‑Diethylaminoethanol (100‑37‑8) which are specified in 1C350;

Note: 1C450.b.5. does not control the following:

a. N,N‑Dimethylaminoethanol (108‑01‑0) and corresponding protonated salts;

b. Protonated salts of N,N‑Diethylaminoethanol (100‑37‑8);

6. N,N‑Dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane‑2‑thiols and corresponding protonated salts, other than N,N‑Diisopropyl‑(beta)‑aminoethane thiol (5842‑07‑9) which is specified in 1C350;

7. See 1C350 for ethyldiethanolamine (139‑87‑7);

8. Methyldiethanolamine (105‑59‑9).

Note 1: For exports to "States not Party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C450.b.1., .b.2., .b.3., .b.4., .b.5. and .b.6. in which no individually specified chemical constitutes more than 10% by the weight of the mixture.

Note 2: For exports to "States Party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C450.b.1., .b.2., .b.3., .b.4., .b.5. and .b.6. in which no individually specified chemical constitutes more than 30% by the weight of the mixture.

Note 3: 1C450 does not control “chemical mixtures" containing the chemical specified in entry 1C450.b.8. in which the specified chemical constitutes no more than 30% by the weight of the mixture.

Note 4: 1C450 does not control products identified as consumer goods packaged for retail sale for personal use or packaged for individual use.

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 or modified for the "use" of goods specified in 1B101 1B102, 1B115, 1B117, 1B118 or 1B119.

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. Being any of the following:

1. Zirconia with an average particle size equal to or less than 1 µm and no more than 10% of the particles larger than 5 µm;

2. Other base materials with an average particle size equal to or less than 5 µm and no more than 10% of the particles larger than 10 µm; or

3. 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, 1B102, 1B115 to 1B119, 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 pyrolytically 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.

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.b.3. or b.4., 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.

**CATEGORY 2 – MATERIALS PROCESSING**

2A Systems, Equipment and Components

N.B.: For quiet running bearings, see the ML9.g.

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

Note: 2A001does 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 all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 (or ANSI/ABMA Std 20 Tolerance Class ABEC‑7 or RBEC‑7, or other national equivalents), or better, and having both rings and rolling elements (ISO 5593) made from monel or beryllium;

Note: 2A001.a. does not control tapered roller bearings.

b. Other ball bearings and solid roller bearings having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC‑9 or RBEC‑9, or other national equivalents), or better;

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

c. Active magnetic bearing systemsusing 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.

2A225Crucibles made of materials resistant to liquid actinide metals, as follows:

a. Crucibles having both of the following characteristics:

1. A volume of between 150 cm3 and 8,000 cm3; and

2. Made of or coated with any of the following materials, having a purity of 98% or greater by weight:

a. Calcium fluoride (CaF2);

b. Calcium zirconate (metazirconate) (CaZrO3);

c. Cerium sulphide (Ce2S3);

d. Erbium oxide (erbia) (Er2O3);

e. Hafnium oxide (hafnia) (HfO2);

f. Magnesium oxide (MgO);

g. Nitrided niobium‑titanium‑tungsten alloy (approximately 50% Nb, 30% Ti, 20% W);

h. Yttrium oxide (yttria) (Y2O3); or

i. Zirconium oxide (zirconia) (ZrO2);

b. Crucibles having both of the following characteristics:

1. A volume of between 50 cm3 and 2,000 cm3; and

2. Made of or lined with tantalum, having a purity of 99.9% or greater by weight;

c. Crucibles having all of the following characteristics:

1. A volume of between 50 cm3 and 2,000 cm3;

2. Made of or lined with tantalum, having a purity of 98% or greater by weight; and

3. Coated with tantalum carbide, nitride, boride, or any combination thereof.

2A226 Valves having all of the following characteristics:

a. A 'nominal size' of 5 mm or greater;

b. Having a bellows seal; and

c. Wholly made of or lined with aluminium, aluminium alloy, nickel, or nickel alloy containing more than 60% nickel by weight.

Technical Note:

For valves with different inlet and outlet diameters, the 'nominal size' in 2A226 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. Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device(e.g. a screw or a rack‑and‑pinion).

2. For the purposes of 2B, the number of axes which can be co‑ordinated simultaneously for "contouring control" is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative movements within the machine are performed such as:

*a. Wheel‑dressing systems in grinding machines;*

*b. Parallel rotary axes designed for mounting of separate workpieces;*

*c. Co‑linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.*

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

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

5. Stated positioning accuracy levels derived from measurements made according to ISO 230/2 (1988)[[1]](#footnote-1) or national equivalents may be used for each machine tool model instead of individual machine tests. Stated positioning accuracy means the accuracy value provided to the competent authorities of the Member State in which the exporter is established as representative of the accuracy of a machine model.

*Determination of Stated Values*

*a. Select five machines of a model to be evaluated;*

*b. Measure the linear axis accuracies according to ISO 230/2 (1988)[[2]](#footnote-2);*

*c. Determine the A‑values for each axis of each machine. The method of calculating the A‑value is described in the ISO standard;*

*d. Determine the mean value of the A‑value of each axis. This mean value Â becomes the stated value of each axis for the model (Âx Ây...);*

*e. Since the Category 2 list refers to each linear axis there will be as many stated values as there are linear axes;*

*f. If any axis of a machine model not controlled by 2B001*.*a. to 2B001.c. or 2B201 has a stated accuracy Â of 6 microns for grinding machines and 8 microns for milling and turning machines or better, the manufacturer should be required to reaffirm the accuracy level once every eighteen months.*

2B001 Machine tools and any combination thereof, for removing (or cutting) metals, ceramics or "composites", which, according to the manufacturer’s technical specification, can be equipped with electronic devices for "numerical control", and specially designed components as follows:

N.B.: SEE ALSO 2B201.

Note 1: 2B001 does not control special purpose machine tools limited to the manufacture of gears. For such machines see 2B003.

Note 2: 2B001 does not control special purpose machine tools limited to the manufacture of any of the following parts:

a. Crankshafts or cam shafts;

b. Tools or cutters;

c. Extruder worms;

d. Engraved or facetted jewellery parts.

Note 3: A machine tool having at least two of the three turning, milling or grinding capabilities (e.g. a turning machine with milling capability), must be evaluated against each applicable entry 2B001.a., b. or c.

a. Machine tools for turning, having all of the following characteristics:

1. Positioning accuracy with "all compensations available" equal to or less (better) than 6 µm according to ISO 230/2 (1988)[[3]](#footnote-3) or national equivalents along any linear axis; 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 ofthe following characteristics:

1. Having all of the following:

a. Positioning accuracy with "all compensations available" equal to or less (better) than 6 µm according to ISO 230/2 (1988)[[4]](#footnote-4) or national equivalents along any linear axis; 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";

3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than 4 µm according to ISO 230/2 (1988)[[5]](#footnote-5) or national equivalents along any linear axis; or

4. Fly cutting machines, having all of the following characteristics:

a. Spindle "run‑out" and "camming" less (better) than 0.0004 mm TIR; and

1. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR over 300 mm of travel.

c. Machine tools for grinding, having any ofthe following characteristics:

1. Having all of the following:

a. Positioning accuracy with "all compensations available" equal to or less (better) than 4 µm according to ISO 230/2 (1988)[[6]](#footnote-6) or national equivalents along any linear axis; 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 that do not have a z‑axis or a w‑axis, with a positioning accuracy with "all compensations available" less (better) than 4 µm according to ISO 230/2 (1988)[[7]](#footnote-7) or national equivalents.

3. 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" having all of the following characteristics:

1. Removing material by means of any of the following:

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 Numerically controlled machine tools using a magnetorheological finishing

(MRF) process equipped to produce non‑spherical surfaces and having any of the following characteristics:

1. Finishing the form to less (better) than 1.0 µm; or
2. Finishing to a roughness less (better) than 100 nm rms.

*Technical Note:*

For the purposes of 2B002, MRF is a material removal process using an abrasive magnetic fluid whose viscosity is controlled by a magnetic field.

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 (Rc = 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 components and accessories therefor:

N.B.: SEE ALSO 2B104 and 2B204.

a. A controlled thermal environment within the closed cavity and 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.

N.B. For specially designed dies, moulds and tooling see 1B003, 9B009 and the Munitions List.

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. Chemical vapour deposition (CVD) production equipment having all of the following:

**N.B.: SEE ALSO 2B105.**

1. Process modified for one of the following:

a. Pulsating CVD;

b. Controlled nucleation thermal deposition (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. Ion implantation production equipment having beam currents of 5 mA or more;

c. Electron beam physical vapour deposition (EB‑PVD) production equipment incorporating power systems rated for over 80 kW, having any of the following:

1. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; or

2. 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. 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. Sputter deposition production equipment capable of current densities of 0.1 mA/mm2 or higher at a deposition rate of 15 µm/h or more;

f. Cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;

g. 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, equipment and "electronic assemblies", as follows:

a. Computer controlled or "numerically controlled" co‑ordinate measuring machines (CMM), having a three dimensional (volumetric) maximum permissible error of indication (MPEE) at any point within the operating range of the machine (i.e., within the length of axes) 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 (2001);

N.B.: SEE ALSO 2B206.

b. Linear and angular displacement measuring instruments, as follows:

1. Linear displacement measuring instruments having any of the following:

Technical Note:

For the purpose of 2B006.b.1. 'linear displacement' means the change of distance between the measuring probe and the measured object.

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;

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); or

d. "Electronic assemblies" specially designed to provide feedback capability in systems specified in 2B006.b.1.c.;

Note: 2B006.b.1. does not control measuring interferometer systems, with an automatic control system that is designed to use no feedback techniques, containing a "laser" to measure slide movement errors of machine‑tools, dimensional inspection machines or similar equipment.

2. Angular displacement 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 (e.g. laser 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).

Note: 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.

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 "programs" or to generate or modify numerical program data;

Technical 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 a total radiation dose greater than 5 x 103 Gy (silicon) without operational degradation; or

Techncial Note:

The term Gy(silicon) refers to the energy in Joules per kilogram absorbed by an unshielded silicon sample when exposed to ionising radiation.

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

2B008 Assemblies or units,specially designed for machine tools, or dimensional inspection or measuring systems and equipment, as follows:

1. 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 x L x 10‑3)) nm (L equals the effective length in mm);

N.B.: 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°;

N.B.: 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 of2B009 regarded as flow‑forming machines.

2B104 "Isostatic presses", not controlled in 2B004, having all of the following:

**N.B.: SEE ALSO 2B204.**

a. Maximum working pressure of 69 MPa or greater;

b. Designed to achieve and maintain a controlled thermal environment of 873 K (600°C) or greater; and

c. Possessing a chamber cavity with an inside diameter of 254 mm or greater.

2B105 Chemical vapour deposition (CVD) furnaces, not controlled in 2B005.a., designed or modified for the densification of carbon‑carbon composites.

2B109 Flow‑forming machines, not controlled in 2B009, and specially designed components as follows:

N.B.: SEE ALSO 2B209.

a. Flow‑forming machines having all of the following:

1. 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

2. With more than two axes which can be coordinated simultaneously for "contouring control".

b. Specially designed components for flow‑forming machines specified in 2B009 or 2B109.a.

Note: 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 9A005, 9A007.a. or 9A105.a.

Technical Note:

Machines combining the function of spin‑forming and flow‑forming are for the purpose of 2B109 regarded as flow‑forming machines.

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 an acceleration equal to or greater than 10 g rms between 20 Hz and 2 kHz and imparting forces equal to or greater than 50 kN, measured 'bare table';

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 equal to or greater than 50 kN, measured 'bare table', 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.

Technical Note:

In 2B116, 'bare table' means a flat table, or surface, with no fixture or fittings.

2B117 Equipment and process controls, not controlled in 2B004, 2B005.a., 2B104 or 2B105, designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

2B119 Balancing machines and related equipment, as follows:

**N.B.: SEE ALSO 2B219.**

a. Balancing machines having all the following characteristics:

1. Not capable of balancing rotors/assemblies having a mass greater than 3 kg;

2. Capable of balancing rotors/assemblies at speeds greater than 12,500 rpm;

3. Capable of correcting unbalance in two planes or more; and

4. Capable of balancing to a residual specific unbalance of 0.2 g mm per kg of rotor mass;

Note: 2B119.a. does not control balancing machines designed or modified for dental or other medical equipment.

b. Indicator heads designed or modified for use with machines specified in 2B119.a.

Technical Note:

Indicator heads are sometimes known as balancing instrumentation.

2B120 Motion simulators or rate tables having all of the following characteristics:

a. Two axes or more;

b. Slip rings capable of transmitting electrical power and/or signal information; and

c. Having any of the following characteristics:

1. For any single axis having all of the following:

a. Capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and

b. A rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s;

2. Having a worst‑case rate stability equal to or better (less) than plus or minus 0.05 % averaged over 10 degrees or more; or

3. A positioning accuracy equal to or better than 5 arc second.

Note: 2B120 does not control rotary tables designed or modified for machine tools or for medical equipment. For controls on machine tool rotary tables see 2B008.

2B121 Positioning tables (equipment capable of precise rotary positioning in any axes), not controlled in 2B120, having all the following characteristics:

a. Two axes or more; and

b. A positioning accuracy equal to or better than 5 arc second.

Note: 2B121 does not control rotary tables designed or modified for machine tools or for medical equipment. For controls on machine tool rotary tables see 2B008.

2B122 Centrifuges capable of imparting accelerations above 100 g and having slip rings

capable of transmitting electrical power and signal information.

2B201 Machine tools and any combination thereof, not controlled 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" equal to or less (better) than 6 µm according to ISO 230/2 (1988)[[8]](#footnote-8) or national equivalents along any linear axis; 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 2 m; and

b. Overall positioning accuracy on the x‑axis more (worse) than 30 µm.

b. Machine tools for grinding, having any of the following characteristics:

1. Positioning accuracies with "all compensations available" equal to or less (better) than 4 µm according to ISO 230/2 (1988)[[9]](#footnote-9) or national equivalents along any linear axis; 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 a maximum workpiece capacity of 150 mm or length; and

2. Axes limited to x, z and c;

*b. Jig grinders that do not have a z‑axis or a w‑axis with an overall positioning accuracy less (better) than 4 µm according to ISO 230/2 (1988)*[[10]](#footnote-10) *or national equivalents.*

Note 1: 2B201 does not control special purpose machine tools limited to the manufacture of any of the following parts:

1. Gears;
2. Crankshafts or camshafts;
3. Tools or cutters;
4. Extruder worms.

Note 2: A machine tool having at least two of the three turning, milling or grinding capabilities (e.g., a turning machine with milling capability), must be evaluated against each applicable entry 2B001.a. or 2B201.a. or b.

2B204 "Isostatic presses", not controlled in 2B004 or 2B104, and related

equipment, as follows:

a. "Isostatic presses" having both of the following characteristics:

1. Capable of achieving a maximum working pressure of 69 MPa or greater; and

2. A chamber cavity with an inside diameter in excess of 152 mm;

b. Dies, moulds and controls, specially designed for "isostatic presses" specified in 2B204.a.

Technical Note:

In 2B204 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, instruments or systems, not controlled in 2B006, as follows:

a. Computer controlled or numerically 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 millimetres) (Ref.:VDI/VDE 2617 Parts 1 and 2);

b. Systems for simultaneous 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°.

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.

Note 2: A machine specified in 2B206 is controlled if it exceeds the control threshold anywhere within its operating range.

Technical Notes:

1. 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.

2. All parameters of measurement values in 2B206 represent plus/minus i.e., not total band.

2B207 "Robots", "end‑effectors" and control units, not controlled in 2B007, as follows:

a. "Robots" or "end‑effectors" specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives);

b. Control units specially designed for any of the "robots" or "end‑effectors" specified in 2B207.a.

2B209 Flow forming machines, spin forming machines capable of flow forming functions, not controlled in 2B009 or 2B109, and mandrels, as follows:

a. Machines having both of the following characteristics:

1. Three or more rollers (active or guiding); and

2. Which, 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.a. 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.

2B219 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. Swing or journal diameter greater than 75 mm;

2. Mass capability of from 0.9 to 23 kg ; and

3. Capable of balancing speed of revolution greater 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. Journal diameter greater than 75 mm;

2. Mass capability of from 0.9 to 23 kg;

3. Capable of balancing to a residual imbalance equal to or less than 0.01 kg x mm/kg per plane; and

4. Belt drive type.

2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics:

a. A capability of penetrating 0.6 m or more of hot cell wall (through‑the‑wall operation); or

b. 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).

Technical 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 Controlled atmosphere (vacuum or inert gas) induction furnaces, and power supplies therefor, as follows:

N.B: SEE ALSO 3B.

a. Furnaces having all of the following characteristics:

1. Capable of operation above 1,123 K (850°C);

2. Induction coils 600 mm or less in diameter; and

3. Designed for power inputs of 5 kW or more;

b. Power supplies, with a specified power output of 5 kW or more, specially designed for furnaces specified in 2B226.a.

Note: 2B226.a. does not control furnaces designed for the processing of semiconductor wafers.

2B227 Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment as follows:

a. Arc remelt and casting furnaces having both of the following characteristics:

1. Consumable electrode capacities between 1,000 cm3 and 20,000 cm3, and

2. Capable of operating with melting temperatures above 1,973 K (1,700oC);

b. Electron beam melting furnaces and plasma atomization and melting furnaces, having both of the following characteristics:

1. A power of 50 kW or greater; and

2. Capable of operating with melting temperatures above 1,473 K (1,200oC).

c. Computer control and monitoring systems specially configured for any of the furnaces specified in 2B227.a. or b.

2B228 Rotor fabrication or assembly equipment, rotor straightening equipment,

bellows‑forming mandrels and dies, as follows:

a. Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles, and end caps;

Note: 2B228.a. includes precision mandrels, clamps, and shrink fit machines.

1. Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis;

Technical Note:

In 2B228.b. such equipment normally consists 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.

Technical Note:

In 2B228.c. the bellows have all of the following characteristics:

1. Inside diameter between 75 mm and 400 mm;

2. Length equal to or greater than 12.7 mm;

3. Single convolution depth greater than 2 mm; and

4. Made of high‑strength aluminium alloys, maraging steel or high strength "fibrous or filamentary materials".

2B230 "Pressure transducers" capable of measuring absolute pressures at any point in the range 0 to 13 kPa and having both of the following characteristics:

a. Pressure sensing elements made of or protected by aluminium, aluminium alloy, nickel or nickel alloy with more than 60% nickel by weight; and

b. Having either of the following characteristics:

1. A full scale of less than 13 kPa and an 'accuracy' of better than + 1% of full‑scale; or

2. 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 having all of the following characteristics:

a. Input throat size equal to or greater than 380 mm;

b. Pumping speed equal to or greater than 15 m3/s; and

c. Capable of producing an ultimate vacuum better than 13 mPa.

Technical Notes:

1. The pumping speed is determined at the measurement point with nitrogen gas or air.

2. The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.

2B232 Multistage light gas guns or other high‑velocity gun systems (coil, electromagnetic, and electrothermal types, and other advanced systems) capable of accelerating projectiles to 2 km/s or greater.

2B350 Chemical manufacturing facilities, equipment and components, as follows:

a. Reaction vessels or reactors, with or without agitators, with total internal (geometric) volume greater than 0.1 m3 (100 litres) and less than 20 m3 (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 specified in 2B350.a.; and impellers, blades or shafts designed for such agitators, 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 m3 (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 greater than 0.15 m2, and less than 20 m2; and tubes, plates, coils or blocks (cores) designed for such heat exchangers or condensers, 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 or 'carbon graphite';

5. Nickel or alloys with more than 40% nickel by weight;

6. Tantalum or tantalum alloys;

7. Titanium or titanium alloys;

8. Zirconium or zirconium alloys;

9. Silicon carbide; or

10. Titanium carbide;

e. Distillation or absorption columns of internal diameter greater than 0.1 m; and liquid distributors, vapour distributors or liquid collectors designed for such distillation or absorption columns, 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 or 'carbon 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

1. Nickel or alloys with more than 40% nickel by weight;

g. Valves with nominal sizes greater than 10 mm and casings (valve bodies) or preformed casing liners designed for such 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 or 'carbon 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 and seal‑less pumps, with manufacturer's specified maximum flow‑rate greater than 0.6 m3/hour, or vacuum pumps with manufacturer's specified maximum flow‑rate greater than 5 m3/hour (under standard temperature (273 K (0oC)) and pressure (101.3 kPa) conditions); and casings (pump bodies), preformed casing liners, impellers, rotors or jet pump nozzles designed for such pumps, 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 or 'carbon 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 (1,000oC), 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

1. Nickel or alloys with more than 40% nickel by weight.

*Technical Note:*

*'Carbon graphite' is a composition consisting of amorphous carbon and graphite, in which the graphite content is eight percent or more 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 or chemicals specified in 1C350, at concentrations of less than 0.3 mg/m3; 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 (2nd edition, Geneva 1993).

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 20 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. One or more 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 (tangential) flow filtration equipment and components as follows:

1. Cross (tangential) flow filtration equipment capable of separation of pathogenic micro‑organisms, viruses, toxins or cell cultures, without the propagation of aerosols, having both of the following characteristics:

a. A total filtration area equal to or greater than1 m2; and

b. Capable of being sterilised or disinfected in‑situ;

Technical Note:

*In 2B352*.*d.1.b. sterilised denotes the elimination of all viable microbes from the equipment through the use of either physical (e.g. steam) or chemical agents. Disinfected denotes the destruction of potential microbial infectivity in the equipment through the use of chemical agents with a germicidal effect. Disinfection and sterilisation are distinct from sanitisation, the latter referring to cleaning procedures designed to lower the microbial content of equipment without necessarily achieving elimination of all microbial infectivity or viability.*

2. Cross (tangential) flow filtration components (e.g. modules, elements, cassettes, cartridges, units or plates) with filtration area equal to or greater than 0.2 m2 for each component and designed for use in cross (tangential) flow filtration equipment specified in 2B352.d.;

*Note: 2B352*.*d. does not control reverse osmosis equipment, as specified by the manufacturer.*

e. Steam sterilisable freeze drying equipment with a condenser capacity exceeding 10 kg of ice in 24 hours and less than 1,000 kg of ice in 24 hours;

f. Protective and containment equipment, as follows:

1. Protective full or half suits, or hoods dependent upon a tethered external air supply and operating under positive pressure;

Note: 2B352.f.1. does not control suits designed to be worn with self‑contained breathing apparatus.

2. Class III biological safety cabinets or isolators with similar performance standards;

Note: In 2B352.f.2., isolators include flexible isolators, dry boxes, anaerobic chambers, glove boxes and laminar flow hoods (closed with vertical flow).

g. Chambers designed for aerosol challenge testing with "microorganisms", viruses or "toxins" and having a capacity of 1 m3 or greater.

2C Materials

None.

2D Software

2D001 "Software", other than that specified in 2D002, specially designed or modified for the "development", "production" or "use" of equipment specified in 2A001 or 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 co‑ordinating simultaneously more than four axes for "contouring control".

Note 1:2D002does not control "software" specially designed or modified for the operation of machine tools not specified in Category 2.

Note 2:2D002 does not control "software" for items specified in 2B002. See 2D001 for control of "software" for items specified in 2B002.2D101 "Software" specially designed or modified for the "use" of equipment specified in 2B104, 2B105, 2B109, 2B116, 2B117 or 2B119 to 2B122.

N.B.: SEE ALSO 9D004.

2D201 "Software" specially designed for the "use" of equipment specified in 2B204, 2B206, 2B207, 2B209, 2B219 or 2B227.

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:

1. "Technology" for the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of part programs;

b. "Technology" for metal‑working manufacturing processes, as follows:

1. "Technology" for the design of tools, dies or fixtures specially designed for any ofthe 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 programs) 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.

Note: The table and Technical Note appear after entry 2E301.

2E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 2B004, 2B009, 2B104, 2B109, 2B116, 2B119 to 2B122 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" according to the General Technology Note for the "use" of goods

specified in 2B350 to 2B352.

TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1)[[11]](#footnote-11)\* 2. Substrate 3. Resultant Coating

A. Chemical Vapour "Superalloys" Aluminides for internal

Deposition (CVD) passages

Ceramics (19) and Low‑ Silicides

expansion glasses (14) Carbides

Dielectric layers (15)

Diamond

Diamond‑like carbon (17)

Carbon‑carbon, Silicides

Ceramic and Carbides

Metal "matrix" Refractory metals

"composites" Mixtures thereof (4)

Dielectric layers (15)

Aluminides

Alloyed aluminides (2)

Boron nitride

Cemented tungsten Carbides

carbide (16), Tungsten

Silicon carbide (18) Mixtures thereof (4)

Dielectric layers (15)

Molybdenum and Dielectric layers (15)

Molybdenum alloys

Beryllium and Dielectric layers (15)

Beryllium alloys Diamond

Diamond‑like carbon (17)

Sensor window Dielectric layers (15)

materials (9) Diamond

Diamond‑like carbon (17)

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TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

B. Thermal‑Evaporation

Physical Vapour

Deposition (TE‑PVD)

B.1. Physical Vapour "Superalloys" Alloyed silicides

Deposition (PVD): Alloyed aluminides (2)

Electron‑Beam MCrAlX (5)

(EB‑PVD) Modified zirconia (12)

Silicides

Aluminides

Mixtures thereof (4)

Ceramics (19) and Low‑ Dielectric layers (15)

expansion glasses (14)

Corrosion resistant MCrAlX (5)

steel (7) Modified zirconia (12)

Mixtures thereof (4)

Carbon‑carbon, Silicides

Ceramic and Carbides

Metal "matrix" Refractory metals

"composites" Mixtures thereof (4)

Dielectric layers (15)

Boron nitride

Cemented tungsten Carbides

carbide (16), Tungsten

Silicon carbide (18) Mixtures thereof (4)

Dielectric layers (15)

Molybdenum and Dielectric layers (15)

Molybdenum alloys

Beryllium and Dielectric layers (15)

Beryllium alloys Borides

Beryllium

Sensor window Dielectric layers (15)

materials (9)

Titanium alloys (13) Borides

Nitrides

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TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

B.2. Ion assisted resistive Ceramics (19) and Low‑ Dielectric layers (15)

heating Physical Vapour expansion glasses (14) Diamond‑like carbon (17)

Deposition (PVD)

(Ion Plating)

Carbon‑carbon, Dielectric layers (15)

Ceramic and Metal

"matrix" "composites"

Cemented tungsten Dielectric layers (15)

carbide (16),

Silicon carbide

Molybdenum and

Molybdenum alloys Dielectric layers (15)

Beryllium and

Beryllium alloys Dielectric layers (15)

Sensor window Dielectric layers (15)

materials (9) Diamond‑like carbon (17)

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B.3. Physical Vapour Ceramics (19) and Low‑ Silicides

Deposition (PVD): expansion glasses (14) Dielectric layers (15)

"Laser" Vaporization Diamond‑like carbon (17)

Carbon‑carbon, Dielectric layers (15)

Ceramic and Metal

"matrix" "composites"

Cemented tungsten Dielectric layers (15)

carbide (16),

Silicon carbide

Molybdenum and Dielectric layers (15)

Molybdenum alloys

Beryllium and Dielectric layers (15)

Beryllium alloys

Sensor window Dielectric layers (15)

materials (9) Diamond‑like carbon

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TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

B.4. Physical Vapour "Superalloys" Alloyed silicides

Deposition (PVD): Alloyed aluminides (2)

Cathodic Arc Discharge MCrAlX (5)

Polymers (11) and Borides

Organic "matrix" Carbides

"composites" Nitrides

Diamond‑like carbon (17)

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C. Pack cementation Carbon‑carbon, Silicides

(see A above for Ceramic and Carbides

out‑of‑pack Metal "matrix" Mixtures thereof (4)

cementation) (10) "composites"

Titanium alloys (13) Silicides

Aluminides

Alloyed aluminides (2)

Refractory metals Silicides

and alloys (8) Oxides

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D. Plasma spraying "Superalloys" MCrAlX (5)

Modified zirconia (12)

Mixtures thereof (4)

Abradable Nickel‑Graphite

Abradable materials

containing Ni‑Cr‑Al

Abradable Al‑Si‑Polyester

Alloyed aluminides (2)

Aluminium alloys (6) MCrAlX (5)

Modified zirconia (12)

Silicides

Mixtures thereof (4)

Refractory metals Aluminides

and alloys (8) Silicides

Carbides

TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

D. (continued) Corrosion resistant MCrAlX (5)

steel (7) Modified zirconia (12)

Mixtures thereof (4)

Titanium alloys (13) Carbides

Aluminides

Silicides

Alloyed aluminides (2)

Abradable Nickel‑Graphite

Abradable materials

containing Ni‑Cr‑Al

Abradable Al‑Si‑Polyester

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E. Slurry Deposition Refractory metals Fused silicides

and alloys (8) Fused aluminides

except for resistance

heating elements

Carbon‑carbon, Silicides

Ceramic and Carbides

Metal "matrix" Mixtures thereof (4)

"composites"

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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‑ Silicides

expansion glasses (14) Platinum

Mixtures thereof (4)

Dielectic layers (15)

Diamond‑like carbon (17)

TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

F. (continued) Titanium alloys (13) Borides

Nitrides

Oxides

Silicides

Aluminides

Alloyed aluminides (2)

Carbides

Carbon‑carbon, Silicides

Ceramic and Metal Carbides

"matrix" "composites" Refractory metals

Mixtures thereof (4)

Dielectric layers (15)

Boron nitride

Cemented tungsten Carbides

carbide (16), Tungsten

Silicon carbide (18) Mixtures thereof (4)

Dielectric layers (15)

Boron nitride

Molybdenum and

Molybdenum alloys Dielectric layers (15)

Beryllium and Borides

Beryllium alloys Dielectric layers (15)

Beryllium

Sensor window Dielectric layers (15)

materials (9) Diamond‑like carbon (17)

Refractory metals Aluminides

and alloys (8) Silicides

Oxides

Carbides

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TABLE ‑ DEPOSITION TECHNIQUES

1. Coating Process (1) 2. Substrate 3. Resultant Coating

G. Ion Implantation High temperature Additions of

bearing steels Chromium

Tantalum or

Niobium (Columbium)

Titanium alloys (13) Borides

Nitrides

Beryllium and Borides

Beryllium alloys

Cemented tungsten Carbides

carbide (16) Nitrides

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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. The term 'mixtures thereof' includes 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 and alloys' include 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, diamond, gallium phosphide, sapphire and the following metal halides: sensor window materials of more than 40 mm diameter for zirconium fluoride and hafnium fluoride.

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 only 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 x 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, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel‑chromium and chromium carbide/nickel.

17. "Technology" specially designed to deposit diamond‑like carbon on any of the following is not controlled:

magnetic disk drives and heads, equipment for the manufacture of disposables, valves for faucets, acoustic diaphragms for speakers, engine parts for automobiles, cutting tools, punching‑pressing dies, office automation equipment, microphones or medical devices or moulds, for casting or moulding of plastics, manufactured from alloys containing less than 5% beryllium.

18. 'Silicon carbide' does not include cutting and forming tool materials.

19. Ceramic substrates, as used in this entry, does not include ceramic materials containing 5% by weight, or greater, clay or cement content, either as separate constituents or in combination.

TABLE ‑ DEPOSITION TECHNIQUES ‑ TECHNICAL NOTE

Processes specified in Column 1 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 deposition (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 0.1 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. Ion Assisted Resistive Heating PVD employs electrically resistive heating sources in combination with impinging ion beam(s) to produce a controlled and uniform flux of evaporated coating species;

3. "Laser" Vaporization uses either pulsed or continuous wave "laser" beams to vaporize 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.

5. 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 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.

c. 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°C) and 1,375 K (1,102°C) for sufficient time to deposit the coating.

d. 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.

N.B.1 Low pressure means less than ambient atmospheric pressure.

N.B.2 High velocity refers to nozzle‑exit gas velocity exceeding 750 m/s calculated at 293 K (20°C) at 0.1 MPa.

e. 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.

f. 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 vaporisation of non‑metallic coating materials.

N.B.2 Low‑energy ion beams (less than 5 keV) can be used to activate the deposition.

g. 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.

**CATEGORY 3 ‑ ELECTRONICS**

3A Systems, Equipment and Components

Note 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.

Note 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:

Note 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.

Note 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 x 103  Gy (silicon) or higher;

b. A dose rate upset of 5 x 106 Gy (silicon)/s or higher; or

c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5 x 1013 n/cm2 or higher on silicon, or its equivalent for other materials;

*Note: 3A001*.*a.1.c. does not apply to Metal Insulator Semiconductors (MIS).*

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 logic devices, 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.

3. "Microprocessor microcircuits", "micro‑computer microcircuits" and microcontroller microcircuits, manufactured from a compound semiconductor andoperating at a clock frequency exceeding 40 MHz;

Note: 3A001.a.3. includes digital signal processors, digital array processors and digital coprocessors.

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:

**N.B. SEE ALSO 3A101**

1. A resolution of 8 bit or more, but less than 10 bit, with an output rate greater than 500 million words per second;

2. A resolution of 10 bit or more, but less than 12 bit, with an output rate greater than 200 million words per second;

3. A resolution of 12 bit with an output rate greater than 50 million words per second;

4. A resolution of more than 12 bit, but equal to or less than 14 bit, with an output rate greater than 5 million words per second; or

5. A resolution of more than 14 bit with an output rate greater than 1 million words per second;

b. Digital‑to‑analogue converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

Technical Notes:

1. A resolution of n bit corresponds to a quantisation of 2n levels.

2. The number of bits in the output word is equal to the resolution of the analogue‑to‑digital converter.

3. The output rate is the maximum output rate of the converter, regardless of the architecture or oversampling. Vendors may also refer to the output rate as sampling rate, conversion rate or throughput rate. It is often specified in megaghertz (MHz) or mega samples per second (MSPS).

4. For the purpose of measuring output rate, one output word per second is equivalent to one Hertz or one sample per second.

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 logic devices having any of the following:

a. An equivalent usable gate count of more than 30,000 (2 input gates);

b. A typical "basic gate propagation delay time" of less than 0.1 ns; or

c. A toggle frequency exceeding 133 MHz;

Note: 3A001.a.7. includes:

‑ Simple Programmable Logic Devices (SPLDs)

‑ Complex Programmable Logic Devices (CPLDs)

‑ Field Programmable Gate Arrays (FPGAs)

‑ Field Programmable Logic Arrays (FPLAs)

‑ Field Programmable Interconnects (FPICs)

N.B.: Field programmable logic devices are also known as field programmable gate or field programmable logic arrays.

8. Deleted;

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 1,000 terminals;

b. A typical "basic gate propagation delay time" of less than 0.1 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 3000 (2 input gates); or

b. A toggle frequency exceeding 1.2 GHz;

12. Fast Fourier Transform (FFT) processors having a rated execution time for an N‑point complex FFT of less than (N log2 N) /20,480 ms, where N is the number of points;

Technical Note:

When N is equal to 1,024 points, the formula in 3A001.a.12. gives an execution time of 500 µs.

b. Microwave or millimetre wave components, as follows:

1. Electronic vacuum tubes and cathodes, as follows:

Note 1: 3A001.b.1. does not control tubes designed or rated for operation in any frequency band which meets all of the following characteristics:

a. Does not exceed 31.8 GHz; and

b. Is "allocated by the ITU" for radio‑communications services, but not for radio‑determination.

Note 2: 3A001.b.1. does not control non‑"space‑qualified" tubes which meet all of the following characteristics:

a. An average output power equal to or less than 50 W; and

b. Designed or rated for operation in any frequency band which meets all of the following characteristics:

1. Exceeds 31.8 GHz but does not exceed 43.5 GHz; and

2. Is "allocated by the ITU" for radio‑communications

services, but not for radio‑determination.

a. Travelling wave tubes, pulsed or continuous wave, as follows:

1. Operating at frequencies exceeding 31.8 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 a "fractional 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 producing a continuous emission current density at rated operating conditions exceeding 5 A/cm2;

2. Microwave monolithic integrated circuits (MMIC) power amplifiers having any of the following:

a. Rated for operation at frequencies exceeding 3.2 GHz up to and including 6 GHz and with an average output power greater than 4W (36 dBm) with a "fractional bandwidth" greater than 15%;

b. Rated for operation at frequencies exceeding 6 GHz up to and including 16 GHz and with an average output power greater than 1W (30 dBm) with a "fractional bandwidth" greater than 10%;

c. Rated for operation at frequencies exceeding 16 GHz up to and including 31.8 GHz and with an average output power greater than 0.8W (29 dBm) with a "fractional bandwidth" greater than 10%;

d. Rated for operation at frequencies exceeding 31.8 GHz up to and including 37.5 GHz;

e. Rated for operation at frequencies exceeding 37.5 GHz up to and including 43.5 GHz and with an average output power greater than 0.25W (24 dBm) with a "fractional bandwidth" greater than 10%; or

f. Rated for operation at frequencies exceeding 43.5 GHz.

Note 1: 3A001.b.2. does not control broadcast satellite equipment designed or rated to operate in the frequency range of 40.5 GHz to 42.5 GHz.

Note 2: The control status of the MMIC whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.2.a. to 3A001.b.2.f., is determined by the lowest average output power control threshold.

Note 3: Notes 1 and 2 in the chapeau to Category 3 mean that 3A001.b.2. does not control MMICs if they are specially designed for other applications, e.g., telecommunications, radar, automobiles.

3. Discrete microwave transistors having any of the following:

a. Rated for operation at frequencies exceeding 3.2 GHz up to and including 6 GHz and having an average output power greater than 60W (47.8 dBm);

b. Rated for operation at frequencies exceeding 6 GHz up to and including 31.8 GHz and having an average output power greater than 20W (43 dBm);

c. Rated for operation at frequencies exceeding 31.8 GHz up to and including 37.5 GHz and having an average output power greater than 0.5W (27 dBm);

d. Rated for operation at frequencies exceeding 37.5 GHz up to and including 43.5 GHz and having an average output power greater than 1W (30 dBm); or

e. Rated for operation at frequencies exceeding 43.5 GHz.

*Note: The control status of a transistor whose rated operating frequency includes frequencies listed in* *more than one frequency range, as defined by 3A001*.*b.3.a. to 3A001b.3.e., is determined by the lowest average output power control threshold.*

4. Microwave solid state amplifiers and microwave assemblies/modules containing microwave amplifiers, having any of the following:

a. Rated for operation at frequencies exceeding 3.2 GHz up to and including 6 GHz and with an average output power greater than 60W (47.8 dBm) with a "fractional bandwidth" greater than 15%;

b. Rated for operation at frequencies exceeding 6 GHz up to and including 31.8 GHz and with an average output power greater than 15W (42 dBm) with a "fractional bandwidth" greater than 10%;

c. Rated for operation at frequencies exceeding 31.8 GHz up to and including 37.5 GHz;

d. Rated for operation at frequencies exceeding 37.5 GHz up to and including 43.5 GHz and with an average output power greater than 1W (30 dBm) with a "fractional bandwidth" greater than 10%;

e. Rated for operation at frequencies exceeding 43.5 GHz; or

f. Rated for operation at frequencies above 3.2 GHz and having all of the following:

1. An average output power (in watts), P, greater than 150 divided by the maximum operating frequency (in GHz) squared [P>150 W\*GHz2/fGHz2];

2. A fractional bandwidth of 5% or greater; and

3. Any two sides perpendicular to one another with length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [d≤ 15cm\*GHz/ fGHz].

Technical Note:

3.2 GHz should be used as the lowest operating frequency (fGHz) in the formula in 3A001.b.4.f.3., for amplifiers that have a rated operating range extending downward to 3.2 GHz and below [d≤ 15cm\*GHz/3.2 GHz].

N.B.: MMIC power amplifiers should be evaluated against the criteria in 3A001.b.2.

Note 1: 3A001.b.4. does not control broadcast satellite equipment designed or rated to operate in the frequency range of 40.5 to 42.5 GHz.

Note 2: The control status of an item whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.4.a. to 3A001.b.4.e., is determined by the lowest average output power control threshold.

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 (fmax/fmin) 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. Deleted;

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 cm3;

Note: 3A001.b.8. does not control equipment designed or rated for operation in any frequency band which is "allocated by the ITU" for radio‑communications services, but not for radio‑determination.

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. 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

2. 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 cm3 (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.

c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m2 at an operating temperature of 301 K (28°C) under a tungsten illumination of 1 kW/m2 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 than 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.**

Note: 3A001.e.3. does not control "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.

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/mm2;

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.

2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s;

Note: 3A002.a.2. does not control digital video magnetic tape recorders specially designed for television recording using a signal format, which may include a compressed signal format, standardised or recommended by the ITU, the IEC, the SMPTE, the EBU, the ETSI or the IEEE 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:

a. Digitising rate equal to or more than 200 million samples per second and a resolution of 10 bit 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.

1. Digital instrumentation data recorders, using magnetic disk storage technique, having all of the following:
2. Digitising rate equal to or more than 100 million samples per second and a resolution of 8 bit or more; and
3. A continuous throughput of 1 Gbit/s or more;

b. "Frequency synthesiser" "electronic assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;

c. Radio frequency "signal analysers", as follows:

1. "Signal analysers" capable of analysing frequencies exceeding 31.8 GHz but but not exceeding 37.5 GHz and having a 3 dB resolution bandwidth (RBW) exceeding 10 MHz;

2. "Signal analysers" capable of analysing frequencies exceeding 43.5 GHz;

3. "Dynamic signal analysers" having a "real‑time bandwidth" exceeding 500 kHz;

Note: 3A002.c.3. does not control those "dynamic signal analysers" using only constant percentage bandwidth filters (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 exceeding31.8 GHz but not exceeding 43.5 GHz and rated to generate a pulse duration of less than 100 ns;

2. A maximum synthesised frequency exceeding 43.5 GHz;

3. A "frequency switching time" from one selected frequency to another of less than 1 ms; or

4. A single sideband (SSB) phase noise better than ‑(126 + 20 log10F ‑ 20 log10f) in dBc/Hz, where F is the off‑set from the operating frequency in Hz and f is the operating frequency in MHz;

Technical Note:

*For the purposes of 3A002*.*d.1., 'pulse duration' is defined as the time interval between the leading edge of the pulse achieving 90% of the peak and the trailing edge of the pulse achieving 10% of the peak.*

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 43.5 GHz;

f. Microwave test receivers having all of the following:

1. A maximum operating frequency exceeding 43.5 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 x 10‑11/month; or

2. Being "space qualified".

Note: 3A002.g.1. does not control non‑"space qualified" rubidium standards.

3A003 Spray cooling thermal management systems employing closed loop fluid handling and reconditioning equipment in a sealed enclosure where a dielectric fluid is sprayed onto electronic components using specially designed spray nozzles that are designed to maintain electronic components within their operating temperature range, and specially designed components therefor.

3A101 Electronic equipment, devices and components, not controlled in 3A001, as follows:

a. Analogue‑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, not controlled in 3A001, as follows;

a. Capacitors having either of the following sets of characteristics:

1. a. Voltage rating greater than 1.4 kV;

b. Energy storage greater than 10 J;

c. Capacitance greater than 0.5 µF; and

d. Series inductance less than 50 nH; or

2. a. Voltage rating greater than 750 V;

b. Capacitance greater than 0.25 µF; and

c. Series inductance less than 10 nH;

b. Superconducting solenoidal electromagnets having all of the following characteristics:

1. Capable of creating magnetic fields greater than 2 T;

2. A ratio of length to inner diameter greater than 2;

3. Inner diameter greater than 300 mm; and

4. Magnetic field uniform to better than 1% over the central 50% of the inner volume;

Note: 3A201.b. does not control 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 having either of the following sets of characteristics:

1. a. An accelerator peak electron energy of 500 keV or greater but less than 25 MeV; and

b. With a 'figure of merit' (K) of 0.25 or greater; or

2. a. An accelerator peak electron energy of 25 MeV or greater; and

b. A 'peak power' greater than 50 MW.

Note: 3A201.c. does not control accelerators that are component parts of devices designed for purposes other than electron beam or X‑ray radiation (electron microscopy, for example) nor those designed for medical purposes:

Technical Notes:

1. The 'figure of merit' K is defined as:

K = 1.7 x 103V2.65Q

V is the peak electron energy in million electron volts.

If the accelerator beam pulse duration is less than or equal to 1 µs, then Q is the total accelerated charge in Coulombs. If the accelerator beam pulse duration is greater than 1 µs, then Q is the maximum accelerated charge in 1 µs.

Q equals the integral of i with respect to t, over the lesser of 1 µs or the time duration of the beam pulse (Q = ∫ idt), where i is beam current in amperes and t is time in seconds.

2. 'Peak power' = (peak potential in volts) x (peak beam current in amperes).

3. In machines based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 µs or the duration of the bunched beam packet resulting from one microwave modulator pulse.

4. In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.

3A225 Frequency changers or generators, not controlled in 0B001.b.13., having all of the following characteristics:

a. Multiphase output capable of providing a power of 40 W or greater;

b. Capable of operating in the frequency range between 600 and 2000 Hz;

c. Total harmonic distortion better (less) than 10%; and

d. Frequency control better (less) than 0.1%.

Technical Note:

Frequency changers in 3A225 are also known as converters or inverters.

3A226 High‑power direct current power supplies, not controlled in 0B001.j.6., having both of the following characteristics:

a. Capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 A or greater; and

b. Current or voltage stability better than 0.1% over a time period of 8 hours.

3A227 High‑voltage direct current power supplies, not controlled in 0B001.j.5., having both of the following characteristics:

a. Capable of continuously producing, over a time period of 8 hours, 20 kV or greater with current output of 1 A or greater; and

b. Current or voltage stability better than 0.1% over a time period of 8 hours.

3A228 Switching devices, as follows:

a. Cold‑cathode tubes, whether gas filled or not, operating similarly to a spark gap, having all of the following characteristics:

1. Containing three or more electrodes;

2. Anode peak voltage rating of 2.5 kV or more;

3. Anode peak current rating of 100 A or more; and

4. Anode delay time of 10 µs or less;

Note: 3A228 includes gas krytron tubes and vacuum sprytron tubes.

b. Triggered spark‑gaps having both of the following characteristics:

1. An anode delay time of 15 µs or less; and

2. 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 kV;

2. Anode peak current rating of 500 A or more; and

3. Turn‑on time of 1 µs or less.

3A229 Firing sets and equivalent high‑current pulse generators as follows:

N.B.: SEE ALSO ML4.b.

a. Explosive detonator firing sets designed to drive multiple controlled detonators specified in 3A232;

b. Modular electrical pulse generators (pulsers) having all of the following characteristics:

1. Designed for portable, mobile, or ruggedized‑use;

2. Enclosed in a dust‑tight enclosure;

3. Capable of delivering their energy in less than 15 µs;

4. Having an output greater than 100 A;

5. Having a 'rise time' of less than 10 µs into loads of less than 40 ohms;

6. No dimension greater than 254 mm;

7. Weight less than 25 kg; and

8. Specified for use over an extended temperature range 223 K  (‑50oC) to 373 K (100oC) or specified as suitable for aerospace applications.

Note: 3A229.b. includes xenon flash‑lamp drivers.

Technical Note:

In 3A229.b.5. 'rise time' is defined as the time interval from 10% to 90% current amplitude when driving a resistive load.

3A230 High‑speed pulse generators having both of the following characteristics:

a. Output voltage greater than 6 V into a resistive load of less than 55 ohms, and

b. 'Pulse transition time' less than 500 ps.

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, having both of the following

characteristics:

a. Designed for operation without an external vacuum system; and

b. Utilizing electrostatic acceleration to induce a tritium‑deuterium nuclear reaction.

3A232 Detonators and multipoint initiation systems, as follows:

N.B.: SEE ALSO ML4.b.

a. Electrically driven explosive detonators, as follows:

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 mm2 from a single firing signal with an initiation timing spread over the surface of less than 2.5 µs.

Note: 3A232 does not control detonators using only primary explosives, such as lead azide.

Technical Note:

In 3A232 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, not controlled 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 UF6;

e. Molecular beam mass spectrometers having either of the following characteristics:

1. A source chamber constructed from, lined with or plated with stainless steel or molybdenum and equipped with a cold trap capable of cooling to 193 K (‑80oC) or less; or

2. A source chamber constructed from, lined with or plated with materials resistant to UF6;

f. Mass spectrometers equipped with a microfluorination ion source designed for 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. Equipment designed for epitaxial growth, as follows:

1. Equipment capable of producing a layer of any material other than silicon with a 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 or solid sources;

b. Equipment designed for ion implantation, having any of the following:

1. A beam energy (accelerating voltage) exceeding 1MeV;

2. Being specially designed and optimised to operate at a beam energy (accelerating voltage) of less than 2 keV;

3. Direct write capability; or

4. A beam energy of 65 keV or more and a beam current of 45 mA or more for high energy oxygen implant into a heated semiconductor material "substrate";

1. Anisotropic plasma dry etching equipment, as follows:

1. Equipment with cassette‑to‑cassette operation and load‑locks, and having any of the following:

a. Designed or optimised to produce critical dimensions of 180 nm or less with ± 5% 3 sigma precision; or

b. Designed for generating less than 0.04 particles/cm2 with a measurable particle size greater than 0.1 µm in diameter;

2. Equipment specially designed for equipment specified in 3B001.e. and having any of the following:

a. Designed or optimised to produce critical dimensions of 180 nm or less with ± 5% 3 sigma precision; or

b. Designed for generating less than 0.04 particles/cm2 with a measurable particle size greater than 0.1 µm in diameter;

d. Plasma enhanced CVD equipment, as follows:

1. Equipment with cassette‑to‑cassette operation and load‑locks, and designed according to the manufacturer's specifications or optimised for use in the production of semiconductor devices with critical dimensions of 180 nm or less;

2. Equipment specially designed for equipment controlled by 3B001.e. designed according to the manufacturer's specifications or optimised for use in the production of semiconductor devices with critical dimensions of 180 nm or less;

e. 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. Lithography equipment, as follows:

1. Align and expose step and repeat (direct step on wafer) or step and scan (scanner) equipment for wafer processing using photo‑optical or X‑ray methods, having any of the following:

a. A light source wavelength shorter than 245 nm; or

b. Capable of producing a pattern with a 'minimum resolvable feature' size of 180 nm or less;

Technical Note:

The 'minimum resolvable feature' size is calculated by the following formula:

MRF = (an exposure light source wavelength in nm) x (K factor)

*numerical aperture*

where the K factor = 0.45

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.

*Note: 3B001*.*h. does not control multi‑layer masks with a phase shift layer designed for the fabrication of memory devices not controlled by 3A001.*

3B002 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 31.8 GHz;

b. Deleted;

c. For testing microwave integrated circuits specified in 3A001.b.2.

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;

c. Silicon carbide; or

d. 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 350 nm;

b. All resists designed for use with electron beams or ion beams, with a sensitivity of 0.01 µcoulomb/mm2 or better;

c. All resists designed for use with X‑rays, with a sensitivity of 2.5 mJ/mm2 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 any of the following:

a. Equipment specified in 3B001.a. to f.; or

b. Equipment specified in 3B002.

3D003 'Physics‑based' simulation "software" specially designed for the "development" of

lithographic, etching or deposition processes for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor materials.

Technical Note:

'Physics‑based' in 3D003 means using computations to determine a sequence of physical cause and effect events based on physical properties (e.g., temperature, pressure, diffusion constants and semiconductor materials properties).

Note: Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as "technology".

3D004 "Software" specially designed for the "development" of the equipment specified in 3A003.

3D101 "Software" specially designed or modified 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 1: 3E001 does not control "technology" for the "production" of equipment or components controlled by 3A003.

Note 2: 3E001 does not control "technology" for the "development" or "production" of integrated circuits specified in 3A001.a.3. to 3A001.a.12., having all of the following:

1. Using "technology" of 0.5 µm or more, and

2. Not incorporating 'multi‑layer structures'.

Technical Note:

The term 'multi‑layer structures' does not include devices incorporating a maximum of three metal layers and three polysilicon layers.

3E002 "Technology" according to the General Technology Note other than that specified in 3E001 for the "development" or "production" of "microprocessor microcircuits", "micro‑computer microcircuits" and microcontroller microcircuits having a "composite theoretical performance" ("CTP") of 530 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of 32 bits or more.

Note: Decontrol note 2 to 3E001 also applies to 3E002.

3E003 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;

*Note: 3E003*.*b. does not control technology for high electron mobility transistors (HEMT) operating at frequencies lower than 31.8 GHz and hetero‑junction bipolar transistors (HBT) operating at frequencies lower than 31.8 GHz.*

c. "Superconductive" electronic devices;

d. Substrates of films of diamond for electronic components;

e. Substrates of silicon‑on‑insulator (SOI) for integrated circuits in which the insulator is silicon dioxide;

f. Substrates of silicon carbide for electronic components;

g. Electronic vacuum tubes operating at frequencies of 31.8 GHz or higher.

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, 3A225 to 3A233.

**CATEGORY 4 ‑ COMPUTERS**

Note 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).

Note 2: 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).

N.B.: For the control status of "software" specially designed for packet switching, see 5D001.

Note 3: 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 x 103 Gy (silicon);

b. Dose Rate Upset 5 x 106 Gy (silicon)/s; or

c. Single Event Upset 1 x 10‑7 Error/bit/day;

b. Having characteristics or performing functions exceeding the limits in Category 5, Part 2 ("Information Security").

Note: 4A001.b. does not control electronic computers and related equipment when accompanying their user for the user’s personal use.

4A003 "Digital computers", "electronic assemblies", and related equipment therefor, as

follows, and specially designed components therefor:

Note 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".

Note 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.

N.B. 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 an "Adjusted Peak Performance" ("APP") exceeding 0.75 Weighted TeraFLOPS (WT);

c. "Electronic assemblies" specially designed or modified for enhancing performance by aggregation of processors so that the "APP" of the aggregation exceeds the limit in 4A003.b.;

Note 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.e.

Note 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. Deleted;

e. Equipment performing analogue‑to‑digital conversions exceeding the limits in 3A001.a.5.;

f. Deleted;

g. Equipment specially designed to provide external interconnection of "digital computers" or associated equipment which allows communications at data rates exceeding 1.25 Gbyte/s.

Note: 4A003.g. does not control internal interconnection equipment (e.g. backplanes, buses), passive interconnection equipment, "network access controllers" or "communications channel controllers".

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, not controlled in 4A001.a.1., which are ruggedized and designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

4A102 "Hybrid computers" specially designed for modelling, simulation or design integration of space launch vehicles specified in 9A004 or sounding rockets specified in 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 a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" specified in 4A001 to 4A004, or 4D.

b. "Software", other than that specified in 4D001.a., specially designed or modified for the "development" or "production" of:

1. "Digital computers" having an "Adjusted Peak Performance" ("APP") exceeding 0.04 Weighted TeraFLOPS (WT); or

2. "Electronic assemblies" specially designed or modified for enhancing performance by aggregation of processors so that the "APP" of the aggregation exceeds the limit in 4D001.b.1.;

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. Deleted;

c. "Software" having characteristics or performing functions exceeding the limits in Category 5, Part 2 ("Information Security");

Note: 4D003.c. does not control "software" when accompanying its user for the user's personal use.

4E Technology

4E001 a. "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 4A or 4D.

b. "Technology", other than that specified in 4E001.a., specially designed or modified for the "development" or "production" of:

1. "Digital computers" having an "Adjusted Peak Performance" ("APP") exceeding 0.04 Weighted TeraFLOPS (WT); or

2. "Electronic assemblies" specially designed or modified for enhancing performance by aggregation of processors so that the "APP" of the aggregation exceeds the limit in 4E001.b.1.;

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.

TECHNICAL NOTE ON "CTP"

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) | 1  if no add is implemented use:  2  If neither add nor multiply is implemented use the fastest available arithmetic operation as follows:  3  See Notes X & Z |
| FP only  (R fp) | 4  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. | 5  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. |

TECHNICAL NOTE ON "CTP"

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:



"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:



6

If the "CE" implements FP reciprocal but not FP add, FP multiply or FP divide, then



7

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.

TECHNICAL NOTE ON "CTP"

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,

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" (Rxp);

Each FP‑only "CE" (Rfp);

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.

TECHNICAL NOTE ON "CTP"

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 (TPfp, TPxp))

"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.c.

"CTP" = TP1 + C2 \* TP2 + ... + Cn \* TP n,

where the TPs are ordered by value, with TP1 being the highest, TP2 being the second highest, ..., and TPn being the lowest. Ci is a coefficient determined by the strength of the interconnection between "CEs", as follows:

For multiple "CEs" operating simultaneously and sharing memory:

C2 = C3 = C4 = ... = Cn = 0.75

TECHNICAL NOTE ON "CTP"

Note 1 When the "CTP" calculated by the above method does not exceed 194Mtops, the following formula may be used to calculate Ci:

 (i = 2,...,n)

where m = the number of "CEs" or groups of "CEs" sharing access.

provided:

1. The TPi of each "CE" or group of "CEs" does not exceed 30Mtops;

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:

Ci = 0.75 \* ki (i = 2, ... , 32) (see Note below)

= 0.60 \* ki (i = 33, ... , 64)

= 0.45 \* ki (i = 65, ... , 256)

= 0.30 \* ki (i > 256)

The value of Ci is based on the number of "CE"s, not the number of nodes.

where ki = min (Si/Kr, 1), and

Kr = normalizing factor of 20 MByte/s.

Si = sum of the maximum data rates (in units of MByte/s) for all data channels connected to the ith "CE" or group of "CEs" sharing memory.

When calculating a Ci for a group of "CEs", the number of the first "CE" in a group determines the proper limit for Ci. 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 Ci for this group is 0.60.

Aggregation (of "CEs" or groups of "CEs") should be from the fastest‑to‑slowest; i.e.:

TP1 > TP2 >.... > TPn , and

in the case of TPi = TPi + 1, from the largest to smallest; i.e.:

Ci > Ci + 1

Note The ki factor is not to be applied to "CEs" 2 to 12 if the TPi of the "CE" or group of "CEs" is more than 50 Mtops; i.e., Ci for "CEs" 2 to 12 is 0.75.

TECHNICAL NOTE ON "ADJUSTED PEAK PERFORMANCE" ("APP")

"APP" is an adjusted peak rate at which "digital computers" perform 64‑bit or larger floating point additions and multiplications.

"APP" is expressed in Weighted TeraFLOPS (WT), in units of 1012 adjusted floating point operations per second

### Abbreviations used in this Technical Note

n number of processors in the "digital computer"

i processor number (i,...n)

ti processor cycle time (ti = 1/Fi)

Fi processor frequency

Ri peak floating point calculating rate

Wi architecture adjustment factor

Outline of "APP " calculation method

1. For each processor i, determine the peak number of 64‑bit or larger floating point operations, FPOi, performed per cycle for each processor in the "digital computer".

Note In determining FPO, include only 64‑bit or larger floating point additions and/or multiplications. All floating point operations must be expressed in operations per processor cycle; operations requiring multiple cycles may be expressed in fractional results per cycle. For processors not capable of performing calculations on floating point operands of 64‑bits or more, the effective calculating rate R is zero.

2. Calculate the floating point rate R for each processor Ri = FPOi/ti.

3. Calculate "APP" as "APP" = W1 x R1 + W2 x R2 + … + Wn x Rn.

4. For "vector processors", Wi = 0.9. For non‑"vector processors", Wi = 0.3.

Note 1 For processors that perform compound operations in a cycle, such as addition and multiplication, each operation is counted.

Note 2 For a pipelined processor the effective calculating rate R is the faster of the pipelined rate, once the pipeline is full, or the non‑pipelined rate.

Note 3 The calculating rate R of each contributing processor is to be calculated at its maximum value theoretically possible before the "APP" of the combination is derived. 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 Do not include processors that are limited to input/output and peripheral functions (e.g., disk drive, communication and video display) when calculating "APP".

TECHNICAL NOTE ON "ADJUSTED PEAK PERFORMANCE" ("APP")

Note 5 "APP" values are not to be calculated for processor 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 6 "APP" values must be calculated for:

1. Processor combinations containing processors specially designed to enhance performance by aggregation, operating simultaneously and sharing memory; or
2. Multiple memory/processor combinations operating simultaneously utilizing specially designed hardware.

Note 7 A "vector processor" is defined as a processor with built‑in instructions that perform multiple calculations on floating‑point vectors (one‑dimensional arrays of 64‑bit or larger numbers) simultaneously, having at least 2 vector functional units and at least 8 vector registers of at least 64 elements each.

**CATEGORY 5 ‑ TELECOMMUNICATIONS AND "INFORMATION SECURITY"**

Part 1 ‑ TELECOMMUNICATIONS

Note 1: The control status of components, "lasers", test and "production" equipment and "software" therefor which are specially designed for telecommunications equipment or systems is determined in Category 5, Part 1.

Note 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, botharising 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 control equipment designed or modified for use 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:

1. 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;

2. Being radio equipment operating in the 1.5 MHzto 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

1. 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 frequency range of 1.5 MHz or more but less than 30 MHz, or 250 W or more in the frequency range of 30 MHz or more but not exceeding 87.5 MHz, over an "instantaneous bandwidth" of one octave or more and with an output harmonic and distortion content of better than ‑80 dB;

3. Being radio equipment employing "spread spectrum" techniques, including "frequency hopping" techniques, not controlled in 5A001.b.4., 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.3.b. does not control radio equipment specially designed for use with civil cellular radio‑communications systems.

Note: 5A001.b.3 does not control equipment designed to operate at an output power of 1.0 Watt or less.

4. Being radio equipment employing ultra‑wideband modulation techniques, having user programmable channelising codes, scrambling codes or network identification codes, having any of the following characteristics:

1. A bandwidth exceeding 500 MHz; or
2. A "fractional bandwidth" of 20% or more;

5. 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.5. does not control radio equipment specially designed for use with civil cellular radio‑communications systems.

6. Employing functions of digital "signal processing" to provide 'voice coding' output at rates of less than 2,400 bit/s.

Technical Notes:

1. For variable rate voice coding, 5A001.b.6. applies to the voice coding output of continuous speech.
2. For the purposes of 5A001.b.6., 'voice coding' is defined as the technique to take samples of human voice and then convert these samples into a digital signal, taking into account specific characteristics of human speech.

c. Optical fibre communication cables, optical fibres and accessories, as follows:

1. Optical fibres of more than 500 m in length, and specified by the manufacturer as being capable of withstanding a proof test tensile stress of 2 x 109 N/m2 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 (20oC) and relative humidity 40%. Equivalent national standards may be used for executing the proof test.

2. Optical fibre cables and accessories designed for underwater use.

Note: 5A001.c.2. does not control standard civil telecommunication cables and accessories.

N.B. 1: For underwater umbilical cables, and connectors therefor, see 8A002.a.3.

N.B. 2: For fibre‑optic hull penetrators or connectors, see 8A002.c.

d. "Electronically steerable phased array antennae" operating above 31.8 GHz.

Note: 5A001.d. does not control "electronically steerable phased array antennae" for landing systems with instruments meeting ICAO standards covering microwave landing systems (MLS).

e. Radio direction finding equipment operating at frequencies above 30 MHz and having all of the following characteristics, and specially designed components therefor:

1. "Instantaneous bandwidth" of 10 MHz or more; and

2. Capable of finding a line of bearing (LOB) to non‑cooperating radio transmitters with a signal duration of less than 1 ms.

f. Jamming equipment specially designed or modified to intentionally and selectively interfere with, deny, inhibit, degrade or seduce cellular mobile telecommunications services, having any of the following characteristics, and specially designed components therefor:

1. Simulating the functions of Radio Access Network (RAN) equipment; or

2. Detecting and exploiting specific characteristics of the mobile telecommunications protocol employed (e.g., GSM).

N.B. For GNSS jamming equipment see ML11.b.

5A101 Telemetering and telecontrol equipment, including ground equipment, designed or modified for 'missiles'.

Technical Note:

*In 5A101 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.*

Note: 5A101 does not control:

a. Equipment designed or modified for manned aircraft or satellites;

b. Ground based equipment designed or modified for terrestrial or marine applications;

c. Equipment designed for commercial, civil or ‘Safety of Life’ (e.g. data integrity, flight safety) GNSS services;

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, functions or features specified in 5A001, 5B001, 5D001 or 5E001.

Note: 5B001.a. does not control optical fibre characterization equipment.

b. Equipment and specially designed components or accessories therefor, specially designed for the "development" of any of the following telecommunication transmission or switching equipment:

1. Equipment employing digital techniques designed to operate at a "total digital transfer rate" exceeding 15 Gbit/s;

Technical Note:

*For switching equipment the "total digital transfer rate" is measured at the highest speed port or line.*

2. Equipment employing a "laser" and having any of the following:

a. A transmission wavelength exceeding 1750 nm;

b. Performing "optical amplification";

c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques); or

d. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;

Note: 5B001.b.2.d. does not control equipment specially designed for the "development" of commercial TV systems.

3. Equipment employing "optical switching";

4. Radio equipment employing quadrature‑amplitude‑modulation (QAM) techniques above level 256; or

5. Equipment employing "common channel signalling" operating in non‑associated mode of operation.

5C1 Materials

None

5D1 Software

5D001 a. "Software" specially designed or modified for the "development", "production" or "use" of equipment, functions or features specified by 5A001 or 5B001;

b. "Software" specially designed or modified to support "technology" specified in 5E001;

c. Specific "software" specially designed or modified to provide characteristics, functions or features of equipment specified in 5A001 or 5B001;

d. "Software" specially designed or modified for the "development" of any of the following telecommunication transmission or switching equipment:

1. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 15 Gbit/s;

Technical Note:

*For switching equipment the "total digital transfer rate" is measured at the highest speed port or line.*

2. Equipment employing a "laser" and having any of the following:

a. A transmission wavelength exceeding 1750 nm; or

b. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;

Note: 5D001.d.2.b. does not control "software" specially designed or modified for the "development" of commercial TV systems.

3. Equipment employing "optical switching"; or

4. Radio equipment employing quadrature‑amplitude‑modulation (QAM) techniques above level 256.

5D101 "Software" specially designed or modified for the "use" of equipment specified in 5A101.

5E1 Technology

5E001 a. "Technology" according to the General Technology Note for the

"development", "production" or "use" (excluding operation) of equipment, functions or features or "software" specified in 5A001, 5B001 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 "development" of digital cellular radio base station receiving equipment whose reception capabilities that allow multi‑band, multi‑channel, multi‑mode, multi‑coding algorithm or multi‑protocol operation can be modified by changes in "software";

4. "Technology" for the "development" of "spread spectrum" techniques, including "frequency hopping" techniques.

c. "Technology" according to the General Technology Note for the "development" or "production" of any of the following telecommunication transmission or switching equipment, functions or features:

1. Equipment employing digital techniques designed to operate at a "total digital transfer rate" exceeding 15 Gbit/s;

Technical Note:

*For switching equipment the "total digital transfer rate" is measured at the highest speed port or line.*

2. Equipment employing a "laser" and having any of the following:

a. A transmission wavelength exceeding 1750 nm;

b. Performing "optical amplification" using praseodymium‑doped fluoride fibre amplifiers (PDFFA);

c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);

d. Employing wavelength division multiplexing techniques exceeding 8 optical carriers in a single optical window; or

e. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;

Note: 5E001.c.2.e. does not control "technology" for the "development" or "production" of commercial TV systems.

3. Equipment employing "optical switching";

4. Radio equipment having any of the following:

a. Quadrature‑amplitude‑modulation (QAM) techniques above level 256; or

b. Operating at input or output frequencies exceeding31.8 GHz; or

Note: 5E001.c.4.b. does not control "technology" for the "development" or "production" of equipment designed or modified for operation in any frequency band which is "allocated by the ITU" for radio‑communications services, but not for radio‑determination.

5. Equipment employing "common channel signalling" operating in non‑associated mode of operation.

5E101 "Technology" according to the General Technology Note for the "development",

"production" or "use" of equipment specified in 5A101.

**Part 2 ‑ "INFORMATION SECURITY"**

Note 1: 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 2even if they are components or "electronic assemblies" of other equipment.

Note 2: Category 5 – Part 2 does not control products when accompanying their user for the user's personal use.

Note 3: Cryptography Note

5A002 and 5D002 do not control goods that meet all of the following:

a. Generally available to the public by being sold, without restriction, from stock at retail selling points by means of any of the following:

1. Over‑the‑counter transactions;

2. Mail order transactions;

3. Electronic transactions; or

4. Telephone call transactions;

1. The cryptographic functionality cannot easily be changed by the user;

c. Designed for installation by the user without further substantial support by the supplier; and

d. When necessary, details of the goods are accessible and will be provided, upon request, to the competent authorities of the Member State in which the exporter is established in order to ascertain compliance with conditions described in paragraphs a. to c. above.

Technical Note:

In Category 5 ‑ Part 2, parity bits are not included in the key length.

**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 performing any cryptographic function other than authentication or digital signature having any of the following:

Technical Notes:

1. Authentication and digital signature functions include their associated key management function.

2. Authentication includes all aspects of access control where there is no encryption of files or text except as directly related to the protection of passwords, Personal Identification Numbers (PINs) or similar data to prevent unauthorised access.

3. "Cryptography" does not include "fixed" data compression or coding techniques.

Note: 5A002.a.1. includes equipment designed or modified to use "cryptography" employing analogue principles when implemented with digital techniques.

a. A "symmetric algorithm" employing a key length in excess of 56 bits; or

b. An "asymmetric algorithm" where the security of the algorithm is based on any of the following:

1. Factorisation of integers in excess of 512 bits (e.g., RSA);

2. Computation of discrete logarithms in a multiplicative group of a finite field of size greater than 512 bits (e.g., Diffie‑Hellman over Z/pZ); or

3. Discrete logarithms in a group other than mentioned in 5A002.a.1.b.2. in excess of 112 bits (e.g., Diffie‑Hellman over an elliptic curve);

2. Designed or modified to perform cryptanalytic functions;

3. Deleted;

4.Specially designed or modified to reduce the compromising emanations of information‑bearing signals beyond what is necessary for health, safety or electromagnetic interference standards;

5.Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" systems, not controlled in 5A002.a.6., including the hopping code for "frequency hopping" systems;

6.Designed or modified to use cryptographic techniques to generate channelising codes, scrambling codes or network identification codes, for systems using ultra‑wideband modulation techniques, having any of the following characteristics:

a. A bandwidth exceeding 500 MHz; or

b. A "fractional bandwidth" of 20% or more.

7.Deleted;

8.Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion;

9. Designed or modified to use "quantum cryptography".

Technical Note:

"Quantum cryptography" is also known as quantum key distribution (QKD).

Note: 5A002 does not control:

a. "Personalised smart cards":

1. Where the cryptographic capability is restricted for use in equipment or systems excluded from control under entries b. to f. of this Note; or

1. For general public‑use applications where the cryptographic capability is not user‑accessible and it is specially designed and limited to allow protection of personal data stored within.

N.B. If a "personalised smart card" has multiple functions, the control status of each function is assessed individually;

b. Receiving equipment for radio broadcast, pay television or similar restricted audience broadcast of the consumer type, without digital encryption except that exclusively used for sending the billing or programme‑related information back to the broadcast providers;

c. Equipment where the cryptographic capability is not user‑accessible and which is specially designed and limited to allow any of the following:

1. Execution of copy‑protected "software";

2. Access to any of the following:

a. Copy‑protected contents stored on read‑only media; or

b. Information stored in encrypted form on media (e.g. in connection with the protection of intellectual property rights) when the media is offered for sale in identical sets to the public;

3. Copying control of copyright protected audio/video data; or

4. Encryption and/or decryption for protection of libraries, design attributes, or associated data for the design of semiconductor devices or integrated circuits;

d. Cryptographic equipment specially designed and limited for banking use or 'money transactions';

Technical Note:

'Money transactions' in 5A002 Note d. includes the collection and settlement of fares or credit functions.

e. Portable or mobile radiotelephones for civil use (e.g. for use with commercial civil cellular radiocommunications systems) that are not capable of end‑to‑endencryption;

f. Cordless telephone equipment not capable of end‑to‑end encryption where the maximum effective range of unboosted cordless operation (i.e. a single, unrelayed hop between terminal and home base station) is less than 400 metres according to the manufacturer's specifications.

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;

1. "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.

**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. Incorporationof 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:

Note 1: The control status of acoustic projectors, including transducers, specially designed for other equipment is determined by the control status of the other equipment.

Note 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/mm2/Hz for devices operating at frequencies below 10 kHz;

2. A continuously radiated 'acoustic power density' exceeding 0.001 mW/mm2/Hz for devices operating at frequencies below 10 kHz; or

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. Side‑lobe suppression exceeding 22 dB;

d. Acoustic systems, equipment and specially designed components for determining the position of surface vessels or underwater vehicles 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;

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.

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 having any of the following characteristics:

Note: The control status of hydrophones specially designed for other equipment is determined by the control status of the other equipment.

1. Incorporating continuous flexible sensing elements;

2. Incorporating flexible assemblies of discrete sensing elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;

3. Having any of the following sensing elements:

a. Optical fibres;

b. 'Piezoelectric polymer films' other than polyvinylidene‑fluoride (PVDF) and its co‑polymers {P(VDF‑TrFE) and P(VDF‑TFE)}; or

c. 'Flexible piezoelectric composites';

1. A 'hydrophone sensitivity' better than ‑180 dB at any depth with no acceleration compensation;
2. When designed to operate at depths exceeding 35 m with acceleration compensation; or
3. Designed for operation at depths exceeding 1,000 m;

Technical Notes:

*1*. *'Piezoelectric polymer film' sensing elements consist of polarised polymer film that is stretched over and attached to a supporting frame or spool (mandrel).*

*2*. *'Flexible piezoelectric composite' sensing elements consist of piezoelectric ceramic particles or fibres combined with an electrically insulating, acoustically transparent rubber, polymer or epoxy compound, where the compound is an integral part of the sensing elements.*

*3*. *'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 havingany of the following:

1. Hydrophone group spacing of less than 12.5 m or 'able to be modified' to have hydrophone group spacing of less than 12.5 m;

2. Designed or 'able to be modified' to operate at depths exceeding 35 m;

Technical Note:

'Able to be modified' in 6A001.a.2.b.1. and 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. Heading sensors specified in 6A001.a.2.d.;

4. Longitudinally reinforced array hoses;

5. An assembled array of less than 40 mm in diameter;

6. 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

7. 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 beam forming 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

1. 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;

e. Bottom or bay cable systems havingany of the following:

1. Incorporating hydrophones specified in 6A001.a.2.a.; or

2. Incorporating multiplexed hydrophone group signal modules having all of the following characteristics:

a. 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; and

b. Capable of being operationally interchanged with towed acoustic hydrophone array modules;

f. 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 beam forming 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.

N.B.: Silicon and other material based microbolometer non "space‑qualified" "focal plane arrays" are only specified in 6A002.a.3.f.

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 12 µm or less; and

3. Any of the following photocathodes:

a. S‑20, S‑25 or multialkali photocathodes with a luminous sensitivity exceeding 350 µA/lm;

b. GaAs or GaInAs photocathodes; or

c. Other III‑V compound semiconductor photocathodes;

Note: 6A002.a.2.a.3.c. does not apply to 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 12 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.

1. Non‑"space‑qualified" "focal plane arrays", as follows:

N.B.: Silicon and other material based microbolometer non "space‑qualified" "focal plane arrays" are only specified in 6A002.a.3.f.

Technical Notes:

1. Linear or two‑dimensional multi‑element detector arrays are referred to as "focal plane arrays";

2. For the purposes of 6A002.a.3. 'cross scan direction' is defined as the axis parallel to the linear array of detector elements and the 'scan direction' is defined as the axis perpendicular to the linear array of detector elements.

Note 1: 6A002.a.3. includes photoconductive arrays and photovoltaic arrays.

Note 2: 6A002.a.3. does not control:

a. Multi‑element (not to exceed 16 elements) encapsulated photoconductive cells using either lead sulphide or lead selenide;

b. Pyroelectric detectors using any of the following:

1. Triglycine sulphate and variants;

2. Lead‑lanthanum‑zirconium titanate and variants;

3. Lithium tantalate;

4. Polyvinylidene fluoride and variants; or

5. Strontium barium niobate and variants.

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" non‑linear (2‑dimensional) "focal plane arrays", havingindividual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

N.B.: Silicon and other material based microbolometer non "space‑qualified" "focal plane arrays" are only specified in 6A.002.a.3.f.

d. Non‑"space‑qualified" linear (1‑dimensional) "focal plane arrays", having all of the following:

1. Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 2,500 nm; and

2. Any of the following:

a. A ratio of scan direction dimension of the detector element to the cross‑scan direction dimension of the detector element of less than 3.8; or

b. Signal processing in the element (SPRITE);

e. Non‑"space‑qualified" linear (1‑dimensional) "focal plane arrays", havingindividual elements with a peak response in the wavelength range exceeding 2,500 nm but not exceeding 30,000 nm.

f. Non‑"space‑qualified" non‑linear (2‑dimensional) infrared "focal plane arrays" based on 'micro‑bolometer' material having individual elements with an unfiltered response in the wavelength range equal to or exceeding 8,000 nm but not exceeding 14,000 nm.

Technical Note:

For the purposes of 6A002.a.3.f. 'micro‑bolometer' is defined as a thermal imaging detector that, as a result of a temperature change in the detector caused by the absorption of infrared radiation, is used to generate any usable signal.

b. "Monospectral imaging sensors" and"multispectral imaging sensors" designed for remote sensing applications, having anyof 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;

1. Equipment specially designed for laboratory use.

d. Special support components for optical sensors, as follows:

1. "Space‑qualified" cryocoolers;

2. Non‑"space‑qualified" cryocoolers, havinga 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.

1. "Space qualified" "focal plane arrays" havingmore 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 and specially designed components therefor, as follows:

Note: Instrumentation cameras, specified in 6A003.a.3. to 6A003.a.5., with modular structures should be evaluated by their maximum capability, using plug‑ins available according to the camera manufacturer's specifications.

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 designed for 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 havingwriting speeds exceeding 10mm/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.

6. Plug‑ins, having all of the following characteristics:

a. Specially designed for instrumentation cameras which have modular structures and which are specified in 6A003.a.; and

b. Enabling these cameras to meet the characteristics specified in 6A003.a.3., 6A003.a.4., or 6A003.a.5., according to the manufacturer's specifications.

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 a peak response in the wavelength range exceeding 10  nm, but not exceeding 30,000 nm and having all of the following:

a. Having any of the following:

1. More than 4 x 106 "active pixels" per solid state array for monochrome (black and white) cameras;

2. More than 4 x 106 "active pixels" per solid state array for colour cameras incorporating three solid state arrays; or

3. More than 12 x 106 "active pixels" for solid state array colour cameras incorporating one solid state array; and

b. Having any of the following:

1. Optical mirrors controlled by 6A004.a.;

2. Optical control equipment controlled by 6A004.d.; or

3. The capability for annotating internally generated camera tracking data.

Technical Notes:

1. For the purpose of this entry, digital video cameras should be evaluated by the maximum number of "active pixels" used for capturing moving images.

2. For the purpose of this entry, camera tracking data is the information necessary to define camera line of sight orientation with respect to the earth. This includes: 1) the horizontal angle the camera line of sight makes with respect to the earth's magnetic field direction and; 2) the vertical angle between the camera line of sight and the earth's horizon.

2. Scanning cameras and scanning camera systems, having all of the following:

a. A peak response in the wavelength range exceeding 10 nm, but not exceeding 30,000 nm;

b. Linear detector arrays with more than 8,192 elements per array; and

c. Mechanical scanning in one direction;

3. Imaging cameras incorporating image intensifier tubes specified in 6A002.a.2.a.;

4. 'Imaging cameras' incorporating "focal plane arrays" having any of the following:

a. Incorporating "focal plane arrays" controlled by 6A002.a.3.a. to 6A002.a.3.e.; or

b. Incorporating "focal plane arrays" controlled by 6A002.a.3.f.

Note 1: 'Imaging cameras' described in 6A003.b.4 include "focal plane arrays" combined with sufficient signal processing electronics, beyond the read out integrated circuit, to enable as a minimum the output of an analogue or digital signal once power is supplied.

Note 2: 6A003.b.4**.**a. does not control imaging cameras incorporating linear "focal plane arrays" with twelve elements or fewer, not employing time‑delay‑and‑integration within the element, designed for any of the following:

a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

b. Industrial equipment used for inspection or monitoring of heat flows in buildings, equipment or industrial processes;

c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. Equipment specially designed for laboratory use; or

e. Medical equipment.

Note 3: 6A003.b.4.b. does not control imaging cameras having any of the following characteristics:

a. A maximum frame rate equal to or less than 9 Hz;

b. Having all of the following:

1. Having a minimum horizontal or vertical Instantaneous‑Field‑of‑View (IFOV) of at least 10 mrad/pixel (milliradians/pixel);

2. Incorporating a fixed focal‑length lens that is not designed to be removed;

3. Not incorporating a 'direct view' display; and

4. Having any of the following:

a. No facility to obtain a viewable image of the detected field‑of‑view, or

b. The camera is designed for a single kind of application and designed not to be user modified; or

c. Where the camera is specially designed for installation into a civilian passenger land vehicle of less than three tonnes (gross vehicle weight) and having all of the following:

1. Is only operable when installed in any of the following:

a. The civilian passenger land vehicle for which it was intended; or

b. A specially designed, authorized maintenance test facility; and

2. Incorporates an active mechanism that forces the camera not to function when it is removed from the vehicle for which it was intended.

Technical Notes:

1. Instantaneous Field of View (IFOV) specified in 6A003.b.4. Note 3.b. is the lesser figure of the Horizontal IFOV or the Vertical IFOV.

Horizontal IFOV = horizontal Field of View (FOV) / number of horizontal detector elements

Vertical IFOV = vertical Field of View (FOV) / number of vertical detector elements.

2. 'Direct view' in 6A003.b.4. Note 3.b. refers to an imaging camera operating in the infrared spectrum that presents a visual image to a human observer using a near‑to‑eye micro display incorporating any light‑security mechanism.

6A004 Optics

a. Optical mirrors (reflectors), as follows:

1. "Deformable mirrors" havingeither 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 havingan average "equivalent density" of less than 30 kg/m2 and a total massexceeding 10 kg;

3. Lightweight "composite" or foam mirror structures havingan average "equivalent density" of less than 30 kg/m2 and a total massexceeding 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) havinga 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 cm3 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. Raw substrates, processed 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 x 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)/s2; or

2. Exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0.5 rad (radians)/s2;

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.

e. 'Aspheric optical elements' having all of the following characteristics:

1. The largest dimension of the optical‑aperture is greater than 400 mm;

2. The surface roughness is less than 1 nm (rms) for sampling lengths equal to or greater than 1 mm; and

3. The coefficient of linear thermal expansion's absolute magnitude is less than 3x10‑6/K at 25°C.

Technical Notes:

1. An 'aspheric optical element' is any element used in an optical system whose imaging surface or surfaces are designed to depart from the shape of an ideal sphere.

2. Manufacturers are not required to measure the surface roughness listed in 6A004.e.2. unless the optical element was designed or manufactured with the intent to meet, or exceed, the control parameter.

Note 6A004.e. does not control aspheric optical elements having any of the following:

a. A largest optical‑aperture dimension less than 1 m and a focal length to aperture ratio equal to or greater than 4.5:1;

b. A largest optical‑aperture dimension equal to or greater than 1 m and a focal length to aperture ratio equal to or greater than 7:1;

c. Being designed as Fresnel, flyeye, stripe, prism or diffractive optical elements;

d. Being fabricated from borosilicate glass having a coefficient of linear thermal expansion greater than 2.5x10‑6 /K at 25 °C; or

e. Being an x‑ray optical element having inner mirror capabilities (e.g. tube‑type mirrors).

N.B. For aspheric optical elements specially designed for lithography equipment, see 3B001.

6A005 "Lasers", not controlled in 0B001.g.5. or 0B001.h.6., components and optical equipment, as follows:

N.B.: SEE ALSO 6A205.

Note 1: Pulsed "lasers" include those that run in a continuous wave (CW) mode with pulses superimposed.

Note 2: Pulse‑excited "lasers" include those that run in a continuously excited mode with pulse excitation superimposed.

Note 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 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 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 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 output power exceeding 30 W;

N.B. For eximer "lasers" specially designed for lithography equipment, see 3B001

2. Metal vapour "lasers", as follows:

a. Copper (Cu) "lasers" havingan average output power exceeding 20 W;

b. Gold (Au) "lasers" havingan average output power exceeding 5 W;

c. Sodium (Na) "lasers" havingan output power exceeding 5 W;

d. Barium (Ba) "lasers" havingan average 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 (CO2) "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 (O2‑I) "lasers";

2. Deuterium Fluoride‑Carbon dioxide (DF‑CO2) "lasers";

6. 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. Semiconductor "lasers", as follows:

1. Individual single‑transverse mode semiconductor "lasers", having any of the following:

a. A wavelength equal to or less than 1,510 nm, and having an average or CW output power exceeding 1.5 W; or

b. A wavelength greater than 1,510 nm, and having an average or CW output power exceeding 500 mW;

2. Individual, multiple‑transverse mode semiconductor "lasers", having any of the following:

a. A wavelength of less than 1,400 nm, and having an average or CW output power exceeding 10 W;

b. A wavelength equal to or greater than 1,400 nm and less than 1,900 nm, and having an average or CW output power exceeding 2.5 W; or

1. A wavelength equal to or greater than 1,900 nm and having an average or CW output power exceeding 1 W.

3. Individual semiconductor "laser" arrays, having any of the following:

a. A wavelength of less than 1,400 nm, and having an average or CW output power exceeding 80 W;

b. A wavelength equal to or greater than 1,400 nm and less than 1,900 nm, and having an average or CW output power exceeding 25 W; or

c. A wavelength equal to or greater than 1,900 nm, and having an average or CW output power exceeding 10 W.

4. Array stacks of semiconductor "lasers" containing at least one array that is controlled under 6A005.b.3.

Technical Notes:

1. Semiconductor "lasers" are commonly called "laser" diodes.

2. An 'array' consists of multiple semiconductor "laser" emitters fabricated as a single chip so that the centres of the emitted light beams are on parallel paths.

3. An 'array stack' is fabricated by stacking, or otherwise assembling, 'arrays' so that the centres of the emitted light beams are on parallel paths.

Note 1: 6A005.b. includes semiconductor "lasers" having optical output connectors (e.g. fibre optic pigtails).

Note 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: Al2O3  ), thulium ‑ YAG (Tm: YAG), thulium ‑ YSGG (Tm: YSGG), alexandrite (Cr: BeAl2O4 ) 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

1. 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‑transverse mode "lasers";

b. 30 W for multiple‑transverse mode "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:

N.B.: For shared aperture optical elements, capable of operating in "Super‑High Power Laser" ("SHPL") applications, see ML19.a.

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 andcomponents 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", underwater electric field sensors and compensation systems, and specially designed components therefor, as follows:

Note: 6A006 does not control instruments specially designed for fishery applications or biomagnetic measurements for medical diagnostics.

a. "Magnetometers" and subsystems as follows:

1. Using "superconductive" (SQUID) "technology" and having any of the following characteristics:

a. SQUID systems designed for stationary operation, without specially designed subsystems designed to reduce in‑motion noise, and having a "noise level" (sensitivity) equal to or lower (better) than 50 fT (rms) per square root Hz at a frequency of 1 Hz; or

b. SQUID systems having an in‑motion‑magntometer "noise level" (sensitivity) lower (better) than 20 pT (rms) per square root Hz at a frequency of 1 Hz and specially designed to reduce in‑motion noise;

2. Using optically pumped or nuclear precession (proton/Overhauser) "technology" having a "noise level" (sensitivity) lower (better) than 20 pT (rms) per square root Hz;

3. Using fluxgate "technology" having a "noise level" (sensitivity) equal to or lower (better) than 10 pT (rms) per square root Hz at a frequency of 1 Hz;

4. Induction coil "magnetometers" having a "noise level" (sensitivity) lower (better) than any of the following:

a. 0.05 nT (rms) per square root Hz at frequencies of less than 1 Hz;

b. 1 x 10‑3 nT (rms) per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or

c. 1 x 10‑4 nT (rms) per square root Hz at frequencies exceeding 10 Hz;

5. Fibre optic "magnetometers" having a "noise level" (sensitivity) lower (better) than 1 nT (rms) per square root Hz;

b. Underwater electric field sensors having a "noise level" (sensitivity) lower (better) than 8 nanovolt per metre per square root Hz when measured at 1 Hz;

c. "Magnetic gradiometers", as follows:

1. "Magnetic gradiometers" using multiple "magnetometers" specified in 6A006.a.;

2. 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;

3. "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;

d. Compensation systems for magnetic or underwater electric field sensors resulting in a performance equal to or better than the control parameters of 6A006.a., 6A006.b. or 6A006.c.

6A007 Gravity meters (gravimeters) and gravity gradiometers, as follows:

N.B.: SEE ALSO 6A107.

a. Gravity meters designed or modified 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 designed for mobile platforms, 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);

1. 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', not controlled in 6A002, specially designed or modified for 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 x 105 rads (silicon).

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. This includes devices that sense by one time operation or failure.

6A107 Gravity meters (gravimeters) and components for gravity meters and gravity gradiometers,

as follows:

a. Gravity meters, not controlled in 6A007.b, designed or modified for airborne or marine use, and having a static or operational accuracy of 7 x 10‑6  m/s2 (0.7 milligal) or less (better), and having a time‑to‑steady‑state registration of two minutes or less;

b. Specially designed components for gravity meters specified in 6A007.b or 6A107.a. and gravity gradiometers specified in 6A007.c.

6A108 Radar systems and tracking systems, not controlled in entry 6A008, as follows:

1. Radar and laser radar systems designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104;

Note: 6A108.a. includes the following:

a. Terrain contour mapping equipment;

b. Imaging sensor equipment;

c. Scene mapping and correlation (both digital and analogue) equipment;

1. Doppler navigation radar equipment.

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.

Technical Note:

*In 6A108*.*b. 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.*

6A202 Photomultiplier tubes having both of the following characteristics:

a. Photocathode area of greater than 20 cm2; and

b. Anode pulse rise time of less than 1 ns.

6A203 Cameras and components, not controlled 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;

2. Streak cameras with writing speeds greater than 0.5 mm per microsecond;

Note: In 6A203.a. components of such cameras include their synchronizing electronics units and rotor assemblies consisting of turbines, mirrors and bearings.

b. Electronic streak cameras, electronic framing cameras, tubes and devices, as follows:

1. Electronic streak cameras capable of 50 ns or less time resolution;

2. Streak tubes for cameras specified in 6A203.b.1.;

3. Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;

4. Framing tubes and solid‑state imaging devices for use with cameras specified in 6A203.b.3., 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 Pockels cell electro‑optical shuttering;

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.3.;

c. Radiation‑hardened TV cameras, or lenses therefor, specially designed or rated as radiation hardened to withstand a total radiation dose greater than 50 x 103 Gy(silicon) (5 x 106 rad (silicon)) without operational degradation.

Technical Note:

The term Gy (silicon) refers to the energy in Joules per kilogram absorbed by an unshielded silicon sample when exposed to ionising radiation.

6A205 "Lasers", "laser" amplifiers and oscillators, not controlled in 0B001.g.5., 0B001.h.6. and 6A005; as follows:

a. Argon ion "lasers" having both of the following characteristics:

1. Operating at wavelengths between 400 nm and 515 nm; and

2. An average output power greater than 40 W;

b. Tunable pulsed single‑mode dye laser oscillators having all of the following characteristics:

1. Operating at wavelengths between 300 nm and 800 nm;

2. An average output power greater than 1 W;

3. A repetition rate greater than 1 kHz; and

4. Pulse width less than 100 ns;

c. Tunable pulsed dye laser amplifiers and oscillators, having all of the following characteristics:

1. Operating at wavelengths between 300 nm and 800 nm;

2. An average output power greater than 30 W;

3. A repetition rate greater than 1 kHz; and

4. Pulse width less than 100 ns;

Note: 6A205.c. does not control single mode oscillators;

d. Pulsed carbon dioxide "lasers" having all of the following characteristics:

1. Operating at wavelengths between 9,000 nm and 11,000 nm;

2. A repetition rate greater than 250 Hz;

3. An average output power greater than 500 W; and

4. Pulse width of less than 200 ns;

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 characteristics:

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 exceeding 1 km/s during time

intervals of less than 10 microseconds.

Note: 6A225 includes velocity interferometers such as VISARs (Velocity interferometer systems for any reflector) and DLIs (Doppler laser interferometers).

6A226 Pressure sensors, as follows:

a. Manganin gauges for pressures greater than 10 GPa;

b. Quartz pressure transducers for pressures greater than 10 GPa.

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, not controlled in 6B008, specially designed for radar cross section measurement usable for "missiles" and their subsystems.

6C Materials

6C002 Optical sensor materials, as follows:

a. Elemental tellurium (Te) of purity levels of 99.9995% or more;

b. Single crystals (including epitaxial wafers) of any of the following:

1. Cadmium zinc telluride (CdZnTe), with zinc content of less than 6% by 'mole fraction';

2. Cadmium telluride (CdTe) of any purity level; or

3. Mercury cadmium telluride (HgCdTe) of any purity level.

Technical Note:

'Mole fraction' is defined as the ratio of moles of ZnTe to the sum of moles of CdTe and ZnTe present in the crystal.

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 cm3; 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 (AgGaSe2 );

3. Thallium arsenic selenide (Tl3AsSe3, also known as TAS);

c. Non‑linear optical materials, having all of the following:

1. Third order susceptibility (chi 3) of 10‑6 m2/V2 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 (ZrF4 ) and hafnium fluoride (HfF4 ), 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 x 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 acoustic beam forming for "real time processing" of acoustic data for passive reception using bottom or bay cable systems;

4. "Source code" for "real time processing" of acoustic data for passive reception using bottom or bay cable systems;

b. 1. "Software" specially designed for magnetic and electric field compensation systems for magnetic and electric field sensors designed to operate on mobile platforms;

2. "Software" specially designed for magnetic and electric field 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 "programs" 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 or modified for the "use" of goods specified in 6A108.

6D103 "Software" which processes post‑flight, recorded data, enabling determination of vehicle position throughout its flight path, specially designed or modified for 'missiles'.

Technical Note:

*In 6D103 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.*

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 x 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 m2;

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;

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.

**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 Linear 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. For angular or rotational accelerometers, see 7A002.

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, and angular or rotational accelerometers, 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 one month 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 12 g; or

2. Less (better) than 0.5° per hour when specified to function at linear acceleration levels from 12 g to 100 g inclusive; or

b. An angle random walk of less (better) than or equal to 0.0035° per square root hour; or

Note: 7A002.b. does not control spinning mass gyros (spinning mass gyros are gyros which use a continually rotating mass to sense angular motion).

Technical Note:

For the purposes of 7A002.b., 'angle random walk' is the angular error buildup with time that is due to white noise in angular rate. (IEEE STD 528‑2001)

c. Specified to function at linear acceleration levels exceeding 100 g.

7A003 Inertial Systems and specially designed components, as follows:

N.B.: SEE ALSO 7A103.

1. Inertial navigation systems (INS) (gimballed or strapdown) and inertial equipment designed for "aircraft", land vehicle, vessels (surface or underwater) or "spacecraft" for attitude, guidance or control, having any of the following characteristics, and specially designed components therefor:

1. Navigation error (free inertial) subsequent to normal alignment of 0.8 nautical mile per hour (nm/hr) 'Circular Error Probable' (CEP) or less (better); or

2. Specified to function at linear acceleration levels exceeding 10 g;

b. Hybrid Inertial Navigation Systems emebedded with Global Navigation Satellite Systems(s) (GNSS) or with "Data‑Based Referenced Navigation" ("DBRN") System(s) for attitude, guidance or control, subsequent to normal alignment, having an INS navigation position accuracy, after loss of GNSS or "DBRN" for a period of up to four minutes, of less (better) than 10 metres 'Circular Error Probable' (CEP).

c. Inertial Equipment for Azimuth, Heading, or North Pointing having any of the following characteristics, and specially designed components therefor:

1. Designed to have an Azimuth, Heading, or North Pointing accuracy equal to, or less (better) than 6 arc minutes RMS at 45 degrees latitude; or

2. Designed to have a non‑operating shock level of 900 g or greater at a duration of 1 msec, or greater.

Note 1: The parameters of 7A003.a. and 7A003.b. 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 g2/Hz over a frequency interval of 15 to 1,000 Hz; and

b. The PSD attenuates with frequency from 0.04 g2/Hz to 0.01 g2/Hz over a frequency interval from 1,000 to 2,000 Hz;

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.

Note 2: 7A003 does not control inertial navigation systems which are certified for use on "civil aircraft" by civil authorities of a "participating state".

*Note 3: 7A003*.*c.1. does not control theodolite systems incorporating inertial equipment specially designed for civil surveying purposes.*

Technical Notes:

1. 7A003.b. refers to systems in which an INS and other independent navigation aids are built into a single unit (embedded) in order to achieve improved performance.

2. 'Circular Error Probable' (CEP) – In a circular normal distribution, the radius of the circle containing 50 percent of the individual measurements being made, or the radius of the circle within which there is a 50 percent probability of being located.

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, not controlled in 7A001, as follows, and specially designed components therefor:

a. Linear accelerometers, designed for use in inertial navigation systems or in guidance systems of all types, usable in 'missiles', having all the following characteristics, and specially designed components therefor;

1. A "bias" 'repeatability' of less (better) than 1250 micro g; and

2. A "scale factor" 'repeatability' of less (better) than 1250 ppm;

Note: 7A101.a. does not specify accelerometers which are specially designed and developed as MWD (Measurement While Drilling) Sensors for use in downhole well service operations.

Technical Notes:

1. In 7A101.a. 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km;
2. In 7A101.a. the measurement of "bias" and "scale factor" refers to a one sigma standard deviation with respect to a fixed calibration over a period of one year;
3. In 7A101.a. 'repeatability' is defined according to IEEE standard 528‑2001 as the closeness of agreement among repeated measurements of the same variable under the same operating conditions when changes in conditions or non‑operating periods occur between measurements.

b. Continuous output accelerometers specified to function at acceleration levels exceeding 100g.

7A102 All types of gyros, not controlled 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.

Technical Note:

In 7A102 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

7A103 Instrumentation, navigation equipment and systems, not controlled in 7A003, as follows; and specially designed components therefor:

a. Inertial or other equipment using accelerometers specified in 7A001 or 7A101 or gyros specified in 7A002 or 7A102 and systems incorporating such equipment;

Note: 7A103.a. does not specify equipment containing accelerometers specified in 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 space launch vehicles specified in 9A004, unmanned aerial vehicles specified in 9A012 or sounding rockets specified in 9A104;

c. 'Integrated navigation systems', designed or modified for 'missiles' and capable of providing a navigational accuracy of 200m Circle of Equal Probability (CEP) or less.

Technical Notes:

1. An 'integrated navigation system' typically incorporates the following components:

a. An inertial measurement device (e.g., an attitude and heading reference system, inertial reference unit, or inertial navigation system);

b. One or more external sensors used to update the position and/or velocity, either periodically or continuously throughout the flight (e.g., satellite navigation receiver, radar altimeter, and/or Doppler radar); and

c. Integration hardware and software;

2. In 7A103.c. 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

7A104 Gyro‑astro compasses and other devices, not controlled in 7A004, which derive position or orientation by means of automatically tracking celestial bodies or satellites and specially designed components therefor.

7A105 Receiving equipment for Global Navigation Satellite Systems (GNSS; e.g. GPS,

GLONASS, or Galileo), having any of the following characteristics, and specially designed components therefor:

a. Designed or modified for use in space launch vehicles specified in 9A004, unmanned aerial vehicles specified in 9A012 or sounding rockets specified in 9A104; or

b. Designed or modified for airborne applications and having any of the following:

1. Capable of providing navigation information at speeds in excess of 600 m/s (1,165 nautical miles/hour);

2. Employing decryption, designed or modified for military or governmental services, to gain access to GNSS secured signal/data; or

3. Being specially designed to employ anti‑jam features (e.g. null steering antenna or electronically steerable antenna) to function in an environment of active or passive countermeasures.

*Note: 7A105*.*b.2. and 7A105.b.3. do not control equipment designed for commercial, civil or 'Safety of Life' (e.g., data integrity, flight safety) GNSS services.*

7A106 Altimeters, not controlled in 7A006, of radar or laser radar type, designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

7A115 Passive sensors for determining bearing to specific electromagnetic source (direction finding equipment) or terrain characteristics, designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

Note: 7A115 includes sensors for the following equipment:

a. Terrain contour mapping equipment;

b. Imaging sensor equipment (both active and passive);

c. Passive interferometer equipment.

7A116 Flight control systems and servo valves, as follows; designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

a. Hydraulic, mechanical, electro‑optical, or electro‑mechanical flight control systems (including fly‑by‑wire types);

b. Attitude control equipment;

c. Flight control servo valves designed or modified for the systems specified in 7A116.a. or 7A116.b., and designed or modified to operate in a vibration environment greater than 10 g rms between 20 Hz and 2 kHz.

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.

Note: 7B003 includes:

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 "Production facilities" and "production equipment" as follows:

a. "Production facilities" specially designed for equipment specified in 7A117;

b. Production equipment, and other test, calibration and alignment equipment, other than that specified in 7B001 to 7B003, designed or modified to be used with equipment specified in 7A.

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, including inertial equipment not controlled by 7A003 or 7A004, or Attitude and Heading Reference Systems (AHRS).

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:

1. Doppler radar velocity data;

2. Global navigation satellite systems (i.e., GPS or GLONASS) reference data; or

3. Data from "Data‑Based Referenced Navigation" ("DBRN") systems;

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 or modified for the "use" of equipment specified in 7A001 to 7A006, 7A101 to 7A106, 7A115, 7A116.a., 7A116.b., 7B001, 7B002, 7B003, 7B102 or 7B103.

7D102 Integration "software" as follows:

a. Integration "software" for the equipment specified in 7A103.b.;

b. Integration "software" specially designed for the equipment specified in 7A003 or 7A103.a.;

c. Integration "software" designed or modified for the equipment specified in 7A103.c.

*Note: A common form of integration "software" employs Kalman filtering.*

7D103 "Software" specially designed for modelling or simulation of the "guidance sets"

specified in 7A117 or for their design integration with the space launch vehicles specified in 9A004 or sounding rockets specified in 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.

1. 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:

a. "Development" "technology" for integration of digital flight control, navigation and propulsion control data into a digital flight management system for "flight path optimisation";

b. "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, 7B001, 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 7E102.a. and 7E102.b.

7E104 "Technology" for the integration of the flight control, guidance, and propulsion data into a flight management system for optimization of rocket system trajectory.

**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 ofall 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' meanshalf 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

1. 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 designdraught)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 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 800lines 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 containingall 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 mhaving 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;

Note: 8A002.f. does not control digital cameras specially designed for consumer purposes, other than those employing electronic image multiplication techniques.

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 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 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 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:

1. 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 designedfor 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 designedfor 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.

Note: 8A002.q. does not control an individual apparatus for personal use when accompanying its user.

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' designedfor underwater use, having all of the following:

a. Designed for marine depths exceeding 1,000 m; and

b. A density less than 561 kg/m3.

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.

**CATEGORY 9 ‑ PROPULSION SYSTEMS, SPACE VEHICLES AND RELATED EQUIPMENT**

9A Systems, Equipment and Components

N.B.: For propulsion systems designed or rated against neutron or transient ionizing radiation, see ML12.

9A001 Aero gas turbine engines having any of the following:

N.B.: SEE ALSO 9A101.

a. Incorporating any of the "technologies" specified in 9E003.a.; or

Note: 9A001.a. does not control aero gas turbine engines which meet all of the following:

a. Certified by the civil aviation authority in a "participating state"; and

b. Intended to power non‑military manned aircraft for which one of the following has been issued by a "participating state" for the aircraft with this specific engine type:

1. A civil Type Certificate; or
2. An equivalent document recognized by the International Civil Aviation Organisation (ICAO).

b. Designed to power an aircraft to cruise at Mach 1 or higher 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 the following gas turbine engine propulsion systems:

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**.

Note: 9A004 does not control payloads.

N.B.: 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, 9A108 and 9A120.

1. 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 x 10‑3 cm2 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/cm3 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.

1. 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°/s2 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.

9A012 "Unmanned aerial vehicles" ("UAVs"), associated systems, equipment and components as follows:

a. "UAVs" having any of the following:

1. An autonomous flight control and navigation capability (e.g., an autopilot with an Inertial Navigation System); or
2. Capability of controlled‑flight out of the direct vision range involving a human operator (e.g., televisual remote control).

b. Associated systems, equipment and components as follows:

1. Equipment specially designed for remotely controlling the "UAVs" specified in 9A012.a.;
2. Guidance or control systems, not controlled in 7A, specially designed for integration into "UAVs" specified in 9A012.a.;
3. Equipment and components specially designed to convert a manned "aircraft" to a "UAV" specified in 9A012.a.

9A101 Lightweight turbojet and turbofan engines (including turbocompound engines), not controlled in 9A001, as follows:

a. Engines having both of the following characteristics:

1. Maximum thrust value greater than 400 N (achieved un‑installed) excluding civil certified engines with a maximum thrust value greater than 8,890 N (achieved un‑installed); and

2. Specific fuel consumption of 0.15 kg/N/hr or less (at maximum continuous power at sea level static and standard conditions);

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", not controlled in 9A005, having a total impulse capacity equal to or greater than 1.1 MNs;

b. Liquid propellant rocket engines, usable in complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, not controlled in 9A005 or 9A105.a., having a total impulse capacity equal to or greater than of 0.841 MNs.

9A106 Systems or components, not controlled 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 greater than 10 g rms between 20 Hz and 2 kHz.

Note: The only servo valves and pumps specified in 9A106.d., are the following:

a. Servo valves designed for flow rates equal to or greater than 24 litres per minute, at an absolute pressure equal to or greater than 7 MPa, 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 complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, not controlled in 9A007, having total impulse capacity equal to or greater than 0.841 MNs.

N.B.: SEE ALSO 9A119.

9A108 Components, not controlled in 9A008, usable in "missiles", as follows, specially designed for solid rocket propulsion systems:

a. Rocket motor cases and "insulation" components 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', not controlled in 9A009, and specially designed components therefor.

N.B.: SEE ALSO 9A119.

Technical Note:

In 9A109 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9A110 Composite structures, laminates and manufactures thereof, not controlled in 9A010, specially designed for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104 or the subsystems specified in 9A005, 9A007, 9A105.a., 9A106 to 9A108, 9A116 or 9A119.

N.B.: SEE ALSO 1A002.

9A111 Pulse jet engines, usable in "missiles", and specially designed components therefor.

N.B.: SEE ALSO 9A011 and 9A118.

9A115 Launch support equipment as follows:

a. Apparatus and devices for handling, control, activation or launching, designed or modified for space launch vehicles specified in 9A004, unmanned aerial vehicles specified in 9A012 or sounding rockets specified in 9A104;

b. Vehicles for transport, handling, control, activation or launching, designed or modified for space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

9A116 Reentry vehicles, usable in "missiles", and equipment designed or modified therefor, as follows:

a. Reentry vehicles;

1. 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 complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, not controlled in 9A005, 9A007, 9A009, 9A105, 9A107 and 9A109.

9A120 Liquid propellant tanks, not controlled in 9A006, specially designed for propellants specified in 1C111 or 'other liquid propellants', used in rocket systems capable of delivering at least a 500 kg payload to a range of at least 300 km.

Note: In 9A120 'other liquid propellants' includes, but is not limited to, propellants specified in ML8.b.

9A350 Spraying or fogging systems, specially designed or modified for fitting to aircraft, "lighter‑than‑air vehicles" or unmanned aerial vehicles, and specially designed components therefor, as follows:

1. Complete spraying or fogging systems capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 µm at a flow rate of greater than two litres per minute;
2. Spray booms or arrays of aerosol generating units capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 µm at a flow rate of greater than two litres per minute;
3. Aerosol generating units specially designed for fitting to systems specified in 9A350.a. and b.

Note: Aerosol generating units are devices specially designed or modified for fitting to aircraft such as nozzles, rotary drum atomizers and similar devices.

Note: 9A350 does not control spraying of fogging systems and components that are demonstrated not to be capable of delivering biological agents in the form of infectious aerosols.

Technical Notes:

1. Droplet size for spray equipment or nozzles specially designed for use on aircraft, "lighter‑than‑air vehicles" or unmanned aerial vehicles should be measured using either of the following:

*a. Doppler laser method;*

1. *Forward laser diffraction method.*

2. In 9A350 'VMD' means Volume Median Diameter and for water‑based systems this equates to Mass Median Diameter (MMD).

9B Test, Inspection and Production Equipment

9B001 Specially designed equipment, tooling and fixtures, as follows, for manufacturing gas turbine blades, vanes or tip shroud castings:

a. Directional solidification or single crystal casting equipment;

b. Ceramic cores or shells;

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 x 106.

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.

9B010 Equipment specially designed for the production of "UAVs" and associated systems, equipment and components specified in 9A012.

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 equal to or greater than 10 g rms, measured 'bare table', between 20 Hz and 2 kHz imparting forces equal to or greater than 5 kN; and

2. Altitude equal to or greater than 15 km; or

3. Temperature range of at least 223 K (‑50oC) to 398 K (+ 125oC);

Technical Notes:

1. 9B106.a. describes systems that are capable of generating a vibration environment with a single wave (e.g., a sine wave) and systems capable of generating a broad band random vibration (i.e., power spectrum);
2. In 9B106.a.1. 'bare table' means a flat table, or surface with no fixture or fittings.

b. Environmental 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 µPa) or with a total rated acoustic power output of 4 kW or greater; and

2. Altitude equal to or greater than 15 km; or

3. Temperature range of at least 223 K (‑50oC) to 398 K (+ 125oC).

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 space launch vehicles specified in 9A004, or systems, sub‑systems, and components specified in 9A005 to 9A009, 9A011, 9A101, 9A104 to 9A109, 9A111, or 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

9C108 "Insulation" material in bulk form and "interior lining", not controlled in 9A008, for rocket motor cases usable in "missiles" or specially designed for 'missiles'.

Technical Note:

In 9C108 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9C110 Resin impregnated fibre prepregs and metal coated fibre preforms therefor, for composite structures, laminates and manufactures specified in 9A110, made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a "specific tensile strength" greater than 7.62 x 104 m and a "specific modulus" greater than 3.18 x 106 m.

N.B.: SEE ALSO 1C010 and 1C210.

Note: The only resin impregnated fibre prepregs specified in entry 9C110 are those using resins with a glass transition temperature (Tg), after cure, exceeding 418 K (145oC) as determined by ASTM D4065 or equivalent.

9D Software

9D001 "Software" specially designed or modified for the "development" of equipment or "technology" specified in 9A001 to 9A119, 9B or 9E003.

9D002 "Software" specially designed or modified for the "production" of equipment specified in 9A001 to 9A119 or 9B.

9D003 "Software" specially designed or modified 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.

e. "Software" specially designed or modified for the "use" of "UAVs" and associated systems, equipment and components specified by 9A012.

9D101 "Software" specially designed or modified for the "use" of goods specified in 9B105, 9B106, 9B116 or 9B117.

9D103 "Software" specially designed for modelling, simulation or design integration of the space launch vehicles specified in 9A004 or sounding rockets specified in 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.

9D104 "Software" specially designed or modified for the "use" of goods specified in 9A001, 9A005, 9A006.d., 9A006.g., 9A007.a., 9A008.d., 9A009.a., 9A010.d., 9A011, 9A101, 9A105, 9A106.c., 9A106.d., 9A107, 9A108.c., 9A109, 9A111, 9A115.a., 9A116.d., 9A117 or 9A118.

9D105 "Software" which coordinates the function of more than one subsystem, specially designed or modified for "use" in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

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 9A012, 9A350, 9B or 9D.

9E002 "Technology" according to the General Technology Note for the "production" of

equipment specified in 9A001.c., 9A004 to 9A011, 9A350 or 9B.

N.B.: 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 ofthe 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 any of the following:

a. Organic "composite" materials designed to operate above 588 K (315°C);

b. Metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials specified in 1C007; or

c. "Composite" material specified in 1C010 and manufactured with resins specified in 1C008.

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" specified in 2E003.b.;

8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials specified in 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;

Note 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.

Note 2: 9E003.a.10. does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.

11. Hollow fan blades.

b. "Technology" "required" for the "development" or "production" ofany 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

1. "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 the "development" or "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems;

e. "Technology" for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

1. A 'box volume' of 1.2 m3 or less;

2. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; and

3. A power density of more than 700 kW/m3 of 'box volume';

Technical Note:

'Box volume' in 9E003.e. is 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.

f. "Technology" "required" for the "production" of specially designed components, as follows, for high output diesel engines:

1. "Technology" "required" for the "production" of engine systems having all of the following components employing ceramics materials specified in 1C007:

a. Cylinder liners;

b. Pistons;

c. Cylinder heads; and

d. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

2. "Technology" "required" for the "production" of turbocharger systems, with single‑stage compressors having all of the following:

a. Operating at pressure ratios of 4:1 or higher;

b. A mass flow in the range from 30 to 130 kg per minute; and

c. Variable flow area capability within the compressor or turbine sections;

3. "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:

a. Injection amount in excess of 230 mm3 per injection per cylinder; and

b. 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;

g. "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 space launch vehicles specified in 9A004, or goods specified in 9A005 to 9A011, 9A101, 9A104 to 9A111, 9A115 to 9A119, 9B105, 9B106, 9B115, 9B116, 9B117, 9D101 or 9D103.

**SENSITIVE LIST OF DUAL‑USE GOODS AND TECHNOLOGIES**

*Note This List contains a sub‑set of the Items controlled in Categories 1 to 9 of the Part 2 List of Dual‑Use Goods and Technologies. The items in this List are considered to be sensitive, requiring additional care in their transfer. General Export Licences are generally not available for the export of the following sensitive goods.*

*N.B. Where abbreviated entries are used, see Part 2 for full details. Text that differs from that in Part 2 is in* ***bold type****.*

|  |  |
| --- | --- |
| Category 1 |  |
|  |  |
| 1A002 | "Composite" structures or laminates... |
|  |  |
| 1C001 | Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers.  NB : SEE ALSO 1C101 |
|  |  |
| 1C007.c. & 1C007.d. | Ceramic‑ceramic "composite" materials... |
| 1C010.c. & 1C010.d. | Fibrous or filamentary materials... |
| 1C012 | Materials as follows... |
|  |  |
| 1C101 | Materials or devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures; not controlled in 1C001, usable in 'missiles', "missile" subsystems or "unmanned aerial vehicles" specified in 9A012. |
|  |  |
| 1C239 | High explosives, not controlled in the Munitions List, or substances or mixtures containing more than 2% thereof, with a crystal density greater than 1.8 gm per cm³ and having a detonation velocity greater than 8000 m/s. |
|  |  |
| 1D002 | "Software" for the "development" of organic "matrix", metal "matrix" or carbon "matrix" laminates or "composites" **listed in this List.** |
|  |  |
| 1D103 | "Software" specially designed for analysis of reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures. |
|  |  |
| 1E001 | "Technology" according to the General Technology Note for the "development" or "production" of equipment and materials in **1A002 or 1C of this List.** |
|  |  |
| 1E002.e. & 1E002.f. | Other "technology"... |
| 1E101 | "Technology" according to the GTN for the "use" of goods specified in 1C101 or 1D103. |
|  |  |
| 1E102 | "Technology" according to the GTN for the "development" of "software" specified in 1D103. |
|  |  |
| 1E201 | "Technology" according to the General Technology Note for the "use" of goods specified in 1C239. |
|  |  |
| Category 2 |  |
|  |  |
| 2B001.a. | Deleted |
| 2B001.b. | Deleted |
| 2B001.d. | Deleted |
| 2B001.f. | Deleted |
|  |  |
| 2B003 | Deleted |
|  |  |
| 2D001 | **"Software", other than that controlled by 2D002, specially designed for the "development" or "production" of the following equipment:**  a. Machine tools for turning, having all of the following characteristics:  1. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;and  2. Two or more axes which can be coordinated simultaneously for "contouring control".  b. Machine tools for milling, having any of the following characteristics:  1.a. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;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" **and have a positioning accuracy with "all compensations available" equal to or less (better) than 3.6 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;** or  3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than 3 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;  c. Electrical discharge machines (EDM)....  d. Deep‑hole‑drilling machines....  e. "Numerically controlled" or manual machine tools... |
|  |  |
| 2E001 | **"Technology" according to the General Technology Note for the "development" of equipment or "software" in 2D of this List or for the "development" of the following equipment:**  a. Machine tools for turning, having all of the following characteristics:  1. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;and  2. Two or more axes which can be coordinated simultaneously for "contouring control".  b. Machine tools for milling, having any of the following characteristics:  1.a. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;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" **and have a positioning accuracy with "all compensations available" equal to or less (better) than 3.6 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;** or  3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than 3 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;  c. Electrical discharge machines (EDM)....  d. Deep‑hole‑drilling machines....  e. "Numerically controlled" or manual machine tools... |
| 2E002 | **"Technology" according to the General Technology Note for the "production" of the following equipment:**  a. Machine tools for turning, having all of the following characteristics:  1. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;and  2. Two or more axes which can be coordinated simultaneously for "contouring control".  b. Machine tools for milling, having any of the following characteristics:  1.a. Positioning accuracy with "all compensations available" equal to or less (better) than **3.6 µm** according to ISO 230/2 (1997) or national equivalents along any linear axis;and  b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";   1. Five or more axes which can be coordinated simultaneously for "contouring control" **and have a positioning accuracy with "all compensations available" equal to or less (better) than 3.6 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;** or   3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than 3 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;  c. Electrical discharge machines (EDM)....  d. Deep‑hole‑drilling machines....  e. "Numerically controlled" or manual machine tools... |
|  |  |
| Category 3 |  |
|  |  |
| 3A002.g.2. | Atomic frequency standards.... |
|  |  |
| 3A229 | Firing sets and equivalent high‑current pulse generators, as follows…  NB : SEE ALSO ML4.a.,b., ML909 |
| 3A232 | Detonators and multipoint initiation systems, as follows…  NB : SEE ALSO ML4.a. |
|  |  |
| 3B001.a.2. | Metal organic chemical vapour deposition reactors.... |
|  |  |
| 3D001 | "Software" specially designed for the "development" or "production" of equipment in **3A002.g. or 3B of this List.** |
| 3E001 | "Technology" according to the General Technology Note for the "development" or "production" of equipment in **3A or 3B of this List.** |
|  |  |
| 3E201 | "Technology" according to the General Technology Note for the "use" of equipment specified in 3A229 or 3A232. |
|  |  |
| Category 4 |  |
|  |  |
| 4A001.a.2. | Electronic computers......radiation hardened; |
|  |  |
| 4A003.b. | Deleted |
| 4A003.c. | Deleted |
|  |  |
| 4D001 | **"Software" specially designed for the "development" or "production" of equipment in 4A of this List or for the "development" or "production" of "digital computers" having an "Adjusted Peak Performance" ("APP") exceeding 0.1 Weighted TeraFLOPS (WT).** |
|  |  |
| 4E001 | **"Technology" according to the General Technology Note for the "development" or "production" of the following equipment or "software":**  **- Equipment in 4A of this List;**  **- "Digital computers" having an "Adjusted Peak Performance" ("APP") exceeding 0.1 Weighted TeraFLOPS (WT); or**  **- "Software" in 4D of this List.** |
|  |  |
| Category 5 ‑ Part 1 |  |
|  |  |
| 5A001.b.3. | Being radio equipment ....... |
| 5A001.b.5. | Being digitally controlled radio receivers... |
|  |  |
| 5B001.a. | Equipment and specially designed components or accessories therefor, specially designed for the "development", "production" or "use" of equipment, functions or features in Category 5 ‑ Part 1 **of this List.** |
|  |  |
| 5D001.a. | **"Software" specially designed for the "development" or "production" of equipment, functions or features in Category 5 ‑ Part 1 of this List.** |
| 5D001.b. | "Software" specially designed or modified to support “technology” listed under 5E001 **of this List.** |
|  |  |
| 5E001.a. | **"Technology" according to the General Technology Note for the "development" or "production" of equipment, functions, features or "software" in Category 5 ‑ Part 1 of this List.** |
|  |  |
| Category 5 ‑ Part 2 |  |
|  |  |
| 5A002.a.2. | Equipment designed or modified to perform cryptanalytic functions. |
| 5D002.c.1. | Only software having the characteristics, or performing or simulating the functions, of equipment specified in 5A002.a.2. |
|  |  |
| 5E002 | Only "technology" for the "development", "production" or "use" of the goods specified in 5A002.a.2. or 5D002.c.1. above. |
| Category 6 |  |
|  |  |
| 6A001.a.1.b. | Object detection or location systems having any of the following:  1. A transmitting frequency below **5 kHz**;  6. Designed to withstand…; |
|  |  |
| 6A001.a.2.a.2.  6A001.a.2.a.3.  6A001.a.2.a.6. | Hydrophones...Incorporating…  Hydrophones...Having any…  Hydrophones...Designed for… |
|  |  |
| 6A001.a.2.b. | Towed acoustic hydrophone arrays... |
|  |  |
| 6A001.a.2.c. | Processing equipment, specially designed for **real time application with** 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; |
|  |  |
| 6A001.a.2.d. | Heading sensors.... |
|  |  |
| 6A001.a.2.e. | Bottom or bay cable systems having any of the following:  1. Incorporating hydrophones... or  2. Incorporating multiplexed hydrophone group signal modules…; |
| 6A001.a.2.f. | Processing equipment, specially designed for **real time application with** 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; |
|  |  |
| 6A002.a.1.a.,b., and c. | "Space‑qualified" solid‑state detectors..... |
|  |  |
| 6A002.a.2.a. | Image intensifier tubes ...  1. A peak response…  2. A microchannel plate…  3. Photocathodes, as follows:  a. **S‑20, S‑25 or multialkali photocathodes with a luminous sensitivity exceeding 700 lm;**  b. GaAs or GaInAs photocathodes;   1. Other III‑V compound semiconductor photocathodes. |
| 6A002.a.3. | Non‑space qualified "focal plane arrays"…;  **Note 3**  **In 6A002.a.3. the following "focal plane arrays" are not included in this List:**  ***a. Platinum Silicide (PtSi) "focal plane arrays" having less than 10,000 elements;***  ***b. Iridium Silicide (IrSi) "focal plane arrays".***  **Note 4**  **In 6A002.a.3. the following "focal plane arrays" are not included in this List:**  ***a. Indium Antimonide (InSb) or Lead Selenide (PbSe) "focal plane arrays" having less than 256 elements;***  ***b. Indium Arsenide (InAs) "focal plane arrays";***  ***c. Lead Sulphide (PbS) "focal plane arrays";***  ***d. Indium Gallium Arsenide (InGaAs) "focal plane arrays".*** |
|  | **Note 5**  **In 6A002.a.3. Mercury Cadmium Telluride (HgCdTe) "focal plane arrays" as follows are not included in this List:**  ***a.* *Scanning Arrays having any of the following:***  ***1*. *30 elements or less; or***  ***2*. *incorporating time delay‑and‑integration within the element and having 2 elements or less;***  ***b. Staring Arrays having less than 256 elements.*** |
|  |  |
|  | ***Technical Notes***   1. ***'Scanning Arrays' are defined as "focal plane arrays" designed for use with a scanning optical system that images a scene in a sequential manner to produce an image;*** 2. ***'Staring Arrays' are defined as "focal plane arrays" designed for use with a non‑scanning optical system that images a scene.*** |
|  | ***Note 6***  ***In 6A002*.*a.3*. *the following "focal plane arrays" are not included in this List:***   * 1. **Gallium Arsenide (GaAs) or Gallium Aluminium Arsenide (GaAlAs) quantum well "focal plane arrays" having less than 256 elements;**  1. **Microbolometer "focal plane arrays” having less than 8,000 elements.** |
|  |  |
| 6A002.b. | "Monospectral imaging sensors" and "multispectral imaging sensors".... |
|  |  |
| 6A002.c. | Direct view imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:  1. Image intensifier tubes having the characteristics listed in **6A002.a.2.a. of this List**; or  2. "Focal plane arrays" having the characteristics listed in **6A002.a.3. of this List**; |
|  |  |
| 6A002.e. | "Space‑qualified" "focal plane arrays".... |
|  |  |
| 6A003.b.3 | Imaging cameras incorporating image intensifier tubes having the characteristics listed in **6A002.a.2.a. of this List**; |
| 6A003.b.4 | Imaging cameras incorporating "focal plane arrays" having any of the following: |
|  | a. Incorporating "focal plane arrays" listed in **6A002.a.3.a. to 6A002.a.3.e. of this List;** or |
|  | b. Incorporating "focal plane arrays" listed in **6A002.a.3.f. of this List** |
|  | *Note 1 ‘Imaging cameras’ described in 6A003*.*b.4 include "focal plane arrays" combined with sufficient signal processing electronics, beyond the read out integrated circuit, to enable as a minimum the output of an analogue or digital signal once power is supplied.* |
|  | *Note 2 6A003*.*b.4***.***a. does not control imaging cameras incorporating linear "focal plane arrays" with twelve elements or fewer, not employing time‑delay‑and‑integration within the element, designed for any of the following:* |
|  | *a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;* |
|  | *b. Industrial equipment used for inspection or monitoring of heat flows in buildings, equipment or industrial processes;* |
|  | *c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;* |
|  | *d. Equipment specially designed for laboratory use; or* |
|  | 1. *Medical equipment.* |
| 6A003.b.4. contd. | *Note 3 6A003*.*b.4*.*b. does not control imaging cameras having any of the following characteristics:* |
|  | *a. A maximum frame rate equal to or less than 9 Hz;* |
|  | *b. Having all of the following:* |
|  | *1*. *Having a minimum horizontal or vertical Instantaneous‑Field‑of‑View (IFOV) of at least 10 mrad/pixel (milliradians/pixel);* |
|  | *2*. *Incorporating a fixed focal‑length lens that is not designed to be removed;* |
|  | *3*. *Not incorporating a direct view display; and* |
|  | *Technical Note:*  *‘Direct view’ refers to an imaging camera operating in the infrared spectrum that presents a visual image to a human observer using a near‑to‑eye micro display incorporating any light‑security mechanism.* |
|  | *4*. *Having any of the following:* |
|  | *a. No facility to obtain a viewable image of the detected field‑of‑view; or* |
|  | *b. The camera is designed for a single kind of application and designed not to be user modified; or* |
|  | *Technical Note*  *Instantaneous Field of View (IFOV) specified in Note 3*.*b. is the lesser figure of the Horizontal FOV or the Vertical FOV.*  *Horizontal IFOV = horizontal Field of View (FOV)/number of horizontal detector elements*  *Vertical IFOV= vertical Field of View (FOV)/number of vertical detector elements.* |
|  | *c. Where the camera is specially designed for installation into a civilian passenger land vehicle of less than three tonnes (gross vehicle weight) and having all of the following:* |
|  | *1*. *Is only operable when installed in any of the following:* |
|  | *a. The civilian passenger land vehicle for which it was intended; or* |
|  | *b. A specially designed, authorized maintenance test facility; and* |
|  | *2*. *Incorporates an active mechanism that forces the camera not to function when it is removed from the vehicle for which it was intended.* |
|  | *Note: When necessary, details of the item will be provided, upon request, to the appropriate authority in the exporter’s country in order to ascertain compliance with the conditions described in Note 3*.*b.4*. *and Note 3*.*c. above.* |
| 6A004.c. | "Space‑qualified" components for optical systems.... |
| 6A004.d. | Optical control equipment..... |
|  |  |
| 6A006.a. | "Magnetometers" ... using optically pumped or nuclear precession (proton/Overhauser) having a "noise level" (sensitivity) lower (better) than 2 pT rms per square root Hz. |
| 6A006.g. | Magnetic compensation systems... |
|  | ***Note In 6A006*.*g. those compensators which provide only absolute values of the earth's magnetic field as output, (i.e., the frequency bandwidth of the output extends from DC to at least 0*.*8 Hz) are not included in this List.*** |
| 6A006.h. | "Superconductive" electromagnetic sensors...... |
| 6A008.d. | Radar systems.....Capable of… |
| 6A008.h. | Radar systems…Employing processing |
| 6A008.k. | Radar systems…Having "signal processing"… |
| 6A008.l.3. | Radar systems…Having data processing… Processing for… |
|  |  |
| 6B008 | Pulse radar cross‑section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefor.  NB: SEE ALSO 6B108 |
|  |  |
| 6B108 | Systems specially designed for radar cross section measurement usable for "missiles" and their subsystems. |
|  |  |
| 6D001 | "Software" specially designed for the "development" or "production" of equipment in **6A004, 6A008 or 6B008 of this List**. |
|  |  |
| 6D003.a. | "Software", as follows:… |
|  |  |
| 6E001 | "Technology" according to… |
|  |  |
| 6E002 | **"Technology" according to the General Technology Note for the "production" of equipment in 6A or 6B of this List.** |

|  |  |
| --- | --- |
| Category 7 |  |
|  |  |
| 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), **except "guidance sets" designed for missiles with a range under 300 km or manned aircraft.** |
| 7B001 | Test, calibration or alignment equipment specially designed for equipment specified **in 7A117 above**.  *Note: 7B001 does not control test, calibration or alignment equipment for Maintenance Level I or Maintenance Level II.* |
|  |  |
| 7B003 | Equipment specially designed for the "production" of equipment specified **in 7A117 above**. |
|  |  |
| 7B103 | "Production facilities" specially designed for equipment specified **in 7A117 above**. |
|  |  |
| 7D002 | "Source code" for the "use"… |
|  |  |
| 7D003.a. | "Software" specially designed or modified to… |
| 7D003.b. | "Source code" for… |
| 7D003.c. | "Source code" for… |
| 7D003.d.1. to 4. & 7. | "Source code" for the "development" of… |
|  |  |
| 7D101 | "Software" specially designed for the "use" of equipment specified in 7B003 or 7B103 **above**. |
|  |  |
| 7E001 | "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 7A117, 7B003, 7B103 or 7D101 **above**. |
|  |  |
| 7E002 | "Technology" according to the General Technology Note for the "production" of equipment specified in 7A117, 7B003 and 7B103 **above**. |
|  |  |
| 7E101 | "Technology" according to the General Technology Note for the "use" of equipment specified in 7A117, 7B003, 7B103 and 7D101 **above**. |
|  |  |
| Category 8 |  |
|  |  |
| 8A001.b. | Manned, untethered submersible vehicles… |
| 8A001.c. | Unmanned, tethered submersible vehicles..... |
| 8A001.d. | Unmanned, untethered submersible vehicles... |
|  |  |
| 8A002.b. | Systems specially designed or modified for the automated control of the motion of submersible vehicles **in 8A001 of this List** using navigation data and having closed loop servo‑controls:  1. Enabling…;  2. Maintaining…; or  3. Maintaining…; |
| 8A002.h. | "Robots" specially designed for underwater use...... |
| 8A002.j. | Air independent power systems....... |
| 8A002.o.3. | Noise reduction systems designed for use on vessels of 1000 tonnes displacement... |
| 8A002.p. | Pumpjet propulsion systems.... |
|  |  |
| 8D001 | **"Software" specially designed for the "development" or "production" of equipment in 8A of this List.** |
|  |  |
| 8D002 | Specific "software"........ |
|  |  |
| 8E001 | "Technology" according to the General Technology Note for the "development" or "production" of equipment in **8A of this List.** |
|  |  |
| 8E002.a. | "Technology" for the "development", "production", repair, overhaul or refurbishing (re‑machining) of propellers specially designed for underwater noise reduction. |
|  |  |
| Category 9 |  |
|  |  |
| 9A004 | Space launch vehicles **capable of delivering at least a 500 kg payload to a range of at least 300 km.**  N.B.: SEE ALSO 9A104.  *Note 1: 9A004 does not control payloads.* |
|  |  |
| 9A005 | Liquid rocket propulsion systems containing any of the systems or components specified in 9A006 **usable for space launch vehicles specified in 9A004 above or sounding rockets specified in 9A104 below**.  N.B.: SEE ALSO 9A105 and 9A119. |
|  |  |
| 9A007.a. | Solid rocket propulsion systems, **usable for space launch vehicles specified in 9A004 above or sounding rockets specified in 9A104 below**, with any of the following:  N.B.: SEE ALSO 9A119.  a. Total impulse capacity exceeding 1.1 MNs; |
|  |  |
| 9A008.d. | Components, as follows, specially designed for solid rocket propulsion systems:  N.B.: SEE ALSO 9A108.c.  d. Movable nozzle or secondary fluid injection thrust vector control systems, **usable for space launch vehicles specified in 9A004 above or sounding rockets specified in 9A104 below**, 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°/s2 or more. |
|  |  |
| 9A011 | Ramjet, scramjet or combined cycle engines... |
|  |  |
| 9A104 | Sounding rockets, capable of **delivering at least a 500 kg payload to** a range of at least 300 km.  N.B.: SEE ALSO 9A004. |
| 9A105.a. | Liquid propellant rocket engines, as follows:  N.B.: SEE ALSO 9A119.  a. Liquid propellant rocket engines usable in "missiles", not controlled in 9A005, having a total impulse capacity equal to or greater than 1.1 MNs; **except liquid propellant apogee engines designed or modified for satellite applications and having all of the following:**  **1. nozzle throat diameter of 20 mm or less; and**  **2. combustion chamber pressure of 15 bar or less.** |
|  |  |
| 9A106.c. | Systems or components, not controlled in 9A006, usable in "missiles", as follows, specially designed for liquid rocket propulsion systems:  c. Thrust vector control sub‑systems**, except those designed for rocket systems that are not capable of delivering at least a 500 kg payload to a range of at least 300 km.**  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.* |
|  |  |
| 9A108.c. | Components, not controlled in 9A008, usable in "missiles", as follows, specially designed for solid rocket propulsion systems:  c. Thrust vector control sub‑systems**, except those designed for rocket systems that are not capable of delivering at least a 500 kg payload to a range of at least 300 km.**  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.* |
| 9A116 | Reentry vehicles, usable in "missiles", and equipment designed or modified therefor, as follows, **except for reentry vehicles designed for non‑weapon payloads**:  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. |
|  |  |
| 9A119 | Individual rocket stages, usable in complete rocket systems or "unmanned aerial vehicles", capable of **delivering at least a 500 kg payload to** a range of 300 km, not controlled in 9A005 or 9A007.a. **above** |
|  |  |
| 9B001.b. | Ceramic cores or shells |
|  |  |
| 9B115 | Specially designed "production equipment" for the systems, sub‑systems and components specified in 9A005, 9A007.a., 9A008.d., 9A105.a., 9A106.c., 9A108.c., 9A116 or 9A119 **above**. |
|  |  |
| 9B116 | Specially designed "production facilities" for the space launch vehicles specified in 9A004, or systems, sub‑systems, and components specified in 9A005, 9A007.a., 9A008.d., 9A104, 9A105.a., 9A106.c., 9A108.c., 9A116 or 9A119 **above**. |
|  |  |
| 9D001 | **"Software" specially designed or modified for the "development" of equipment or "technology" in 9A, 9B or 9E003 of this List.** |
|  |  |
| 9D002 | **"Software" specially designed or modified for the "production" of equipment in 9A or 9B of this List.** |
|  |  |
| 9D004.a. | Other "software"…2D or 3D… |
| 9D004.c. | Other "software"…"Software" specially… |
|  |  |
| 9D101 | "Software" specially designed for the "use" of goods specified in 9B116 **above**. |
|  |  |
| 9E001 | "Technology" according to the General Technology Note..... |
|  |  |
| 9E002 | "Technology" according to the General Technology Note… |
|  |  |
| 9E003.a.1. | Other "technology"…Gas turbine blades… |
| 9E003.a.2. to 5. & 9E003.a.8., 9.E.3.a.9. | Other "technology"… |
|  |  |
| 9E101 | "Technology" according to the General Technology Note for the "development" or "production" of goods specified in 9A104, 9A105.a., 9A106.c., 9A108.c., 9A116 or 9A119 **above**. |
|  |  |
| 9E102 | "Technology" according to the General Technology Note for the "use" of space launch vehicles specified in 9A004, 9A005, 9A007.a., 9A008.d., 9A104, 9A105.a., 9A106.c., 9A108.c., 9A116, 9A119, 9B115, 9B116 or 9D101 **above**. |

**VERY SENSITIVE LIST OF DUAL‑USE GOODS AND TECHNOLOGIES**

*Note This List is a sub‑set of the items contained in the Sensitive List. The items in this List are considered to be very sensitive, requiring extreme care in their transfer. General Export Licences are not available for the export of the following very sensitive goods.*

*N.B. Where abbreviated entries are used, see Part 2 for full details. Text that differs from that in Part 2 is in* ***bold type****.*

|  |  |  |
| --- | --- | --- |
| Category 0 | All of Category 0 of Part 2 is included in the Very Sensitive List.  N.B.: For 0C003 and 0C004, only if for use in a "nuclear reactor" (within 0A001.a.). | |
| Category 1 |  | |
| 1A002.a. | **"Composite" structures or laminates having an organic "matrix" and made from materials listed under 1C010.c. or 1C010.d.** | |
|  |  | |
| 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. | |
| 1B231 | Tritium facilities or plants, and equipment therefor, as follows:  a. Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium;  b. Equipment for tritium facilities or plants, 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 W;  2. Hydrogen isotope storage or purification systems using metal hydrides as the storage or purification medium. | |
| 1B233 | Lithium isotope separation facilities or plants, and equipment therefor, as follows:  a. Facilities or plants 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 or lithium amalgam pumps;  3. Lithium amalgam electrolysis cells;  4. Evaporators for concentrated lithium hydroxide solution. | |
|  |  | |
| 1C001 | Materials specially designed for use as absorbers of electromagnetic waves... | |
|  |  | |
| 1C012 | Materials as follows... | |
|  |  | |
| 1C233 | Lithium enriched in the lithium‑6 (6Li) isotope to greater than its natural isotopic abundance, and products or devices containing enriched lithium, as follows: elemental lithium, alloys, compounds, mixtures containing lithium, manufactures thereof, waste or scrap of any of the foregoing.  Note: 1C233 does not control thermoluminescent dosimeters.  Technical Note:  The natural isotopic abundance of lithium‑6 is approximately 6.5 weight per cent (7.5 atom per cent). | |
|  |  | |
| 1C235 | Tritium, tritium compounds, mixtures containing tritium in which the ratio of tritium to hydrogen atoms exceeds 1 part in 1000, and products or devices containing any of the foregoing.  *Note: 1C235 does not control a product or device containing less than 1*.*48 x 103 GBq (40 Ci) of tritium.* | |
|  |  | |
| 1C351.d.4. | Ricin | |
| 1C351.d.5. | Saxitoxin | |
|  |  | |
| 1E001 | "Technology" according to the General Technology Note for the "development" or "production" of equipment and materialsin **1A002 or 1C of this List**. | |
|  |  | |
| 1E201 | "Technology" according to the General Technology Note for the "use" of goods specified in 1B226, 1B231, 1B233, 1C233 or 1C235. | |
|  |  | |
| Category 2 | None | |
| Category 3 |  | |
|  |  | |
| 3A228 | Switching devices, as follows:  a. Cold‑cathode tubes, whether gas filled or not, operating similarly to a spark gap, having all of the following characteristics:  1. Containing three or more electrodes;  2. Anode peak voltage rating of 2.5 kV or more;  3. Anode peak current rating of 100 A or more; and  4. Anode delay time of 10 µs or less;  Note: 3A228 includes gas krytron tubes and vacuum sprytron tubes.  b. Triggered spark‑gaps having both of the following characteristics:   * + - 1. An anode delay time of 15 µs or less; and       2. Rated for a peak current of 500 A or more; | |
|  |  | |
| 3A231 | Neutron generator systems, including tubes, having both of the following characteristics:  a. Designed for operation without an external vacuum system; and  b. Utilizing electrostatic acceleration to induce a tritium‑deuterium nuclear reaction | |
|  |  | |
| 3E201 | "Technology" according to the General Technology Note for the "use" of equipment specified in 3A228.a., 3A228.b. or 3A231. | |
|  |  | |
| Category 4 | None | |
|  |  | |
| Category 5 ‑ Part 1 |  | |
|  |  | |
| 5A001.b.5. | Digitally controlled radio receivers... | |
|  |  | |
| 5D001.a. | **"Software" specially designed for the "development" or "production" of equipment, functions or features in Category 5, Part 1 of this List.** | |
|  |  | |
| 5E001.a. | **"Technology" according to the General Technology Note for the "development" or "production" of equipment, functions, features or "software" in Category 5, Part 1 of this List.** | |
|  |  | |
| Category 5 ‑ Part 2 | None | |
|  |  | |
| Category 6 |  | |
|  |  | |
| 6A001.a.1.b.1. | **Object detection or location systems having a sound pressure level exceeding 210 dB (reference 1 Pa at 1 m) and an operating frequency in the band from 30 Hz to 2 kHz.** | |
|  |  | |
|  |  | |
|  |  | |
|  |  | |
| 6A001.a.2.a.1.  6A001.a.2.a.2.  6A001.a.2.a.3.  6A001.a.2.a.5.  6A001.a.2.a.6. | Hydrophones...Incorporating…  Hydrophones...Incorporating flexible assemblies…  Hydrophones...Having any…  Hydrophones...When designed...  Hydrophones...Designed for… | |
|  |  | |
| 6A001.a.2.b. | Towed acoustic hydrophone arrays... | |
|  |  | |
| 6A001.a.2.c. | Processing equipment, specially designed for **real time application with** 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; | |
|  |  | |
| 6A001.a.2.e. | Bottom or bay cable systems having any of the following:  1. Incorporating hydrophones... or  2. Incorporating multiplexed hydrophone group signal modules …; | |
|  |  | |
| 6A001.a.2.f. | Processing equipment, specially designed for **real time application with** 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; | |
|  |  | |
| 6A002.a.1.c. | "Space‑qualified" solid‑state detectors... | |
|  |  | |
| 6A008.l.3. | Radar systems…Having data processing… Processing for… | |
|  |  | |
| 6A203 | Cameras and components, not controlled 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;  2. Streak cameras with writing speeds greater than 0.5 mm per microsecond;  *Note: In 6A203*.*a. components of such cameras include their synchronizing electronics units and rotor assemblies*  *consisting of turbines, mirrors and bearings.* | |
|  |  | |
| 6A225 | Velocity interferometers for measuring velocities exceeding 1 km/s during time intervals of less than 10 microseconds.  *Note: 6A225 includes velocity interferometers such as VISARs*  *(Velocity interferometer systems for any reflector) and DLI*  *(Doppler laser interferometers).* | |
|  |  | |
| 6A226 | Pressure sensors, as follows:  a. Manganin gauges for pressures greater than 10 GPa;  b. Quartz pressure transducers for pressures greater than 10 GPa. | |
|  |  | |
| 6B008 | Pulse radar cross‑section… | |
|  |  | |
| 6D001 | "Software" specially designed for the "development" or "production" of equipment in **6A008, or 6B008 of this List.** | |
|  |  | |
| 6D003.a. | "Software", as follows:… | |
|  |  | |
| 6E001 | "Technology" according to the General Technology Note for the "development" of **equipment or "software" in 6A, 6B, or 6D of this List**. | |
|  |  | |
| 6E002 | "Technology" according to the General Technology Note for the "production" of equipmentin **6A or 6B of this List**. | |
|  |  | |
| Category 7 |  | |
|  |  | |
| 7D003.a. | "Software" specially designed or modified to… | |
| 7D003.b. | "Source code" for… | |
|  |  | |
| Category 8 |  | |
|  |  | |
| 8A001.b. | Manned, untethered submersible vehicles... | |
| 8A001.d. | Unmanned, untethered submersible vehicles... | |
|  |  | |
| 8A002.o.3.b. | Active noise reduction or cancellation systems... | |
|  |  | |
| 8D001 | **"Software" specially designed for the "development" or "production" of equipment in 8A of this List.** |
|  |  |
| 8E001 | "Technology" according to the General Technology Note for the "development" or "production" of equipmentin **8A of this List**. |
|  |  |
| Category 9 |  |
|  |  |
| 9A011 | Ramjet, scramjet or combined cycle engines... |
|  |  |
| 9D001 | **"Software" specially designed or modified for the "development" of equipment or "technology" in 9A or 9E003 of this List.** |
|  |  |
| 9D002 | **"Software" specially designed or modified for the "production" of equipment in 9A of this List.** |
|  |  |
| 9E001 | "Technology" according to the General Technology Note for the "development" of equipment or "software"in **9A011 or 9D of this List**. |
|  |  |
| 9E002 | "Technology" according to the General Technology Note for the "production" of equipmentin **9A011 of this List**. |
|  |  |
| 9E003.a.1. | Other "technology"…Gas turbine blades… |
| 9E003.a.3.a. | "Technology" "required" for …  Components manufactured from...  Organic "composite" materials designed to operate above 588 K (315°C). |

**INDEX OF CONTROLLED GOODS**

1,1,3 Trinitroazetidine (TNAZ) ML8a.28

1,1,3,3,3,‑Pentafluoro‑2‑(trifluoromethyl)‑1‑propene 1C450a.6

1,2,3 Tris(1,2 bis(difluoroamino)ethoxy) propane ML8e.43

1,2,4 Butanetriol ML8e.45

1,2,4 Trihydroxybutane ML8e.45

1,2‑bis (2‑chloroethylthio) ethane ML7a

1,3,5 Trichlorobenzene ML8e.44

1,3,5 Trinitro 1,3,5 triaza cyclohexane ML8a.20

1,3,5,7 Tetraacetyl 1,3,5,7 tetraazacyclooctane (TAT) ML8e.46

1,3,5,7 Tetranitro 1,3,5,7 tetrazacyclooctane ML8a.7

1,3‑bis (2‑chloroethylthio) ‑n‑propane ML7a

1,4,5,8 Tetraazadecalin ML8e.47

1,4,5,8 Tetranitro 1,4,5,8 tetraazadecalin (TNAD) ML8a.29

1,4‑bis (2‑chloroethylthio) ‑n‑butane ML7a

1,5‑bis (2‑chloroethylthio) ‑n‑pentane ML7a

2 (5 Cyanotetrazolato) pentaamminecobalt(III)perchlorate ML8a.22

2,2‑Diphenyl‑2‑hydroxyacetic acid 1C350.32

2,4,6 Trinitro 2,4,6 triazacyclohexanone (K 6 or Keto RDX) ML8a.26

2,4,6,8 Tetranitro 2,4,6,8 tetraazabicyclo(3,3,0)octan 3 one ML8a.27

2‑Chloroethanol 1C350.15

2‑Chloroethylchloromethylsulphide ML7a

2‑chlorovinyldichloroarsine ML7a

2‑Nitrodiphenylamine 1C111c.4

3 Nitro 1,2,4 triazol 5 one ML8a.17

3‑Hydroxy‑1‑methylpiperidine 1C350.10

3‑Quinuclidinol 1C350.13

3‑Quinuclidone 1C350.37

3‑Quinuclindinyl benzilate (BZ) ML7a

5,7 Diamino 4,6 dinitrobenzofurazane 1 oxide (CL 14) ML8a.25

7 Amino 4,6 dinitrobenzofurazane 1 oxide (ADNBF) ML8a.24

## A

Absolute reflectance measurement equipment 6B004a

Absorbers of electromagnetic waves 1C001

Absorbers, hair type 1C001a

Absorbers, non‑planar & planar 1C001a

Absorption columns 2B350e

Accelerators (electro‑magnetic radiation) 3A101b

Accelerators or coprocessors, graphics 4A003d

Accelerometer axis align stations 7B003f

Accelerometers & accelerometer components 7A001&101

Acoustic beam forming software 6D003a.1

Acoustic hydrophone arrays, towed 6A001a.2.b

Acoustic location & object detection systems 6A001a.1.b

Acoustic mounts, noise reduction equipment for vessels 8A002o.3.a

Acoustic positioning systems 6A001a.1.d

Acoustic projectors 6A001a.1.c

Acoustic systems, marine 6A001a

Acoustic transducers 6A001a.2.a

Acoustic underwater communications systems 5A001b.1

Acoustic vibration test equipment 9B006

Acoustic wave devices 3A001c

Acoustic‑optic signal processing devices 3A001c.3

Active acoustic systems 6A001a.1

Active compensating system rotor clearance control software 9D004d

Active flight control system software 7D003e

Active flight control system technology 7E004b

Active magnetic bearing systems 2A001c

Actively cooled mirrors 6A005e.1

Adaptive control software 2D002

ADCs (analogue‑to‑digital converters) 3A001a.5

ADCs (analogue‑to‑digital converters) 3A101a

ADCs (analogue‑to‑digital converters) 4A003e

Additives, precursors & stabilisers ML8e

ADN (ammonium dinitramide) ML8a.32

ADNBF (7 Amino 4,6 dinitrobenzofurazane 1 oxide) ML8a.24

Aero engines, military ML10c

Aero gas turbine engine/assemblies/component test software 9D004b

Aero gas turbine engines 9A001

Aerodynamic isotope separation plant 0B001a.3

Aerodynamic separation process systems & components 0B001d

Aerosol challenge testing chambers 2B352g

Aflatoxin 1C351d.11

African swine fever virus (animal pathogens) 1C352a.1

Agent Orange ML7a

Agitators (chemical manufacturing) 2B350b

AHRS (Attitude Heading Reference Systems), source code 7D002

Aiming devices ML5

Air independent power systems (for underwater use) 8A002j

Air traffic control software 6D003d

Air weapons ML1

Air weapons ML901b

Airborne altimeters 7A006

Airborne altimeters 7A106

Airborne components, military ML10

Airborne equipment, military ML10e i

Airborne vehicles, military ML10a,b

Aircraft & aircraft components, military ML10

Aircraft engines, military ML10c

Aircraft equipment, military ML10d i

Aircraft fuels (military high energy) ML8d

Aircraft inertial navigation systems & equipment 7A003

Aircraft inertial navigation systems & equipment 7A103

Aircraft refuellers, military ML10f

Aircraft simulators, military ML14

Alexandrite 6C005b

Alexandrite lasers 6A005c.1

Align & expose step & repeat equipment (wafer processing) 3B001f

Alkyl Phosphonyl Difluorides ML7b.1

Alkylphenylene ethers or thio‑ethers, as lubricating fluids 1C006b

All wheel drive utility vehicles ML6

Alloy strips, magnetic 1C003c

Alloyed metal materials in powder or particulate form 1C002b

Alloyed metal materials in powder or particulate form 1C002c

Alloyed metal materials in powder or particulate form 1C202

Alloys, aluminium 1C002a.1

Alloys, aluminium 1C002a.2.d

Alloys, aluminium 1C202a

Alloys, magnesium 1C002a.2.e

Alloys, metal powder 1C002b

Alloys, nickel 1C002a.1.a

Alloys, nickel 1C002a.2.a

Alloys, niobium 1C002a.2.b

Alloys, titanium 1C002a.1.b

Alloys, titanium 1C202b

Alpha‑emitting radionuclides 1C236

Altimeters, airborne 7A006

Altimeters, radar or laser types 7A106

Aluminides, nickel 1C002a.1.a

Aluminides, titanium 1C002a.1.b

Aluminium alloy powder, made from materials of 1C002a 1C002b.1.d

Aluminium alloy powder, made from materials of 1C002a 1C002c

Aluminium alloys, aq 1C002a.1

Aluminium alloys, aq 1C002a.2.d

Aluminium alloys, aq 1C002c

Aluminium alloys, aq 1C202

Aluminium organo‑metallic compounds 3C003

Aluminium powder, spherical ML8c.8

Aluminium powder, spherical 1C111a.1

Amalgam electrolysis cells, lithium isotope separation 1B233

Amalgam pumps, lithium 1B233

Amino dinitrobenzo furoxan (ADNBF) ML8a.24

Amiton 1C450a.1

AMMO (Azidomethylmethyloxetane) & its polymers ML8e.1

Ammonia crackers 0B004b.5

Ammonia distillation towers 0B004b

Ammonia hydrogen exchange plant, equipment and components 0B004a.2

Ammonia hydrogen exchange plant, equipment and components 0B004a.2

Ammonia synthesis converters & units 1B227

Ammonium dinitramide (ADN) ML8a.32

Ammonium hydrogen fluoride 1C350.42

Ammonium perchlorate ML8a.19

Ammunition & components ML3

Ammunition & components, non‑military ML902

Ammunition trailers ML6f

Amorphous alloy strips 1C003

Amphibious cargo carriers, military ML6i

Amphibious vehicles ML6g

Amplifiers, microwave solid state 3A001b.4

Anaerobic chambers 2B352f.2

Analogue computers 4A001

Analogue computers 4A101

Analogue instrumentation tape recorders 3A002a.1

Analogue‑to‑digital conversion equipment 4A003e

Analogue‑to‑digital converters, integrated circuits 3A001a.5

Analogue‑to‑digital converters, integrated circuits 3A101a

Analysers, network 3A002e

Analysers, spectrum 3A002c.1

Analysis on line of UF6 gas lines 0B002g.4

Anechoic chambers 9B106b

Angular measuring instruments 2B006b.2

Angular measuring instruments 2B206

Angular‑linear inspection equipment (hemishells) 2B006c

Angular‑linear inspection equipment (hemishells) 2B206

Animal pathogens 1C352

Antennae, phased array 5A001d

Antennae, phased array (for radar) 6A008e

Anti‑g suits ML10g

Anti‑vibration mounts, military ML10

Anti‑vibration mounts, military ML6

Anti‑vibration mounts, military ML9

Anti‑vibration mounts (noise reduction), civil vessels 8A002o.3.a

Antibodies, defence against CBW agents ML7e

Antimony hydrides 3C004

Aramid fibres & filamentary materials 1C010a

Aramid fibres & filamentary materials 1C210a

Arc remelt & casting furnaces 2B227a

Argon ion lasers 6A005a.6

Argon ion lasers 6A205a

Armed vehicles & related equipment/components ML6b

Armour Body 1A005

Armoured plate ML13a

Armoured railway trains & related equipment ML6c

Armoured vehicles & related equipment ML6b

Aromatic polyamide fibres production technology 1E002d

Aromatic polyamide‑imides 1C008a.2

Aromatic polyetherimides 1C008a.4

Aromatic polyimides 1C008a.3

Array processor microcircuits 3A001a.3

Array processors/assemblies 4A003

Array processors/assemblies 4A004

Arsenic hydrides 3C004

Arsenic trichloride 1C350.31

Artificial Intelligence software 4D003b

Asynchronous transfer mode (ATM) equipment 5B001b.1

Asynchronous transfer mode (ATM) development software 5D001d.1

Atomic clocks, frequency standards 3A002g

Atomic transition solid state lasers 6A005c.2

Atomic vapour laser isotope separation plant (ALVIS) 0B001g

Atomic vapour laser isotope separation process equipment 0B001g

Attack alerting/warning systems ML5b

Attitude control equipment 7A116

Attitude Heading Reference Systems (AHRS), source software 7D002

Aujeszkys disease virus (Porcine herpes virus) 1C352a.6

Autoclave regulation technology 1E103

Autoclaves, gaseous diffusion or centrifuge cascade 0B002a

Automated control systems, submersible vehicles 8A002b

Avian influenza virus 1C352a.2

Avionics EMP/EMI protection technology 7E102

Azidomethylmethyloxetane (AMMO) & its polymers ML8e.1

## B

Bacillus anthracis 1C351c.1

Bacteria 1C351c

Bacteria 1C352b

Bacteria 1C353

Bacteria 1C354a

Bacteria ML7a,e

Balancing machines, centrifugal multiplane 2B119 & 2B229

Ball & solid roller bearings 2A001a

Ball & solid roller bearings 2A001b

Ballistic protection materials for military systems ML13b

Band‑pass filters, tunable 3A001b.5

Barium metal vapour lasers 6A005a.2.d

Basic copper salicylate ML8e.2

Batch mixers with vacuum & temperature control 1B111 & 1B117

Bathymetric survey systems 6A001a.1.b

Batteries/cells (high energy), primary 3A001e.1.a

Batteries/cells (high energy), rechargeable/secondary 3A001e.1.b

Bay cable systems 6A001a.2.e

Bay cable systems software 6D003a.3

BCMO (Bischloromethy1oxetane) ML8e.8

Beam steering mirrors 6A004a.4

Beamforming techniques 6A001a.2.c

Bearings, ball & solid roller 2A001a

Bearings, ball & solid roller 2A001b

Bearings, gas centrifuge 0B001b.7

Bearings, gas centrifuge 0B001b.8

Bearings, high precision/temperature/special 2A001

Bearings, magnetic (active) 2A001c

Bearings, magnetic (suspension) 0B001b.7

Bearings, silent for marine use ML9g

Bearings, solid roller 2A001b

Bellows pumps 2B350i

Bellows seal valves 0B001c.6

Bellows seal valves 0B001d.6

Bellows seal valves 2A226

Bellows seal valves Bellows seal valves 2B350g

Bellows‑forming dies 2B228c

Bellows‑forming mandrels 2B228c

Benzeneacetic acid, alpha‑hydroxy‑alpha‑phenyl‑ 1C350.32

Benzilic acid 1C350.32

Benzilic acid 1C350.32

Beryllium metal or alloy powder 1C111a.2.b

Beryllium metal or alloy powder 1C230

Beryllium metal or alloy powder ML8a.2.b

Beryllium/beryllium substrate blanks 6C004d

BHEGA (Bis(2 hydroxyethyl)glycolamide) ML8e.5

Binary precursors ML7b

Biocatalyst incorporation in military carriers technology ML7i.3

Biocatalyst production systems ML7h.2

Biocatalysts, military ML7h.1

Biological agents adapted for use in war ML7a

Biological containment facilities, ACDP level 3 or 4 2B352a.1

Biological isolators 2B352a.3

Biological manufacturing equipment & facilities 2B352

Biological safety cabinets 2B352a.3

Biological systems ML7h.2

Biopolymer technology ML7i.2

Biopolymers for chemical warfare agent indentification ML7g

Bioreactors (capacity 300 L or more) 2B352b

Bis (2‑chloroethyl) ethylamine (HN1) ML7a

Bis (2‑chloroethyl) methylamine (HN2) ML7a

Bis (2‑chloroethylthioethyl) ether ML7a

Bis (2‑chloroethylthiomethyl) ether ML7a

Bis (2‑chlorovinyl) chloroarsine ML7a

Bis (2 fluoro 2,2 dinitroethyl)formal (FEFO) ML8e.4

Bis (2 hydroxyethyl)glycolamide (BHEGA) ML8e.5

Bis (2 methyl aziridinyl) 2 (2 hydroxypropanoxy)propylamino phosphine oxide (BOBBA 8) ML8e.41

Bis (2 methylaziridinyl)methylaminophosphine oxide (Methyl BAPO) ML8e.6

Bis (2,2 dinitropropyl)acetal ML8e.3

Bis (2,2 dinitropropyl)formal ML8e.3

Bis (2‑chloroethyl) sulphide ML7a

Bis (2‑chloroethylthio) methane ML7a

Bisazidomethyloxetane & its polymers ML8e.7

Bischloromethy1oxetane (BCMO) ML8e.8

Bismaleimides 1C008a.1

Bismuth 1C229

Bladders for aircraft/aerospace/missiles, fuel 1A001a

Bladders for aircraft/aerospace/missiles, fuel 1A001c

Blank ammunition ML3

Blanks, beryllium/beryllium (Be/Be) deposited material 6C004d

Blanks, Zinc selenide (ZnSe) substrate 6C004a

Blanks, Zinc sulphide (ZnS) substrate 6C004a

Blowers 0B001c.3

Blowers, positive displacement/centrifugal/axial flow), gas 0B001d.3

Bluetongue virus 1C352a.3

BNCP (Cis bis(5 nitrotetrazolato) pentaaminecobalt(III) perchlorate) ML8a.23

BNO (Butadienenitrileoxide) ML8e.9

Boats, military ML9

BOBBA 8 (Bis(2 methyl aziridinyl) 2 (2 hydroxypropanoxy) propylamino phosphine oxide) ML8e.41

Body armour 1A005

Body armour ML13d

Bomb activation equipment ML4b

Bomb control equipment ML4b

Bomb detection equipment ML4b

Bomb handling equipment ML4b

Bomb jamming equipment ML4b

Bomb laying equipment, military ML4b

Bomb powering equipment, military one time operation ML4b

Bomb sweeping equipment, military ML4b

Bombing computers ML5a

Bombs ML4a

Boring machines (CNC) 2B001

Boring machines (CNC) 2B201

Boron & boron compounds 1C225

Boron carbide powder (fuel) 1C011b

Boron carbide powder (fuel) ML8a.2.d

Boron metal or alloy powder 1C011b

Boron metal or alloy powder 1C111a.2.c

Boron metal powder (fuel) ML8a.2.d

Bottom cable systems 6A001a.2.e

Bottom cable systems software 6D003a.3

Botulinum toxin 1C351d.1

Boules of electro‑optic materials 6C004b

Brayton cycle engine, air independent 8A002j

Bridges, military ML17m

Bridge laying vehicles ML6i

Bromobenzyl cyanide (CA) ML7c.1

Brucella abortus 1C351c.2

Brucella melitensis 1C351c.3

Brucella suis 1C351c.4

BTTN (Butanetrioltrinitrate) ML8e.10

Bulk acoustic wave devices 3A001c.2

Bulk fluoride glass, low optic absorption 6C004e.2

Bulk refuellers, military ML6i

Bullet proof materials & clothing ML13d

Bullet proof tyres ML6j

Bullet resistant materials & clothing ML13d

Butacene ML8.f.4.a & 1C111c.1

Butadienenitrileoxide (BNO) ML8e.9

Butanetrioltrinitrate (BTTN) ML8e.10

Butyl 2‑chloro‑4‑fluorophenoxyacetate (LNF) ML7a

Butylene imine trimesamide isocyanuric ML8e.32

BZ (3‑Quinuclindinyl benzilate) ML7a

## C

C3I (Command, Communications, Control & Intelligence) software ML21b.1.d

CA (Bromobenzyl cyanide) ML7c.1

Cable ‑ optical fibre & accessories for underwater use, 5A001c.2

Cable, underwater communication 5A001c.2

Cables with surreptitious intrusion detection 5A002a.7

Cables, Optical fibre 5A001c.1

CAD (Computer‑aided‑design) software for semiconductors 3D003

Cadmium telluride (CdTe) single crystals/epitaxial wafers 6C002b

Cadmium zinc telluride single crystals & epitaxial wafers 6C002b

Calcium 1C227

Calcium fluoride (CaF2) made/coated crucibles 2A225a.2

Calcium zirconate (metazirconate) (Ca2ZrO3) crucibles 2A225a.2

Cameras & components ML15b

Cameras and components 6A003

Cameras and components 6A203

Cameras, electronic framing type 6A003a.4

Cameras, electronic framing type 6A203b.3

Cameras, electronic streak type 6A003a.3

Cameras, electronic streak type 6A203b.1

Cameras, framing 6A003a

Cameras, framing 6A203

Cameras, imaging 6A203c

Cameras, imaging 6A003b

Cameras, imaging ML15d

Cameras, mechanical 6A003a

Cameras, mechanical 6A203a.1

Cameras, mechanical ML15b,d

Cameras, military ML15b

Cameras, radiation hardened TV 6A203c

Cameras, scanning & scanning camera systems 6A003b.2

Cameras, scanning & scanning camera systems ML15

Cameras, underwater photographic 8A002e

Cameras, video using solid state sensors 6A003b.1

Canisters, smoke ML4a

Canned drive pumps 2B350i

Cannons, large calibre ML2a

Capacitors 3A001e.2

Capacitors 3A201a

Carbines ML1a

Carbines, non‑military ML901a

Carbon dioxide (CO2) lasers 6A005a.4

Carbon fibre & filamentary materials 1C010b

Carbon fibre & filamentary materials 1C210

Carbon monoxide (CO) lasers 6A005a.3

Carbon or alumina fibre conversion equipment 1B001d

Carbon or alumina fibre conversion equipment 1B101d

Carbon‑carbon exit cones 9A006h

Carbon‑carbon materials 1A102

Carbon‑carbon thrust chambers 9A006h

Carbonyl dichloride 1C450a.7

Carboranes & derivatives ML8c.3

Carboxy‑terminated polybutadiene (CTPB) 1C111b.1

Cargo carriers, military ML6

Cargo parachutes ML10h.2

Cartridges ML3

Cartridges ML4a

Casting and remelt arc furnaces 2B227a

Castings, military ML16

Castings, non‑military firearms ML903

Catalysts, platinized 1A225

Catalytic burners 0B004b.7

CATB (Diaminotrinitrobenzene) ML8a.9

Cathodes (Impregnated) for electronic microwave tubes 3A001b.1.c

Cathodic arc deposition production equipment 2B005f

Catocene ML8f.4.b

Cell culture development/production/use technology ML7i.2

Cell cultures, biocatalyst production systems ML7h.2

Cell cultures, chemical warfare (CW) agent indentification ML7g

Cells or batteries (high energy), primary 3A001e.1.a

Cells or batteries (high energy), rechargeable 3A001e.1.b

Cellular radio systems development/production technology 5E001b.3

Centrifugal decanters 2B352c

Centrifugal fixtures for gyro bearings 0B001b

Centrifugal fixtures for gyro bearings 0B002

Centrifugal fixtures for gyro bearings 7B003e

Centrifugal isotope separation plant, equipment & components 0B001a.1

Centrifugal multiplane balancing machine, use software 2D201

Centrifugal multiplane balancing machines for flexible rotors 2B229a

Centrifugal multiplane balancing machines, fixed or portable 2B219

Centrifugal pumps 2B350i

Centrifugal separators 2B352c

Centrifuge rotor assembly equipment 2B228a

Centrifuge rotor balancing equipment 2B229

Centrifuges, gas 0B001b.1

Ceramic base materials development/production technology 1E002c.1

Ceramic base materials, single or complex borides of Ti 1C007a

Ceramic composite materials, useable for radomes or nose tips 1C107b

Ceramic core manufacturing equipment 9B001c

Ceramic cores for blades & vanes 9B001d

Ceramic materials & composites 1C007

Ceramic shell manufacturing equipment 9B001c

Ceramic shell wax pattern preparation equipment 9B001d

Ceramic shells for blades & vanes 9B001b

Ceramic‑ceramic composite materials 1C007f

Ceramic‑matrix composite materials 1C007c

Ceramic‑matrix composite materials 1C007d

Ceramic‑matrix non‑composite materials 1C007b

Cerium sulphide (Ce2S3) made/coated crucibles 2A225a.2

Certification software for information security software 5D002c.2

Chambers, aerosol challenge testing (capacity of 1 m3 or more) 2B352g

Changers, frequency (converters or inverters) 0B001b.13

Changers, frequency (converters or inverters) 3A225

Charge (explosive) activation equipment ML4b

Charge (explosive) control equipment ML4b

Charges, military explosive ML4a

Charges, military explosive ML8a,b

Chemical exchange isotope separation process plant, components 0B001e

Chemical exchange isotope separation process plant, equipment 0B001a.4

Chemical incinerators 2B350j

Chemical lasers 6A005a.5

Chemical manufacturing equipment 2B350

Chemical manufacturing facilities 2B350

Chemical storage tanks & containers 2B350c

Chemical vapour deposition (CVD) equipment, epitaxial growth 3B001

Chemical vapour deposition (CVD) equipment, plasma enhanced 3B001d

Chemical vapour deposition (CVD) equipment, production 2B005a

Chemical vapour deposition (CVD) equipment, production (fibre) 1B001d

Chemical warfare (CW) binary precursors ML7b

Chemical warfare (CW) precursors 1C350

Chemical warfare agent indentification biopolymers & cultures ML7g

Chemicals, precursors for toxic chemical agents 1C350

Chemostats for biological processing (capacity 300 L or more) 2B352b

Chikungunya virus (Human pathogen) 1C351a.1

Chlamydia psittaci 1C351c.5

Chlorates composited with metal or high energy fuels ML8a.3

Chlorine trifluoride (ClF3) 1C238

Chlorofluorocarbon compoundsoils as hydraulic fluids 1C006a.2

Chloropicrin 1C450a.3

Chlorosarin ML7b.3

Chlorosoman ML7b.4

Chromates composited with metal or high energy fuels ML8a.3

Cinema recording cameras 6A003a.1

CL 14 (Diamino dinitrobenzofurozan) ML8a.25

CL 20 (Hexanitrohexaazaisowurtzitane or HNIW) ML8a.30

Cladding test/inspection equipment, for reactor fuel elements 0B005

Clathrates of CL‑20 ML8a.4

Clicker dies 1B101e

Climatic chambers 9B106

Clips, ammunition ML1d

Closed circuit diving apparatus 8A002q

Closed‑cycle refrigeration systems 9A006b

Clostridium botulinum 1C351c.6

Clostridium perfringens toxins 1C351d.2

Clothing & materials, bullet proof ML13d

Clothing & materials, bullet resistant ML13d

Clothing & materials, bullet‑resistant 1A005

CN (Phenylacyl chloride) ML7c.3

CNTD (Controlled nucleation thermal decomposition) equipment 2B005a.1.b

Coating & processing equipment, for non‑electronic substrates 2B005

Coating application technology, for non‑electronic substrates 2E003f

Coatings for reduced electromagnetic visibility 1C101

Coatings, designed for reduced reflectivity ML17c

Cochliobolus miyabeanus (Helminthosporium oryzae) 1C354b.2

Cold boxes, hydrogen distillation 0B004b

Cold traps/desublimers for UF6 removal 0B001d.7.d

Cold traps/desublimers for UF6 removal 0B002b

Cold‑cathode tubes 3A228a

Colletotrichum coffeanum var. virulans, fungi 1C354b.1

Colour centre lasers 6A005c.1

Columbium (Niobium) alloys 1C002a.2.b

Column, absorption or distillation 2B350e

Column, liquid‑liquid exchange, for lithium amalgams 1B233

Combat aircraft ML10a

Combat parachutes ML10h

Combatant vessels & components ML9

Combined cycle engines/components 9A011

Combustion regulation devices, jet engines 9A118

Command, Communications, Control & Intelligence software ML21b.1.d

Common channel signalling equipment/systems 5B001b.5

Common channel signalling equipment/systems, technology 5E001c.5

Communications cable systems, secure 5A002a.7

Communications Systems (underwater) 5A001b.1

Compasses (gyro‑astro) & devices 7A004

Compasses (gyro‑astro) & devices, other than those of 7A004 7A104

Compilers (Software) for multi‑data‑stream processing equipment 4D003a

Composite components/structures for rockets 9A010

Composite conductors, superconductive 1C005

Composite materials 1C007f

Composite materials software 1D002

Composite structures for propulsion systems or space vehicles 9A110

Composite structures, as tubes 1A202

Composite structures, laminates or tubes 1A002

Composite temperature/pressure/atmosphere regulation technology 1E103

Composite/laminate manufactures for rockets 9A110

Compound semiconductor integrated circuits, industrial 3A001a.11

Compound semiconductor photocathodes 6A002a.2.b.3

Compounds composed of fluorine & other halogens, oxygen or nitrogen ML8a.5

Compressors 0B001c.3

Compressors 0B001d.3

Compressors 0B001h.3

Compressors 0B004b.2

Compressors, 1B232

Computer interconnect equipment 4A003g

Computer, electronic assemblies & equipment & components 4A001‑4

Computer, electronic components 4A101

Computer, electronic components 4A102

Computer‑aided‑design (CAD) software for IC's & semiconductors 3D003

Computer/assemblies/components, neural 4A004b

Computer/assemblies/components, optical 4A004c

Computer/assemblies/components, systolic array 4A004a

Computers, analogue 4A001

Computers, analogue & analogue ruggedised 4A101

Computers, digital 4A001

Computers, digital 4A003

Computers, digital 4A004

Computers, digital ruggedised 4A101

Computers, having information security characteristics 4A001b

Computers, hybrid 4A102

Computers, radiation hardened 4A001a.2

Computers, with extended operating temperature range 4A001a.1

Condensers or heat exchangers 0A001i

Condensers or heat exchangers 0B001d.4

Condensers or heat exchangers 0B001c.5

Condensers or heat exchangers 2B350d

Conductive polymers 1C001

Congo‑Crimean haemorrhagic fever virus 1C351a.2

Connectors, Optical fibre 5A001c.1

Conotoxin 1C351d.3

Construction equipment, military ML17b

Contactors, chemical exchange (ammonia hydrogen) 0B004b.4

Contactors, liquid liquid centrifugal 0B001e

Containers, chemical 2B350e

Containment facilities 2B352a

Continuous mixers with vacuum & temperature control facility 1B111 & 1B118

Continuous‑flow systems for biological processing 2B352b

Contrarotating propellers 8A002o.1.b

Control agents, riot ML7c

Control apparatus and devices for rocket launchers 9A115a

Control equipment, explosive ML4b

Control rods, for nuclear reactors 0A001d

Control units for metallurgical melting & casting furnaces 2B227

Controllable‑pitch propellers 8A002o.2.a

Controlled atmosphere melting & casting furnaces 2B227

Controlled environment (vacuum or inert gas) induction furnaces 2B226

Controlled nucleation thermal decomposition (CNTD) equipment 2B005a.1.b

Controllers for high explosive handling robots 2B207

Controllers, machine tool (CNC) 1B001a

Controllers, robot 2B007

Converter integrated circuits 3A001a.5

Converter interfaces for digital video magnetic tape recorders 3A002a.4

Converters, frequency 0B001b.13

Converters, frequency 3A225

Converters, microwave frequency extender 3A001b.7

Cooling equipment for molten uranium 0B001g.2

Cooling fluids ‑ electronic 1C006d

Copper metal vapour lasers 6A005a.2.a

Copper or phosphor bronze mesh packings 1A226

Copper salicylate ML8

Coprocessor microcircuits 3A001a.3

Coprocessors or accelerators, graphics 4A003d

Correlation‑velocity sonar log equipment 6A001c

Counter current solvent extractors 0B006

Countermeasure & counter countermeasure equipment, military ML15f

Countermeasure equipment, fire control systems ML5c

Couplers, Optical fibre 5A001c.1

Coxiella burnetii 1C351b.1

CP (2 (5 Cyanotetrazolato) pentaamminecobalt(III) perchlorate) ML8a.22

CR (Dibenz‑(b,f)‑1,4‑oxazephine) ML7c.4

Critically safe tanks, nuclear fuel reprocessing 0B006

Cross‑flow filtration equipment 2B352d

Crossed‑field amplifier tubes 3A001b.1.b

Crucibles, liquid actinide resistant 2A225

Crucibles, resistant to molten uranium 0B001i.5

Crucibles, resistant to molten uranium 0B001g.2

Crucibles, resistant to molten uranium 0B001g.2

Crucibles, tantalum 2A225c.2

Cryocoolers for optical sensors 6A002d.1

Cryocoolers for optical sensors 6A002d.2

Cryogenic containers 9A006b

Cryogenic distillation columns 1B228

Cryogenic distillation towers & cold boxes 0B004b

Cryogenic equipment/accessories/components, military ML20

Cryogenic heat exchangers 0B001d.7.a

Cryogenic heat pipes 9A006a

Cryogenic refrigeration units 0B001d.7.b

Cryogenic refrigerators 9A006a

Cryoseparators 0B001d.7.a

Cryptanalytic equipment or devices, digital 5A002a.2

Cryptography equipment or devices, analogue 5A002a.3

Cryptography equipment or devices, digital 5A002a.1

CS (o‑Chlorobenzylidenemalononitrile) ML7c.2

Cs bis(5 nitrotetrazolato)pentaaminecobalt(III) perchlorate (BNCP) ML8a.23

CTPB (Carboxy‑terminated polybutadiene) 1C111b.1

Cultures of bacteria 1C351c

Cultures of bacteria 1C352b

Cultures of bacteria 1C353

Cultures of bacteria 1C354a

Cultures of fungi 1C353

Cultures of fungi 1C354b

Cultures of rickettsiae 1C351b

Cultures of rickettsiae 1C353

Cultures of viruses 1C351a

Cultures of viruses 1C352a

Cultures of viruses 1C353

Custom integrated circuits, industrial 3A001a.10

Cutting machines, gears 2B003

Cutting tool inserts, single diamond point 2B008e

CVD (Chemical vapour deposition) equipment 1B001d

CVD (Chemical vapour deposition) equipment 1B101d

CVD (Chemical vapour deposition) equipment 2B005a

CVD (Chemical vapour deposition) equipment, plasma enhanced 3B001d

CVD (Chemical vapour deposition) furnaces 2B104b & 2B105

CW (Chemical warfare) precursors 1C350

CW defoliants ML7a

CW incapacitating agents ML7a

CW nerve agents ML7a

CW vesicant agents ML7a

Cyanoethylated polyamine ML8e.12

Cyanoethylated polyamine ML8e.13

Cyanoethylated polyamine ML8e.37

Cyanoethylated polyamine ML8e.38

Cyanogen chloride 1C450a.4

Cyclonite (RDX) ML8a.20

Cyclotetramethylenetetranitramine (HMX) ML8a.7

Cyclotrimethylenetrinitramine (RDX) ML8a.20

Cylinder wall lubrication technology, diesel engines 9E003e.3

## D

DACs (Digital‑to‑analogue converters) 3A001a.5

Damping, flotation or lubricating fluids 1C006

Data acquisition equipment for wind tunnels, automatic 9B005

Data acquisition systems for gas turbine development 9B002

Databases libraries, parametric technical data ML17f

Decanters, centrifugal 2B352c

Decarborane & derivatives ML8a.6

Decontamination biocatalysts, chemical warfare (CW) agent ML7h.1

Decoying equipment/apparatus/devices ML4b

Deep‑hole drilling machines 2B001f

Defensive systems against toxicological agents ML7e

Deformable mirrors 6A004a.1

Degassing equipment 2B350

DEGDN (diethylene glycol dinitrate) 1C111c

Degradation biocatalysts, chemical warfare (CW) agent ML7h.1

Demolition charges & components ML4a

Demolition charges & components ML8a b

Demolition kits & components, military ML4a

Dengue fever virus 1C351a.3

Depleted uranium 0C001

Depth charges & components ML4a

Depth sounders 6A001a.1

Design integration of guidance sets, software 7D103

Desublimers for UF6 removal 0B002b

Detection and protection equipment (software) 1A004

Detection devices, underwater ML9c

Detection equipment explosive ML4b

Detection or location systems (acoustic) 6A001a.1.b

Detection/defence systems, directed energy weapon systems ML19d

Detectors, optical 6A002a

Detectors, radiation hardened 6A102

Detectors, space‑qualified solid state optical 6A002a.1

Detonation apparatus/devices/equipment (explosive) ML4a

Detonation apparatus/devices/equipment (explosive) ML4b

Detonation apparatus/devices/equipment (explosive) ML8a c

Detonation apparatus/devices/equipment (explosive) ML909

Detonator firing sets, for multiple detonators of 3A232 3A229a

Detonator materials & devices containing them, military ML8

Detonators, electric explosive ML4a

Detonators, exploding bridge (EB) 3A232a.1

Detonators, exploding bridge wire (EBW) 3A232a.2

Detonators, exploding foil initiators (EFI) 3A232a.4

Detonators, slapper (electric) 3A232a.3

Deuterated compounds, (eg Deuterated paraffins) 0C003

Deuterium & deuterium compounds as mixtures & solutions 0C003

Deuterium fluoride (DF) lasers 6A005a.5.b

Deuterium fluoride‑carbon dioxide (DF‑CO2) lasers 6A005a.5.c.2

Deuterium/deuterium compound production plant, equipment & components 0B004

Devices containing military explosives, propellants & related substances ML8

DF (Methyl phosphonyl difluoride) ML7b.1

DF (Methyl Phosphonyldifluoride) ML7b.1

Di‑isopropylamine 1C350.48

Dialkyl N,N‑dialkyl‑phosphoramidates 1C450b.2

Diamino dinitrobenzofurozan (CL 14) ML8a.25

Diaminohexanitrobiphenyl (DIPAM) ML8a.15

Diaminotrinitrobenzene (DATB) ML8a.9

Diamond film substrate development/production technology 3E002d

Diamond point cutting tool inserts, single 2B008e

Diaphragm pumps 2B350i

Diaphragm valves 2B350g

Diaphragms, made from fluorinated compounds 1A001a

Dibenz‑(b,f)‑1,4‑oxazephine (CR) ML7c.4

Dibromotetrafluoroethane based damping or flotation fluids 1C006c.1

Dies, bellows‑forming 2B228c

Diesel cycle engine, air independent 8A002j

Diethyl ethylphosphonate 1C350.17

Diethyl methylphosphonate 1C350.56

Diethyl methylphosphonite 1C350.33

Diethyl phosphite 1C350.19

Diethyl‑N, N‑dimethylphosphoramidate 1C350.18

Diethylaminoethanol 1C350.49

Diethylene glycol dinitrate (DEGDN) 1C111c

Diffusion bonding technology, metal working 2E003b.1.b

Diffusion bonding technology/data, super alloys or Ti alloys 2E003b.2.b

Diffusion bonding tools, dies, moulds or fixtures 1B003

Digital array processors 3A001a.3

Digital computer electronic assemblies, parallel processing 4A003c

Digital computer systems 4A001

Digital computer systems 4A003b

Digital computer systems 4A003c

Digital computer systems 4A004

Digital computers, 4A003

Digital computers, electronic assemblies & related equipment 4A001

Digital computers, electronic assemblies & related equipment 4A003

Digital computers, fault tolerant 4A003a

Digital computers, logic processors 4A003

Digital computers, ruggedised 4A101

Digital computers, signal processing 4A003

Digital computers, vector processors 4A003

Digital coprocessors 3A001a.3

Digital differential analysers, ruggedised 4A101

Digital electronic engine control software 9D003a

Digital instrumentation tape data recorders 3A002a.3

Digital signal processors 3A001a.3

Digital signal processors 4A003

Digital video magnetic tape recorders 3A002a.2

Digital‑to‑analogue converter integrated circuits (DACs) 3A001a.5

Digitally controlled radio receivers 5A001b.4

Digitisers, waveform 3A002a.5

Dimensional inspection equipment/systems 2B006a

Dimensional inspection equipment/systems 2B006c

Dimensional Inspection machines 2B206

Dimensional measuring equipment, instruments/systems 2B006b

Dimensional measuring equipment, instruments/systems 2B006d

Dimethyl ethylphosphonate 1C350.34

Dimethyl hydrazine, symmetrical/unsymmetrical ML8a.18

Dimethyl methylphosphonate 1C350.3

Dimethyl phosphite 1C350.6

Dimethylamine 1C350.16

Dimethylamine hydrochloride 1C350.20

DINGU (Dinitroglycoluril or DNGU) ML8a.13

Dinitroazetidine t butyl salt ML8e.14

Dinitrogen pentoxide 1C111a.3.c

Dinitrogen tetroxide (Nitrogen dioxide) 1C111a.3.b

Dinitrogen trioxide 1C111a.3.a

Dinitroglycoluril (DINGU/DNGU) ML8a.13

Diodes, laser 6A005b

DIPAM (Diaminohexanitrobiphenyl) ML8a.15

Diphenyl methylphosphonate 1C450b.1

Direct view imaging equipment 6A002c

Direct‑acting hydraulic pressing technology for metal working 2E003b.2.c

Directed energy weapons (DEW) ML19

Direction finding systems, equipment & components 7A007

Direction finding systems, equipment & components 7A103

Directional solidification casting control software 9D004c

Directional solidification casting equipment 9B001a

Discharging equipment, explosive ML4b

Dissemination equipment for biological agents ML7d

Dissemination equipment for radioactive materials ML7d

Dissolvers, for nuclear fuel 0B006

Distillation columns 2B350e

Distillation columns, cryogenic 1B228

Distillation Towers (ammonia) 0B004b

Distillation towers and cold boxes (hydrogen cryogenic) 0B004b

Distillation towers, packings 1A226

Diving apparatus, articles & components 8A002q

Diving apparatus, articles & components ML17a

DMCDB (Elastomer modified cast double based propellants) ML8b.7

DNGU (Dinitroglycoluril or DINGU) ML8a.13

Doppler laser interferometers (DLIs) 6A225

Double seal pumps 2B350i

Double seal valves 2B350g

Drag parachutes ML10h.3

Drilling machines, deep‑hole 2B001f

Drogue parachute ejector seats ML10h.4

Drogue parachutes ML10h.3,4

Drones ML10d

Dry boxes capable of use with biological agents 2B352a.3

Dry etching equipment, anisotropic plasma 3B001c

Dummy ammunition, large bore weapons ML3

Dye lasers 6A005d

Dye lasers 6A205

Dynamic adaptive routing software 5D001c.3

Dynamic signal analysers 3A002c.2

Dynamic wavefront (phase) measuring equipment 6A005f

## E

Eastern equine encephalitis virus 1C351a.4

EB‑PVD (Electron beam physical vapour deposition) equipment 2B005c

Ebola virus 1C351a.5

EDMs, non wire feed types 2B001d

EEFO (Bis (2 fluoro 2,2 dinitroethyl) formal) ML8e.4

EEPROMs (Electrical erasable programmable read‑only memories) 3A001a.4

Ejector seats ML10a,b

Elastomer modified cast double based propellants (EMCDB) ML8b.5

Electric detonators, explosive 3A232a

Electric detonators, explosive ML4a

Electric propulsion engines 8A002o.2.b

Electrical discharge machines, non wire feed CNC 2B001d

Electrical erasable programmable read‑only memories 3A001a.4

Electrically driven explosive detonators 3A232a

Electro‑optic materials 6C004

Electro‑optical integrated circuits 3A001a.6

Electrochemical reduction cells 0B001e.3

Electrochemical reduction cells 0B001e.4

Electrolysis cells, amalgam lithium isotope separation 1B233

Electrolytic cells, fluorine production 1B225

Electromagnetic amplifiers, superconductive devices 3A001d.1

Electromagnetic energy storage, superconductive devices 3A001e.3,4

Electromagnetic interference (EMI) protection technology 7E102

Electromagnetic isotope separation equipment & components 0B001j

Electromagnetic isotope separation plant 0B001a.9

Electromagnetic isotope separators 1B226

Electromagnetic pulse (EMP) protection technology, avionics 7E102

Electromagnetic pulse (EMP) protection, detectors 6A102

Electromagnetic radiation sensors, optical fibre 6A002d.3.a

Electromagnetic signature reduction material & devices 1C101

Electromagnetic underwater communications systems 5A001b.1

Electromagnets, superconductive 3A001e.3

Electromagnets, superconductive ML20

Electromagnets, superconductive 3A201b

Electron beam cutting machines (CNC) 2B001e.1.b

Electron beam equipment for mask making/semiconductor devices 3B001f

Electron beam guns 0B001g.1

Electron beam melting furnaces 2B227b

Electron beam physical vapour deposition (EB‑PVD) equipment 2B005c

Electron beam sensitive resist materials 3C002b

Electron beam systems, for probing semiconductor devices 3B002d

Electron bombardment mass spectrometers 3A233d

Electron cyclotron resonance (ECR) CVD equipment 3B001d

Electron cyclotron resonance (ECR) plasma dry etching equipment 3B001c

Electronic assemblies 4A003

Electronic cameras 6A003a.5

Electronic components 3A001

Electronic components 3A101

Electronic components 3A201

Electronic components ML11

Electronic computers & related equipment 4A001‑4

Electronic computers & related equipment 4A101

Electronic computers & related equipment 4A102

Electronic cooling fluids 1C006d

Electronic devices, high current/voltage/speed switching 3A228

Electronic devices, high current/voltage/speed switching ML11

Electronic equipment for reentry vehicles 9A116c

Electronic equipment, military ML11

Electronic framing cameras 6A203b.3

Electronic streak cameras & streak tubes 6A003a.3

Electronic streak cameras & streak tubes 6A203b

Electronic vacuum tubes, microwave/millimetre wave devices 3A001b.1

Electronic vacuum tubes, microwave/millimetre wave devices ML11

Electronic valves, industrial vacuum 3A228

Electronically steerable antennae, phased array 5A001d

EMP/EMI protection technology, avionic systems 7E102

Encoders, rotary input shaft type 3A001f

Encrypted GPS (Global Positioning System) equipment & components 7A005a

Encryption equipment, assemblies & components 5A002

Encryption software 5D002

End effectors, robot 2B007

End effectors, robot 2B207

End effectors, robot ML17e

Energetic monomers, plasticisers & polymers ML8e.15

Energy storage capacitors (high capacity) 3A001e.2

Energy storage, superconductive devices 3A001e.3

Energy storage, superconductive devices 3A001e.4

Engines & related equipment/components, military vehicles ML6i

Engines, aircraft military ML10c

Enriched uranium or materials containing it 0C002

Enrichment plant, isotope 0B001

Environmental chambers, capable of simulating flight conditions 9B106a

Environmental test facilities, military ML18b

Epitaxial growth equipment 3B001a

Epitaxial wafers, Cadmium telluride (CdTe) 6C002b

Erbium oxide (erbia) (Er2O3) made/coated crucibles 2A225a.2

Ethers (alkylphenylene) in the form of a lubricating fluid 1C006b.1

Ethyldiethanolamine 1C350.59

Ethyl phosphinyl dichloride 1C350.21

Ethyl phosphinyl difluoride 1C350.35

Ethyl phosphonyl dichloride 1C350.22

Ethyl phosphonyl difluoride 1C350.23

Ethyldiethanolamine 1C450b.7

Evaporators for concentrated lithium hydroxide solution 1B233

Exchange columns, liquid‑liquid for lithium amalgams 1B233

Excimer lasers 6A005a.1

Exit cones, liquid rocket propulsion 9A006h

Expander cycle turbine drive systems 9A006d

Expert systems ‑ integration systems technology 2E003d

Expert systems software 4D003b

Exploding bridge (EB) detonators 3A232a.1

Exploding bridge wire (EBW) detonators 3A232a.2

Exploding foil initiators (EFI) 3A232a.4

Explosive charge activation equipment ML4b

Explosive charge control equipment ML4b

Explosive charge decoying equipment ML4b

Explosive charge detection equipment ML4b

Explosive charge handling equipment ML4b

Explosive charge jamming equipment ML4b

Explosive charge laying equipment ML4b

Explosive detection equipment ML4b

Explosive detonators, industrial electric 3A232a

Explosive detonators, military ML4a

Explosive detonators, military ML8a,b

Explosive detonators, non‑military ML909

Explosive devices ML4a

Explosive devices ML8a,b

Explosive devices, non‑military ML909

Explosive, high (industrial) 1C239

Explosive, material ML8a,b

Explosive, material, non‑military ML908

Explosive/munitions environment handling robots 2B007b

Explosives/propellants/pyrotechnics ML8b.6

Expression vectors, biocatalyst production systems ML7h.2

Extended temperature range semiconductor components 3A001a.2

## F

FADEC (Full authority digital electronic engine control)‑software 9D003

Fast exchange liquid liquid centrifugal contactors 0B001e.2

Fast exchange liquid liquid pulse columns 0B001e.1

Fast Fourier Transform (FFT) processors 3A001a.12

Fast Fourier Transform processors, acoustic signal processing 6A001c

Fast switching function modules or assemblies 3A228c

Fault tolerance FADEC software 9D003b

Fault tolerant digital computers 4A003a

Fe2O3 (Hematite), superfine ML8e.24

Feed preparation systems for Uranium Chloride production 0B001e.5

Fermenters, biological processing 2B352b

Fibre and filimentary material 1C010

Fibre and filimentary material 1C210

Fibre optic cable 5A001c.1

Fibre optic hull penetrators/connectors 8A002c

Fibre optic magnetometers 6A006e

Fibre surface treatment equipment 1B101e

Fibrous & filamentary materials 1C010d

Fibrous or filamentary material production 1B001

Fibrous or filamentary material production 1B101

Fibrous or filamentary materials 1C010

Fibrous or filamentary materials 1C210

Field engineer equipment ML17d

Field programmable gate arrays (FPGA) 3A001a.7

Field programmable logic arrays (FPLA) 3A001a.8

Filament winding machine software 1D001

Filament winding machine software 1D101

Filament winding machine software 1D201

Filament winding machines 1B001a

Filament winding machines 1B101a

Filament winding machines 1B201

Filament‑wound composite motor cases 9A008a

Filamentary materials 1C010b

Filling equipment, remotely controlled 2B350f

Film processing equipment, military ML15b

Film type integrated circuits ML11

Film type integrated circuits, industrial 3A001a

Filters, optical opacity switch 6A004d.3

Filters, tunable band‑pass 3A001b.5

Fingers, for surface effect vessels 8A002k

Finishing machines, gear 2B003

Fire bombs & components ML4a

Fire control (military) equipment & related systems ML5

Firearms ML1

Firearms, non‑military ML901

Firing sets ML4b

Firing sets, for multiple detonators of 3A232 3A229a

Fissile materials or materials containing them 0C002

Fittings, designed for reduced reflectivity ML17c

Flame throwers, military ML2a

Flash discharge X‑ray generators 3A201c

Flash suppressors ML1d

Flexible isolators capable of use with biological agents 2B352a.3

Flexible nozzles, solid rocket motor 9A108c

Flexible nozzles, thrust vector control sub‑system 9A106b

Flexible rotor centrifugal balancing machines 2B229a

Flexible sensors for hydrophones 6A001a.2.a.1

Flight control actuator technology 7E004a.5

Flight control system development technology 7E004

Flight control systems 7A116

Flight control systems ‑ software 7D003e

Flight instrument systems, integrated 7A103

Flight management system integration technology 1E104

Flight simulators ML14

Flightweight Dewars 9A006a

Flow forming/Spin forming equipment, software 2D101

Flow forming/Spin forming equipment, software 2D201

Flow‑forming machines 2B009

Flow‑forming machines 2B109

Flow‑forming machines 2B209

Fluid energy mills 1B119

Fluid or secondary gas injection thrust systems 9A108c

Fluorinated compounds 1C009

Fluorinated compounds, components 1A001

Fluorinated phosphazene elastomers 1C009c

Fluorinated polyimides 1C009b

Fluorinated silicone fluid 1C006b.2

Fluorinating equipment, UF5 to UF6 0B001h.4

Fluorine production (electrolysis cells) 1B225

Fluoroelastomer compounds, technology 1E002b

Fluorophosphate glass 6C004e

Flurocarbon electronic cooling fluids 1C006d

Fluxgate magnetometer technology 6E003c

Fly‑by‑light flight control system software 7D003e

Fly‑by‑wire control system technology 7E004b

Fly‑by‑wire flight control ststem software 7D003e

Fly‑by‑wire systems 7A116

Foam mirror structures, lightweight 6A004a.3

Foam, syntactic for underwater use 8C001

Focal plane arrays, direct vieW 6A002c.2

Focal plane arrays, linear & 2D 6A002a.3

Focal plane arrays, space qualified 6A002e

Foot & mouth disease virus 1C352a.4

Forgings, for non‑military firearms ML903

Forgings, military ML16

FPF 1 (Poly 2,2,3,3,4,4 hexafluoropentane 1,5 diol formal) ML8e.16

FPF 3 (Poly 2,4,4,5,5,6,6 heptafluoro 2 trifluoromethyl 3 oxaheptane 1,7 diol formal) ML8e.17

FPGA's (Field programmable gate arrays) 3A001a.7

FPLA's (Field programmable logic arrays) 3A001a.8

Framing cameras, electronic type 6A203b.3

Framing cameras, electronic type 6A003a.4

Framing cameras, mechanical 6A203a.1

Framing tubes & solid state imaging devices 6A203b.4

Francisella tularensis 1C351c.7

Freeze drying equipment, steam sterilisable 2B352e

Frequency agile systems 5A002a.5

Frequency agile tubes 3A001b.1

Frequency agility development technology 5E001b.10

Frequency analysers (signal analysers) 3A002c.1

Frequency changers (converters or inverters) 0B001b.13

Frequency changers (converters or inverters) 3A225

Frequency extenders, mixers/converters 3A001b.7

Frequency hopping (frequency agile) radio equipment 5A001b

Frequency standards, atomic 3A002g

Frequency synthesised signal generators 3A002d

Frequency synthesiser, electronic assemblies 3A002b

Fuel cell air independent power systems 8A002j

Fuel element chopping or shredding machines 0B006

Fuel element fabrication plant, for nuclear reactors 0B005

Fuel element handling equipment, for nuclear reactors 0A001c

Fuel, aircraft (military high energy) ML8d

Fuels, industrial metal powder 1C111a.1

Fuels, industrial metal powder 1C111a.2

Full Authority Digital Electronic Engine Control software 9D003

Functional testing equipment, for integrated circuits 3B002b

Fungi, plant pathogens 1C354b

Furnaces 2B226

Furnaces 2B227

Furnaces, Chemical Vapour Deposition (CVD) 2B104b

Fused silica, low optical absorption types 6C004e

## G

GA (Tabun) ML7a

GaAs photocathodes 6A002a.2.b.2

GaAs semiconductor integrated circuits, industrial 3A001a.11

GaInAs photocathodes 6A002a.2.b.2

Gallium III/V compound substrates, hetero‑epitaxial grown‑multi‑layer 3C001c

Gallium organo‑metallic compounds 3C003

GAP (Glycidylazide Polymer) 0B001d.3

GAP (Glycidylazide Polymer) ML8e.18

Gas blowers 0B001c.3

Gas centrifuge isotope separation equipment & components 0B001b

Gas centrifuge isotope separation plant 0B001a.1

Gas centrifuge plant auxiliary equipment 0B002

Gas centrifuge rotor assembly equipment 2B228a

Gas centrifuge rotor balancing equipment 2B229

Gas centrifuges 0B001b.1

Gas discharge & ion lasers 6A005a.6

Gas generator turbine drive system 9A006d

Gas krytron tubes 3A228a

Gas lasers 6A005a

Gas monitoring systems, toxic 2B351

Gas projectors/generators ML2b

Gas turbine (aero engine) test software 9D004b

Gas turbine aeroengine assemblies/components ML10c

Gas turbine aeroengines, civil non‑certified/supersonic 9A001

Gas turbine aeroengines, military ML10c

Gas turbine blade technology 9E003a

Gas turbine blade, manufacturing or measuring equipment 9B001

Gas turbine brush seal production/test equipment 9B003

Gas turbine components, solid state joining equipment 9B004

Gas turbine development control systems or instrumentation 9B002

Gas turbine engine development systems/instrumentation 9B002

Gas turbine engine propulsion systems & assemblies/components 9A003

Gas turbine engine technology 9E003

Gas turbine engines & assemblies/components, marine 9A002

Gas turbine engines, aero ML10c

Gas turbine test/flow modelling software 9D004a

Gas, tear ML7c

Gaseous diffusion barriers 0B001c.1

Gaseous diffusion housings 0B001c.2

Gaseous diffusion isotope separation equipment & components 0B001c

Gaseous diffusion isotope separation plant 0B001a.2

Gaseous diffusion plant auxiliary equipjment 0B002

Gaskets 1A001a

Gate arrays, field programmable (FPGA) 1A001a.7

Gate silicon intensifier target (SIT) videcon tubes 6A203b.4.b

GB (Sarin) ML7a

GD (Soman) ML7a

GDMS (Glow discharge mass spectrometers) 3A233b

Gear cutting machines 2B003

Gear finishing machines 2B003

Gear grinding machines 2B003

Gear honing machines 2B003

Generation of machine tool instruction ‑ technology 2E003d

Generator systems, neutron 3A231

Generators, high‑current pulse for detonators 3A229

Generators, high‑speed pulse 3A230

Generators, pyrotechnic ML2b

Genetically‑modified microorganisms 1C353

Geophones, terrestrial 6A001b

Germanium, hetero‑epitaxial grown multi‑layer substrates 3C001b

Gimbals, optical control 6A004d.3

Glass fibre or filamentary materials 1C210b

Glass fibre, for optical communications 5A001c.1

Glass matrix reinforced composite materials 1C007f

Glass preforms, for optical fibre production 5C001

Glass Windows, nuclear radiation shielding 1A227

Glass, high homogeneity 6C004e

Global positioning system (GPS) equipment & components 7A005

Glove boxes capable of use with biological agents 2B352a.3

Glow discharge mass spectrometers (GDMS) 3A233b

Glycidylazide Polymer (GAP) & its derivatives ML8e.18

Goat pox virus 1C352a.5

Gold (Au) metal vapour lasers 6A005a.2.b

GPS (Global positioning system) equipment/components 7A005

GPS equipment, other than those of 7A005 7A105

Gradiometers & components, gravity 6A007c

Gradiometers & components, gravity 6A107

Gradiometers & components, magnetic 6A006

Graphics accelerators or graphics coprocessors 4A003d

Graphite heat exchangers 2B350d

Graphite, bulk 1C107a

Graphite, fine grain recrystallised high density 1C107a

Graphite, nuclear‑grade 0C004

Gravimeters (Gravity meters) & components, gravity 6A007a

Gravimeters (Gravity meters) & components, gravity 6A007b

Gravimeters (Gravity meters) & components, gravity 6A107

Gravity gradiometer software 6D003c

Gravity gradiometers & components 6A007c

Gravity gradiometers & components 6A107

Gravity meter (gravimeters) products & calibration equipment 6B007

Gravity meters (gravimeters) & components 6A007a

Gravity meters (gravimeters) & components 6A007b

Gravity meters (gravimeters) & components 6A107

Gravity meters (gravimeters) software 6D003c

Grenades & components ML4a

Grinding machines 2B001c

Grinding machines 2B201b

Grinding machines, gear 2B003

Ground support launch vehicles 9A115b

Guanidine nitrate 1C011

Guanidine nitrate ML8e.19

Guidance set, production facilities 7B103

Guidance sets 7A117

Gun carriers & related equipment/components ML6f

Gun laying equipment ML5a

Gun mountings ML1d

Gun propellants ML8a,b

Guns & components ML1

Guns, large calibre ML2a

Gyro dynamic balance stations 7B003b

Gyro evacuation/fill stations 7B003d

Gyro run‑in/motor test stations 7B003c

Gyro tuning test stations 7B003a

Gyro‑astro compasses & devices 7A104

Gyros & gyro components 7A002

Gyros & gyro components 7A102

Gyroscope production/manufacturing/test equipment 7B003

## H

Hafnium fluoride (HfF4) glass 6C004e

Hafnium metal, alloys & compounds 1C231

Hafnium oxide (hafnia) (HfO2) made/coated crucibles 2A225a.2

Hair type absorbers 1C001a

Half tracks & related equipment/components ML6d

HAN (Hydroxylammonium nitrate) ML8a.21

Handling apparatus/devices for explosives & explosive devices ML4b

Handling equipment for propellants and their constituents 1B111

Handling equipment for rocket launchers 9A115a

Handling systems, semiconductor wafers 3B001e

Hantaan virus 1C351a.6

HAP (Hydroxylammonium perchlorate) ML8a.21

HBIW (Hexabenzylhexaazaisowurtzitane) ML8e.20

Heading sensors 6A001a.2.d

Heading sensors, towed hydrophones 6A001a.2.b.4

Heat exchangers & condensers 0A001i

Heat exchangers & condensers 0B001c.5

Heat exchangers & condensers 0B001d.4

Heat exchangers & condensers 2B350d

Heat pipe cooled mirrors 6A005e.1

Heat shields/components, reentry vehicle 9A116a

Heat sinks/components, reentry vehicle 9A116b

Heat source materials 1C012

Heavy artillery transporters ML6i

Heavy duty recovery vehicles, military ML6e

Heavy water (Deuterium oxide) 0C003

Heavy water concentration equipment 0B004b.8

Heavy water production plant, equipment & components 0B004

Helicopter power transfer system technology 9E003d

Helicopter system development technology 7E004c

Helicopters, military ML10a,b

Helium refrigeration units 1B231

Helium, enriched 1C232

Helmets, military ML13c

Helmets, military ML10g

Helminthosporium oryzae (Cochliobolus miyabeanus) 1C354b.2

Hematite (Fe2O3), superfine ML8e.24

Hemishell dimensional inspection equipment/systems 2B006c

Hetero‑epitaxial grown multi‑layer substrates 3C001

Hetero‑structure semiconductor technology 3E002b

Hexabenzylhexaazaisowurtzitane (HBIW) ML8e.20

Hexahydro 1,3,5 trinitro 1,3,5 triazine ML8a.20

Hexanitrohexaazaisowurtzitane (CL 20 or HNIW) ML8a.30

Hexanitrostilbene (HNS) ML8a.8

Hexogen ML8a.20

Hexogene ML8a.20

High birefringence optical fibre 6A002d.3.b

High energy fuels (military aircraft) ML8d

High energy photvoltaic arrays 3A001e.1.c

High energy storage capacitors 3A001e.2

High energy storage capacitors 3A201a

High power electron beam guns 0B001g.1

High pressure nozzles 9A006d

High pressure thrust chambers 9A006e

High pressure turbo pumps, pump components 9A006d

High voltage power supplies for ion sources 0B001j.5

High‑speed cameras 6A003

High‑speed cameras 6A203

High‑speed pulse generators 3A230

High‑velocity gun systems 2B232

HIPS (Hot Isostatic Presses) 2B004

HIPS (Hot Isostatic Presses) 2B104a

HIPS (Hot Isostatic Presses) 2B204

HMX (Cyclotetramethylenetetranitramine) ML8a.7

HN1 (bis (2‑chloroethyl) ethylamine) ML7a

HN2 (bis (2‑chloroethyl) methylamine) ML7a

HN3 (tris (2‑chloroethyl) amine) ML7a

HNIW (Hexanitrohexaazaisowurtzitane or CL 20) ML8a.30

HNS (Hexanitrostilbene) ML8a.8

Holding or storage vessels, critically safe 0B006

Hollow cylinder centrifugal balancing machines 2B229b

Honing machines, gear 2B003

Hopping code generation capability, equipment with 5A002a.5

Hopping code generation capability, equipment with ML11

Hot cell manipulators 2B225

Hot isostatic densification technology/data, Al/Ti/Superalloys 2E003b.2.d

Hot isostatic press, use software 2D201

Hot isostatic presses (HIPS) 2B004

Hot isostatic presses (HIPS) 2B104a

Hot isostatic presses (HIPS) 2B204

Hovercraft 8A001

Howitzers ML2a

HTPB (Hydroxy‑terminated polybutadiene) propellant additive 1C111b.2

HTPB (Hydroxyl terminated polybutadiene) ML8e.22

Hull penetrators, military ML9f

Hull penetrators/connectors, fibre optic 8A002c

Human pathogens 1C351a‑c

Hybrid computer electronic systems/electronic assemblies 4A001a

Hybrid computer electronic systems/electronic assemblies 4A001b

Hybrid computers 4A102

Hybrid computers & components 4A001

Hybrid computers, containing digital computers of 4A003 4A002

Hybrid integrated circuits, industrial 3A001a

Hybrid integrated circuits, military ML11

Hybrid rocket motors/propulsion systems 9A009

Hybrid rocket motors/propulsion systems 9A109

Hydraulic fluids, pressure transmission 1C006a

Hydraulic pressing technology (metal working) 2E003b

Hydraulic stretch‑forming machines technology 2E003c

Hydrazine in concentrations of 70% or more ML8c.4.a

Hydrazine nitrate ML8d.8

Hydrazine perchlorates ML8d.9

Hydrides of Antimony, arsenic & phosphorus 3C004

Hydrocarbon fuels thickeners (including M1, M2, M3) ML8d

Hydrocarbon oils, synthetic 1C006

Hydroclave regulation technology 1E103

Hydrocyanic acid 1C450a.5

Hydrofoil vessels 8A001h

Hydrofoils 8A002m

Hydrogen cyanide 1C450a.5

Hydrogen fluoride 1C350.24

Hydrogen fluoride (HF) lasers 6A005a.5.a

Hydrogen isotope storage & purification systems 1B231

Hydrogen refrigeration units 1B231

Hydrogen sulphide water exchange plant, equipment & components 0B004a.1

Hydrogen sulphide water exchange plant, equipment & components 0B004a.1

Hydrogen sulphide‑water exchange plant, equipment & components 1B229

Hydrophone arrays, towed acoustic 6A001a.2.b

Hydrophones 6A001a.2.a

Hydrophones, military ML9c

Hydroxy‑terminated polybutadiene (HTPB) 1C111b.2

Hydroxyl terminated polybutadiene (HTPB) ML8e.22

Hydroxylammonium nitrate (HAN) ML8a.21

Hydroxylammonium perchlorate (HAP) ML8a.21

## I

ICP/MS (Inductively coupled plasma mass spectrometers) 3A233a

Identification systems, directed energy weapon systems ML19d

III/V compound substrates, gallium or indium 3C001c

Image enhancement, digital equipment 4A003

Image intensifier tubes & components 6A002a.2

Image intensifier tubes, direct view 6A002c.1

Image intensifier tubes, military ML15c,d

Image processing equipment, military ML15a

Imaging cameras 6A003b

Imaging cameras 6A203c

Imaging cameras ML15b

Imaging cameras with focal plane arrays of 6A002a.2.b 6A003b.4

Imaging cameras with image intensifiers of 6A002a.2.a 6A003b.3

Imaging devices 6A002

Imaging devices 6A203b.4

Imaging devices ML15b e

Imaging equipment, visible & infrared 6A002c

Imaging equipment, visible & infrared ML15d

Imaging radar sensor equipment ML15e

Imaging sensors, multispectral and monospectral 6A002b

Imaging systems, underwater electronic 8A002f

Impregnated cathodes for electronic microwave tubes 3A001b.1.c

Incendiary bombs & components ML4a

Incendiary munitions ML3

Incinerators designed to destroy the chemicals of 1C350 2B350j

Independent (air) power systems underwater 8A002j

Indium III/V compounds substrates 3C001c

Indium organo‑metallic compounds 3C003

Induction coil magnetometers 6A006b

Induction furnace, controlled environment inert gas 2B226

Induction furnace, vacuum 2B226

Inductively coupled plasma mass spectrometers (ICP/MS) 3A233a

Inert gas environment induction furnaces 2B226

Inertial navigation system software, source code 7D002

Inertial navigation systems integration software 7D102

Inertial navigation, systems/equipment/components 7A003

Inertial navigation, systems/equipment/components 7A103

Inertial sensors, optical fibre 6A002d.3.a

Information security ‑ test, inspection equipment for 5B002

Information security software 5D002

Information security systems/equipment/devices 5A002

Information security technology 5E002

Information security technology support software 5D002b

Infrared (thermal) imaging equipment ML15d

Infrared absorption analysers, on line 0B004b.6

Infrared cameras, industrial 6A003b

Infrared cameras, military ML15

Infrared detectors ML15

Infrared detectors, industrial space qualified 6A002a.1

Infrared detectors, industrial space qualified 6A002a.3

Infrared detectors, industrial space qualified 6A002a.4

Infrared sensors, industrial 6A002a,b

Infrared sensors, military ML15d

Inhibited red fuming nitric acid (IRFNA) ML8d

Initiation systems, single or multipoint (electric) 3A232b

Initiators, explosive detonators (electric) 3A232a

Injectors for use with liquid propelling charges ML2a

Inorganic fibres & filamentary materials 1C010c

Inorganic fibres & filamentary materials 1C210b

Inorganic overlay coating application technology 2E003f

Inspection equipment (linear‑angular for hemishells 2B006c

Instruction generators for machine tools ‑ technology 2E003d

Instrumentation cameras 6A003a

Instrumentation cameras 6A203

Instrumentation for gas turbine development 9B002

Instrumentation for wind tunnels 9B005

Instrumentation systems, inertial navigation 7A003

Insulation bonding/liner system components, rocket motor 9A008a

Insulation, rocket motor case 9A108a

Integrated circuit computer‑aided‑design (CAD) software 3D003

Integrated circuit test equipment, 3B002b

Integrated circuit test equipment, 3B002c

Integrated circuit, masks 3B001g

Integrated circuits ML11

Integrated circuits, general purpose industrial 3A001a

Integrated circuits, microwave 3A001b.2

Integrated flight instrument systems/components 7A103

Integrated system source code, avionic/mission systems 7D003c

Integration software for expert systems 2E003e

Integration technology for flight management systems 1E104

Interconnect equipment (Computer) 4A003g

Interferometers, velocity (VISARs) 6A225

Interior linings, rocket motor case 9A108a

Interlacing machines 1B001c

Internals, reactor nuclear 0A001h

Interstages for rockets 9A117

Intrinsic magnetic gradiometers 6A006f

Inverse synthetic aperture radar (ISAR) 6A008d

Inverters (Frequency changers or converters) 0B001b.13

Inverters (Frequency changers or converters) 3A225

Ion beam equipment for mask making/semiconductor devices 3B001f

Ion beam sensitive resist materials 3C002b

Ion collector plates, Uranium fluoride resistant 0B001j.2

Ion exchange columns 0B001f.2

Ion exchange isotope separation plant 0B001a.5

Ion exchange processing 0B006

Ion exchange reflux systems 0B001f.3

Ion exchange resins 0B001f.1

Ion exchange separation process equipment & components 0B001f

Ion implantation equipment 3B001b

Ion implantation production equipment 2B005b

Ion lenses 6A005a.6

Ion plating production equipment 2B005g

Ion sources, electron bombardment mass spectrometers 3A233d

Ion sources, glow discharge mass spectrometers (GDMS) 3A233b

Ion sources, ICP/MS mass spectrometers 3A233a

Ion sources, mass spectrometers (UF6 enrichment plant) 0B002g

Ion sources, molecular beam mass spectrometers 3A233e

Ion sources, single or multiple 0B001j.1

Ion sources, thermal ionization mass spectrometers (TIMS) 3A233c

IRFNA (Inhibited red fuming nitric acid) ML8d

Iron metal/alloy powder (fuel) ML8a.2.c

Iron oxide ML8f.19

Iron powder ML8a.2.c

Isolators capable of use with biological agents 2B352a.3

Isostatic press, software for use of 2D201

Isostatic presses, hot 2B004

Isostatic presses, hot 2B104a

Isostatic presses, hot 2B204

Isotope separation plant, systems, equipment & components 0B001

Isotope separators, electromagnetic 0B001a.9

Isotope separators, electromagnetic 1B226

Isotopic analysis, collector systems 0B002g.4

## J

Jamming equipment, explosive device ML4b

Japanese encephalitis virus 1C351a.20

Jet engine combustion regulation devices 9A118

Jet engines/components, pulse 9A111

Jet probes, thrust vector control sub‑system 9A106b

Jet probes, thrust vector control sub‑system 9A108c

Jet vane, thrust vector control sub‑systems 9A106b

Jet vanes/probes, thrust vector control sub‑systems 9A108c

Josephson effect devices 6A006h

Joule‑Thomson self‑regulating minicoolers 6A002d.2.b.6

Junin virus 1C351a.7

## K

K 55 (Tetranitrosemiglycouril) ML8a.27

K 6 (2,4,6 Trinitro 2,4,6 triazacyclohexanoneor ML8a.26

Kerr or Pockel cells, electro‑optical shuttering 6A203b.4.c

Keto bicyclic HMX ML8a.27

Keto RDX (2,4,6 Trinitro 2,4,6 triazacyclohexanone or K 6) ML8a.26

KICA 12 (Neopentyl (diallyl) oxy, tri (dioctyl) phosphatoti butanolate tris(dioctyl) phosphato O) ML8e.30.a

Kinetic energy weapon systems & related equipment ML12a

KR3512 (Titanium IV, ((2 propenolato 1)methyl, N propanolato methyl)butanolato 1 ML8e.30.c

KR3538 (Titanium IV, ((2 propenolato 1)methyl, N propanolato methyl)butanolato 1 ML8e.30.b

Krypton ion lasers 6A005a.6

Krytron tubes, gas 3A228a

## L

Laminates & composite structures, organic or carbon 1A002

Laminates, in tube form 1A202

Laminates, rockets/propulsion systems/space vehicles 9A110

Land inertial navigation equipment 7A003

Land‑based gravity meters production equipment 6B007

Large calibre weapons ML2a

Laser altimeters 7A106

Laser based linear position feedback units 2B008b

Laser based measuring instruments 2B006b.1.c

Laser beam cutting machines (CNC) 2B001e.1.c

Laser beam equipment for mask making/semiconductor devices 3B001f

Laser beam systems, for probing semiconductor devices 3B002d

Laser communication technique software 5D001d..2

Laser communication technique technology 5E001b.2

Laser diagnostic equipment 6A005f

Laser diodes, general purpose 6A005b

Laser gyro mirror characterisation equipment, 7B102

Laser isotope plant, systems, equipment & components 0B001

Laser isotope plant, systems, equipment & components 0B001g

Laser isotope plant, systems, equipment & components 0B001h

Laser radar or Light Detection & Ranging (LIDAR) equipment 6A008j

Laser radar systems 6A108

Laser ring gyro test equipment 7B002

Laser ring gyros & gyro components 7A002

Laser weapon systems ML19a

Lasers ML19a

Lasers or laser systems, uranium isotope separation 0B001g.5

Lasers or laser systems, uranium isotope separation 0B001h.6

Lasers, industrial 6A005

Lasers, industrial 6A205

Lassa fever virus 1C351a.8

Lathes (CNC) 2B001a

Launch apparatus or devices, missile 9A115a

Launch ground support vehicles 9A115b

Launch vehicle components/structures 9A010

Launchers, projectile ML4b

Launchers, projectile ML2a

Launching equipment ML2a

Launching equipment ML4b

Laying equipment, explosive ML4b

Lead beta resorcylate ML8e.25

Lead citrate ML8f.6

Lead copper chelates ML8e.27

Lead maleate ML8e.26

Lead salicylate ML8e.2

Lead stannate ML8e.26

Lenses for radiation hardened TV cameras 6A203c

Lewisites ML7a

Libraries, of military parametric technical databases ML17f

Lidar equipment (Laser radar) 6A008j

Lift fans, for surface effect vessels 8A002l

Light gas guns ML12a

Light gas guns (multistage) systems 2B232

Light systems, underwater 8A002d.2

Light systems, underwater 8A002g

Light‑weight reduction gearing, marine transmissions 8A002o.1.d

Lightweight composite or foam mirror structures 6A004a.3

Lightweight monolithic mirrors 6A004a.2

Lightweight turbofan/turbojet engines 9A101

Linear focal plane arrays 6A002a.3

Linear measuring equipment/instruments 2B006b.1

Linear measuring equipment/instruments 2B006b.2

Linear position feedback units or sensors 2B008b

Linear voltage displacement transformer (LVDT) based instruments 2B006b.1.b.1

Linear‑angular inspection equipment for hemishells 2B006c

Liquid fuels, military high energy ML8a,b,d

Liquid lasers 6A005d

Liquid or water jet cutting machines (CNC) 2B001e.1.a

Liquid oxidisers ML8d

Liquid oxidisers, various nitrous oxides 1C111a.3

Liquid propellant control systems 9A106b

Liquid propellant injectors 9A006g

Liquid propellant rocket engines 9A005

Liquid propellant rocket engines 9A105

Liquid rocket fuels ML8a,b,d

Liquid rocket propulsion systems & components 9A005

Liquid rocket propulsion systems & components 9A006

Liquid rocket propulsion systems & components 9A010

Liquid rocket propulsion systems & components 9A105

Liquid rocket propulsion systems & components 9A106

Liquid rocket propulsion systems & components 9A119

Liquid Uranium handling systems 0B001i.4

Liquid‑liquid exchange columns, for lithium amalgams 1B233

Lithium amalgam electrolysis cells 1B233

Lithium amalgam processing equipment 1B233

Lithium amalgam pumps 1B233

Lithium hydroxide solution, evaporators for 1B233

Lithium isotope separation facilities, plant and equipment 1B233

Lithium metal, hydrides or alloys 1C233

Lithography equipment, mask making for semiconductor wafer‑processing 3B001f

Live cultures, isolated 1C351

Live cultures, isolated 1C352

Live cultures, isolated 1C353

Live cultures, isolated 1C354

Location & object detection systems, acoustic 6A001a.1.b

Logic arrays, field programmable (FPLA) 3A001a.8

Logic processors and assemblies 4A003

Lubricating materials 1C006b

LVDT (Linear voltage displacement transformer) based instruments 2B006b.1.b.1

Lymphocytic choriomeningitis virus 1C351a.9

Lyssa virus 1C352a.8

## M

M1 thickeners for hydrocarbon fuels ML8d

M2 thickeners for hydrocarbon fuels ML8d

M3 thickeners for hydrocarbon fuels ML8d

Machine guns & components ML1a,d

Machine pistols ML1a

Machine tool assemblies for equipment of 2B006 & 2B007 2B008

Machine tool components for equipment of 2B006 & 2B007 2B008

Machine tool controller instruction development technology 2E003a

Machine tool cutting tools 2B008

Machine tool feedback units 2B008b

Machine tool instruction generators ‑ technology 2E003d

Machine tool slides 2B008d

Machine tool spindles 2B008a

Machine tools for grinding (CNC) 2B001c

Machine tools for grinding (CNC) 2B201b

Machine tools, E‑beam 2B001e.1.b

Machine tools, laser 2B001e.1.c

Machine tools, numerically controlled 2B201

Machine tools, numerically controlled 2B001

Machine tools, water/other liquid jet 2B001e.1.a

Machines for milling (CNC) 2B001b

Machines for milling (CNC) 2B201a

Machines for turning (CNC) 2B001a

Machining centres (CNC) 2B001

Machining centres (CNC) 2B201

Machupo virus 1C351a.10

Magnesium metal, alloys & powders 1C002a.2.e

Magnesium metal, alloys & powders 1C002b.1.e

Magnesium metal, alloys & powders 1C011

Magnesium metal, alloys & powders 1C111a.2.d

Magnesium metal, alloys & powders 1C228

Magnesium metal/alloy powder (fuel) ML8c.5.b.1

Magnesium oxide (MgO) made or coated crucibles 2A225a.2

Magnet power supplies, direct current) 0B001j.6

Magnetic alloy strips 1C003c

Magnetic anomaly detection software 6D003b.2

Magnetic bearings (suspension) 0B001b.7

Magnetic bearings (suspension) 2A001c

Magnetic compensation systems for magnetic sensors 6A006g

Magnetic compensation systems software 6D003b.1

Magnetic confinement CVD equipment 3B001d.1

Magnetic confinement plasma dry etching equipment 3B001c.1.a

Magnetic drive pumps 2B350i

Magnetic gradiometers 6A006d

Magnetic gradiometers, intrinsic 6A006f

Magnetic metals 1C003

Magnetic pole pieces, diameter over 2 metre 0B001j.4

Magnetic sensor, magnetic compensation systems 6A006g

Magnetometer systems 6A006

Magnetometers 6A006

Magnetometers ML9e

Magnetostrictive alloys 1C003b

Magnetrons 3A001b.1.a

Mandrels for rotor assembly, bellows forming 2B228a

Mandrels, bellows‑forming 2B228c

Manganin gauges, pressure 6A226a

Manifolds, vacuum 0B002f

Manipulators 2B225

Manipulators, for submersibles 8A002i

Manned, submersible vehicles ML9

Manned, tethered submersible vehicles 8A001a

Manned, untethered submersible vehicles 8A001b

MAPO & MAPO derivatives ML8e.41

MAPO (Tris 1 (2 methyl)aziridinyl phosphine oxide) ML8e.41

MAPO derivatives ML8e.41

Maraging steel 1C116

Maraging steel 1C216

Marburg virus 1C351a.11

Marine acoustic systems 6A001a

Marine engines, diesel ML9b

Marine engines, electric ML9b

Marine gas turbine engines 9A002

Masks, integrated circuits of 3A001 3B001g

Mass spectrometers & ion sources (UF6 enrichment plant) 0B002g

Mass spectrometers & ion sources (UF6 enrichment plant) 3A233

Materials development, production & use software 1D001

Materials for military systems ballistic protection ML13b

Materials for reduced electromagnetic reflectivity 1C101

Materials for reduced electromagnetic reflectivity ML17c

Materials processing equipment, use technology 2E101

Materials processing equipment, use technology 2E201

Materials processing equipment, use technology 2E301

MCT (HgCdTe) crystals & epitaxial wafers 6C002b

Measurement equipment, underwater velocity 6A001c

Measuring instruments or systems, 2B006

Mechanical cameras, framing 6A003a.1‑3

Melting furnaces 2B227b

Memory integrated circuits 3A001a.4

Mercury amalgam pumps 1B233

Mercury cadmium telluride crystals & epitaxial wafers 6C002b

Metal & metal alloy powder production equipment 1B002

Metal alloy powders 1C002b

Metal alloy powders 1C011

Metal alloy powders 1C111a

Metal alloys 1C002a

Metal alloys 1C002b

Metal alloys 1C002c

Metal alloys 1C003

Metal alloys 1C004

Metal alloys 1C111a.2.f

Metal alloys 1C116

Metal alloys 1C117

Metal alloys 1C202

Metal alloys 1C216

Metal alloys 1C226

Metal alloys 1C230

Metal alloys 1C231

Metal alloys 1C233

Metal alloys 1C234

Metal coated fibre preforms 9A110

Metal organic chemical vapour deposition (MOCVD) reactors 3B001a.2

Metal palmates (or octol) ML8d

Metal particulate 1C011

Metal powder fuels 1C011

Metal powder fuels 1C111a.1

Metal powder fuels 1C111a.2

Metal powder fuels ML8a.2

Metal powder production equipment 1B002

Metal stearates ML8d

Metal working process tools, die & fixture technology 2E003b.1

Metal‑organic compounds, aluminium/gallium/indium 3C003

Metallurgical melting & casting furnace, software for 2D201

Metallurgical melting & casting furnaces 2B227

Metals with high initial relative (magnetic) permeability 1C003a

Metering devices for use with liquid propelling charges ML2a

Methyl benzilate 1C350.25

Methyl phosphinyl dichloride 1C350.26

Methyl phosphinyl difluoride 1C350.36

Methylphosphonothioic dichloride 1C350.63

Methyl phosphonyl dichloride 1C350.5

Methyl phosphonyl difluoride (DF) 1C350.4

Methyl phosphonyl difluoride (DF) ML7b.1

Methyl Phosphonyldifluoride (DF) ML7b.1

Methyldiethanolamine 1C450b.8

Methylphosphonic acid 1C350.55

Microchannel plates, image intensifier tubes 6A002a.2

Microcircuit emulators 3A002h

Microcircuits, silicon/compound semiconductor 3A001a

Microcomputer microcircuits 3A001a.3

Microcontroller microcircuits 3A001a.3

Microcyclus ulei (syn. Dothidella ulei) 1C354b.3

Microcystins (Cyanginosins) 1C351d.10

Microfluorination ion sources 3A233f

Microorganisms, genetically modified 1C353

Microprocessor microcircuits 3A001a.3

Microwave amplifiers, solid state 3A001b.4

Microwave assemblies 3A001b.6

Microwave assemblies ML11

Microwave devices 3A001b.1

Microwave devices ML11

Microwave frequency extenders, mixers/converters 3A001b.7

Microwave integrated circuit test equipment 3B002c

Microwave integrated circuits 3A001b.2

Microwave modules 3A001b.2

Microwave power sources (frequency above 30 GHz) 0B001i.1

Microwave test receivers 3A002f

Microwave transistors 3A001b.3

Military aero engines ML10c

Military aircraft ML10a,b

Military bridges ML17m

Military cartridges & components ML4a

Military electronic equipment/components ML11

Military engines & related equipment/components ML6k

Military environmental test facilities ML18b

Military explosives, propellants & related substances ML8

Military flame throwers ML2a

Military half tracks & related equipment/components ML6d

Military helicopters ML10a,b

Military helmets ML10g

Military helmets ML13c

Military high energy liquid fuels ML8d

Military high energy solid fuels ML8d

Military mobile repair shops & related equipment/components ML6h

Military power transfer systems & related equipment ML6k

Military production equipment ML18a

Military production technology ML18c

Military propellants ML8

Military propellants ML8b.6

Military propellants ML8c

Military pyrotechnics & components ML4a

Military recovery vehicles & related equipment/components ML6e

Military simulators & components ML4a

Military smoke projectors/generators ML2b

Military trailers (ammunition) ML6f

Military training equipment, accessories/components ML14

Military type armed/armoured vehicles & related equipment ML6b

Military vehicle suspensions ML6m

Military vehicles & related equipment & components ML6

Military weapon systems softwareg ML21

Millimetre wave devices 3A001b.1

Milling machines, (CNC) with two or more co‑ordinated axes 2B001b

Milling machines, (CNC) with two or more co‑ordinated axes 2B201a

Mine control equipment ML4b

Mine decoying equipment ML4b

Mine detection equipment ML4b

Mine handling equipment ML4b

Mine jamming equipment ML4b

Mines & components, explosive ML4a

Mirror assemblies/segments, space assembly 6A004c.3

Mirror characterisation equipment, reflectometers 7B102

Mirror control equipment, phased array/segment 6A004d.4

Mirror positioning gimbals 6A004d.3

Mirror structures, lightweight foam or composite type 6A004a.3

Mirrors, actively cooled or heat pipe cooled 6A005e.1

Mirrors, beam steering 6A004a.4

Mirrors, optical 6A004a

Mirrors, optical 6A005e.2

Missile (usable) guidance sets 7A117

Missile activation equipment ML4b

Missile control equipment ML4b

Missile handling equipment ML4b

Missile telemetry, remote control 5A101

Missiles & missile components ML4a

Mixers, batch & continuous 1B111

Mixers, microwave frequency extenders 3A001b.7

Mobile repair shops & related equipment, military ML6h

Modelling/simulation of guidance sets, software 7D103

Models, military ML19e

Modules, microwave 3A001b.2

Modules/assemblies, fast switching function 3A228c

Molecular beam epitaxial growth equipment using gas sources 3B001a.3

Molecular beam mass spectrometers 3A233e

Molecular laser isotopic separation plant 0B001a.7

Molecular laser separation process equipment & components 0B001h

Molecular pumps 0B001b.9

Molybdenum & tungsten metals alloys 1C117

Monitoring systems, toxic gas 2B351

Monkey pox virus 1C351a.12

Monolithic integrated circuits, industrial 3A001a

Monomethyl hydrazine ML8a.18

Monospectral imaging sensors 6A002b

Mortars ML2a

Motion simulators 2B120

Motor stators 0B001b.10

Movable nozzle control systems, rocket 9A008d

Multi‑chamber central wafer handling systems 3B001e

Multi‑element detector arrays 6A002a.3

Multi‑element photodiodes & phototransistors 6A002a.4

Multi‑layer hetero‑epitaxial material substrates & wafers 3C001

Multi‑layer masks (with phase shift layer), for integrated circuits 3B001h

Multichip integrated circuits, industrial 3A001a

Multilevel security capability, equipment 5A002a.6

Multimode optical fibre & cables, high tensile strength 5A001c.1

Multiple seal valves incorporating a leak detection port 2B350g

Multipoint initiation systems 3A232b

Multispectral imaging sensors 6A002b

Multistage light gas gun systems 2B232

Multistage light gas gun systems ML12a

Mustard Gas ML7a

Mycoplasma mycoides 1C352b.1

## N

N,N‑dialkyl aminoethane‑2‑ols 1C450b.5

N,N‑dialkyl aminoethane‑2‑thiols 1C450b.6

N,N‑dialkyl aminoethyl‑2‑chlorides 1C450b.4

N,N‑dialkyl phosphoramidic dihalides 1C450b.3

N,N‑diethylaminoethyl‑2‑chloride 1C450b.4

N,N‑diethylaminoethyl‑2‑chloride, hydrochloride 1C450b.4

N,N‑diisopropyl‑(beta)‑amino ethanol 1C350.27

N,N‑diisopropyl‑(beta)‑aminoethane thiol 1C350.12

N,N‑diisopropyl‑(beta)‑aminoethane‑2‑thiol hydrochloride 1C350.12

N,N‑diisopropyl‑(beta)‑aminoethyl chloride 1C350.11

N,N‑diisopropyl‑(beta)‑aminoethyl chloride hydrochloride 1C350.54

N,N‑dimethylaminophosphoryl dichloride 1C350.57

N,N‑dimethyl phosphoramidic dichloride 1C350.57

N,N‑dimethylaminoethane‑2‑thiol hydrochloride 1C450b.6

N‑butyl ferrocene & other ferrocene derivatives ML8f.4.d&e

N‑methyl p nitroaniline ML8f.13

Nanocrystalline alloy strips 1C003

Natural uranium 0C001

Naval equipment or components ML9

Naval vessels, with or without armaments or fittings ML9

Navigation equipment, military ML9e

Navigation systems, equipment & components, inertial 7A103

Navigation systems, equipment & components, inertial 7A003

NDT (non‑destructive test) inspection equipment (3D) 1B001f

NDT (non‑destructive test) inspection equipment (3D) 9B007

Neodymium lasers 6A005c.2

Neodymium lasers 6A205f

Neopentyl (diallyl) oxy, tri (dioctyl) phosphato titanate (LIC 12) ML8e.30.a

Neptunium‑237 1C012b

Nets, submarine ML9d

Nets, torpedo ML9d

Network analysers 3A002e

Neural computers/assemblies/components 4A004b

Neural network integrated circuits 3A001a.9

Neutron detection and measuring instruments 0A001j

Neutron generator systems & tubes 3A231

Newcastle disease virus 1C352a.9

Nickel alloys and powders 1C002b.1

Nickel alloys and powders 1C002c.1.a

Nickel alloys and powders 1C240

Nickel aluminides 1C002a.1

Nickel metal (made from powder metals/alloys/powders) 0C005

Nickel metal (made from powder metals/alloys/powders) 1C240

Nickel metal powders 0C005

Nickel metal powders 1C240

Niobium (Columbium) alloys and powders 1C002a.2.b

Niobium (Columbium) alloys/powders 1C002b.1.b

Nitratomethylmethyloxetane (NMMO or poly NIMMO) ML8e.28

Nitrided niobium‑titanium‑tungsten alloy crucibles 2A225a.2

Nitrogen dioxide (dinitrogen tetroxide) 1C111a.3.b

Nitrogen mustards ML7a

Nitroguanidine (NQ) 1C011.d

NMMO (Nitratomethylmethyloxetane or poly NIMMO) ML8e.28

NNTA (3 Nitro 1,2,4 triazol 5 one or NTO) ML8a.17

Noise cancellation systems for vessels, active 8A002o.3.b

Noise reduction equipment for vessels, acoustic mounts 8A002o.3.a

Noise reduction systems for vessels, active 8A002o.3.b

Non‑composite ceramic materials, technology 1E002c.2

Non‑destructive test inspection equipment, 1B001f

Non‑destructive test inspection equipment, rocket motor 9B007

Non‑fluorinated polymeric manufactures 1A003

Non‑fluorinated polymeric substances 1C008

Non‑linear optical materials 6C004b.3

Non‑planar absorbers 1C001a

Non‑tunable solid state lasers 6A005c.2

Nozzles, aerodynamic isotope separation 0B001d.1

Nozzles, for pyrolitic deposition 1B116

Nozzles, rocket motor (liquid) 9A006e

Nozzles, rocket motor (liquid) 9A008c

Nozzles, rocket motor (liquid) 9A106b

Nozzles, rocket motor (liquid) 9A108b

NQ (Nitroguanidine) ML8a.4

NTO (3 Nitro 1,2,4 triazol 5 one or ONTA) ML8a.17

Nuclear grade graphite 0C004

Nuclear heat sources 1C012

Nuclear reactors & reactor components 0A001

Nuclear reactors fuel element fabrication plant/equipment 0B005

Nuclear reactors fuel element reprocessing plant/equipment 0B006

Numerical control for machine tools ‑ software 2D002

Numerical control for machine tools ‑ technology 2E003d

## O

O ethyl 2 diisopropylaminoethyl methylphosphonite (QL) ML7b.2

O,O‑Diethyl phosphorodithioate 1C350.61

O,O‑Diethyl phosphorothioate 1C350.60

O,O‑diethyl S‑[2‑(diethylamino)ethyl] phosphorothiolate 1C450a.1

O‑alkyl alkyl ‑ phosphonofluoridates ML7a

O‑alkyl N,N‑dialkyl phosphoramidocyanidates ML7a

O‑alkyl O‑2‑dialkyl aminoethyl alkyl phosphonite ML7b.2

O‑alkyl S‑2‑dialkyl aminoethyl alkyl phosphonothiolates ML7a

O‑chlorobenzalmalononitrile (CS) ML7c.2

O‑chlorobenzylidenemalononitrile (CS) ML7c.2

O‑ethyl N,N‑dimethylphosphoramidocyanidate (Tabun) ML7a

O‑ethyl S‑2‑diisopropylaminoethyl methyl phosphonothiolate (VX) ML7a

O‑ethyl‑2‑diisopropylaminoethyl methylphosphonite 1C350.29

O‑isopropyl methylphosphonochloridate ML7b.3

O‑isopropyl methylphosphonofluoridate (Sarin) ML7a

O‑pinacolyl methylphosphonofluoridate (Soman) ML7a

O‑pinakolyl methylphosphonochloridate ML7b.4

Object detection and location systems (acoustic) 6A001a.1.b

Ocean salvage systems 8A001e

Octahydro 1,3,5,7 tetranitro 1,3,5,7 tetrazine ML8a.7

Octogen (Octahydro 1,3,5,7 tetranitro 1,3,5,7 tetrazine) ML8a.7

Octogene (1,3,5,7 tetranitro 1,3,5,7 tetrazacyclooctane) ML8a.7

Octol (metal palmates) ML8d

On board weapon control systems ML5a

Operating system development tools/compilers as source code 4D003a

Operating system software, development tools & compilers 4D003a

Operating system software, multi‑data‑stream processing equipment 4D003a

Operating systems for real time processing equipment, software 4D003d

Optical (Infrared) tracking (range) radars 6A108b.2

Optical components for lasers 6A005e

Optical components for lasers, 6A004b

Optical components, space‑qualified 6A004c

Optical computers 4A004c

Optical control equipment 6A004d

Optical detectors & sensors 6A002

Optical detectors, radiation hardened 6A102

Optical equipment 6A005f

Optical equipment ML15

Optical equipment ML19

Optical fabrication technologies 6E003a.2

Optical fibre & accessories, communications 5A001d.1

Optical fibre & accessories, underwater use 5A001c.2

Optical fibre characterisation equipment 5A001a

Optical fibre couplers or connectors for underwater use 5A001c.2

Optical fibre couplers or connectors for underwater use 8A002c

Optical fibre manufacturing equipment 5B001a

Optical fibre preforms 5C001

Optical fibre sensing elements, hydrophones 6A001a.2.a.2

Optical fibres/fibre cable, fluoride 6A004f

Optical fibres/fibre cable, sensing 6A001d.3

Optical integrated circuits 3A001a.6

Optical materials, with non‑linear characteristics 6C004b.3

Optical mirrors (reflectors) 6A004a

Optical mirrors (reflectors) 6A005e.1

Optical sensor cryocoolers 6A001d.1

Optical sensors ‑ flight control systems ‑ technology 7E004

Optical sensors, optical fibre 6A001d.3.a

Optical surface coating/treatment technology 6E003a.1

Optical surface irregularity measuring equipment 1B006d

Optical switching software 5D001d.3

Optical switching technology 5E001c.3

Optical‑electro shutters, Kerr or Pockel cells 6A103b.3.c

Optics, (optical components) 6A004

Optimisation of rocket systems trajectory technology 1E104

Organic fibres & filamentary materials 1C010a

Organic high explosives ML8b.2

Organo metallic coupling agents ML8e.30

Organo‑metallic compounds 3C003

Oxalyl chloride 1C350.65

Oxide matrix reinforced materials 1C007f

Oxygen difluoride ML8d

Oxygen equipment, aircraft ML10i

Oxygen Iodine (O1‑I) laser 6A005a.5

## P

Para‑hydrogen Raman shifters 6A105e

Parachutes, military ML10h.1.a

Parachutes, military ML10h.1.b

Parachutes, military ML10h.7

Paragliders ML10h.3

Particle beam directed energy weapon systems ML19b

Passive acoustic systems 6A001a.1

Passive sensors, direction finding systems 7A115

Pasteurella pseudotuberculosis var pestis (Yersinia pestis) 1C351c.13

Pathogens, animal 1C352

Pathogens, genetically modified microorganisms 1C353a

Pathogens, human 1C351

Pathogens, military ML7a

Pathogens, plant 1C354

PBAA (Polybutadiene‑acrylic acid) 1C111b.3

PBAN (Polybutadiene‑acrylic acid‑acrylonitrile) 1C111b.4

PCDE (Polycyanodifluoroaminoethyleneoxide) ML8e.31

PCDE (Polycyanodifluoroaminoethyleneoxide) ML8e.31

PEEK (Polyether ether ketone) 1C008c.1

PEK (Polyether ketone) 1C008c.3

PEKEKK (Polyether ketone ether ketone ketone) 1C008c.4

PEKK (Polyether ketone ketone) 1C008c.1

Penetrators/connectors (fibre optic), hull 8A001c

Pentaborane & derivatives ML8a.6

Perchlorates composited with metal/high energy fuels ML8a.3

Performance improvement software, navigation systems 7D003a

Performance improvement source code, navigation systems 7D003b

Peste des petits ruminants virus 1C351a.10

PFIB 1C450a.6

PGN (Poly(nitratomethyl oxirane or Poly GLYN) ML8e.33

Phased array antennae (in radar) 5A001d

Phased array antennae (in radar) 6A008e

Phased array/segment mirror control equipment 6A004d.4

Phenylacyl chloride (w‑chloroacetophenone) (CN) ML7c.3

Phenylene, lubricating fluids 1C006b

Phosgene 1C450a.7

Phosphate glass 6C004e

Phosphonic acid, methyl‑, (5‑ethyl‑2‑methyl‑1,3,2‑ dioxa‑phosphorinan‑5‑yl) methyl methyl ester, P‑oxide) 1C450b.1

Phosphonic acid, methyl‑, bis((5‑ethyl‑2‑methyl‑1,3,2‑ dioxa‑ phosphorinan‑5‑yl) methyl ester, P,P’‑dioxide) 1C450b.1

Phosphonic acid, methyl‑, bis(3‑(trimethoxysilyl)propyl) ester 1C450b.1

Phosphonic acid, methyl‑, compd. with (aminoiminomethyl) urea (1:1) 1C450b.1

Phosphonic acid, methyl‑, methyl 3‑(trimethoxysilyl)‑propyl ester 1C450b.1

Phosphonic acid, methyl‑, monoammonium salt 1C450b.1

Phosphonic acid, methyl‑, monomethyl ester, monosodium salt 1C450b.1

Phosphonothioic dichloride, ethyl‑ 1C450b.1

Phosphor bronze or copper mesh packings 1A226

Phosphorus hydrides 3C004

Phosphorus oxychloride 1C350.2

Phosphorus pentachloride 1C350.38

Phosphorus pentasulphide 1C350.47

Phosphorus trichloride 1C350.7

Photocathodes 6A002a.2.b

Photodiodes, single & multi‑element semiconductor type 6A001a.4

Photographic still cameras, underwater 8A001e

Photomultiplier tubes 6A202

Photomultiplier tubes ML15c,d

Phototransistors, single & multi‑element 6A001a.4

Photovoltaic arrays, space qualified or radiation hardened 3A001e.1

Physical test models/test results, directed energy weapons ML23e

Picrylaminodinitropyridine (PYX) ML8a.16

Piezoelectric polymer & copolymer, components 1A001b

Piezoelectric sensing elements, hydrophones 6A001a.2.a.2.b,c

Pinacolone 1C350.39

Pinacolyl alcohol 1C350.28

Piping, multi‑walled incorporating a leak detection port 2B350h

Pistols ML1a

Pistols, non‑military ML901a

Planar absorbers 1C001a

Plant pathogens, bacteria or fungi 1C354

PLAs (Programmable Logic Arrays) 3A001a.8

Plasma atomisation & melting furnaces 2B227b

Plasma dry etching equipment 3B001c

Plasma enhanced CVD equipment 3B001d

Plasma enhanced or plasma assisted CVD production equipment 2B005a.1.c

Plasma isotope separation plant 0B001a.8

Plasma separation process equipment & components 0B001i

Plasma separation RF ion excitation coils 0B001i.2

Plasma spraying production equipment, with controlled atmosphere 2B005d

Plasticisers, military ML8

Platinized catalysts 1A225

Plutonium 0C002

Plutonium metal production systems 0B006

Plutonium nitrate conversion systems 0B006

Plutonium‑238 in any form with assay over 50% 1C012a

Pneumatic tyre casings ML6j

Pockel cell electro‑optical shuttering 6A203b.4.c

Poly 2,2,3,3,4,4 hexafluoropentane 1,5 diol formal (FPF 1) ML8e.16

Poly 2,4,4,5,5,6,6 heptafluoro 2 trifluoromethyl 3 oxaheptane 1,7 diol formal (FPF 3) ML8e.17

Poly GLYN (Poly(nitratomethyl oxirane)) ML8e.33

Poly NIMMO (Nitratomethylmethyloxetane or NMMO) ML8e.28

Poly(3 Nitratomethyl,3 methyl oxetane) ML8e.28

Poly(epichlorohydrin) ML8e.48

Poly(epichlorohydrindiol) & triol ML8e.48

Poly(nitratomethyl oxirane) (Poly GLYN or PGN) ML8e.33

Polybutadiene‑acrylic acid (PBAA) 1C111b.3

Polybutadiene‑acrylic acid‑acrylonitrile (PBAN) 1C111b.4

Polycyanodifluoroaminoethyleneoxide (PCDE) ML8e.31

Polyfunctional aziridine amides ML8e.32

Polyglycidylnitrate (Poly GLYN or PGN) ML8e.33

Polynitrocubanes ML8a.31

Polynitroorthocarbonates ML8e.34

Polysilazanes, precursor for silicon nitride 1C007e.2

Polythiophene 1C001c

Porcine enterovirus type 9 1C352a.11

Porcine herpes virus (Aujeszkys disease) 1C352a.6

Porous nickel metal 0C005

Porous nickel metal 1C240

Positioning equipment 7A105

Positioning equipment/components, global 7A005

Positioning systems, acoustic 6A001a.1.d

Positioning Tables 2B121

Positive resists for semiconductor lithography 3C002a

Post‑flight data processing software 6D103

Potassium bifluoride 1C350.41

Potassium cyanide 1C350.40

Potassium fluoride 1C350.14

Potassium hydrogen fluoride see potassium bifluoride 1C350.41

Potassium titanyl arsenate (KTA) 6C004b.1

Powder metallurgy manufacturing equipment 9B009

Powdered metals, as fuel 1C111a.1

Powdered metals, as fuel 1C111a.2

Power supplies, direct current 0B001j.6

Power supplies, direct current high power (dc) 3A226

Power supplies, direct current high‑voltage 3A227

Power supplies, high current 0B001j.5

Power systems, air independant, for underwater use 8A002j

Power transfer systems/related equipment/components, ML6i

Power transmission shaft systems, marine 8A002o.1.d

Power transmission shaft systems, marine 8A002o.1.e

Power transmission shaft systems, military vehicles ML6i

Precision rotor forming mandrels 2B209b

Precision tracking systems, usable for missiles 6A108b

Precursors for military explosives/propellants ML8

Precursors for toxic chemical agents 1C350

Preform production equipment 1B101e

Preforms for space vehicles (metal coated fibre) 9A110

Preforms, fibrous or filamentary materials 1C010e

Preforms, fibrous or filamentary materials 9A110

Preforms, metal coated fibre (for propulsion systems) 9A110

Prepreg production equipment 1B001e

Prepregs, fibrous or filamentary materials 1C010e

Prepregs, fibrous or filamentary materials 9A110

Presses, hot isostatic 2B004

Presses, hot isostatic 2B104a

Presses, hot isostatic 2B204

Pressure control systems, tyre ML6l

Pressure refuellers, aircraft ML10f

Pressure sensors, manganin & quartz 6A226

Pressure suits ML10g

Pressure transducers 2B230

Pressure tubes, for fuel elements & primary coolant 0A001e

Pressure vessels, for nuclear reactors 0A001b

Primary cells/batteries, high energy 3A001e.1.a

Probing (test) systems, semiconductor devices 3B002d

Process control instrumentation, for reprocessing plant 0B006

Processing equipment for bay or bottom cable systems 6A001a.2.e.3

Processors, digital array 3A001a.3

Processors, digital array 4A003

Processors, digital signal 3A001a.3

Processors, digital signal 4A003

Product & tails collector systems, uranium vapour 0B001g.3

Product & tails collectors, uranium vapour 0B001i.1

Product & tails stations, UF6 0B002c

Production equipment, military ML18a

Production equipment, propulsion systems & components 9B115

Production equipment, reentry vehicles 9B115

Production facilities, reentry vehicles 9B116

Production facilities, rockets/propulsion systems 9B116

Production technology, military ML18c

Programmable gate & logic arrays (FPGA's & FPLA's), field 3A001a.7

Programmable gate & logic arrays (FPGA's & FPLA's), field 3A001a.8

Projectile accelerators 2B232

Projectile launchers ML2a

Projectiles & components ML3

Projectiles & components, non‑military ML902

Projection telescopes, laser diagnostics 6A005f.4

Projectors, acoustic 6A001a.1.c

Projectors, pyrotechnic ML2b

Propellant bonding liner systems 9A008a

Propellant control systems 9A106b

Propellant production equipment 1B111

Propellant storage systems 9A006f

Propellant test and handling equipment 1B111

Propellants and their constituents 1B111

Propellants, additives & agents, spacecraft 1C111

Propellants, military ML8a,b,d

Propellants, non‑military ML908

Propeller blades or propfans composite technology 9E003b.2

Propeller noise reduction software 8D002

Propeller noise reduction technology 8E002a

Propellers, contrarotating 8A002o.1.b

Propellers, water screw 8A002o.1

Propulsion system composite components/structures 9A110

Propulsion system composite components/structures, launch‑vehicle 9A010

Propulsion system test/inspection/production software 9D101

Propulsion systems & components, military vehicles ML6i

Propulsion systems, rocket 9A005

Propulsion systems, rocket 9A007

Propulsion systems, rocket 9A009

Propulsion systems, rocket 9A119

Propulsion systems/components, production equipment 9B115

Propyleneimide, 2 methylaziridine ML8e.35

Protective and detection equipment 1A004

Protective clothing, independently ventilated 2B352f.1

Protective garments ML13.d

Proximity focused image intensifier tubes 6A203b.4.a

Pseudomonas mallei (Burkholderia mallei) 1C351c.8

Pseudomonas pseudomallei (Burkholderia pseudomallei) 1C351c.9

Puccinia graminis (syn. Puccinia graminis f. sp. tritici) 1C354b.4

Puccinia striiformis (syn. Puccinia glumarum) 1C354b.5

Pulsating Chemical Vapour Deposition production equipment 2B005a.1.a

Pulse excited Q switched neodymium‑doped lasers 6A205f

Pulse generators, high‑current for detonators 3A229

Pulse generators, high‑speed 3A230

Pulse jet engines/components 9A111

Pulse liquid rocket engines 9A010d

Pulse radar cross‑section measurement systems & components 6B008

Pulsed electron accelerators 3A201c

Pumpjet propulsion systems 8A002p

Pumps, bellows 2B350i

Pumps, canned drive 2B350i

Pumps, centrifugal 2B350i

Pumps, diaphragm 2B350i

Pumps, double‑seal 2B350i

Pumps, liquid propellant 9A106c

Pumps, lithium amalgam 1B233

Pumps, magnetic drive 2B350i

Pumps, mercury amalgam 1B233

Pumps, molecular 0B001b.9

Pumps, multiple seal 2B350i

Pumps, nuclear reactor coolant 0A001g

Pumps, potassium amide in liquid ammonia 1B230

Pumps, submersible stage recirculation 0B004b.4

Pumps, vacuum 0B002f

Pumps, vacuum 2B231

Pumps, vacuum 2B350i

Pyrolitic deposition nozzles 1B116

Pyrolitic deposition systems 2B104b

Pyrolitically derived materials production technology 1E104

Pyrolized carbon‑carbon materials 1A102

Pyrolysis equipment, for rocket nozzles/re‑entry nose tips 2B104b

Pyrolysis equipment, use software 2D101

Pyrolysis process control equipment 2B104b

Pyrotechnic flare signals & components, military ML4a

Pyrotechnic materials, military ML8b.6

Pyrotechnic projectors/generators ML2b

Pyrotechnics & components, military ML8c

Pyrotechnics & components, military ML4a

PYX (Picrylaminodinitropyridine) ML8a.16

## Q

Q‑switched lasers 6A005c.2

Q‑switched lasers 6A205f

QAM based radio equipment operating above level 128 5B001b.4

QAM based radio equipment operating above level 128, software 5D001d.4

QAM techniques development technology 5E001c.4

QL (o Ethyl 2 di isopropylamino ethyl methylphosphonite) ML7b.2

Quadrature amplitude modulation equipment 5B001b.4

Quartz pressure sensors/transducers 6A226b

## R

Radar altimeters 7A106

Radar cross section measurement systems ML11

Radar cross section measurement systems ML18

Radar cross section measurement systems ML21

Radar cross section measurement systems, missile 6B108

Radar systems & components ML11

Radar systems & components ML5b

Radar systems & components, civilian 6A008

Radar systems, employing automatic pattern recognition 6A008l.3

Radar systems, employing signal processing 6A008h

Radar systems, employing signal processing, pulse compression 6A008k

Radiation hardened designed (or rated) robots 2B007c

Radiation hardened detectors 6A002

Radiation hardened detectors 6A102

Radiation hardened electronic computers 4A001a.2

Radiation hardened integrated circuits, industrial 3A001a.1

Radiation hardened robots 2B007c

Radiation hardened sensors 6A002

Radiation hardened TV cameras 6A203c

Radiation sensors, optical fibres 6A002d.3

Radiation shielding windows 1A227

Radio equipment 5A001

Radio equipment 5B001

Radio equipment ML11

Radio frequency directed energy weapon systems ML19c

Radio frequency ion excitation coils 0B001i.2

Radioactive materials adapted for use in war ML7a

Radiographic equipment 3A101b

Radionuclides, alpha‑emitting 1C236

Radium‑226 1C237

Radome design software 6D003d

Ram type electrical discharge machines (CNC) 2B001d

Raman shift lasers 6A205e

Ramjet engines and components 9A011

Range finding systems ML5b

Range gated illumination systems, underwater 8A002d.2

Range instrumentation radars 6A108b.2

Rankine cycle engine, air independent 8A002j

Rate tables 2B120

RDX (Cyclonite) ML8a.20

Reactor fuel elements, reprocessing plant & equipment 0B006

Reactor vessels, chemical 2B350a

Reactors, metal organic chemical vapour deposition (MOCVD) 3B001a.2

Reactors, nuclear 0A001a

Real time processing 2D002

Rebreathing apparatus, underwater swimming 8A002q

Rebreathing apparatus, underwater swimming ML17a

Receivers, microwave test 3A002f

Receivers, radio 5A001

Receivers, radio 5B001

Receivers, radio ML11

Rechargeable cells/batteries, high energy 3A001e.1.b

Reciprocating diesel engine & component technology 9E003e.2

Reciprocating engines ML10c

Recoilless rifles ML2a

Recorders, military ML15a

Recording equipment, analogue & digital tape recorders 3A002a

Recovery of source code ‑ software 5D001c.2

Recovery parachutes ML10h.5

Recovery vehicles & related equipment/components ML6e

Reduced observables analysis software 1D103

Reduction gearing, light‑weight marine transmissions 8A002o.1.d

Reentry vehicles & equipment 9A116

Reentry vehicles/components, production equipment 9B115

Reflectance measuring equipment, absolute 6B004

Reflectivity (electromagnetic) reducing materials 1C101

Reflectivity reducing materials ML17c

Reflectometers, mirror characterisation 7B102

Reflectors (mirrors), optical 6A004a.1

Refrigeration units, cryogenic 0B001d.7.b

Refrigeration units, hydrogen or helium 1B231

Refuellers (pressure), aircraft ML10f

Regulation of composites technology 1E103

Reinforced composite materials 1C007f

Remote manipulators 2B225

Remotely controlled manipulators, for submersibles 8A002i

Remotely operated (air) vehicles (ROVs) ML10d

Remotely operated filling equipment, chemical 2B350f

Remotely piloted (air) vehicles (RPVs) ML10d

Reprocessing plant, nuclear fuel 0B006

Resaturated pyrolized materials 1A102

Resaturated pyrolized materials, carbon & carbon 1C102

Resin (thermoset) impregnated continuous materials 1C210c

Resin impregnated fibre prepregs, propulsion & space systems 9A110

Resins, fast reacting ion exchange 0B001f.1

Resist material, coated (semiconductor) substrates 3C002

Resist materials, semiconductor lithography 3C002

Reticles, integrated circuits of 3A001 3B001h

Revolvers ML1a

Revolvers, non‑military ML901a

Ricin 1C351d.4

Rickettsia prowasecki 1C351b.2

Rickettsia quintana 1C351b.3

Rickettsia rickettsii 1C351b.4

Rickettsiae 1C351b

Rifles, military ML1a

Rifles, non‑military ML901a

Rift Valley fever virus 1C351a.13

Rinderpest virus 1C352a.12

Ring gyros (laser) & gyro components 7A002

Ring laser gyro mirror characterizing equipment 7B002

Ring shaped motor stators for AC motors 0B001b.10

Riot control agents ML7a

Riot control agents ML7c

Robot & end‑effectors, use Software 2D201

Robot controllers ML17e

Robot controllers for high explosive handling 2B207

Robot controllers, industrial 2B007

Robot end‑effectors 2B007

Robot end‑effectors 2B207

Robots ML17e

Robots with real time 3D image processing or scene analysis 2B007a

Robots with real time 3D image processing or scene analysis 2B007b

Robots with real time 3D image processing or scene analysis 2B007c

Robots with real time 3D image processing or scene analysis 2B207

Robots with real time 3D image processing or scene analysis 8A002h

Rocket decoying equipment ML4b

Rocket engines, liquid propellant 9A005

Rocket engines, solid propellant 9A107

Rocket fuels 1C111

Rocket fuels ML8a.1,2

Rocket handling & control equipment 9A115a

Rocket handling & control equipment ML4b

Rocket launching equipment 9A115a

Rocket launching equipment ML2b

Rocket launching equipment ML4b

Rocket modelling, simulation & integration software 9D103

Rocket motor cases, solid 9A008b

Rocket motor cases, solid 9A108a

Rocket motor inspection equipment 9B007

Rocket motor insulation, solid rocket motor 9A008a

Rocket motor insulation, solid rocket motor 9A108a

Rocket motors, hybrid 9A005

Rocket motors, hybrid 9A007

Rocket motors, hybrid 9A009

Rocket motors, hybrid 9A105

Rocket motors, hybrid 9A109

Rocket nozzles, liquid fuel motor 9A006e

Rocket nozzles, liquid fuel motor 9A106a

Rocket nozzles, solid fuel motor 9A008c

Rocket nozzles, solid fuel motor 9A108b

Rocket stages, hybrid 9A009

Rocket stages, liquid fuel 9A005

Rocket stages, other than those of 9A005/7/9, 9A105/107/109 9A119

Rocket stages, solid fuel 9A007

Rocket/rocket motor, test benches/stands 9B117

Rockets & components, military ML4a

Rockets, sounding 9A104

Rockets, space launch 9A004

Roller bearings, solid 2A001a

Roller bearings, solid 2A001b

Rotary position feedback units 2B008c

Rotary shaft seals (for compressors/blowers), UF6 resistant 0B001c.4

Rotor assemblies, gas centrifuge 0B001b.2

Rotor assembly mandrels, bellows forming 2B228a

Rotor blade components, tooling for manufacture 9B009

Rotor blade tip clearance control, compensating system software 9D004d

Rotor centrifugal balancing machines 2B229

Rotor fabrication/assembly equipment 2B228a

Rotor forming mandrels, precision 2B209b

Rotor straightening equipment or systems 0B001b.5

Rotor straightening equipment or systems 0B001b.6

Rotor straightening equipment or systems 2B228b

Rotor tube cylinders & components, gas centrifuge 0B001b.3

Rotor tube rings or bellows, gas centrifuge 0B001b.4

ROVs (Remotely operated air vehicles) ML10d

RPVs (Remotely piloted air vehicles) ML10d

Russian Spring‑Summer encephalitis virus 1C351a.14

## S

S‑parameter test/measurement equipment 3B002a

S20 and S25 photocathodes 6A002

Safety cabinets, capableof biological use 2B352a.3

Salicyclate, basic copper & lead ML8e.2

Salmonella typhi 1C351c.10

Salvage systems, ocean 8A001e

Sarin (GB) ML7a

Satellite communication equipment technology 5E001b.1

Satellite radio systems 5E001b.1

Satellite receivers 7A005

Satellite receivers, other than those of 7A005 7A105

Satellites 9A004

SAW (Surface Acoustic Wave) components 3A001c.1

Saxitoxin 1C351d.5

Scanning cameras & systems 6A003b.2

Scoops for UF6 extraction in gas centrifuges 0B001b.12

Scramjet engines ML10c

Scramjet engines/components 9A011

Sea‑induced motion control systems, automatic 8A002n

Seal test/inspection equipment, for reactor fuel elements 0B005

Sealing equipment, for reactor fuel elements 0B005

Seals, aircraft/aerospace use 1A001a

Seals, for surface effect vessels 8A002k

Secondary cells/batteries, high energy 3A001e.1.b

Security equipment, information 5A002

Security equipment, information, software 5D002

Segmented mirrors, assembly in space 6A004c.3

Self propelled guns & related equipment/components ML6a

Self‑contained diving apparatus 8A002q

Semi finished products, military ML16

Semi‑closed diving apparatus 8A002q

Semiconductor component design software, computer‑aided‑design 3D003

Semiconductor components, extended temperature range 3A001a.2

Semiconductor compound photocathodes 6A002a.2.b.3

Semiconductor lasers 6A005b

Semiconductor probing systems, electron & laser beam 3B002d

Semiconductor, test equipment 3B002

Sensing elements, hydrophone 6A001a.2.a

Sensors, direction finding systems (passive) 7A115

Sensors, industrial infrared 6A002a

Sensors, industrial infrared 6A002b

Sensors, linear position feedback unit 2B008b

Sensors, military infrared ML15d

Sensors, multispectral imaging 6A002b

Sensors, on‑line development of gas turbines 9B002

Sensors, optical 6A002

Sensors, pressure (manganin & quartz) 6A226

Sensors, radiation hardened 6A102

Sensors, superconductive electromagnetic 6A006h

Separation mechanisms for rockets 9A117

Separation nozzles, aerodynamic isotope separation 0B001d.1

Separation nozzles, UF6/Carrier gas separation 0B001d.7.c

Separation plant, aerodynamic isotope separation 0B001a.3

Separation process (aerodynamic) equipment 0B001d

Separation tubes, aerodynamic isotope separation 0B001d.2

Separation tubes, aerodynamic isotope separation 0B001i.6

Separator module housings 0B001g.4

Separators, centrifugal (biological) 2B352c

Separators, electromagnetic isotope 1B226

Separators, laser isotopic separation 0B001g

Separators, molecular laser 0B001h

Servo valves, propellant control systems 9A106b

Sesquimustard ML7a

Shaft encoders (rotary input type) 3A001f

Sheep pox virus 1C352a.13

Shiga toxin 1C351d.6

Shigella dysenteriae 1C351c.11

Ship positioning systems, acoustic 6A001a.1.d

Shotguns ML901a

Shrink fit machines for rotor fabrication/assembly 2B228a

Sidelooking airborne radar ML5b

Sidelooking airborne radar (SLAR) 6A008d

Sighting devices, military ML5a

Sights, weapon ML5a

Sights, weapon, for small calibre weapons ML1d

Sights, weapon, for large calibre weapons ML2c

Sights, weapon, non‑military ML904

Signal analysers 3A002c.1

Signal generators, frequency synthesiser based 3A002d

Signal processing devices, acousto‑optic 3A001c.3

Signal processing equipment, general purpose digital 4A003

Signal processing equipment, hydrophone arrays 6A001a.2.c

Signal processing equipment, sonar 6A001c

Signal processor microcircuits 3A001a.3

Signal tracking development/use technology, laser 5E001b.2

Signature (electromagnetic) reduction devices 1C001

Signature (electromagnetic) reduction devices 1C101

Signature reduction devices, fittings & components ML17c

Signature reduction devices, fittings & components ML2a

Signature suppression coatings/treatments for military use ML17c

Signature suppression components ML17c

Signature suppression devices, treatments & fittings 1C001

Signature suppression devices, treatments & fittings 1C101

Silahydrocarbon oils 1C006a.1

Silencers ML1d

Silent bearings ML9g

Silicon carbide (SiC) substrate blanks 6C004d

Silicon microcircuits, industrial 3A001a

Silicon, hetero‑epitaxial grown multi‑layer substrates 3C001a

Silicon‑on‑sapphire integrated circuits 3A001a

Silicone fluid, fluorinated 1C006b.2

Silver gallium selenide (AgGaSe2) 6C004b.2

Silyated resists for semiconductor lithography 3C002d

Simulation equipment & accessories, military aircraft ML14

Simulators & components, military ordnance ML4a

Simulators, flight ML14

Simultaneous initiation arrangements or systems, single & multipoint 3A232b

Single crystal casting control software 9D004c

Single crystal casting equipment 9B001a

Single crystals 6C002b

Single mode optical fibre & cable 5A001c.1

Single point diamond cutting tool inserts 2B008e

Single point diamond turning techniques, technology 6E003a.2.b

Single‑element & focal plane arrays, space‑qualified 6A002a.1

Single‑element photodiodes & phototransistors 6A002a.4

Skin friction transducers, wall 9B008

Skirts, for surface effect vessels 8A002k

Slapper detonators (Electric) 3A232a.3

Slide way assemblies for machine tools 2B008d

Slurry propellant control systems 9A106b

Slush hydrogen storage 9A006c

Slush hydrogen transfer systems 9A006c

Small arms, weapons ML1a

Small waterplane area vessels 8A001i

Smoke canisters & components ML4a

Smoke grenades & components ML4a

Smoke projectors or generators ML2b

Smooth bore weapons ML1b

Smooth bore weapons, non‑military ML901a

Sodium (Na) metal vapour lasers 6A005a.2

Sodium bifluoride 1C350.44

Sodium cyanide 1C350.45

Sodium fluoride 1C350.43

Sodium hexafluorosilicate 1C350.62

Sodium sulphide 1C350.50

Software, adaptive control 2D002

Software, analysis of reduced observables 1D103

Software, composite materials (organic/metal/carbon matrix) 1D002

Software, digital computers 4D

Software, electronic devices 2D002

Software, filament winding machine use 1D201

Software, military systems software ML21

Software, multi‑data‑stream processing equipment compilers 4D003a

Software, multi‑data‑stream processing equipment operating systems 4D003a

Software, numerical control 2D002

Software, real time processing equipment operating systems 4D003d

Software, real time processing in machine tools 2D002

Software, recovery of source code 5D001c.2

Software, software development tools as source code 4D003a

Software, source code 4D003a

Software, tools in source code 4D003a

Solar cells, space qualified or radiation hardened 3A001e.1.c

Solenoids, superconductive 3A001e.3

Solenoids, superconductive 3A201b

Solid fuels, military high energy ML8a,b,d

Solid propellant rocket engines 9A107

Solid rocket fuels ML8a,b,d

Solid rocket fuels, industrial 1C111

Solid rocket propulsion system, components 9A008

Solid rocket propulsion system, components 9A108

Solid rocket propulsion systems 9A007

Solid rocket propulsion systems 9A119

Solid roller bearings 2A001a

Solid roller bearings 2A001b

Solid state cameras 6A003b.1

Solid state imaging devices 6A203b.4

Solid state joining equipment, tools/dies/fixtures 9B004

Solid state lasers, tunable 6A005c.1

Solid state lasers, tunable 6A005c.2

Solid state microwave amplifiers 3A001b.4

Solid state switches 3A228

Solid‑state imaging devices 6A002

Soman (GD) ML7a

Sonar log equipment 6A001c

Sonar processing equipment 6A001a.2.b

Sonar signal processing equipment 6A001c

SORGUYL (Tetranitroglycoluril or TNGU) ML8a.13

Sounding rocket test, inspection & production software 9D101

Sounding rockets 9A104

Source code recovery software 5D001c.2

Source code, development of goods as specified 7D003d

Source code, for multi‑data‑stream processing equipment 4D003a

Space launch vehicle test, inspection & production software 9D101

Space launch vehicles 9A004

Space probes 9A004

Space qualified focal plane arrays 6A002e

Space‑qualified optical components 6A004c

Space‑qualified solid state detectors 6A002a.1

Spacecraft 9A004

Spacecraft components 9A010

Spacecraft inertial navigation equipment/components 7A003

Spark‑gaps, triggered 3A228b

Special gun mountings ML1d

Spectrum analysers 3A002c.1

Spherical aluminium powder 1C111a.1

Spherical aluminium powder ML8a.1

Spin forming machines 2B009

Spin forming machines 2B209

Spin forming machines combining a flow‑forming function 2B009

Spin forming machines combining a flow‑forming function 2B209

Spin forming/Flow forming equipment, software for 2D201

Spindle assemblies, machine tools 2B008a

Spraying production equipment, plasma with controlled atmosphere 2B005d

Spread spectrum development technology techniques 5E001b.4

Spread spectrum radio equipment 5A001b.3

Spread spectrum spreading code generation 5A002a.5

Sprytron tubes, vacuum 3A228a

Sputter deposition production equipment 2B005e

SQUIDs (Superconducting quantum interference devices) 6A006h

SR 19 (ammonium dinitramide) ML8a.32

SRAMs (Static random‑access memories) 3A001a.4

Stabilisers, military explosives/propellants ML8

Staging mechanisms for rockets 9A117

Staphylococcus aureus toxins 1C351d.7

START gyros & gyro components 7A002

Static random‑access memories (SRAMs) 3A001a.4

Stators, ring shaped (centrifugal rotor motor) 0B001b.10

Stealth technology ML5c

Steam sterilisable freeze drying equipment 2B352e

Steel, maraging 1C116

Steel, maraging 1C216

Step & repeat equipment, semiconductor wafer processing 3B001f

Stirling cycle engine, air independent 8A002j.4

Storage integrated circuits 3A001a.4

Storage tank components used with liquid propelling charges ML2a

Storage tanks, chemical (capacity greater than 100 L) 2B350c

Strap down/gimbal gyros & gyro components 7A002

Streak cameras, electronic type 6A203b.1

Streak cameras, mechanical or electronic 6A003a.3

Streak cameras, mechanical type 6A203a.2

Streak tubes, electronic streak cameras 6A203b.2

Subcavitating hydrofoils 8A002m

Submarine nets ML9d

Submarine vessel positioning systems, acoustic 6A001a.1.d

Submarines, military ML9

Submersible stage recirculation pumps 0B004b.4

Submersible vehicles/vehicle systems or equipment 8A001

Submersible vehicles/vehicle systems or equipment 8A002a

Substrate development/production technology, diamond film 3E002d

Substrates, multi‑layer hetero‑epitaxial materials 3C001

Substrates, semiconductor with resist coating 3C002

Sulphur dichloride 1C350.52

Sulphur monochloride 1C350.51

Sulphur mustards ML7a

Super‑ventilated propellers 8A002o.1.a

Supercavitating hydrofoils 8A002m

Supercavitating propellers 8A002o.1.a

Superconducting quantum interference devices (SQUIDs) 6A006h

Superconductive circuits/systems, energy storage 3A001e.4

Superconductive composite conductors 1C005

Superconductive devices or circuits 3A001d

Superconductive electromagnetic sensors 6A006h

Superconductive electromagnets or solenoids 3A001e.3

Superconductive electromagnets or solenoids 3A201b

Superconductive electronic device technology 3E002c

Superconductive equipment/accessories/components, military ML20

Superconductive gates, current switching 3A001d.2

Superconductive propulsion engines 8A002o.2.c

Superconductive quantum interference devices (SQUIDs) 6A006h

Superfine iron oxide (Fe203 or hematite) ML8e.24

Superplastic forming technology, metal working 2E003b.1.a

Superplastic forming technology/data, Al/Ti/Super alloys 2E003b.2.a

Superplastic forming tools, dies, moulds or fixtures 1B003

Supersonic expansion nozzles for UF6 carrier gas 0B001h.1

Surface acoustic wave devices 3A001c.1

Surface coating & processing equipment 2B005

Surface effect vehicles ML9

Surface irregularity measuring equipment/instruments 2B006d

Surface skimming (shallow bulk) acoustic wave devices 3A001c.1

Surface vessel positioning systems, acoustic 6A001a.1.d

Surface vessels ML9

Surface vessels & components 8A001

Surface‑effect vehicles, (fully skirted variety) 8A001f

Surface‑effect vehicles, (fully skirted variety) 8A001g

Surface‑effect vehicles, (fully skirted variety) 8A002k

Surveillance systems ML5b

Survey systems, bathymetric 6A001a.1.b

Suspensions, military vehicle ML6m

Sweeping equipment, military explosive 8A002q

Sweeping equipment, military explosive ML4b

Swept frequency network analysers 3A002e

Swimming apparatus, underwater ML17a

Swine fever virus (African) 1C352a.1

Swine fever virus (Hog cholera virus) 1C352a.7

Switches, solid state 3A228

Switching devices/modules or assemblies 3A228

Symmetrical dimethyl hydrazine ML8a.18

Syntactic foam, underwater use 8C001

Synthetic aperture radar ML5b

Synthetic aperture radar (SAR) 6A008d

Synthetic diamond material 6C004f

Systolic array computers/assemblies/components 4A004a

## T

T4 (Cyclotrimethylenetrinitramine or RDX) ML8a.20

Tabun (GA) ML7a

TACOT (Tetranitrobenzotriazolobenzotriazole) ML8a.14

TAGN (Triaminoguanidinenitrate) ML8a.11

TAIW (Tetraacetyldibenzylhexaazaisowurtzitane) ML8e.36

Tank destroyers ML2a

Tank transporters ML6i

Tanks & related equipment/components ML6a

Tanks, chemical storage (capacity greater than 100 L) 2B350c

Tantalum crucibles coated with tantalum carbide/nitride/boride 2A225c.3

Tantalum made or lined crucibles 2A225c.2

Tape designed for testing recording equipment of entry 3A002a 3A002a

Tape recording equipment 3A002a

Tape‑laying machines 1B001b

Tape‑laying machines 1B101b

Target acquisition systems ML5b

Target designation systems ML5b

TATB (Triaminotrinitrobenzene) ML8a.10

Tear gases ML7c

Technical military databases libraries, parametric ML17f

Technology, airbourne equipment 7E004a

Technology, composite materials installation, maintenance or repair 1E002e

Technology, composite structures repair 1E002f

Technology, development of frequency agility techniques 5E001b.4

Technology, development of spread spectrum techniques 5E001b.4

Technology, diamond substrate film 3E002d

Technology, gas turbine engines & components 9E003a

Technology, gas turbine engines & components 9E003c

Technology, helicopter power transfer systems 9E003d

Technology, hetero‑structure semiconductor development 3E002b

Technology, high output type diesel engines 9E003e

Technology, integration software for expert systems 2E003e

Technology, machine tool instruction generators 2E003d

Technology, materials processing equipment 2E0

Technology, military goods ML18c

Technology, military goods ML18d

Technology, superconductive electronic device 3E002c

Technology, tilt rotor/wing power transfer systems development 9E003d

Technology, vacuum microelectronic device 3E002a

TEGDN (Triethylene glycol dinitrate) propellant additive 1C111b.2

Telecommunications equipment 5A001

Telecommunications equipment/system software 5D001c.1

Telecommunications production equipment 5B001a

Telecommunications test equipment 5B001a

Telemetering & telecontrol equipment 5A101

Telemetering & telecontrol equipment ML11

Telemetry equipment/systems 5A101

Telescopic sights, non‑military firearms ML904

Television cameras, underwater 8A002d.1.b

Television cameras, underwater 8A002d.3

Television cameras, underwater 8A002d.1.a

Tellurium (Te) with purity of 5N5 % or better 6C002a

Tempest type equipment 5A002a.4

Tension stretchers for prepregs/preform production 1B101e

TEPAN (Tetraethylenepentamineacrylonitrile) ML8e.37

TEPANOL (Tetraethylenepentamineacrylonitrileglycidol) ML8e.38

Terrestrial geophones 6A001b

Teschen disease virus 1C352a.14

Test & evaluation facilities, kinetic energy weapons ML12b

Test (physical models) results, directed energy weapon ML19e

Test benches/stands, rockets/rocket motors 9B117

Test chambers, aerosol challenge 2B352g

Test equipment ‑ propellants and their constituents 1B111

Test equipment, semiconductor devices 3B002

Test facilities, military environmental ML18b

Test receivers, microwave 3A002f

Test tape designed for recording equipment of entry 3A002a 3A002a

Tetraacetyldibenzylhexaazaisowurtzitane (TAIW) ML8e.36

Tetraethylenepentamineacrylonitrile (TEPAN) ML8e.37

Tetraethylenepentamineacrylonitrileglycidol (TEPANOL) ML8e.38

Tetranitrobenzotriazolobenzotriazole (TACOT) ML8a.14

Tetranitroglycoluril (TNGU or SORGUYL) ML8a.13

Tetranitrosemiglycouril (K 55) ML8a.27

Tetrodotoxin 1C351d.8

Thallium arsenic selenide (Tl3AsSe3 or TAS) 6C004b.3

Thermal imaging equipment 6A002c

Thermal imaging equipment ML15d

Thermal ionization mass spectrometers (TIMS) 3A233c

Thermal sensors, optical fibre 6A002d.3

Thermoplastic liquid crystal copolymers 1C008b

Thermoset resin impregnated materials 1C210c

Thickeners for hydrocarbon fuels (including M1, M2, M3) ML8d

Thio‑ethers (alkylphenylene), lubricating fluids 1C006b.1

Thiodiglycol 1C350.1

Thionyl chloride 1C350.9

Thiophosphoryl chloride 1C350.64

Thorium metal/alloys/compounds/concentrates 0C001

Thrust chamber, high pressure 9A006e

Thrust chamber, high pressure 9A106b

Thrust chamber, high pressure 9A108c

Thrust chambers ‑ liquid rocket propulsion systems 9A006h

Thrust vector control systems & sub‑systems 9A008d

Thulium‑YAG (Tm:YAG) lasers 6A005c.1

Thulium‑YSGG (Tm:YSGG) lasers 6A005c.1

Tick‑borne encephalitis virus 1C351a

Tilt rotor/tilt wing power transfer system technology 9E003d

Time or frequency domain processing & correlation equipment 6A001a.2.c

TIMS (Thermal ionization mass spectrometers) 3A233c

Titanium alloys, as tubes/solid forms/forgings 1C202

Titanium alloys, powders, forgings and manufactures 1C002a.1.b

Titanium alloys, powders, forgings and manufactures 1C002a.2.c

Titanium alloys/alloy powders/forgings/manufactures 1C002b.1.c

Titanium aluminides 1C002a.1.b

Titanium doped sapphire laser host material 6C005a

Titanium IV, ((2‑propenolato‑1)methyl, N‑propanolatomethyl)‑butanolato‑1, tris(dioctyl)phosphate ML8e.30.c

Titanium IV, ((2‑propenolato‑1)methyl, N‑propanolatomethyl)‑butanolato‑1, tris(dioctyl)pyrophosphato ML8e.30.b

Titanium IV, 2,2(bis 2 propenolato methyl, butanolate] (LICA 12) ML8e.30.a

Titanium subhydride of stoichiometry TiH 0.65 1.68 ML8a.12

Titanium‑sapphire (Ti: Al2O3) lasers 6A005c.1

Titanium‑stabilised duplex stainless steel (Ti‑DSS) 1C118

TMETN (trimethylolethane trinitrate) 1C111c

TNAZ (1,1,3 Trinitroazetidine) ML8a.28

TNGU (Tetranitroglycoluril or SORGUYL) ML8a.13

Tooling for powder metallurgy rotor blade component manufacture 9B009

Torpedo activation equipment ML4b

Torpedo control equipment ML4b

Torpedo handling equipment ML4b

Torpedo nets ML9d

Torpedoes & components ML4a

Tow‑placement machines 1B001b

Towed acoustic hydrophone arrays 6A001a.2.b

Toxic chemicals 1C450a

Toxic chemicals precursors 1C450b

Toxic gas monitoring systems 2B351

Toxicological agent defence systems/equipment/products ML7e

Toxicological agent dissemination equipment & components ML7d

Toxicological agents ML7a

Toxilogical agent development/production/use technology ML7i.1

Toxilogical agents/tear gases & related equipment & materials ML7

Toxins, natural 1C351d

TPB (Triphenyl bismuth) ML8e.39

Tracking radar 6A008l.1

Tracking systems, ML5b

Tracking systems, precision 6A008l

Tracking systems, precisioo 6A108b.1

Tractors, designed/modified for military use ML6i,f

Trailers, ammunition ML6f

Training equipment, military ML14

Transceivers, radio 5A001b.2

Transceivers, radio ML11

Transducers, acoustic projectors 6A001a.1.c

Transducers, hydrophone 6A001a.2.a

Transducers, wall skin friction 9B008

Transient recorders (Waveform digitisers) 3A002a.5

Transistor test equipment, S‑parameter measurement 3B002a

Transistors, microwave 3A001b.3

Transmitters, radio ML11

Travelling wave tubes (TWTs) ML11

Travelling wave tubes (TWTs), industrial 3A001b.1.a

Tray exchange towers, hydrogen sulphide water 0B004b.1

Treatments, designed for reduced reflectivity ML17c

Triaminoguanidinenitrate (TAGN ML8a.11

Triaminotrinitrobenzene (TATB) ML8a.10

Trichloronitromethane 1C450a.3

Triethanolamine 1C350.46

Triethanolamine hydrochloride 1C350.53

Triethyl phosphite 1C350.30

Triethylene glycol dinitrate (TEGDN) 1C111c.2

Triisopropyl phosphite 1C350.58

Triggered spark‑gaps 3A228b

Trimethyl phosphite 1C350.8

Trimethyladipic backbone structures ML8e.32

Triodes, cold cathode 3A228a

Triodes, cold cathode ML11

Triphenyl bismuth (TPB) ML8e.39

Tris (2‑chloroethyl) amine (HN3) ML7a

Tris (2‑chlorovinyl) arsine ML7a

Tris 1 (2 methyl)aziridinyl phosphine oxide (MAPO) ML8e.41

Tris vinoxy propane adduct (TVOPA) ML8e.40,43

Tris vinoxy propane adduct (TVOPA) ML8e.43

Tris(dioctyl)phosphate (KR3512) ML8e.30.c

Tris(dioctyl)phosphato O (LICA 12) ML8e.30.a

Tris(dioctyl)pyrophosphato (KR3538) ML8e.30.b

Tritium plant 1B231

Tritium recovery, extraction & concentration facilities 1B231

Tritium, compounds & mixtures 1C235

Trusted Computer System Evaluation Criteria (TCSEC) capability 5A002a.6

Tubes, frequency agile 3A001b.1

Tubes, gas krytron 3A228a

Tubes, vacuum sprytron 3A228a

Tunable band‑pass filters 3A001b.5

Tunable lasers, solid state 6A005c.1

Tungsten & molybdenum metal alloys 1C117

Tungsten alloys 1C004

Tungsten alloys, as parts 1C226

Tungsten carbide, as parts 1C226

Tungsten, as parts 1C226

Turbines, gas aero engines 9A001

Turbines, gas aero engines, test software 9D004b

Turbocompound engines 9A101

Turboexpanders and turboexpander compressors 0B004b

Turboexpanders and turboexpander‑compressors 1B232

Turbofan & turbojet engines, lightweight 9A101

Turning machines (CNC) 2B001a

TV cameras, radiation‑hardened 6A203c

TVOPA (1,2,3 Tris(1,2 bis(difluoroamino)ethoxy)propane) ML8e.43

TVOPA (Tris vinoxy propane adduct) ML8e.40

Two dimensional focal plane arrays 6A002a

TWTs (Travelling Wave Tubes) 3A001b.1.a

TWTs (Travelling Wave Tubes) ML11

Tyre pressure control systems, military ML6l

## U

UF6 / carrier gas separation systems 0B001d.7

UF6 / carrier gas separation systems 0B001h.5

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 resistant compounds & powders 0C005

UF6 vacuum pumps 0B002f

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 5A001c.2

Underwater communications systems 5A001b.1

Underwater detection devices ML9c

Underwater electronic imaging systems 8A002f

Underwater noise reduction technology 8E002

Underwater optical fibre cables & accessories 5A001C.2

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 aerial vehicles 9A012

Unmanned airborne vehicles & launchers ML10c

Unmanned tethered submersible vehicles 8A001c

Unmanned untethered submersible vehicles 8A001d

Unsymmetrical dimethyl hydrazine ML8a.18

Uranium conversion plant & equipment 0B003

Uranium cooling equipment 0B001g.2

Uranium electromagnetic separator vacuum housings 0B001j.3

Uranium fluoride (UF5) product collectors 0B001h.2

Uranium fluoride (vapour product & tails collector systems) 0B001g.3

Uranium hexafluoride (UF6) resistant compounds & powders 0C005

Uranium isotopes separation, lasers or laser systems 0B001g.5

Uranium isotopes separation, lasers or laser systems 0B001h.6

Uranium metal, alloys, compounds & concentrates 0C001

Uranium metal, alloys, compounds & concentrates 0C002

Uranium oxidation systems 0B001e.6

Uranium plasma generation systems 0B001i.3

Uranium titanium alloys 1C004

Uranium vapour product & tails collector systems 0B001g.3

Uranium, enriched in Uranium 233 or Uranium 235 0C002

## V

Vacuum furnaces 2B226

Vacuum furnaces 2B227

Vacuum headers 0B002f

Vacuum housings for uranium electromagnetic separators 0B001j.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 2B231

Vacuum pumps 2B350i

Vacuum pumps for UF6 bearing atmospheres 0B002f

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 0B001c.6

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

## W

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 0B004b

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

Waveform digitisers (Transient recorders) 3A002a.5

Wax pattern preparation equipment, ceramic core 9B001d

Weapon control systems ML5a

Weapon sights ML5a

Weapon sights, for small calibre weapons ML1d

Weapon sights, for large calibre weapons ML2c

Weapon sights, for non‑military rifles ML904

Weapons using caseless ammunition ML1c

Weapons using caseless ammunition ML2a

Weapons, other than small arms/firearms ML12

Weapons, other than small arms/firearms ML19

Weapons, other than small arms/firearms ML2

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 28,000 Mtops 4A003b

## X

X‑ray (non planar) inspection equipment, rocket motors 9B007

X‑ray equipment, radiographic 3A201c

X‑ray equipment, radiographic 3A101b

X‑ray generators, flash discharge 3A201c

X‑ray sensitive resist materials 3C002c

Xanthomonas albilineans 1C354a.1

Xanthomonas campestris pv. aurantifolia 1C354a.2

Xanthomonas citri 1C354a.2

## Y

Yellow fever virus 1C351a.19

Yttrium oxide (yttria) (Y2O3), crucibles made of or coated with 2A225a.2

## Z

Zinc selenide (ZnSe), substrate blanks 6C004a

Zinc sulphide (ZnS), substrate blanks 6C004a

Zirconium fluoride (ZrF4) glass 6C004e

Zirconium metal and alloy powder ML8c.5.b.1

Zirconium metal and alloy powder 1C111a.2.a

Zirconium metal and alloy tubes & assemblies 0A001f

Zirconium metal, alloy and compounds 1C234

Zirconium oxide (zirconia) (ZrO2) made/coated crucibles 2A225a.2

Zoonoses 1C351

Endnotes

Endnote 1—About the endnotes

The endnotes provide information about this compilation and the compiled law.

The following endnotes are included in every compilation:

Endnote 1—About the endnotes

Endnote 2—Abbreviation key

Endnote 3—Legislation history

Endnote 4—Amendment history

Endnotes about misdescribed amendments and other matters are included in a compilation only as necessary.

**Abbreviation key—Endnote 2**

The abbreviation key sets out abbreviations that may be used in the endnotes.

**Legislation history and amendment history—Endnotes 3 and 4**

Amending laws are annotated in the legislation history and amendment history.

The legislation history in endnote 3 provides information about each law that has amended (or will amend) the compiled law. The information includes commencement details for amending laws and details of any application, saving or transitional provisions that are not included in this compilation.

The amendment history in endnote 4 provides information about amendments at the provision (generally section or equivalent) level. It also includes information about any provision of the compiled law that has been repealed in accordance with a provision of the law.

**Misdescribed amendments**

A misdescribed amendment is an amendment that does not accurately describe the amendment to be made. If, despite the misdescription, the amendment can be given effect as intended, the amendment is incorporated into the compiled law and the abbreviation “(md)” added to the details of the amendment included in the amendment history.

If a misdescribed amendment cannot be given effect as intended, the amendment is set out in the endnotes.

Endnote 2—Abbreviation key

|  |  |
| --- | --- |
| A = Act | orig = original |
| ad = added or inserted | par = paragraph(s)/subparagraph(s) |
| am = amended | /sub‑subparagraph(s) |
| amdt = amendment | pres = present |
| c = clause(s) | prev = previous |
| C[x] = Compilation No. x | (prev…) = previously |
| Ch = Chapter(s) | Pt = Part(s) |
| def = definition(s) | r = regulation(s)/rule(s) |
| Dict = Dictionary | Reg = Regulation/Regulations |
| disallowed = disallowed by Parliament | reloc = relocated |
| Div = Division(s) | renum = renumbered |
| exp = expires/expired or ceases/ceased to have | rep = repealed |
| effect | rs = repealed and substituted |
| F = Federal Register of Legislative Instruments | s = section(s)/subsection(s) |
| gaz = gazette | Sch = Schedule(s) |
| LI = Legislative Instrument | Sdiv = Subdivision(s) |
| LIA = *Legislative Instruments Act 2003* | SLI = Select Legislative Instrument |
| (md) = misdescribed amendment | SR = Statutory Rules |
| mod = modified/modification | Sub‑Ch = Sub‑Chapter(s) |
| No. = Number(s) | SubPt = Subpart(s) |
| o = order(s) | underlining = whole or part not |
| Ord = Ordinance | commenced or to be commenced |

Endnote 3—Legislation history

| Name | FRLI registration | Commencement | Application, saving and transitional provisions |
| --- | --- | --- | --- |
| Defence and Strategic Goods List - November 1996 | 2 Dec 2008 (F2008B00287) | 1 Nov 1996 |  |
| Defence and Strategic Goods List Amendment 2006 | 16 Oct 2006 (F2006L03230) | 17 Oct 2006 (s 2) |  |

Endnote 4—Amendment history

| Provision affected | How affected |
| --- | --- |
| Defence and Strategic Goods List | rs F2006L03230 |

1. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established. [↑](#footnote-ref-1)
2. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-2)
3. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-3)
4. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-4)
5. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-5)
6. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-6)
7. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-7)
8. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-8)
9. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-9)
10. Manufacturers calculating positioning accuracy in accordance with ISO 230/2 (1997) should consult the competent authorities of the Member State in which they are established [↑](#footnote-ref-10)
11. \* The numbers in parenthesis refer to the Notes following this Table. [↑](#footnote-ref-11)