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(Acts adopted under the EC Treaty/Euratom Treaty whose publication is obligatory)

REGULATIONS

COUNCIL REGULATION (EC) No 1183/2007

of 18 September 2007

amending and updating Regulation (EC) No 1334/2000 setting up a Community regime for the control of exports of dual-use items and technology

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 133 thereof,

Having regard to the proposal from the Commission,

Whereas:

(1) Council Regulation (EC) No 1334/2000 ([1]) requires dual-use items (including software and technology) to be subject to effective control when they are exported from the Community.

(2) In order to enable Member States and the Community to comply with their international commitments, Annex I to Regulation (EC) No 1334/2000 establishes the common list of dual-use items and technology referred to in Article 3 of that Regulation, which implements internationally agreed dual-use controls, including the Wassenaar Arrangement, the Missile Technology Control Regime (MTCR), the Nuclear Suppliers Group (NSG), the Australia Group and the Chemical Weapons Convention (CWC).

(3) Article 11 of Regulation (EC) No 1334/2000 provides for Annex I and Annex IV to be updated in accordance with the relevant obligations and commitments, and any modification thereof, that each Member State has accepted as a member of the international non-proliferation regimes and export control arrangements, or by ratification of relevant international treaties.

(4) Annex I and Annex IV to Regulation (EC) No 1334/2000 should be amended in order to take account of changes adopted by the Wassenaar Arrangement, the Australia Group, the MTCR and the NSG subsequent to the amendments made to those Annexes by Regulation (EC) No 394/2006.

(5) In order to ease references for export control authorities and operators, an updated and consolidated version of the Annexes to Regulation (EC) No 1334/2000 should be published.

(6) Regulation (EC) No 1334/2000 should therefore be amended accordingly,

HAS ADOPTED THIS REGULATION:

Article 1

The Annexes to Regulation (EC) No 1334/2000 shall be replaced by the text in the Annex to this Regulation.

([1]) OJ L 159, 30.6.2000, p. 1. Regulation as last amended by Regulation (EC) No 394/2006 (OJ L 74, 13.3.2006, p. 1).

Article 2

This Regulation shall enter into force on the 30th day following its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 18 September 2007.

For the Council
The President
R. PEREIRA

ANNEX

'ANNEX I

LIST OF DUAL-USE ITEMS AND TECHNOLOGY

(referred to in Article 3 of Regulation (EC) No 1334/2000)

This list implements internationally agreed dual-use controls including the Wassenaar Arrangement, the Missile Technology Control Regime (MTCR), the Nuclear Suppliers' Group (NSG), the Australia Group and the Chemical Weapons Convention (CWC). No account has been taken of any items that Member States wish to place on an exclusion list. No account has been taken of any national controls (non-regime origin controls) that may be maintained by Member States.

GENERAL NOTES TO ANNEX I

1. For control of goods which are designed or modified for military use, see the relevant list(s) of controls on military goods maintained by individual Member States. References in this Annex that state ″SEE ALSO MILITARY GOODS CONTROLS″ refer to the same lists.

2. The object of the controls contained in this Annex 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.*

3. Goods specified in this Annex include both new and used goods.

NUCLEAR TECHNOLOGY NOTE (NTN)

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

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

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

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

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 1 to 9)

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

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

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.*

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:

a. Generally available to the public by being:

1. sold from stock at retail selling points, without restriction, by means of:

a. over-the-counter transactions;

b. mail order transactions;

c. electronic transactions; or

d. telephone order transactions; and

2. 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").

b. "In the public domain".

EDITORIAL PRACTICES

In accordance with the rules set out in paragraph 101 on page 86 of the Interinstitutional Style Guide (1997 edition), for texts in English published in the *Official Journal of the European Communities*:

— a comma is used to separate the whole number from the decimals,

— whole numbers are presented in series of three, each series being separated by a thin space.

DEFINITIONS OF TERMS USED IN THIS ANNEX

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

″Adjusted Peak Performance″ (4) is an adjusted peak rate at which ″digital computers″ perform 64-bit or larger floating point additions and multiplications, and is expressed in Weighted TeraFLOPS (WT) with units of 1012 adjusted floating point operations per second.

N.B.: *see Category 4, Technical note.*

″Aircraft″ (1 7 9) 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.*

″Angle random walk″ (7) means the angular error build-up with time that is due to white noise in angular rate. (IEEE STD 528-2001)

″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″).

″APP″ (4) is equivalent to ″Adjusted Peak Performance″.

″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.

″Average output power″ (6) means the total ″laser″ output energy in joules divided by the ″laser duration″ in seconds.

″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″.

N.B. 1: *″Basic gate propagation delay time″ is not to be confused with the input/output delay time of a complex ″monolithic integrated circuit″.*

N.B. 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.

″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″ is equivalent to ″computing element″.

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

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

″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) 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.

″Compensation systems″ (6) consist of the primary scalar sensor, one or more reference sensors (e.g., vector magnetometers) together with software that permit reduction of rigid body rotation noise of the platform.″

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.

″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.

N.B.: *″secret parameter″: a constant or key kept from the knowledge of others or shared only within a group.*

″CW laser″ (6) means a ″laser″ that produces a nominally constant output energy for greater than 0,25 seconds.

″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.

″Deformable mirrors″ (6) (also known as adaptive optic mirrors) means mirrors having:

a. a single continuous optical reflecting surface which is dynamically deformed by the application of individual torques or forces to compensate for distortions in the optical waveform incident upon the mirror; or

b. multiple optical reflecting elements that can be individually and dynamically repositioned by the application of torques or forces to compensate for distortions in the optical waveform incident upon the mirror.

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

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

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

″Digital computer″ (4 5) means equipment which can, in the form of one or more discrete variables, perform all of the following:

a. accept data;

b. store data or instructions in fixed or alterable (writable) storage devices;

c. process data by means of a stored sequence of instructions which is modifiable; and

d. provide output of data.

N.B.: *modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.*

″Digital transfer rate″ 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 component of gyro output that is functionally independent of input rotation. It is expressed as an angular rate. (IEEE STD 528-2001).

″Dynamic adaptive routing″ (5) means automatic rerouting of traffic based on sensing and analysis of current actual network conditions.

N.B.: *this does not include cases of routing decisions taken on predefined information.*

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

N.B.: *see also ″signal analysers″.*

″Effective gramme″ (0 1) of ″special fissile material″ means:

a. for plutonium isotopes and uranium-233, the isotope weight in grammes;

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

c. for uranium enriched below 1 per cent in the isotope uranium-235, the element weight in grammes 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.

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

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

N.B.: *″active tooling unit″ means a device for applying motive power, process energy or sensing to the workpiece.*

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

″Expert systems″ (7) mean systems providing results by application of rules to data which are stored independently of the ″programme″ and capable of any of the following:

a. modifying automatically the ″source code″ introduced by the user;

b. providing knowledge linked to a class of problems in quasi-natural language; or

c. acquiring the knowledge required for their development (symbolic training).

″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″.

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

″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 minimizes deviations from a four-dimensional (space and time) desired trajectory based on maximizing performance or effectiveness for mission tasks.

″Focal plane array″ (6) means a linear or two-dimensional planar layer, or combination of planar layers, of individual detector elements, with or without readout electronics, which work in the focal plane.

N.B.: *This is not intended to include a stack of single detector elements or any two, three or four element detectors provided time delay and integration is not performed within the element.*

″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 vehicles position and velocity (i.e. navigation) with that of computing and sending commands to the vehicles flight control systems to correct the trajectory.

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

″Hybrid computer″ (4) means equipment which can perform all of the following:

a. accept data;

b. process data, in both analogue and digital representations; and

c. provide output of data.

″Hybrid integrated circuit″ (3) means any combination of integrated circuit(s), or integrated circuit with ″circuit elements″ or ″discrete components″ connected together to perform (a) specific function(s), and having all of the following characteristics:

a. containing at least one unencapsulated device;

b. connected together using typical IC production methods;

c. replaceable as an entity; and

d. not normally capable of being disassembled.

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

N.B. 2: *″discrete component″: a separately packaged ″circuit element″ with its own external connections.*

″Image enhancement″ (4) means the processing of externally derived information-bearing images by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform). This does not include algorithms using only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false coloration.

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

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

″Information security″ (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.

N.B.: *″cryptanalysis″: analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text.*

″Instantaneous bandwidth″ (3 5 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 a 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.

″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) 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″.

″Laser duration″ (6) means the time over which a ″laser″ emits ″laser″ radiation, which for ″pulsed lasers″ corresponds to the time over which a single pulse or series of consecutive pulses is emitted.

″Lighter-than-air vehicles″ (9) means balloons and airships that rely on hot air or other 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).

N.B.: *″data device″ means equipment capable of transmitting or receiving sequences of digital information.*

″Magnetic Gradiometers″ (6) are instruments designed to detect the spatial variation of magnetic fields from sources external to the instrument. They consist of multiple ″magnetometers″ and associated electronics the output of which is a measure of magnetic field gradient.

N.B.: *see also ″intrinsic magnetic gradiometer″.*

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

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

″Materials resistant to corrosion by UF_6″ (0) may be copper, stainless steel, aluminium, aluminium oxide, aluminium alloys, nickel or alloy containing 60 weight percent or more nickel and UF_6- 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.

N.B.: *the internal storage may be augmented by an external storage.*

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

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

N.B. 2: *this 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.

″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.

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

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

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

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

a. single Instruction Multiple Data (SIMD) architectures such as vector or array processors;

b. multiple Single Instruction Multiple Data (MSIMD) architectures;

c. multiple Instruction Multiple Data (MIMD) architectures, including those which are tightly coupled, closely coupled or loosely coupled; or

d. structured arrays of processing elements, including systolic arrays.

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

"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 $S^2_{pp} = 8\ N_o(f_2–f_1)$, where S_{pp} is the peak-to-peak value of the signal (e.g., nanoteslas), N_o is the power spectral density (e.g., $(\text{nanotesla})^2/\text{Hz}$) and $(f_2–f_1)$ defines the bandwidth of interest.

"Nuclear reactor" (0) 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 the highest level of power attained in ″the laser duration″.

″Personalised 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.

″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″.

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

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

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

″Pulsed laser″ (6) means a ″laser″ having a ″pulse duration″ that is less than or equal to 0,25 seconds.

″Quantum cryptography″ (5) means a family of techniques for the establishment of 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.

″Repeatability″ (7) means 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. (Reference: IEEE STD 528-2001 (one sigma standard deviation))

″Required″ (GTN 1-9), as applied to ″technology″, refers to only that portion of ″technology″ which is peculiarly responsible for achieving or extending the controlled performance levels, characteristics or functions. Such ″required″ ″technology″ 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).

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

a. is multifunctional;

b. is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;

c. incorporates three or more closed or open loop servo-devices which may include stepping motors; and

d. has ″user accessible programmability″ by means of teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention.

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

1. *manipulation mechanisms which are only manually/teleoperator controllable;*

2. *fixed sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed stops, such as pins or cams. The sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;*

3. *mechanically controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed, but adjustable stops, such as pins or cams. The sequence of motions and the selection of paths or angles are variable within the fixed programme pattern. Variations or modifications of the programme pattern (e.g., changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;*

4. *non-servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;*

5. *stacker cranes defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval.*

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

″Roving″ (1) is a bundle (typically 12-120) of approximately parallel ″strands″.

N.B.: *″strand″ is a bundle of ″monofilaments″ (typically over 200) arranged approximately parallel.*

″Run-out″ (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″ is equivalent to ″super high power laser″.

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

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

″Software″ (GSN All) means a collection of one or more ″programmes″ or ″microprogrammes″ fixed in any tangible medium of expression.

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

″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/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2) °C) and a relative humidity of (50 ± 5) %.

″Specific tensile strength″ (0 1 9) is ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2) °C) and a relative humidity of (50 ± 5) %.

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

N.B.: *″solidify rapidly″ solidification of molten material at cooling rates exceeding 1 000 K/s.*

″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.

N.B. 1: *″discrete component″: a separately packaged ″circuit element″ with its own external connections.*

N.B. 2: *″circuit element″: a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.*

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

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

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

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

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

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

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

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

N.B.: *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.

N.B.: *″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 goods. This information takes the form of ″technical data″ or ″technical assistance″.

N.B. 1: *″technical assistance″ may take forms such as instructions, skills, training, working knowledge and consulting services and may involve the transfer of ″technical data″.*

N.B. 2: *″Technical data″ may take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.*

″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 0,71 per cent).

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

″User accessible programmability″ (6) means the facility allowing a user to insert, modify or replace ″programmes″ by means other than:

a. a physical change in wiring or interconnections; or

b. the setting of function controls including entry of parameters.

″Vaccine″ (1) is a medicinal product 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″.

N.B.: *″strand″ is a bundle of ″monofilaments″ (typically over 200) arranged approximately parallel.*

ACRONYMS AND ABBREVIATIONS USED IN THIS ANNEX

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

Acronym or abbreviation	Meaning
ABEC	Annular Bearing Engineers Committee
AGMA	American Gear Manufacturers' Association
AHRS	attitude and heading reference systems
AISI	American Iron and Steel Institute
ALU	arithmetic logic unit
ANSI	American National Standards Institute
ASTM	the American Society for Testing and Materials
ATC	air traffic control
AVLIS	atomic vapour laser isotope separation
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
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
ETSI	European Telecommunications Standards Institute
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

Acronym or abbreviation	Meaning
ISO	International 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
MRI	magnetic resonance imaging
MTBF	mean-time-between-failures
Mtops	million theoretical operations per second
MTTF	mean-time-to-failure
NBC	Nuclear, Biological and Chemical
NDT	non-destructive test
PAR	precision approach radar
PIN	personal identification number
ppm	parts per million
PSD	power spectral density
QAM	quadrature-amplitude-modulation
RF	radio frequency
SACMA	Suppliers of Advanced Composite Materials Association
SAR	synthetic aperture radar
SC	single crystal
SLAR	sidelooking airborne radar
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
UV	ultraviolet
UTS	ultimate tensile strength
VOR	very high frequency omni-directional range
YAG	yttrium/aluminium garnet

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 × 10^6 m and a ″specific tensile strength″ greater than 76,2 × 10^3 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 UF_6″ 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;

0B001 b. *(continued)*

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 UF_6″;

12. scoops consisting of tubes of up to 12 mm internal diameter for the extraction of UF_6 gas from within a centrifuge rotor tube by a Pitot tube action, made of or protected by ″materials resistant to corrosion by UF_6″;

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. sn efficiency greater than 80 %;

14. bellows valves made of or protected by ″materials resistant to corrosion by UF_6″, with a diameter of 10 mm to 160 mm;

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 UF_6″ with a pore size of 10 to 100 nm, a thickness of 5 mm or less, and, for tubular forms, a diameter of 25 mm or less;

2. gaseous diffuser housings made of or protected by ″materials resistant to corrosion by UF_6″;

3. compressors (positive displacement, centrifugal and axial flow types) or gas blowers with a suction volume capacity of 1 m^3/min or more of UF_6, and discharge pressure up to 666,7 kPa, made of or protected by ″materials resistant to corrosion by UF_6″;

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 cm^3/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 UF″, 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 UF_6, 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 UF_6″ with a diameter of between 0,5 cm and 4 cm and a length to diameter ratio of 20:1 or less and with one or more tangential inlets;

3. compressors (positive displacement, centrifugal and axial flow types) or gas blowers with a suction volume capacity of 2 m^3/min or more, made of or protected by ″materials resistant to corrosion by UF_6″, and rotary shaft seals therefor;

4. heat exchangers made of or protected by ″materials resistant to corrosion by UF_6″;

5. aerodynamic separation element housings, made of or protected by ″materials resistant to corrosion by UF_6″ to contain vortex tubes or separation nozzles;

0B001 d. *(continued)*

6. bellows valves made of or protected by ″materials resistant to corrosion by UF_6″, with a diameter of 40 mm to 1 500 mm;

7. process systems for separating UF_6 from carrier gas (hydrogen or helium) to 1 ppm UF_6 content or less, including:

a. cryogenic heat exchangers and cryoseparators capable of temperatures of 153 K (– 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 UF_6 from carrier gas;

d. UF_6 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 (100 °C) to 473 K (200 °C);

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 (100 °C) to 473 K (200 °C) and pressures above 0,7 MPa;

3. ion exchange reflux systems (chemical or electrochemical oxidation or reduction systems) for regeneration of the chemical reducing or oxidizing agents used in ion exchange enrichment cascades;

g. equipment and components, specially designed or prepared for atomic vapour ″laser″ 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;

0B001 g. *(continued)*

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 UF_6 and carrier gas to 150 K (– 123 °C) or less and made from ″materials resistant to corrosion by UF_6″;

2. uranium pentafluoride (UF_5) product collectors consisting of filter, impact, or cyclone-type collectors or combinations thereof, and made of ″materials resistant to corrosion by UF_5/UF_6″;

3. compressors made of or protected by ″materials resistant to corrosion by UF_6″, and rotary shaft seals therefor;

4. equipment for fluorinating UF_5 (solid) to UF_6 (gas);

5. process systems for separating UF_6 from carrier gas (e.g. nitrogen or argon) including:

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

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

c. UF_6 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;

0B001 i. *(continued)*

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 UF_6″:

a. feed autoclaves, ovens or systems used for passing UF_6 to the enrichment process;

b. desublimers or cold traps, used to remove UF_6 from the enrichment process for subsequent transfer upon heating;

c. product and tails stations for transferring UF_6 into containers;

0B002 *(continued)*

d. liquefaction or solidification stations used to remove UF_6 from the enrichment process by compressing, cooling and converting UF_6 to a liquid or solid form;

e. piping systems and header systems specially designed for handling UF_6 within gaseous diffusion, centrifuge or aerodynamic cascades;

f. 1. Vacuum manifolds or vacuum headers having a suction capacity of 5 m^3/minute or more; or

2. Vacuum pumps specially designed for use in UF_6 bearing atmospheres;

g. UF_6 mass spectrometers/ion sources specially designed or prepared for taking on-line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:

1. unit resolution for mass of more than 320 amu;

2. ion sources constructed of or lined with nichrome or monel, or nickel plated;

3. electron bombardment 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 UO_3;

b. systems for the conversion of UO_3 to UF_6;

c. systems for the conversion of UO_3 to UO_2;

d. systems for the conversion of UO_2 to UF_4;

e. systems for the conversion of UF_4 to UF_6;

f. systems for the conversion of UF_4 to uranium metal;

g. systems for the conversion of UF_6 to UO_2;

h. systems for the conversion of UF_6 to UF_4;

i. systems for the conversion of UO_2 to UCl_4.

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 % H_2S) with a throughput capacity greater than or equal to 56 m^3/second when operating at pressures greater than or equal to 1,8 MPa suction and having seals designed for wet H_2S service;

0B004 b. *(continued)*

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 utilising 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 utilising 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;

0B006 *Note: e. (continued)*

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

0C001 "Natural uranium" or "depleted uranium" or thorium in the form of metal, alloy, chemical compound or concentrate and any other material containing one or more of the foregoing;

Note: 0C001 does not control the following:

a. four grammes or less of "natural uranium" or "depleted uranium" when contained in a sensing component in instruments;

b. "depleted uranium" specially fabricated for the following civil non-nuclear applications:

1. shielding;

2. packaging;

3. ballasts having a mass not greater than 100 kg;

4. counter-weights having a mass not greater than 100 kg;

c. alloys containing less than 5 % thorium;

d. ceramic products containing thorium, which have been manufactured for non-nuclear use.

0C002 "Special fissile materials"

Note: 0C002 does not control four "effective grammes" or less when contained in a sensing component in instruments.

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/cm^3.

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 BE_z for impurities (excluding BE_{carbon} since carbon is not considered an impurity) including boron, where:

BE_z (ppm) = CF × concentration of element Z in ppm;

where CF is the conversion factor $= \frac{\sigma_Z \times A_B}{\sigma_B \times A_Z}$

and σ_B and σ_Z are the thermal neutron capture cross sections (in barns) for naturally occurring boron and element Z respectively; and A_B and A_Z 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 UF_6 (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″ AND ″TOXINS″

1A Systems, Equipment and Components

1A001 Components made from fluorinated compounds, as follows:

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

b. piezoelectric polymers and copolymers made from vinylidene fluoride materials specified in 1C009.a.:

1. in sheet or film form; and

2. with a thickness exceeding 200 μm;

c. seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers containing at least one vinylether 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. Consisting of an organic ″matrix″ and materials specified in 1C010.c., 1C010.d. or 1C010.e.; or

b. Consisting of a metal or carbon ″matrix″ and any of the following:

1. carbon ″fibrous or filamentary materials″ with:

a. a ″specific modulus″ exceeding $10{,}15 \times 10^6$ m; and

b. a ″specific tensile strength″ exceeding $17{,}7 \times 10^4$ 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 ″civil aircraft″ structures or laminates, provided the size does not exceed 100 cm × 100 cm.

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 and designed for the production of electronic printed circuit boards.

1A004 Protective and detection equipment and components, other than those specified in military goods controls, 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;

1A004 *(continued)*

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 MILITARY GOODS CONTROLS.

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, other than those specified 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 Specialised 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 m^2;

b. a density greater than 3 g/cm^3; 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 specially designed for ″composite″ materials, as follows:

1. x-ray tomography systems for three dimensional defect inspection;

2. numerically controlled ultrasonic testing machines of which the motions for positioning transmitters and/or receivers are simultaneously coordinated and programmed in four or more axes to follow the three dimensional contours of the component under inspection.

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 the Military Goods Controls.

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 organisation of the process in an argon-water environment;

b. electroburst equipment usable for obtaining sputtered or spherical metallic powders with organisation 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 the Military Goods Controls;

1B115 *(continued)*

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 the Military Goods Controls.

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 Military Goods Controls.

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 (1 300 °C) to 3 173 K (2 900 °C) 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 Military Goods Controls, and specially designed components therefor.

1B201 Filament winding machines, other than those specified 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 H_2-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 (KNH_2/NH_3), having all of the following characteristics:

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

b. a capacity greater than 8,5 m^3/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 1 000 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 2×10^8 Hz but less than 3×10^{12} 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.

1C001 a. *Note 1:* *c.* *(continued)*

2. tensile strength less than 7×10^6 N/m^2; and

3. compressive strength less than 14×10^6 N/m^2;

d. planar absorbers made of sintered ferrite, having:

1. a specific gravity exceeding 4,4; and

2. a maximum operating temperature of 548 K (275 °C).

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 $1,5 \times 10^{14}$ Hz but less than $3,7 \times 10^{14}$ Hz and not transparent to visible light;

c. cntrinsically conductive polymeric materials with a 'bulk electrical conductivity' exceeding 10 000 S/m (Siemens per metre) or a 'sheet (surface) resistivity' of less than 100 ohms/square, based on any of the following polymers:

1. polyaniline;

2. polypyrrole;

3. polythiophene;

4. poly phenylene-vinylene; or

5. poly thienylene-vinylene.

Technical note:

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

1C002 Metal alloys, metal alloy powder and alloyed materials, as follows:

N.B.: SEE ALSO 1C202.

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

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 (K_t) 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;

1C002 *(continued)*

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

1. nickel alloys with:

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

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

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);

5. 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, 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 10^9 alloy particles;

b. niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);

c. titanium alloys (Ti-Al-X or Ti-X-Al);

d. aluminium alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); or

e. magnesium alloys (Mg-Al-X or Mg-X-Al);

2. Made in a controlled environment by any of the following processes:

a. ″vacuum atomisation″;

1C002 c. 2. *(continued)*

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 5×10^{-4}; or

2. a magnetomechanical coupling factor (k) of more than 0,8; or

c. amorphous or 'nanocrystalline' alloy strips, having all of the following characteristics:

1. a composition having a minimum of 75 weight percent of iron, cobalt or nickel;

2. a saturation magnetic induction (B_s) of 1,6 T or more; and

3. any of the following:

a. a strip thickness of 0,02 mm or less; or

b. an electrical resistivity of 2×10^{-4} ohm cm or more.

Technical note:

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

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

a. a density exceeding 17,5 g/cm^3;

b. an elastic limit exceeding 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. ″Superconductive″ ″composite″ conductors containing one or more niobium-titanium filaments, having all of the following:

1. embedded in a ″matrix″ other than a copper or copper-based mixed ″matrix″; and

2. having a cross-section area less than 0,28 × 10^{-4} mm^2 (6 μm in diameter for circular filaments);

b. ″superconductive″ ″composite″ conductors consisting of one or more ″superconductive″ filaments other than niobium-titanium, having all of the following:

1. a ″critical temperature″ at zero magnetic induction exceeding 9,85 K (– 263,31 °C); and

2. remaining in the ″superconductive″ state at a temperature of 4,2 K (– 268,96 °C) when exposed to a magnetic field oriented in any direction perpendicular to the longitudinal axis of conductor and corresponding to a magnetic induction of 12 T with critical current density exceeding 1 750 A/mm^2 on overall cross-section of the conductor;

c. ″superconductive″ ″composite″ conductors consisting of one or more ″superconductive″ filaments which remain ″superconductive″ above 115 K (– 158,16 °C).

Technical note:

For the purpose of 1C005 filaments may be in wire, cylinder, film, tape or ribbon form.

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

1C006 a. *(continued)*

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 mm^2/s (5 000 centistokes) measured at 298 K (25 °C);

c. damping or flotation fluids with a purity exceeding 99,8 %, containing less than 25 particles of 200 μm or larger in size per 100 ml and made from at least 85 % of any of the following compounds or materials:

1. dibromotetrafluoroethane;

2. polychlorotrifluoroethylene (oily and waxy modifications only); or

3. polybromotrifluoroethylene;

d. fluorocarbon electronic cooling fluids, having all of the following characteristics:

1. containing 85 % by weight or more of any of the following, or mixtures thereof:

a. monomeric forms of perfluoropolyalkylether-triazines or perfluoroaliphatic-ethers;

b. perfluoroalkylamines;

c. perfluorocycloalkanes; or

d. perfluoroalkanes;

2. density at 298 K (25 °C) of 1,5 g/ml or more;

3. in a liquid state at 273 K (0 °C); and

4. containing 60 % or more by weight of fluorine.

Technical note:

For the purpose of 1C006:

a. clash 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;

1C006 *(continued)*

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, 52 100 steel and naval bronze (60 % Cu, 39 % Zn, 0,75 % Sn);

The chamber is purged with nitrogen, sealed at atmospheric pressure and the temperature raised to and maintained at 644 ± 6 K (371 ± 6 °C) for six hours;

The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:

1. the loss in weight of each ball is less than 10 mg/mm^2 of ball surface;

2. the change in original viscosity as determined at 311 K (38 °C) is less than 25 %; and

3. the total acid or base number is less than 0,40;

e. Autogenous ignition temperature is determined using the method described in ASTM E-659 or national equivalents.

1C007 Ceramic base materials, non-″composite″ ceramic materials, ceramic-″matrix″ ″composite″ materials and precursor materials, as follows:

N.B.: SEE ALSO 1C107.

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

b. non-″composite″ ceramic materials in crude or semi-fabricated form, composed of borides of titanium with a density of 98 % or more of the theoretical density;

Note: 1C007.b. does not control abrasives.

c. ceramic-ceramic ″composite″ materials with a glass or oxide-″matrix″ and reinforced with fibres 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 × 10^{3}m;

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

e. precursor materials (i.e., special purpose polymeric or metallo-organic materials) for producing any phase or phases of the materials specified in 1C007.c., as follows:

1. polydiorganosilanes (for producing silicon carbide);

2. polysilazanes (for producing silicon nitride);

3. polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components);

1C007 *(continued)*

f. ceramic-ceramic ″composite″ materials with an oxide or glass ″matrix″ reinforced with continuous fibres from any of the following systems:

1. Al_2O_3; or

2. Si-C-N.

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

1C008 Non-fluorinated polymeric substances, as follows:

a. 1. bismaleimides;

2. aromatic polyamide-imides;

3. aromatic polyimides;

4. aromatic polyetherimides having a glass transition temperature (T_g) exceeding 513 K (240 °C);

Note 1: 1C008.a. controls the substances in liquid or solid form, including resin, powder, pellet, film, sheet, tape or ribbon;

Note 2: 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 75-2 (2004), method A or national equivalents, with a load of 1,80 N/mm^2 and composed of:

1. any of the following:

a. phenylene, biphenylene or naphthalene; or

b. methyl, tertiary-butyl or phenyl substituted phenylene, biphenylene or naphthalene; and

2. any of the following acids:

a. terephthalic acid;

b. 6-hydroxy-2 naphthoic acid; or

c. 4-hydroxybenzoic acid;

c. not used;

d. polyarylene ketones;

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

f. polybiphenylenethersulphone having a glass transition temperature (T_g) exceeding 513 K (240 °C).

Technical note:

The glass transition temperature (T_g) 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 weight or more of combined fluorine;

c. fluorinated phosphazene elastomers containing 30 % by weight or more of combined fluorine.

1C010 ″Fibrous or filamentary materials″ which may be used in organic ″matrix″, metallic ″matrix″ or carbon ″matrix″ ″composite″ structures or laminates, as follows:

N.B.: SEE ALSO 1C210 AND 9C110.

a. organic ″fibrous or filamentary materials″, having all of the following:

1. a ″specific modulus″ exceeding $12{,}7 \times 10^6$ m; and

2. a ″specific tensile strength″ exceeding $23{,}5 \times 10^4$ m;

Note: 1C010.a. does not control polyethylene.

b. carbon ″fibrous or filamentary materials″, having all of the following:

1. a ″specific modulus″ exceeding $12{,}7 \times 10^6$ m; and

2. a ″specific tensile strength″ exceeding $23{,}5 \times 10^4$ m;

Note: 1C010.b. does not control fabric made from ″fibrous or filamentary materials″ for the repair of ″civil aircraft″ structures or laminates, in which the size of individual sheets does not exceed 100 cm × 100 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 $2{,}54 \times 10^6$ m; and

2. a melting, softening, decomposition or sublimation point exceeding 1 922 K (1 649 °C) in an inert environment;

Note: 1C010.c. does not control:

1. discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random mat form, containing 3 weight percent or more silica, with a specific modulus of less than 10×10^6m;

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.;

1C010 e. *(continued)*

2. made from organic or carbon "fibrous or filamentary materials":

a. with a "specific tensile strength" exceeding $17{,}7 \times 10^4$ m;

b. with a "specific modulus" exceeding $10{,}15 \times 10^6$ m;

c. not controlled by 1C010.a. or 1C010.b.; and

d. when impregnated with materials specified in 1C008 or 1C009.b., having a glass transition temperature (T_g) exceeding 383 K (110 °C) or with phenolic or epoxy resins, having a glass transition temperature (T_g) equal to or exceeding 418 K (145 °C).

Notes: 1C010.e. does not control:

a. epoxy resin "matrix" impregnated carbon "fibrous or filamentary materials" (prepregs) for the repair of "civil aircraft" structures or laminates, in which the size of individual sheets of prepreg does not exceed 100 cm × 100 cm;

b. prepregs when impregnated with phenolic or epoxy resins having a glass transition temperature (T_g) less than 433 K (160 °C) and a cure temperature lower than the glass transition temperature.

Technical note:

The glass transition temperature (T_g) 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 1 Hz and a heating rate of 2 K (°C) per minute using the dry method.

1C011 Metals and compounds, as follows:

N.B.: SEE ALSO MILITARY GOODS CONTROLS 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 of more 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 grammes" or less when contained in a sensing component in instruments.

1C012 *(continued)*

b. ″previously separated″ neptunium-237 in any form.

Note: *1C012.b. does not control shipments with a neptunium-237 content of 1 g or less.*

1C101 Materials and devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures, other than those specified in 1C001, usable in 'missiles', ″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 ultraviolet 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, other than those specified in 1C007, as follows:

a. fine grain graphites with a bulk density of 1,72 g/cm^3 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 × 120 mm × 50 mm or greater;

N.B.: SEE ALSO 0C004

b. pyrolytic or fibrous reinforced graphites, usable for rocket nozzles and re-entry vehicle nose tips usable in ″missiles″, space launch vehicles specified in 9A004 or sounding rockets specified in 9A104;

N.B.: SEE ALSO 0C004

c. ceramic composite materials (dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz) for use in radomes usable in ″missiles″, space launch vehicles specified in 9A004 or sounding rockets specified in 9A104;

d. bulk machinable silicon-carbide reinforced unfired ceramic, usable for nose tips usable in ″missiles″, space launch vehicles specified in 9A004 or sounding rockets specified in 9A104;

e. reinforced silicon-carbide ceramic composites, usable for nose tips, reentry vehicles and nozzle flaps usable in ″missiles″, space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

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

a. propulsive substances:

1. spherical aluminium powder, other than that specified in the Military Goods Controls, 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 the Military Goods Controls, in particle sizes of less than 60 μm, whether spherical, atomised, 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. Oxidiser substances usable in liquid propellant rocket engines 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 (N_2O_4/NO_2) 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 Military Goods Controls for Inhibited Red Fuming Nitric Acid (IRFNA);**

f. **see Military Goods Controls and 1C238 for Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen;**

4. Hydrazine derivatives as follows:

a. trimethylhydrazine;

b. tetramethylhydrazine;

c. N, N diallylhydrazine;

1C111 a. 4. *(continued)*

d. allylhydrazine;

e. ethylene dihydrazine;

f. monomethylhydrazine dinitrate;

g. unsymmetrical dimethylhydrazine nitrate;

h. hydrazinium azide;

i. dimethylhydrazinium azide;

j. **see Military Goods Controls for Hydrazinium nitrate;**

k. diimido oxalic acid dihydrazine;

l. 2-hydroxyethylhydrazine nitrate (HEHN);

m. **see Military Goods Controls for Hydrazinium perchlorate;**

n. hydrazinium diperchlorate;

o. methylhydrazine nitrate (MHN);

p. diethylhydrazine nitrate (DEHN);

q. 1,4-dihydrazine nitrate (DHTN);

b. polymeric substances:

1. carboxy-terminated polybutadiene (CTPB);

2. hydroxy-terminated polybutadiene (HTPB), other than that specified in the Military Goods Controls;

3. polybutadiene-acrylic acid (PBAA);

4. polybutadiene-acrylic acid-acrylonitrile (PBAN);

5. polytetrahydrofuran polyethylene glycol (TPEG);

Technical note:

Polytetrahydrofuran polyethylene glycol (TPEG) is a block co-polymer of poly 1,4-Butanediol and polyethylene glycol (PEG).

c. other propellant additives and agents:

1. **see Military Goods Controls for Carboranes, decaboranes, pentaboranes and derivatives thereof;**

2. triethylene glycol dinitrate (TEGDN);

3. 2-Nitrodiphenylamine (CAS 119-75-5);

4. trimethylolethane trinitrate (TMETN) (CAS 3032-55-1);

5. diethylene glycol dinitrate (DEGDN);

6. ferrocene derivatives as follows:

a. **see Military Goods Controls for catocene;**

b. ethyl ferrocene;

c. propyl ferrocene (CAS 1273-89-8);

1C111 c. 6. *(continued)*

d. **see Military Goods Controls for n-butyl ferrocene;**

e. pentyl ferrocene (CAS 1274-00-6);

f. dicyclopentyl ferrocene;

g. dicyclohexyl ferrocene;

h. diethyl ferrocene;

i. dipropyl ferrocene;

j. dibutyl ferrocene;

k. dihexyl ferrocene;

l. acetyl ferrocenes;

m. **see Military Goods Controls for ferrocene Carboxylic acids;**

n. **see Military Goods Controls for butacene;**

o. other ferrocene derivatives usable as rocket propellant burning rate modifiers, other than those specified in the Military Goods Controls.

Note: for propellants and constituent chemicals for propellants not specified in 1C111, see the Military Goods Controls.

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

N.B.: SEE ALSO 1C216.

1C117 Tungsten, molybdenum and alloys of these metals in the form of uniform spherical or atomized particles of 500 micrometre diameter or less with a purity of 97 % or greater for fabrication of rocket motor components, usable in ″missiles″, space launch vehicles specified in 9A004 or sounding rockets specified in 9A104 (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, other than those specified 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, other than those specified 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 $12{,}7 \times 10^6$ m or greater; or

2. a ″specific tensile strength″ of 235×10^3 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 $3{,}18 \times 10^6$ m or greater; and

2. a ″specific tensile strength″ of $76{,}2 \times 10^3$ 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 (20 °C).

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 (^{10}B) 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 (^{3}He), 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 (^{6}Li) 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 1 000, and products or devices containing any of the foregoing.

Note: 1C235 does not control a product or device containing less than 1,48 × 10^3 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 (^{226}Ra), radium-226 alloys, radium-226 compounds, mixtures containing radium-226, manufactures thereof, 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 (ClF_3).

1C239 High explosives, other than those specified in the Military Goods Controls, or substances or mixtures containing more than 2 % by weight thereof, with a crystal density greater than 1,8 g/cm^3 and having a detonation velocity greater than 8 000 m/s.

1C240 Nickel powder and porous nickel metal, other than those specified 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 cm^2 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 MILITARY GOODS CONTROLS AND 1C450.

1. thiodiglycol (111-48-8);

2. phosphorus oxychloride (10025-87-3);

3. dimethyl methylphosphonate (756-79-6);

1C350 *(continued)*

4. **SEE MILITARY GOODS CONTROLS 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 MILITARY GOODS CONTROLS 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 MILITARY GOODS CONTROLS 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);

1C350 *(continued)*

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);

54. N,N-Diisopropyl-(Beta)-aminoethyl chloride hydrochloride (4261-68-1);

55. methylphosphonic acid (993-13-5);

56. diethyl methylphosphonate (683-08-9);

57. N,N-Dimethylaminophosphoryl dichloride (677-43-0);

58. triisopropyl phosphite (116-17-6);

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

60. O,O-Diethyl phosphorothioate (2465-65-8);

61. O,O-Diethyl phosphorodithioate (298-06-6);

62. sodium hexafluorosilicate (16893-85-9);

63. methylphosphonothioic dichloride (676-98-2).

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 and .62 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.*

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.

1C351 *(continued)*

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

1. coxiella burnetii;
2. bartonella quintana (Rochalimaea quintana, Rickettsia quintana);
3. rickettsia prowasecki;
4. rickettsia rickettsii;

c. bacteria, whether natural, enhanced or modified, either in the form of ″isolated live cultures″ or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

1. bacillus anthracis;
2. brucella abortus;
3. brucella melitensis;
4. brucella suis;
5. chlamydia psittaci;
6. Clostridium botulinum;
7. francisella tularensis;
8. burkholderia mallei (Pseudomonas mallei);
9. burkholderia pseudomallei (Pseudomonas pseudomallei);
10. salmonella typhi;
11. shigella dysenteriae;
12. vibrio cholerae;
13. yersinia pestis;
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 and shiga-like ribosome inactivating proteins;
10. microcystin (Cyanginosin);
11. aflatoxins;
12. abrin;
13. cholera toxin;
14. diacetoxyscirpenol toxin;

1C351 d. *(continued)*

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. *sre pre-packaged for distribution as medical products;*

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

e. 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, as follows:

1. coccidioides immitis;

2. coccidioides posadasii.

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/EEC (OJ L 167, 22.6.1992, p. 1) 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;

1C352 a. *(continued)*

15. vesicular stomatitis virus;

16. lumpy skin disease virus;

17. african horse sickness virus.

b. mycoplasmas, 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. mycoplasma mycoides. subspecies mycoides SC (small colony);

2. mycoplasma capricolum subspecies capripneumoniae.

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., 1C351.b., 1C351.c, 1C351.e., 1C352 or 1C354;

b. 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., 1C351.b., 1C351.c., 1C351.e., 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 including living 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;

3. Xanthomonas oryzae pv. Oryzae (Pseudomonas campestris pv. Oryzae);

4. Clavibacter michiganensis subsp. Sepedonicus (Corynebacterium michiganensis subsp. Sepedonicum or Corynebacterium Sepedonicum);

5. Ralstonia solanacearum Races 2 and 3 (Pseudomonas solanacearum Races 2 and 3 or Burkholderia solanacearum Races 2 and 3);

1C354 *(continued)*

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 MILITARY GOODS CONTROLS.

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 MILITARY GOODS CONTROLS 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);

7. 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.

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

b. toxic chemical precursors, as follows:

1. chemicals, other than those specified in the Military Goods Controls 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;

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

1C450 b. *(continued)*

2. N,N-Dialkyl [methyl, ethyl or propyl (normal or iso)] phosphoramidic dihalides, other than N,N-Dimethylaminophosphoryl dichloride;

N.B.: see 1C350.57. for N,N-Dimethylaminophosphoryl dichloride.

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 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 or N,N-Diisopropyl-(beta)-aminoethyl chloride hydrochloride which are specified in 1C350;

5. N,N-Dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane-2-ols and corresponding protonated salts, other than N,N-Diisopropyl-(beta)-aminoethanol (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 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 one or more of the chemicals specified in entry 1C450.b.8. in which no individually specified chemical constitutes 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″.
1D003	″Software″ specially designed or modified to enable equipment to perform the functions of equipment specified in 1A004.c.
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;

1E002 *(continued)*

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.

g. 'libraries (parametric technical databases)' specially designed or modified to enable equipment to perform the functions of equipment specified in 1A004.c.

Technical note:

For the purpose of 1E002.g., the term 'library (parametric technical database)' means a collection of technical information, reference to which may enhance the performance of relevant equipment or systems.

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 1C118, 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 Military Goods Controls

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

Note: 2A001 does not control balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

a. ball bearings and solid roller bearings having 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 systems using any of the following:

1. materials with flux densities of 2,0 T or greater and yield strengths greater than 414 MPa;

2. all-electromagnetic 3D homopolar bias designs for actuators; or

3. high temperature (450 K (117 °C) and above) position sensors.

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

a. crucibles having both of the following characteristics:

1. a volume of between 150 cm^3 and 8 000 cm^3; and

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

a. calcium fluoride (CaF_2);

b. calcium zirconate (metazirconate) ($CaZrO_3$);

c. cerium sulphide (Ce_2S_3);

d. erbium oxide (erbia) (Er_2O_3);

e. hafnium oxide (hafnia) (HfO_2);

f. magnesium oxide (MgO);

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

h. yttrium oxide (yttria) (Y_2O_3); or

i. zirconium oxide (zirconia) (ZrO_2);

b. crucibles having both of the following characteristics:

1. a volume of between 50 cm^3 and 2 000 cm^3; 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 cm^3 and 2 000 cm^3;

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 movement within the machine are performed such as:*

   a. *eheel-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] 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) [1];*

   c. *cetermine 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.*

[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.

2B001 *5. (continued)*

Note 2: 2B001 does not control special purpose machine tools limited to the manufacture of any of the following parts:

a. crankshafts or camshafts;

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) [1] 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, having all of the following characteristics:

1. machine controller limited to using ophthalmic based software for part programming data input; and

2. no vacuum chucking.

b. machine tools for milling, having any of the 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) [1] 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) [1] 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

b. 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 of the 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) [1] 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";

[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.

2B001 5. *(continued)*

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) ([1]) 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 optical finishing machine tools equipped to produce non-spherical optical surfaces, having all of the following characteristics:

a. finishing the form to less (better) than 1,0 µm;

b. finishing to a roughness less (better) than 100 nm rms;

c. three or more axes which can be coordinated simultaneously for "contouring control"; and

d. using any of the following processes:

1. magnetorheological finishing ('MRF');

2. electrorheological finishing ('ERF'); or

3. 'energetic particle beam finishing'.

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. 'ERF' is a removal process using an abrasive fluid whose viscosity is controlled by an electric field. 'Energetic particle beam finishing' uses Reactive Atom Plasmas (RAP) or ion-beams to selectively remove material.

([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.

2B003 ″Numerically controlled″ or manual machine tools, and specially designed components, controls and accessories therefor, specially designed for the shaving, finishing, grinding or honing of hardened (R_c = 40 or more) spur, helical and double-helical gears with a pitch diameter exceeding 1 250 mm and a face width of 15 % of pitch diameter or larger finished to a quality of AGMA 14 or better (equivalent to ISO 1328 class 3).

2B004 Hot″isostatic presses″, having all of the following, and specially designed 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 Military Goods Controls.

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;

2B005 *(continued)*

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/mm^2 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 (MPE_E) 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; or

2B006 b. 1. *(continued)*

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);

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 "programmes" or to generate or modify numerical programme 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 5×10^3 Gy (silicon) without operational degradation; or

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.

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:

a. linear position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an overall "accuracy" less (better) than $(800 + (600 \times L \times 10^{-3}))$ nm (L equals the effective length in mm);

N.B.: *For "laser" systems see also Note to 2B006.b.1.*

2B008 *(continued)*

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 of 2B009 regarded as flow-forming machines.

2B104 ″Isostatic presses″, other than those specified 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, other than those specified in 2B005.a., designed or modified for the densification of carbon-carbon composites.

2B109 Flow-forming machines, other than those specified 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 equal to or greater than 50 kN, measured 'bare table', 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, other than those specified in 2B004, 2B005.a., 2B104 or 2B105, designed or modified for densification and pyrolysis of structural composite rocket nozzles and re-entry 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;

2B120 c. *(continued)*

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), other than those specified 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, other than those specified in 2B001, as follows, for removing or cutting metals, ceramics or ″composites″, which, according to the manufacturer's technical specification, can be equipped with electronic devices for simultaneous ″contouring control″ in two or more axes:

a. machine tools for milling, having any of the following characteristics:

1. positioning accuracies with ″all compensations available″ equal to or less (better) than 6 μm according to ISO 230/2 (1988) [1] 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) [1] 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 outside diameter 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) [1] or national equivalents.

[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.

2B201 *5. (continued)*

Note 1: 2B201 does not control special purpose machine tools limited to the manufacture of any of the following parts:

a. gears;

b. crankshafts or camshafts;

c. tools or cutters;

d. 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", other than those specified 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, other than those specified 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/1 000) 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, other than those specified 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, other than those specified 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 × 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 cm^3 and 20 000 cm^3, and

2. capable of operating with melting temperatures above 1 973 K (1 700 °C);

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 (1 200 °C).

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.

b. 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 m^3/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 m^3 (100 litres) and less than 20 m^3 (20 000 litres), where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

1. alloys with more than 25 % nickel and 20 % chromium by weight;

2. fluoropolymers;

3. glass (including vitrified or enamelled coating or glass lining);

4. nickel or alloys with more than 40 % nickel by weight;

5. tantalum or tantalum alloys;

6. titanium or titanium alloys;

7. zirconium or zirconium alloys; or

8. niobium (columbium) or niobium 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;

2B350 b. *(continued)*

5. tantalum or tantalum alloys;

6. titanium or titanium alloys;

7. zirconium or zirconium alloys; or

8. niobium (columbium) or niobium alloys;

c. Storage tanks, containers or receivers with a total internal (geometric) volume greater than 0,1 m^3 (100 litres) where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

1. alloys with more than 25 % nickel and 20 % chromium by weight;

2. fluoropolymers;

3. glass (including vitrified or enamelled coatings or glass lining);

4. nickel or alloys with more than 40 % nickel by weight;

5. tantalum or tantalum alloys;

6. titanium or titanium alloys;

7. zirconium or zirconium alloys; or

8. niobium (columbium) or niobium alloys;

d. heat exchangers or condensers with a heat transfer surface area greater than 0,15 m^2, and less than 20 m^2; 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;

10. titanium carbide; or

11. niobium (columbium) or niobium alloys;

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 absorbtion 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';

2B350 e. *(continued)*

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; or

9. niobium (columbium) or niobium alloys;

f. remotely operated filling equipment in which all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

1. alloys with more than 25 % nickel and 20 % chromium by weight; or

2. nickel or alloys with more than 40 % nickel by weight;

g. 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;

7. zirconium or zirconium alloys; or

8. niobium (columbium) or niobium 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;

8. zirconium or zirconium alloys; or

9. niobium (columbium) or niobium alloys;

2B350 *(continued)*

i. multiple-seal, and seal-less pumps, with manufacturer's specified maximum flow-rate greater than 0,6 m^3/hour, or vacuum pumps with manufacturer's specified maximum flow-rate greater than 5 m^3/hour (under standard temperature (273 K (0 °C)) and pressure (101,3 kPa) conditions); 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;

10. zirconium or zirconium alloys; or

11. niobium (columbium) or niobium alloys;

j. incinerators designed to destroy chemicals specified in entry 1C350, having specially designed waste supply systems, special handling facilities and an average combustion chamber temperature greater than 1 273 K (1 000 °C), in which all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with any of the following materials:

1. alloys with more than 25 % nickel and 20 % chromium by weight;

2. ceramics; or

3. nickel or alloys with more than 40 % nickel by weight.

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/m^3; or

b. designed for the detection of cholinesterase-inhibiting activity.

2B352 Equipment capable of use in handling biological materials, as follows:

a. complete biological containment facilities at P3, P4 containment level;

Technical note:

P3 or P4 (BL3, BL4, L3, L4) containment levels are as specified in the WHO Laboratory Biosafety manual (2nd edition, Geneva 1993).

b. fermenters capable of cultivation of pathogenic "micro-organisms", 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.

2B352 *(continued)*

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 than 1 m^2; and

b. capable of being sterilised or disinfected in-situ;

Technical note:

In 2B352.d.1.b. sterlised 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 m^2 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 ″micro-organisms″, viruses or ″toxins″, and having a capacity of 1 m^3 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: 2D002 does 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:

a. ″technology″ for the ″development″ of interactive graphics as an integrated part in ″numerical control″ units for preparation or modification of part programmes;

b. ″technology″ for metal-working manufacturing processes, as follows:

1. ″technology″ for the design of tools, dies or fixtures specially designed for any of the following processes:

a. ″superplastic forming″;

b. ″diffusion bonding″; or

c. ″direct-acting hydraulic pressing″;

2. technical data consisting of process methods or parameters as listed below used to control:

a. ″superplastic forming″ of aluminium alloys, titanium alloys or ″superalloys″:

1. surface preparation;

2. strain rate;

3. temperature;

4. pressure;

b. ″diffusion bonding″ of ″superalloys″ or titanium alloys:

1. surface preparation;

2. temperature;

3. pressure;

c. ″direct-acting hydraulic pressing″ of aluminium alloys or titanium alloys:

1. pressure;

2. cycle time;

d. ″hot isostatic densification″ of titanium alloys, aluminium alloys or ″superalloys″:

1. temperature;

2. pressure;

3. cycle time;

c. ″technology″ for the ″development″ or ″production″ of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;

d. ″technology″ for the ″development″ of generators of machine tool instructions (e.g., part programmes) from design data residing inside ″numerical control″ units;

e. ″technology″ for the ″development″ of integration ″software″ for incorporation of expert systems for advanced decision support of shop floor operations into ″numerical control″ units;

2E003 *(continued)*

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) (*)	2. Substrate	3. Resultant Coating
A. Chemical Vapour Deposition (CVD)	″Superalloys″	Aluminides for internal passages
	Ceramics (19) and Low-expansion glasses (14)	Silicides
		Carbides
		Dielectric layers (15)
		Diamond
		Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Silicides
		Carbides
		Refractory metals
		Mixtures thereof (4)
		Dielectric layers (15)
		Aluminides
		Alloyed aluminides (2)
		Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides
		Tungsten
		Mixtures thereof (4)
		Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
		Diamond
		Diamond-like carbon (17)
	Sensor window materials (9)	Dielectric layers (15)
		Diamond
		Diamond-like carbon (17)

1. Coating Process (1) (*)	2. Substrate	3. Resultant Coating
B. Thermal-Evaporation Physical Vapour Deposition (TE-PVD)		
B.1. Physical Vapour Deposition (PVD): Electron-Beam (EB-PVD)	″Superalloys″	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
	Ceramics (19) and Low expansion glasses (14)	Dielectric layers (15)
	Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15) Borides Beryllium
	Sensor window materials (9)	Dielectric layers (15)
	Titanium alloys (13)	Borides Nitrides

1. Coating Process (1) (')	2. Substrate	3. Resultant Coating
B.2. Ion assisted resistive heating Physical Vapour Deposition (PVD) (Ion Plating)	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon (17)
B.3. Physical Vapour Deposition (PVD): ″Laser″ Vaporisation	Ceramics (19) and Low-expansion glasses (14)	Silicides Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
B.4. Physical Vapour Deposition (PVD): Cathodic Arc Discharge	″Superalloys″	Alloyed silicides Alloyed aluminides (2) MCrAlX (5)
	Polymers (11) and Organic″matrix″ ″composites″	Borides Carbides Nitrides Diamond-like carbon (17)
C. Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Silicides Carbides Mixtures thereof (4)
	Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
	Refractory metals and alloys (8)	Silicides Oxides

1. Coating Process (1) (*)	2. Substrate	3. Resultant Coating
D. Plasma spraying	″Superalloys″	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel-Graphite Abradable 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 and alloys (8)	Aluminides Silicides Carbides
	Corrosion resistant steel (7)	MCrAlX (5) 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
E. Slurry Deposition	Refractory metals and alloys (8)	Fused silicides Fused aluminides except for resistance heating elements
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Silicides Carbides Mixtures thereof (4)

1. Coating Process (1) (')	2. Substrate	3. Resultant Coating
F. Sputter Deposition	″Superalloys″	Alloyed silicides
		Alloyed aluminides (2)
		Noble metal modified aluminides (3)
		MCrAlX (5)
		Modified zirconia (12)
		Platinum
		Mixtures thereof (4)
	Ceramics and Low-expansion glasses (14)	Silicides
		Platinum
		Mixtures thereof (4)
		Dielectic layers (15)
		Diamond-like carbon (17)
	Titanium alloys (13)	Borides
		Nitrides
		Oxides
		Silicides
		Aluminides
		Alloyed aluminides (2)
		Carbides
	Carbon-carbon, Ceramic and Metal ″matrix″ ″composites″	Silicides
		Carbides
		Refractory metals
		Mixtures thereof (4)
		Dielectric layers (15)
		Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides
		Tungsten
		Mixtures thereof (4)
		Dielectric layers (15)
		Boron nitride
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Borides
		Dielectric layers (15)
		Beryllium
	Sensor window materials (9)	Dielectric layers (15)
		Diamond-like carbon (17)
	Refractory metals and alloys (8)	Aluminides
		Silicides
		Oxides
		Carbides

1. Coating Process (1) (*)	2. Substrate	3. Resultant Coating
G. Ion Implantation	High temperature bearing steels	Additions of Chromium Tantalum or Niobium (Columbium)
	Titanium alloys (13)	Borides
		Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides
		Nitrides

(*) The numbers in parenthesis refer to the Notes following this Table.

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 to 1.1 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 $1 \times 10^{-7}\ K^{-1}$ or less measured at 293 K (20 °C).

15. 'Dielectric layers' are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal ″composite″ layers.

16. 'Cemented tungsten carbide' does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, 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.

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 ionised, 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 5×10^3 Gy (silicon) or higher;

   b. a dose rate upset of 5×10^6 Gy (silicon)/s or higher; or

   c. a fluence (integrated flux) of neutrons (1 MeV equivalent) of 5×10^{13} n/cm^2 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) et 398 K (125 °C);

   Note: 3A001.a.2. does not apply to integrated circuits for civil automobiles or railway train applications.

3A001 a. *(continued)*

3. "Microprocessor microcircuits", "microcomputer microcircuits" and microcontroller microcircuits, manufactured *from a compound semiconductor and operating 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 105 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 10 million words per second; or

5. a resolution of more than 14 bit with an output rate greater than 2,5 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 2^n 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 megahertz (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;

3A001 a. 7. *(continued)*

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. not used;

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 3 000 (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 $(N \log_2 N)/20\,480$ 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.

3A001 b. 1. *(continued)*

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/cm^2;

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);

3A001 b. 3. *(continued)*

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 [$P>150\ W*GHz^2/f_{GHz}^2$];

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 [$d = 15\ cm*GHz/f_{GHz}$].

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 ≤ 15 cm*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 (f_{max}/f_{min}) in less than 10 μs having any of the following:

a. a band-pass bandwidth of more than 0,5 % of centre frequency; or

b. a band-stop bandwidth of less than 0,5 % of centre frequency;

3A001 b. *(continued)*

6. not used;

7. mixers and converters designed to extend the frequency range of equipment described in 3A002.c., 3A002.e. or 3A002.f. beyond the limits stated therein;

8. microwave power amplifiers containing tubes specified in 3A001.b. and having all of the following:

a. operating frequencies above 3 GHz;

b. an average output power density exceeding 80 W/kg; and

c. a volume of less than 400 cm^3;

Note: *3A001.b.8. does not control equipment designed or rated for operation in any frequency band which is "allocated by the ITU" for radio-communications services, but not for radio-determination.*

9. microwave power modules (MPM), consisting of, at least, a travelling wave tube, a microwave monolithic integrated circuit and an integrated electronic power conditioner, having all of the following characteristics:

a. a turn-on time from off to fully operational in less than 10 seconds;

b. a volume less than the maximum rated power in Watts multiplied by 10 cm^3/W; and

c. an "instantaneous bandwidth" greater than 1 octave (fmax. > 2 fmin.) and any of the following:

1. for frequencies equal to or less than 18 GHz, an RF output power greater than 100 W; or

2. having a frequency greater than 18 GHz.

Technical notes:

1. to calculate the control volume in 3A001.b.9.b., the following example is provided: for a maximum rated power of 20 W, the volume would be: 20 W × 10 cm^3/W = 200 cm^3.

2. the turn-on time in 3A001.b.9.a. refers to the time from fully-off to fully operational; i.e., it includes the warm-up time of the MPM.

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

3A001 c. 1. *(continued)*

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. 'cells', as follows:

a. 'primary cells' having an 'energy density' exceeding 550 Wh/kg at 20 °C;

b. 'secondary cells' having 250 Wh/kg;

Technical note:

1. For the purpose of 3A001.e.1., ″energy density″ (Wh/kg) is calculated from the nominal voltage multiplied by the nominal capacity in ampere hours divided by the mass in kilograms. If the nominal capacity is not stated, energy density is calculated from the nominal voltage squared then multiplied by the discharge duration in hours divided by the discharge load in ohms and the mass in kilograms.

2. for the purpose of 3A001.e.1., a 'cell' is defined as an electrochemical device, which has positive and negative electrodes, and electrolyte, and is a source of electrical energy. It is the basic building block of a battery.

3. for the purpose of 3A001.e.1.a., a 'primary cell' is a 'cell' that is not designed to be charged by any other source.

4. for the purpose of 3A001.e.1.b., a 'secondary cell' is a 'cell' that is designed to be charged by an external electrical source.

Note: 3A001.e.1. does not control batteries, including single cell batteries.

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;

3A001 e. 2. *(continued)*

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/mm^2;

4. solar cells, cell-interconnect-coverglass (CIC) assemblies, solar panels, and solar arrays, which are ″space qualified″, having a minimum average efficiency exceeding 20 % at an operating temperature of 301 K (28 °C) under simulated 'AM0' illumination with an irradiance of 1 367 watts per square metre (W/m^2).

Technical note:

'AM0', or 'Air Mass Zero', refers to the spectral irradiance of sun light in the earth's outer atmosphere when the distance between the earth and sun is one astronomical unit (AU).

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.

g. solid-state pulsed power switching thyristor devices and 'thyristor modules' using either electrically, optically, or electron radiation controlled switch methods, having any of the following:

1. a maximum turn-on current rate of rise (di/dt) greater than 30 000 A/μs and off-state voltage greater than 1 100 V; or

2. a maximum turn-on current rate of rise (di/dt) greater than 2 000 A/μs and all of the following:

a. an off-state peak voltage equal to or greater than 3 000 V; and

b. a peak (surge) current equal to or greater than 3 000 A.

Note 1: 3A001.g. includes:

— *silicon Controlled Rectifiers (SCRs)*

— *electrical Triggering Thyristors (ETTs)*

— *light Triggering Thyristors (LTTs)*

— *integrated Gate Commutated Thyristors (IGCTs)*

— *gate Turn-off Thyristors (GTOs)*

— *MOS Controlled Thyristors (MCTs)*

— *solidtrons*

3A001 g. *(continued)*

Note 2: 3A001.g. does not control thyristor devices and 'thyristor modules' incorporated into equipment designed for civil railway or "civil aircraft" applications.

Technical note:

For the purposes of 3A001.g., a 'thyristor module' contains one or more thyristor devices.

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 Mbits/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 Mbits/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 Mbits/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.

3A002 a. *(continued)*

6. digital instrumentation data recorders, using magnetic disk storage technique, having all of the following:

a. digitising rate equal to or more than 100 million samples per second and a resolution of 8 bit or more; and

b. 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;

Note: *the control status of signal analysers, signal generators, network analysers and microwave test receivers as stand-alone instruments is determined by 3A002.c., 3A002.d., 3A002.e., and 3A002.f., respectively.*

c. radio frequency ″signal analysers″, as follows:

1. ″signal analysers″capable of analysing frequencies exceeding 31,8 GHz 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 reference oscillator, and having any of the following:

1. a maximum synthesised frequency exceeding 31,8 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 as specified by any of the following:

a. less than 10 ns;

b. less than 100 μs for any frequency change exceeding 1,6 GHz within the synthesised frequency range exceeding 3,2 GHz but not exceeding 10,6 GHz;

c. less than 250 μs for any frequency change exceeding 550 MHz within the synthesised frequency range exceeding 10,6 GHz but not exceeding 31,8 GHz;

d. less than 500 μs for any frequency change exceeding 550 MHz within the synthesised frequency range exceeding 31,8 GHz but not exceeding 43,5 GHz; or

e. less than 1 ms within the synthesised frequency range exceeding 43,5 GHz; or

4. a single sideband (SSB) phase noise better than — (126 + 20 $\log_{10}$F — 20 $\log_{10}$f) in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

Note 1: *for the purpose of 3A002.d., the term frequency synthesised signal generators includes arbitrary waveform and function generators.*

Note 2: *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.*

3A002 d. *(continued)*

Technical notes:

1. *arbitrary waveform and function generators are normally specified by sample rate (e.g. GSample/s), which is converted to the RF domain by the Nyquist factor of two. Thus, a 1 GSample/s arbitrary waveform has a direct output capability of 500 MHz or, when oversampling is used, the maximum direct output capability is proportionately lower.*

2. *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.*

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 1×10^{-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, other than those specified in 3A001, as follows:

a. analogue to digital converters, usable in "missiles", designed to meet military specifications for ruggedised 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.

3A102 'Thermal batteries' designed or modified for 'missiles'.

Technical notes:

1. *In 3A102 'thermal batteries' are single use batteries that contain a solid non-conducting inorganic salt as the electrolyte. These batteries incorporate a pyrolytic material that, when ignited, melts the electrolyte and activates the battery.*

2. *In 3A102 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.*

3A201 Electronic components, other than those specified 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;

3A201 *(continued)*

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:*

$K = 1,7 \times 10^{3} V^{2,65} Q$

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 ($Q = \int i dt$), where i is beam current in amperes and t is time in seconds.

2. *'Peak power' = (peak potential in volts) × (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, other than those specified 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 2 000 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, other than those specified 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, other than those specified 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 100 A; 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, other than those specified in 3A001.g., 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 MILITARY GOODS CONTROLS

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 ruggedised-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;

3A229 b. *(continued)*

7. weight less than 25 kg; and

8. specified for use over an extended temperature range 223 K (– 50 °C) to 373 K (100 °C) 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. utilising electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

3A232 Detonators and multipoint initiation systems, as follows:

N.B.: SEE ALSO MILITARY GOODS CONTROLS

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 mm^2 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, other than those specified in 0B002.g., capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, as follows, and ion sources therefor:

a. inductively coupled plasma mass spectrometers (ICP/MS);

b. glow discharge mass spectrometers (GDMS);

3A233 *(continued)*

c. thermal ionization mass spectrometers (TIMS);

d. electron bombardment mass spectrometers which have a source chamber constructed from, lined with or plated with materials resistant to UF_6;

e. molecular beam mass spectrometers 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 (– 80 °C) or less; or

2. a source chamber constructed from, lined with or plated with materials resistant to UF_6;

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 1 MeV;

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″;

c. 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/cm^2 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/cm^2 with a measurable particle size greater than 0,12 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. 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;

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

3B001 e. *(continued)*

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:

$$MRF = \frac{(\text{an exposure light source wavelength in nm}) \times (\text{K factor})}{\text{numerical aperture}}$$

where the K factor = 0,45

MRF = minimum resolvable feature size

2. imprint lithography equipment capable of producing features of 180 nm or less;

Note: 3B001.f.2. includes:

— *micro contact printing tools*

— *hot embossing tools*

— *nano-imprint lithography tools*

— *step and flash imprint lithography (S-FIL) tools*

3. 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.

i. Imprint lithography templates designed for integrated circuits specified in 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. not used;

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 245 nm;

b. all resists designed for use with electron beams or ion beams, with a sensitivity of 0,01 μcoulomb/mm^2 or better;

c. all resists designed for use with X-rays, with a sensitivity of 2,5 mJ/mm^2 or better;

d. all resists optimised for surface imaging technologies, including 'silylated' resists.

Technical note:

'Silylation' techniques are defined as processes incorporating oxidation of the resist surface to enhance performance for both wet and dry developing.

3C003 Organo-inorganic compounds, as follows:

a. organo-metallic compounds of aluminium, gallium or indium having a purity (metal basis) better than 99,999 %;

b. organo-arsenic, organo-antimony and organo-phosphorus compounds having a purity (inorganic element basis) better than 99,999 %.

Note: 3C003 only controls compounds whose metallic, partly metallic or non-metallic element is directly linked to carbon in the organic part of the molecule.

3C004 Hydrides of phosphorus, arsenic or antimony, having a purity better than 99,999 %, even diluted in inert gases or hydrogen.

Note: 3C004 does not control hydrides containing 20 % molar or more of inert gases or hydrogen.

3C005 Silicon carbide (SiC) wafers having a resistivity of more than 10 000 ohm-cm.

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 a "microprocessor microcircuit", or "microcomputer microcircuit" and microcontroller microcircuit core having an arithmetic logic unit with an access width of 32 bits or more and any of the following features or characteristics:

a. a vector processor unit designed to perform more than two calculations on floating-point vectors (one-dimensional arrays of 32-bit or larger numbers) simultaneously;

Technical note:

A vector processing unit is a processor element with built-in instructions that perform multiple calculations on floating-point vectors (one-dimensional arrays of 32-bit or larger numbers) simultaneously, having at least one vector arithmetic logic unit.

b. designed to perform more than two 64-bit or larger floating-point operation results per cycle; or

c. designed to perform more than four 16-bit fixed-point multiply-accumulate results per cycle (e.g. digital manipulation of analogue information that has been previously converted into digital form, also known as digital signal processing).

Note: 3E002.c. does not control technology for multimedia extensions.

Note 1: 3E002 does not control "technology" for the "development" or "production" of micro-processor cores, having all of the following:

a. using "technology" at or above 0,130 µm; and

b. incorporating multi-layer structures with five or fewer metal layers.

Note 2: 3E002 includes "technology" for digital signal processors and digital array processors.

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;

3E003 *(continued)*

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, 3A102 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., 3A001.g., 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	5×10^3 Gy (silicon);
b. Dose Rate Upset	5×10^6 Gy (silicon)/s; or
c. Single Event Upset	1×10^{-7} Error/bit/day;

b. having characteristics or performing functions exceeding the limits in Category 5, Part 2 ("Information Security").

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".*

4A003 *(continued)*

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.

4A003 *(continued)*

d. not used;

e. equipment performing analogue-to-digital conversions exceeding the limits in 3A001.a.5.;

f. not used;

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, other than those specified 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. not used;

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 ″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 1 012 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 × R1 + W2 × R2 + … + Wn × 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″.*

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, both arising from a nuclear explosion;

2. specially hardened to withstand gamma, neutron or ion radiation; or

3. specially designed to operate outside the temperature range from 218 K (– 55 °C) to 397 K (124 °C).

Note: *5A001.a.3. applies only to electronic equipment.*

Note: *5A001.a.2. and 5A001.a.3. do not control equipment designed or modified for use on board satellites.*

b. telecommunication systems and equipment, 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 MHz to 87,5 MHz band and having any of the following characteristics:

a. automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimise the transmission; and

b. 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, other than those specified 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 radiocommunications systems.*

Note: *5A001.b.3. does not control equipment designed to operate at an output power of 1,0 Watt or less.*

5A001 b. *(continued)*

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:

a. a bandwidth exceeding 500 MHz; or

b. 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 radiocommunications 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 2×10^9 N/m^2 or more;

Technical note:

Proof Test: on-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0,5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 150 mm in diameter. The ambient temperature is a nominal 293 K (20 °C) and relative humidity 40 %. 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).

5A001 *(continued)*

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 Military Goods Controls.

g. passive coherent location systems or equipment specially designed for detecting and tracking moving objects by measuring reflections of ambient radio frequency emissions, supplied by non-radar transmitters.

Technical note:

Non-radar transmitters may include commercial radio, television or cellular telecommunications base stations.

Note: 5A001.g. does not control:

1. *radio-astronomical equipment;*

2. *systems or equipment that require any radio transmission from the target.*

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 characterisation 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 1 750 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 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 1 750 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 1 750 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 exceeding 31,8 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.

c. operating in the 1,5 MHz to 87,5 MHz band and incorporating *adaptive techniques providing more than 15 dB suppression of an interfering signal; or*

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 2 even 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;

b. 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.

5A002 a. 1. *(continued)*

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. not used;

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, other than those specified 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. not used;

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

2. 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;

5A002 a. *Note:* *(continued)*

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-end encryption;

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 basestation) 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;

2. ″software″ to certify ″software″ specified in 5D002.c.1.

Note: 5D002 does not control:

a. ″software″ required for the ″use″ of equipment excluded from control under the Note to 5A002;

b. ″software″ providing any of the functions of equipment excluded from control under the Note to 5A002.

5E2 Technology

5E002 ″Technology″ according to the General Technology Note for the ″development″, ″production″ or ″use″ of equipment or ″software″ specified in 5A002, 5B002 or 5D002.

CATEGORY 6

SENSORS AND LASERS

6A Systems, Equipment and Components

6A001 Acoustics:

a. marine acoustic systems, equipment and specially designed components therefor, as follows:

1. active (transmitting or transmitting-and-receiving) systems, equipment and specially designed components therefor, as follows:

Note: 6A001.a.1. does not control:

a. depth sounders operating vertically below the apparatus, not including a scanning function exceeding ± 20°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;

b. acoustic beacons, as follows:

1. acoustic emergency beacons;

2. pingers specially designed for relocating or returning to an underwater position.

a. wide-swath bathymetric survey systems designed for sea bed topographic mapping, having all of the following:

1. being designed to take measurements at an angle exceeding 20° from the vertical;

2. being designed to measure depths exceeding 600 m below the water surface; and

3. being designed to provide any of the following:

a. incorporation of multiple beams any of which is less than 1,9°; or

b. data accuracies of better than 0,3 % of water depth across the swath averaged over the individual measurements within the swath;

b. object detection or location systems having any of the following:

1. a transmitting frequency below 10 kHz;

2. sound pressure level exceeding 224 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

3. sound pressure level exceeding 235 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

4. forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

5. designed to operate with an unambiguous display range exceeding 5 120 m; or

6. designed to withstand pressure during normal operation at depths exceeding 1 000 m and having transducers with any of the following:

a. dynamic compensation for pressure; or

b. incorporating other than lead zirconate titanate as the transduction element;

c. acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following:

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.

6A001 a. 1. c. *(continued)*

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/mm^2/Hz for devices operating at frequencies below 10 kHz;

2. a continuously radiated 'acoustic power density' exceeding 0,001 mW/mm^2/Hz for devices operating at frequencies below 10 kHz; 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 copolymers {}{P(VDF-TrFE) and P(VDF-TFE)}}; or

c. 'flexible piezoelectric composites';

4. a 'hydrophone sensitivity' better than – 180 dB at any depth with no acceleration compensation;

5. when designed to operate at depths exceeding 35 m with acceleration compensation; or

6. 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.

6A001 a. 2. a. *(continued)*

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 having any 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 beamforming using Fast Fourier or other transforms or processes;

d. heading sensors having all of the following:

1. an accuracy of better than ± 0,5°; and

2. 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 having any 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 beamforming using Fast Fourier or other transforms or processes;

b. correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m.

6A002 Optical sensors

N.B.: SEE ALSO 6A102.

a. optical detectors, as follows:

Note: 6A002.a. does not control germanium or silicon photodevices.

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.

6A002 a. *(continued)*

3. 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″, having individual 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 3 000 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″, having individual elements with a peak response in the wavelength range exceeding 3 000 nm but not exceeding 30 000 nm.

6A002 a. 3. *(continued)*

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 any of the following:

1. an Instantaneous-Field-Of-View (IFOV) of less than 200 μrad (microradians); or

2. being specified for operation in the wavelength range exceeding 400 nm but not exceeding 30 000 nm and having all the following;

a. providing output imaging data in digital format; and

b. being any of the following:

1. ″space-qualified″; or

2. designed for airborne operation, using other than silicon detectors, and having an IFOV of less than 2,5 mrad (milliradians).

c. 'direct view' imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:

1. image intensifier tubes specified in 6A002.a.2.a.; or

2. ″focal plane arrays″ specified in 6A002.a.3.

Technical note:

'Direct view' refers to imaging equipment, operating in the visible or infrared spectrum, that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.

Note: 6A002.c. does not control the following equipment incorporating other than GaAs or GaInAs photocathodes:

a. industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

b. medical equipment;

c. industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. flame detectors for industrial furnaces;

e. equipment specially designed for laboratory use.

d. special support components for optical sensors, as follows:

1. ″space-qualified″ cryocoolers;

2. non-″space-qualified″ cryocoolers, having a cooling source temperature below 218 K (– 55 °C), as follows:

a. closed cycle type with a specified Mean-Time-To-Failure (MTTF), or Mean-Time-Between-Failures (MTBF), exceeding 2 500 hours;

b. Joule-Thomson (JT) self-regulating minicoolers having bore (outside) diameters of less than 8 mm;

3. optical sensing fibres specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.

e. ″space qualified″ ″focal plane arrays″ having more than 2 048 elements per array and having a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm.

6A003 Cameras

N.B.: SEE ALSO 6A203.

N.B.: for cameras specially designed or modified for underwater use, see 8A002.d. and 8A002.e.

a. instrumentation cameras 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 having writing speeds exceeding 10 mm/s;

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 4×10^6 "active pixels" per solid state array for monochrome (black and white) cameras;

2. more than 4×10^6 "active pixels" per solid state array for colour cameras incorporating three solid state arrays; or

3. more than 12×10^6 "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.

6A003 b. 1. *(continued)*

Technical note:

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

6A003 b. 4. *Note 3: b. (continued)*

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:

N.B.: for optical mirrors specially designed for lithography equipment, see 3B001.

1. ″deformable mirrors″ having either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;

2. lightweight monolithic mirrors having an average ″equivalent density″ of less than 30 kg/m^2 and a total mass exceeding 10 kg;

3. lightweight ″composite″ or foam mirror structures having an average ″equivalent density″ of less than 30 kg/m^2 and a total mass exceeding 2 kg;

4. beam steering mirrors more than 100 mm in diameter or length of major axis, which maintain a flatness of lambda/2 or better (lambda is equal to 633 nm) having a control bandwidth exceeding 100 Hz.

b. optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3 000 nm but not exceeding 25 000 nm and having any of the following:

1. exceeding 100 cm^3 in volume; or

2. exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth).

c. ″space-qualified″ components for optical systems, as follows:

1. lightweighted to less than 20 % ″equivalent density″ compared with a solid blank of the same aperture and thickness;

2. 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 5×10^{-6} in any coordinate direction.

6A004 *(continued)*

d. optical control equipment, as follows:

1. specially designed to maintain the surface figure or orientation of the ″space-qualified″ components specified in 6A004.c.1. or 6A004.c.3.;

2. having steering, tracking, stabilisation or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 μrad (microradians) or less;

3. gimbals having all of the following:

a. a maximum slew exceeding 5°;

b. a bandwidth of 100 Hz or more;

c. angular pointing errors of 200 μrad (microradians) or less; and

d. having any of the following:

1. exceeding 0,15 m but not exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 2 rad (radians)/s^2; or

2. exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0,5 rad (radians)/s^2;

4. specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more.

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 3×10^{-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 $2,5 \times 10^{-6}$/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", other than those specified 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: *excimer, semiconductor, chemical, CO, CO_2, and non-repetitive pulsed Nd: glass "lasers" are only specified in 6A005.d.*

Note 3: *6.A005 includes fibre "lasers".*

Note 4: *the control status of "lasers" incorporating frequency conversion (i.e. wavelength change) by means other than one "laser" pumping another "laser" is determined by applying the control parameters for both the output of the source "laser" and the frequency-converted optical output.*

Note 5: *6.A005 does not control the following "lasers":*

a. ruby with output energy below 20 J;

b. nitrogen;

c. krypton.

Technical note:

in 6A005 'Wall-plug efficiency' is defined as the ratio of "laser" output power (or "average output power") to total electrical input power required to operate the "laser", including the power supply/conditioning and thermal conditioning/heat exchanger.

a. non-"tunable" continuous wave "(CW) lasers", having any of the following:

1. an output wavelength less than 150 nm with an output power exceeding 1 W;

2. an output wavelength of 150 nm or more but not exceeding 520 nm and having an output power exceeding 30 W;

Note: *6.A005.a.2. does not control Argon "lasers" having an output power equal to or less than 50 W.*

3. an output wavelength exceeding 520 nm but not exceeding 540 nm and having any of the following:

a. a single transverse mode output having an output power exceeding 50 W; or

b. a multiple transverse mode output having an output power exceeding 150 W;

4. an output wavelength exceeding 540 nm but not exceeding 800 nm and having an output power exceeding 30 W;

5. an output wavelength exceeding 800 nm but not exceeding 975 nm and having any of the following:

a. a single transverse mode output having an output power exceeding 50 W; or

b. a multiple transverse mode output having an output power exceeding 80 W;

6. an output wavelength exceeding 975 nm but not exceeding 1 150 nm and having any of the following:

a. a single transverse mode output having any of the following:

1. a 'wall-plug efficiency' exceeding 12 % and an output power exceeding 100 W; or

2. an output power exceeding 150 W; or

6A005 a. 6. *(continued)*

b. a multiple transverse mode output having any of the following:

1. a 'wall-plug efficiency' exceeding 18 % and an output power exceeding 500 W; or

2. an output power exceeding 2 kW;

Note: 6.A005.a.6.b. does not control multiple transverse mode, industrial "lasers" with output power exceeding 2 kW and not exceeding 6 kW with a total mass greater than 1 200 kg. For the purpose of this note, total mass includes all components required to operate the "laser", e.g. "laser", power supply, heat exchanger, but excludes external optics for beam conditioning and/or delivery.

7. an output wavelength exceeding 1 150 nm but not exceeding 1 555 nm and having any of the following:

a. a single transverse mode having an output power exceeding 50 W; or

b. a multiple transverse mode having an output power exceeding 80 W; or

8. an output wavelength exceeding 1 555 nm and having an output power exceeding 1 W.

b. non-"tunable" "pulsed lasers", having any of the following:

1. an output wavelength less than 150 nm and having any of the following:

a. an output energy exceeding 50 mJ per pulse and a "peak power" exceeding 1 W; or

b. an "average output power" exceeding 1 W;

2. an output wavelength of 150 nm or more but not exceeding 520 nm and having any of the following:

a. an output energy exceeding 1,5 J per pulse and a "peak power" exceeding 30 W; or

b. an "average output power" exceeding 30 W;

Note: 6.A005.b.2.b. does not control Argon "lasers" having an "average output power" equal to or less than 50 W.

3. an output wavelength exceeding 520 nm but not exceeding 540 nm and having any of the following:

a. a single transverse mode output having any of the following:

1. an output energy exceeding 1,5 J per pulse and a "peak power" exceeding 50 W; or

2. an "average output power" exceeding 50 W; or

b. a multiple transverse mode output having any of the following:

1. an output energy exceeding 1,5 J per pulse and a "peak power" exceeding 150 W; or

2. an "average output power" exceeding 150 W;

4. an output wavelength exceeding 540 nm but not exceeding 800 nm and having any of the following:

a. an output energy exceeding 1,5 J per pulse and a "peak power" exceeding 30 W; or

b. an "average output power" exceeding 30 W;

5. an output wavelength exceeding 800 nm but not exceeding 975 nm and having any of the following:

a. a "pulse duration" not exceeding 1 μs and having any of the following:

1. an output energy exceeding 0,5 J per pulse and a "peak power" exceeding 50 W;

2. a single transverse mode output having an "average output power" exceeding 20 W; or

3. a multiple transverse mode output having an "average output power" exceeding 50 W; or

6A005 b. 5. *(continued)*

b. a ″pulse duration″ exceeding 1 μs and having any of the following:

1. an output energy exceeding 2 J per pulse and a ″peak power″ exceeding 50 W;

2. a single transverse mode output having an ″average output power″ exceeding 50 W; or

3. a multiple transverse mode output having an ″average output power″ exceeding 80 W;

6. an output wavelength exceeding 975 nm but not exceeding 1 150 nm and having any of the following:

a. a ″pulse duration″ of less than 1 ns and having any of the following:

1. an output ″peak power″ exceeding 5 GW per pulse;

2. an ″average output power″ exceeding 10 W; or

3. an output energy exceeding 0,1 J per pulse;

b. a ″pulse duration″ exceeding 1 ns but not exceeding 1 μs, and having any of the following:

1. a single transverse mode output having any of the following:

a. a ″peak power″ exceeding 100 MW;

b. an ″average output power″ exceeding 20 W limited by design to a maximum pulse repetition frequency less than or equal to 1 kHz;

c. a 'wall-plug efficiency' exceeding 12 % and an ″average output power″ exceeding 100 W and capable of operating at a pulse repetition frequency greater than 1 kHz;

d. an ″average output power″ exceeding 150 W and capable of operating at a pulse repetition frequency greater than 1 kHz; or

e. an output energy exceeding 2 J per pulse; or

2. a multiple transverse mode output having any of the following:

a. a ″peak power″ exceeding 400 MW;

b. a 'wall-plug efficiency' exceeding 18 % and an ″average output power″ exceeding 500 W;

c. an ″average output power″ exceeding 2 kW; or

d. an output energy exceeding 4 J per pulse; or

c. a ″pulse duration″ exceeding 1 μs and having any of the following:

1. a single transverse mode output having any of the following:

a. a ″peak power″ exceeding 500 kW;

b. a 'wall-plug efficiency' exceeding 12 % and an ″average output power″ exceeding 100 W; or

c. an ″average output power″ exceeding 150 W; or

2. a multiple transverse mode output having any of the following:

a. a ″peak power″ exceeding 1 MW;

b. a 'wall-plug efficiency' exceeding 18 % and an ″average output power″ exceeding 500 W; or

c. an ″average output power″ exceeding 2 kW;

6A005 b. *(continued)*

7. an output wavelength exceeding 1 150 nm but not exceeding 1 555 nm and having any of the following:

a. a ″pulse duration″ not exceeding 1 μs and having any of the following:

1. an output energy exceeding 0,5 J per pulse and a ″peak power″ exceeding 50 W;

2. a single transverse mode output having an ″average output power″ exceeding 20 W; or

3. a multiple transverse mode output having an ″average output power″ exceeding 50 W; or

b. a ″pulse duration″ exceeding 1 μs and having any of the following:

1. an output energy exceeding 2 J per pulse and a ″peak power″ exceeding 50 W;

2. a single transverse mode output having an ″average output power″ exceeding 50 W; or

3. a multiple transverse mode output having an ″average output power″ exceeding 80 W; or

8. an output wavelength exceeding 1 555 nm and having any of the following:

a. an output energy exceeding 100 mJ per pulse and a ″peak power″ exceeding 1 W; or

b. an ″average output power″ exceeding 1 W;

c. ″tunable″ ″lasers″, having any of the following:

Note: 6.A005.c. includes titanium-sapphire (Ti: Al2O3), thulium-YAG (Tm: YAG), thulium-YSGG (Tm: YSGG), alexandrite (Cr: BeAl2O4), colour centre ″lasers″, dye ″lasers″ and liquid ″lasers″.

1. an output wavelength less than 600 nm and having any of the following:

a. an output energy exceeding 50 mJ per pulse and a ″peak power″ exceeding 1 W; or

b. an average or CW output power exceeding 1 W;

2. an output wavelength of 600 nm or more but not exceeding 1 400 nm and having any of the following:

a. an output energy exceeding 1 J per pulse and a ″peak power″ exceeding 20 W; or

b. an average or CW output power exceeding 20 W; or

3. an output wavelength exceeding 1 400 nm and having any of the following:

a. an output energy exceeding 50 mJ per pulse and a ″peak power″ exceeding 1 W; or

b. an average or CW output power exceeding 1 W;

d. other ″lasers″, not specified in 6A005.a., 6A005.b. or 6A005.c. as follows:

1. semiconductor ″lasers″, as follows:

Note 1: 6A005.d.1. 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.

a. individual single-transverse mode semiconductor ″lasers″, having any of the following:

1. a wavelength equal to or less than 1 510 nm and having an average or CW output power exceeding 1,5 W; or

2. a wavelength greater than 1 510 nm and having an average or CW output power exceeding 500 mW;

6A005 d. 1. *(continued)*

b. individual, multiple-transverse mode semiconductor ″lasers″, having any of the following:

1. a wavelength of less than 1 400 nm and having an average or CW output power exceeding 10W;

2. 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

3. a wavelength equal to or greater than 1 900 nm and having an average or CW output power exceeding 1 W;

c. individual semiconductor ″laser″ arrays, having any of the following:

1. a wavelength of less than 1 400 nm and having an average or CW output power exceeding 80 W;

2. 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

3. a wavelength equal to or greater than 1 900 nm and having an average or CW output power exceeding 10 W;

d. array stacks of semiconductor ″lasers″ containing at least one array that is controlled under 6A005.d.1.c.;

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.

2. carbon monoxide (CO) ″lasers″ having any of the following:

a. an output energy exceeding 2 J per pulse and a ″peak power″ exceeding 5 kW; or

b. an average or CW output power exceeding 5 kW;

3. carbon dioxide (CO_2) ″lasers″ having any of the following:

a. a CW output power exceeding 15 kW;

b. a pulsed output having a ″pulse duration″ exceeding 10 μs and having any of the following:

1. an ″average output power″ exceeding 10 kW; or

2. a ″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;

4. 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;

6A005 d. 4. *(continued)*

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 excimer ″lasers″ specially designed for lithography equipment, see 3B001.*

5. ″chemical lasers″, as follows:

a. hydrogen Fluoride (HF) ″lasers″;

b. deuterium Fluoride (DF) ″lasers″;

c. ″transfer lasers″, as follows:

1. oxygen Iodine (O_2-I) ″lasers″;

2. deuterium Fluoride-Carbon dioxide (DF-CO_2) ″lasers″;

6. 'non-repetitive pulsed' Nd: glass ″lasers″ having any of the following:

a. a ″pulse duration″ not 1 μs and an output energy exceeding 50 J per pulse; or

b. a ″pulse duration″ exceeding 1 μs and an output energy exceeding 100 J per pulse;

Note: *'non-repetitive pulsed' refers to ″lasers″ that produce either a single output pulse or that have a time interval between pulses exceeding one minute.*

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 the Military Goods Lists.*

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;

6A005 f. *(continued)*

3. optical equipment and components specially designed for a phased-array "SHPL" system for coherent beam combination to an accuracy of lambda/10 at the designed wavelength, or 0,1 μm, whichever is the smaller;

4. projection telescopes specially designed for use with "SHPL" systems.

6A006 "Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers" 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. 1×10^{-3} nT (rms) per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or

c. 1×10^{-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);

b. Civil Automotive Radar;

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 any any of the following:

1. an average output power exceeding 100 mW; or

2. locating accuracy of 1 m or less (better) in range and 0,2 degree or less (better) in azimuth;

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 side-looking 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;

6A008 *(continued)*

i. providing ground-based operation with a maximum ″instrumented range″ exceeding 185 km;

Note: 6A008.i. does not control:

a. fishing ground surveillance radar;

b. ground radar equipment specially designed for enroute air traffic control, provided that all the following conditions are met:

1. it has a maximum ″instrumented range″ of 500 km or less;

2. it is configured so that radar target data can be transmitted only one way from the radar site to one or more civil ATC centres;

3. it contains no provisions for remote control of the radar scan rate from the enroute ATC centre; and

4. it is to be permanently installed;

c. weather balloon tracking radars.

j. being ″laser″ radar or Light Detection and Ranging (LIDAR) equipment, having any of the following:

1. ″space-qualified″; or

2. employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 μrad (microradians);

Note: 6A008.j. does not control LIDAR equipment specially designed for surveying or for meteorological observation.

k. having ″signal processing″ sub-systems using ″pulse compression″, with any of the following:

1. a ″pulse compression″ ratio exceeding 150; or

2. a pulse width of less than 200 ns; or

l. having data processing sub-systems with any of the following:

1. ″automatic target tracking″ providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage;

Note: 6A008.l.1. does not control conflict alert capability in ATC systems, or marine or harbour radar.

2. calculation of target velocity from primary radar having non-periodic (variable) scanning rates;

3. processing for automatic pattern recognition (feature extraction) and comparison with target characteristic data bases (waveforms or imagery) to identify or classify targets; or

4. superposition and correlation, or fusion, of target data from two or more ″geographically dispersed″ and ″interconnected radar sensors″ to enhance and discriminate targets.

Note: 6A008.l.4. does not control systems, equipment and assemblies used for marine traffic control.

6A102 Radiation hardened 'detectors', other than those specified in 6A002, 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 5×10^5 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, other than those specified in 6A007.b., designed or modified for airborne or marine use, and having a static or operational accuracy of 7×10^{-6} m/s^2 (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, other than those specified in entry 6A008, as follows:

a. 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;

d. 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;

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 cm^2; and

b. anode pulse rise time of less than 1 ns.

6A203 Cameras and components, other than those specified in 6A003, as follows:

a. mechanical rotating mirror cameras, as follows, and specially designed components therefor:

1. framing cameras with recording rates greater than 225 000 frames per second;

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;

6A203 b. *(continued)*

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 50×10^3 Gy(silicon) (5×10^6 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, other than those specified 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;

6A205 *(continued)*

f. neodymium-doped (other than glass) "lasers" with an output wavelength between 1 000 and 1 100 nm having either of the following:

1. pulse-excited and Q-switched with a pulse duration equal to or more than 1 ns, and having either of the following:

a. a single-transverse mode output with an average output power greater than 40 W; or

b. a multiple-transverse mode output having an average power greater than 50 W; or

2. incorporating frequency doubling to give an output wavelength between 500 and 550 nm with an average output power of more than 40 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, other than those specified in 6B008, specially designed for radar cross section measurement usable for 'missiles' and their subsystems.

Technical note:

In 6B108 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

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 cm^3; or

2. a diameter greater than 80 mm having a thickness of 20 mm or more;

b. boules of the following electro-optic materials:

1. potassium titanyl arsenate (KTA);

2. silver gallium selenide ($AgGaSe_2$);

3. thallium arsenic selenide (Tl_3AsSe_3, also known as TAS);

c. non-linear optical materials, having all of the following:

1. third order susceptibility (chi 3) of 10^{-6} m^2/V^2 or more; and

2. a response time of less than 1 ms;

d. ″Substrate blanks″ of silicon carbide or beryllium beryllium (Be/Be) deposited materials exceeding 300 mm in diameter or major axis length;

e. glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF_4) and hafnium fluoride (HfF_4), having all of the following:

1. a hydroxyl ion (OH-) concentration of less than 5 ppm;

2. integrated metallic purity levels of less than 1 ppm; and

3. high homogeneity (index of refraction variance) less than 5×10^{-6};

f. synthetically produced diamond material with an absorption of less than 10^{-5} cm^{-1} for wavelengths exceeding 200 nm but not exceeding 14 000 nm.

6C005 Synthetic crystalline ″laser″ host material in unfinished form, as follows:

a. titanium doped sapphire;

b. alexandrite.

6D Software

6D001 ″Software″ specially designed for the ″development″ or ″production″ of equipment specified in 6A004, 6A005, 6A008 or 6B008.

6D002 ″Software″ specially designed for the ″use″ of equipment specified in 6A002.b., 6A008 or 6B008.

6D003 Other ″software″, as follows:

a. 1. ″software″ specially designed for acoustic beam forming for the ″real time processing″ of acoustic data for passive reception using towed hydrophone arrays;

2. ″source code″ for the ″real time processing″ of acoustic data for passive reception using towed hydrophone arrays;

3. ″software″ specially designed for 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 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 ″programmes″ hosted on general purpose computers located at Air Traffic Control centres and capable of any of the following:

a. processing and displaying more than 150 simultaneous ″system tracks″; or

b. accepting radar target data from more than four primary radars;

2. ″software″ for the design or ″production″ of radomes which:

a. are specially designed to protect the ″electronically steerable phased array antennae″ specified in 6A008.e.; and

b. result in an antenna pattern having an 'average side lobe level' more than 40 dB below the peak of the main beam level.

Technical note:

'Average side lobe level' in 6D003.d.2.b. is measured over the entire array excluding the angular extent of the main beam and the first two side lobes on either side of the main beam.

6D102 ″Software″ specially designed 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 5×10^{-3};

N.B.: SEE ALSO 2E003.f.

2. optical fabrication ″technology″ using single point diamond turning techniques to produce surface finish accuracies of better than 10 nm rms on non-planar surfaces exceeding 0,5 m^2;

b. ″technology″ ″required″ for the ″development″, ″production″ or ″use″ of specially designed diagnostic instruments or targets in test facilities for ″SHPL″ testing or testing or evaluation of materials irradiated by ″SHPL″ beams;

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 Accelerometers, as follows, and specially designed components therefor:

N.B.: SEE ALSO 7A101.

a. linear accelerometers having any of the following:

1. Specified to function at linear acceleration levels less than or equal to 15 g, and having any of the following:

a. a "bias" "stability" of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year; or

b. a "scale factor" "stability" of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year;

2. specified to function at linear acceleration levels exceeding 15 g, and having all of the following:

a. a "bias" "repeatability" of less (better) than 5 000 micro g over a period of one year; and

b. a "scale factor" "repeatability" of less (better) than 2 500 ppm over a period of one year; or

3. designed for use in inertial navigation or guidance systems and specified to function at linear acceleration levels exceeding 100 g;

b. angular or rotational accelerometers specified to function at linear acceleration levels exceeding 100 g.

7A002 Gyros, and angular rate sensors, having any of the following characteristics, and specially designed components therefor:

N.B.: SEE ALSO 7A102.

N.B.: for angular or rotational accelerometers, see 7A001.b.

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 less (better) than 0,5 degree per hour when specified to function at linear acceleration levels up to and including 100 g;

b. an "angle random walk" of less (better) than or equal to 0,0035 degree 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).

c. a rate range greater than or equal to 500 degrees per second and having any of the following:

1. a "drift rate" "stability", when measured in a 1 g environment over a period of three minutes and with respect to a fixed calibration value of less (better) than 40 degrees per hour; or

2. an "angle random walk" of less (better) than or equal to 0,2 degree per square root hour; or

d. specified to function at linear acceleration levels exceeding 100 g.

7A003 Inertial Systems and specially designed components, as follows:

N.B.: SEE ALSO 7A103.

a. 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 embedded 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.

d. inertial measurement equipment including Inertial Measurement Units (IMU) and Inertial Reference Systems (IRS), incorporating accelerometers or gyros specified in 7A001 or 7A002, and specially designed components therefor.

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 g^2/Hz over a frequency interval of 15 to 1 000 Hz; and

b. the PSD attenuates with frequency from 0,04 g^2/Hz to 0,01 g^2/Hz over a frequency interval from 1 000 to 2 000 Hz;

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.

7A008 Underwater sonar navigation systems, using Doppler velocity or correlation velocity logs integrated with a heading source, having a positioning accuracy of equal to or less (better) than 3 % of distance travelled Circular Error Probable (CEP), and specially designed components therefor.

Note: 7A008 does not control systems specially designed for installation on surface vessels or systems requiring acoustic beacons or buoys to provide positioning data.

N.B.: See 6A001.a. for acoustic systems, and 6A001.b. for correlation-velocity sonar log equipment. See 8A002 for other marine systems.

7A101 Accelerometers, other than those specified 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 1 250 micro g; and

2. a ″scale factor″ ″repeatability″ of less (better) than 1 250 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;

b. continuous output accelerometers specified to function at acceleration levels exceeding 100 g.

7A102 All types of gyros, other than those specified in 7A002, usable in 'missiles', with a rated ″drift rate″ 'stability' of less than 0,5° (1 sigma or rms) per hour in a 1 g environment and specially designed components therefor.

7A102 *(continued)*

Technical notes:

1. *In 7A102 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.*

2. *In 7A102 'stability' is defined as a measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition (IEEE STD 528-2001 paragraph 2.247).*

7A103 Instrumentation, navigation equipment and systems, other than those specified in 7A003, as follows; and specially designed components therefor:

a. inertial or other equipment using accelerometers 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 downhole well services operations.

b. integrated flight instrument systems which include gyrostabilisers or automatic pilots, designed or modified for use in 'missiles';

c. 'integrated navigation systems', designed or modified 'missiles' and capable of providing a navigational accuracy of 200 m Circle of Equal Probability (CEP) or less.

Technical notes:

An 'integrated navigation system' typically incorporates the following components:

1. *an inertial measurement device (e.g., an attitude and heading reference system, inertial reference unit, or inertial navigation system);*

2. *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*

3. *integration hardware and software;*

d. three axis magnetic heading sensors, designed or modified to be integrated with flight control and navigation systems, having all the following characteristics, and specially designed components therefor;

1. internal tilt compensation in pitch (± 90 degrees) and roll (± 180 degrees) axes;

2. capable of providing azimuthal accuracy better (less) than 0,5 degrees rms at latitude of ± 80 degrees, reference to local magnetic field.

Note: flight control and navigation systems in 7A103.d. include gyrostabilizers, automatic pilots and inertial navigation systems.

Technical note:

In 7A103 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

7A104 Gyro-astro compasses and other devices, other than those specified in 7A004, which derive position or orientation by means of automatically tracking celestial bodies or satellites and specially designed components therefor.

7A105 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

7A105 *(continued)*

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;

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, other than those specified 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;

g. fibre optic gyro coil winding machines.

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, 7A004 or 7A008;

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 or 7A008by continuously combining heading data with any of the following:

1. doppler radar or sonar 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″;

7. ″DBRN″ systems designed to navigate underwater using sonar or gravity databases that provide a positioning accuracy equal to or less (better) than 0,4 nautical miles;

b. ″development″ ″technology″, as follows, for ″active flight control systems″ (including fly-by-wire or fly-by-light):

1. configuration design for interconnecting multiple microelectronic processing elements (on-board computers) to achieve ″real time processing″ for control law implementation;

2. control law compensation for sensor location or dynamic airframe loads, i.e., compensation for sensor vibration environment or for variation of sensor location from the centre of gravity;

3. electronic management of data redundancy or systems redundancy for fault detection, fault tolerance, fault isolation or reconfiguration;

Note: *7E004.b.3. does not control ″technology″ for the design of physical redundancy.*

4. flight controls which permit inflight reconfiguration of force and moment controls for real time autonomous air vehicle control;

7E004 b. *(continued)*

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 optimisation 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 of all the following:

a. 10 % or more of their weight in air; and

b. 15 kN or more;

2. designed to operate at depths exceeding 1 000 m; or

3. having all of the following:

a. designed to carry a crew of 4 or more;

b. designed to 'operate autonomously' for 10 hours or more;

c. having a 'arange' of 25 nautical miles or more; and

d. having a length of 21 m or less;

Technical notes:

1. For the purposes of 8A001.b., 'operate autonomously' means fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

2. For the purposes of 8A001.b.,'range' means half the maximum distance a submersible vehicle can cover.

c. unmanned, tethered submersible vehicles designed to operate at depths exceeding 1 000 m, having any of the following:

1. designed for self-propelled manoeuvre using propulsion motors or thrusters specified in 8A002.a.2.; or

2. having a fibre optic data link;

d. unmanned, untethered submersible vehicles, having any of the following:

1. designed for deciding a course relative to any geographical reference without real-time human assistance;

2. having an acoustic data or command link; or

3. having a fibre optic data or command link exceeding 1 000 m;

8A001 *(continued)*

e. ocean salvage systems with a lifting capacity exceeding 5 MN for salvaging objects from depths exceeding 250 m and having any of the following:

1. dynamic positioning systems capable of position keeping within 20 m of a given point provided by the navigation system; or

2. seafloor navigation and navigation integration systems for depths exceeding 1 000 m with positioning accuracies to within 10 m of a predetermined point;

f. surface-effect vehicles (fully skirted variety) having all of the following characteristics:

1. a maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1,25 m (Sea State 3) or more;

2. a cushion pressure exceeding 3 830 Pa; and

3. a light-ship-to-full-load displacement ratio of less than 0,70;

g. surface-effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3,25 m (Sea State 5) or more;

h. hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3,25 m (Sea State 5) or more;

i. 'small waterplane area vessels' having any of the following:

1. a full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3,25 m (Sea State 5) or more; or

2. a full load displacement exceeding 1 500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a significant wave height of 4 m (Sea State 6) or more.

Technical note:

A 'small waterplane area vessel' is defined by the following formula: waterplane area at an operational design draught less than 2 × (displaced volume at the operational design draught) $^{2/3}$.

8A002 Systems, equipment and components, as follows:

Note: for underwater communications systems, see Category 5, Part 1 — Telecommunications.

a. systems, equipment and components, 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;

4. components manufactured from material specified in 8C001;

Technical note:

The object of this control should not be defeated by the export of syntactic foam specified by 8C001 when an intermediate stage of manufacture has been performed and it is not yet in the final component form.

8A002 *(continued)*

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 800 lines and specially designed or modified for remote operation with a submersible vehicle;

b. underwater television cameras having a limiting resolution when measured in air of more than 1 100 lines;

c. low light level television cameras specially designed or modified for underwater use containing all of the following:

1. image intensifier tubes specified in 6A002.a.2.a.; and

2. more than 150 000 ″active pixels″ per solid state area array;

Technical note:

Limiting resolution in television is a measure of horizontal resolution usually expressed in terms of the maximum number of lines per picture height discriminated on a test chart, using IEEE Standard 208/1960 or any equivalent standard.

2. systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range-gated illuminators or ″laser″ systems;

e. photographic still cameras specially designed or modified for underwater use below 150 m having a film format of 35 mm or larger, and having any of the following:

1. annotation of the film with data provided by a source external to the camera;

2. automatic back focal distance correction; or

3. automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1 000 m;

f. electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;

Note: 8A002.f. does not control digital cameras specially designed for consumer purposes, other than those employing electronic image multiplication techniques.

8A002 *(continued)*

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:

a. chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. systems specially designed to use a monoatomic gas;

c. devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; or

d. systems specially designed:

1. to pressurise the products of reaction or for fuel reformation;

2. to store the products of the reaction; and

3. to discharge the products of the reaction against a pressure of 100 kPa or more;

2. diesel cycle engine air independent systems, having all of the following:

a. chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. systems specially designed to use a monoatomic gas;

8A002 j. 2. *(continued)*

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;

8A002 o. 1. *(continued)*

c. systems employing pre-swirl or post-swirl techniques for smoothing the flow into a propeller;

d. light-weight, high capacity (K factor exceeding 300) reduction gearing;

e. power transmission shaft systems, incorporating ″composite″ material components, capable of transmitting more than 1 MW;

2. water-screw propeller, power generation systems or transmission systems designed for use on vessels, as follows:

a. controllable-pitch propellers and hub assemblies rated at more than 30 MW;

b. internally liquid-cooled electric propulsion engines with a power output exceeding 2,5 MW;

c. ″superconductive″ propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0,1 MW;

d. power transmission shaft systems, incorporating ″composite″ material components, capable of transmitting more than 2 MW;

e. ventilated or base-ventilated propeller systems rated at more than 2,5 MW;

3. noise reduction systems designed for use on vessels of 1 000 tonnes displacement or more, as follows:

a. systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30 % of the equipment to be mounted;

b. active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source;

p. pumpjet propulsion systems having a power output exceeding 2,5 MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater-radiated noise;

q. self-contained, closed or semi-closed circuit (rebreathing) diving and underwater swimming apparatus.

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' designed for underwater use, having all of the following:

N.B.: SEE ALSO 8A002.a.4.

a. designed for marine depths exceeding 1 000 m; and

b. a density less than 561 kg/m^3.

Technical note:

'Syntactic foam' consists of hollow spheres of plastic or glass embedded in a resin matrix.

8D	**Software**
8D001	″Software″ specially designed or modified for the ″development″, ″production″ or ″use″ of equipment or materials specified in 8A, 8B or 8C.
8D002	Specific ″software″ specially designed or modified for the ″development″, ″production″, repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction.

8E Technology

8E001 ″Technology″ according to the General Technology Note for the ″development″ or ″production″ of equipment or materials specified in 8A, 8B or 8C.

8E002 Other ″technology″, as follows:

a. ″technology″ for the″development″, ″production″, repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;

b. ″technology″ for the overhaul or refurbishing of equipment specified in 8A001, 8A002.b., 8A002.j., 8A002.o. or 8A002.p.

CATEGORY 9

AEROSPACE AND PROPULSION

9A Systems, Equipment and Components

N.B.: for propulsion systems designed or rated against neutron or transient ionizing radiation, see the Military Goods Controls.

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 9A.120.

a. cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30 % per year;

b. cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (– 173 °C) or less for ″aircraft″ capable of sustained flight at speeds exceeding Mach 3, launch vehicles or ″spacecraft″;

c. slush hydrogen storage or transfer systems;

d. high pressure (exceeding 17,5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;

9A006 *(continued)*

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 $1{,}14 \times 10^{-3}$ cm^2 or smaller for non-circular orifices) specially designed for liquid rocket engines;

h. one-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones with densities exceeding 1,4 g/cm^3 and tensile strengths exceeding 48 MPa.

9A007 Solid rocket propulsion systems with any of the following:

N.B.: SEE ALSO 9A107 AND 9A119.

a. total impulse capacity exceeding 1,1 MNs;

b. specific impulse of 2,4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;

c. stage mass fractions exceeding 88 % and propellant solid loadings exceeding 86 %;

d. any of the components specified in 9A008; or

e. insulation and propellant bonding systems using direct-bonded motor designs to provide a 'strong mechanical bond' or a barrier to chemical migration between the solid propellant and case insulation material.

Technical note:

For the purposes of 9A007.e., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

9A008 Components, as follows, specially designed for solid rocket propulsion systems:

N.B.: SEE ALSO 9A108.

a. insulation and propellant bonding systems using liners to provide a 'strong mechanical bond' or a barrier to chemical migration between the solid propellant and case insulation material;

Technical note:

For the purposes of 9A008.a., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

b. filament-wound "composite" motor cases exceeding 0,61 m in diameter or having 'structural efficiency ratios (PV/W)' exceeding 25 km;

Technical note:

The 'structural efficiency ratio (PV/W)' is the burst pressure (P) multiplied by the vessel volume (V) divided by the total pressure vessel weight (W).

c. nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0,075 mm/s;

d. movable nozzle or secondary fluid injection thrust vector control systems capable of any of the following:

1. omni-axial movement exceeding ± 5°;

2. angular vector rotations of 20°/s or more; or

3. angular vector accelerations of $40°/s^2$ or more.

9A009 Hybrid rocket propulsion systems with:

N.B.: SEE ALSO 9A109 AND 9A119.

a. total impulse capacity exceeding 1,1 MNs; or

b. thrust levels exceeding 220 kN in vacuum exit conditions.

9A010 Specially designed components, systems and structures for launch vehicles, launch vehicle propulsion systems or ″spacecraft″, as follows:

N.B.: SEE ALSO 1A002 AND 9A110.

a. components and structures each exceeding 10 kg, specially designed for launch vehicles manufactured using metal ″matrix″, ″composite″, organic ″composite″, ceramic ″matrix″ or intermetallic reinforced materials specified in 1C007 or 1C010;

Note: The weight cut-off is not relevant for nose cones.

b. components and structures specially designed for launch vehicle propulsion systems specified in 9A005 to 9A009 manufactured using metal matrix, composite, organic composite, ceramic matrix or intermetallic reinforced materials specified in 1C007 or 1C010;

c. structural components and isolation systems specially designed to control actively the dynamic response or distortion of ″spacecraft″ structures;

d. pulsed liquid rocket engines with thrust-to-weight ratios equal to or more than 1 kN/kg and a response time (the time required to achieve 90 % of total rated thrust from start-up) of less than 30 ms.

9A011 Ramjet, scramjet or combined cycle engines and specially designed components therefor.

N.B.: SEE ALSO 9A111 AND 9A118.

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, other than those specified 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 Turbojet and turbofan engines (including turbocompound engines), other than those specified 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″, other than those specified 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, other than those specified in 9A005 or 9A105.a., having a total impulse capacity equal to or greater than 0,841 MNs.

9A106 Systems or components, other than those specified in 9A006, usable in ″missiles″, as follows, specially designed for liquid rocket propulsion systems:

a. ablative liners for thrust or combustion chambers;

b. rocket nozzles;

c. thrust vector control sub systems;

Technical note:

Examples of methods of achieving thrust vector control specified in 9A106.c. are:

1. *flexible nozzle;*

2. *fluid or secondary gas injection;*

3. *movable engine or nozzle;*

4. *deflection of exhaust gas stream (jet vanes or probes); or*

5. *thrust tabs.*

d. liquid and slurry propellant (including oxidisers) control systems, and specially designed components therefor, designed or modified to operate in vibration environments 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, other than those specified in 9A007, having total impulse capacity equal to or greater than 0,841 MNs.

N.B.: SEE ALSO 9A119.

9A108 Components, other than those specified in 9A008, usable in ″missiles″, as follows, specially designed for solid rocket propulsion systems:

a. rocket motor cases and ″insulation″ components therefor;

b. rocket nozzles;

c. thrust vector control sub-systems.

9A108 c. *(continued)*

Technical note:

Examples of methods of achieving thrust vector control specified in 9A108.c. are:

1. *flexible nozzle;*
2. *fluid or secondary gas injection;*
3. *movable engine or nozzle;*
4. *deflection of exhaust gas stream (jet vanes or probes); or*
5. *thrust tabs.*

9A109 Hybrid rocket motors, usable in 'missiles', other than those specified in 9A009, and specially designed components therefor.

N.B.: SEE ALSO 9A119.

Technical note:

In 9A109 'missile' means complete rockets system and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9A110 Composite structures, laminates and manufactures thereof, other than those specified 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″ or unmanned aerial vehicles specified in 9A012, 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 Re-entry vehicles, usable in ″missiles″, and equipment designed or modified therefor, as follows:

a. re-entry 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 re-entry vehicles.

9A117 Staging mechanisms, separation mechanisms, and interstages, usable in ″missiles″.

9A118 Devices to regulate combustion usable in engines, which are usable in ″missiles″ or unmanned aerial vehicles specified in 9A012, 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, other than those specified in 9A005, 9A007, 9A009, 9A105, 9A107 and 9A109.

9A120 Liquid propellant tanks, other than those specified 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 the Military Goods Controls.*

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:

a. 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;

b. 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;

c. 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 atomisers and similar devices.*

Note: *9A350 does not control spraying or 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;

   b. 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 25×10^6.

9B006 Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 μPa) with a rated output of 4 kW or more at a test cell temperature exceeding 1 273 K (1 000 °C), and specially designed quartz heaters therefor.

N.B.: SEE ALSO 9B106.

9B007 Equipment specially designed for inspecting the integrity of rocket motors using non-destructive test (NDT) techniques other than planar X-ray or basic physical or chemical analysis.

9B008 Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560 °C).

9B009 Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operating at stress levels of 60 % of ultimate tensile strength (UTS) or more and metal temperatures of 873 K (600 °C) or more.

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.

Technical note:

In 9B105 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

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 (– 50 °C) to 398 K (+ 125 °C);

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 (– 50 °C) to 398 K (+ 125 °C).

9B115 Specially designed "production equipment"for the systems, subsystems 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, subsystems, 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 68 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″, other than those specified 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 $7{,}62 \times 10^4$ m and a ″specific modulus″ greater than $3{,}18 \times 10^6$ 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 (T_g), after cure, exceeding 418 K (145 °C) 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;

f. ″software″ specially designed to design the internal cooling passages of aero gas turbine blades, vans and tip shrouds;

g. ″software″ having all of the following characteristics:

1. being specially designed to predict aero thermal, aeromechanical and combustion conditions in aero gas turbine engines; and

2. having theoretical modelling predictions of the aero thermal, aeromechanical and combustion conditions which have been validated with actual aero gas turbine engine (experimental or production) performance data.

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.

9D103 *(continued)*

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.b., 9A004 to 9A012, 9A350, 9B or 9D.

9E002 "Technology" according to the General Technology Note for the "production" of equipment specified in 9A001.b., 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 of the following gas turbine engine components or systems:

1. gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1 273 K (1 000 °C) at a stress of 200 MPa, based on the average property values;

2. multiple domed combustors operating at average burner outlet temperatures exceeding 1 813 K (1 540 °C) or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;

3. components manufactured from 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;

9E003 a. *(continued)*

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" of any of the following:

1. wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; or

2. "composite" propeller blades or propfans capable of absorbing more than 2 000 kW at flight speeds exceeding Mach 0,55;

c. "technology" "required" for the "development" or "production" of gas turbine engine components using "laser" water jet, ECM or EDM hole drilling processes to produce holes having any of the following sets of characteristics:

1. all of the following:

a. depths more than four times their diameter;

b. diameters less than 0,76 mm; and

c. incidence angles equal to or less than 25°; or

2. all of the following:

a. depths more than five times their diameter;

b. diameters less than 0,4 mm; and

c. incidence angles of more than 25°;

Technical note:

For the purposes of 9E003.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

d. "technology" "required" for 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 m^3 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/m^3 of 'box volume';

9E003 e. *(continued)*

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 mm^3 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.

9E003 g. *(continued)*

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.

ANNEX II

COMMUNITY GENERAL EXPORT AUTHORISATION No EU001

(referred to in Article 6 of Regulation (EC) No 1334/2000)

Issuing authority: European Community

Part 1

This export authorisation covers the following items:

All dual-use items specified in any entry in Annex I of the present Regulation except those listed in Part 2 below.

Part 2

—		All items specified in Annex IV.
—	0C001	″Natural uranium″ or ″depleted uranium″ or thorium in the form of metal, alloy, chemical compound or concentrate and any other material containing one or more of the foregoing.
—	0C002	″Special fissile materials″ other than those specified in Annex IV.
—	0D001	″Software″ specially designed or modified for the ″development″, ″production″ or ″use″ of goods specified in Category 0, *insofar as it relates to 0C001 or to those items of 0C002 that are excluded from Annex IV*.
—	0E001	″Technology″ according to the Nuclear Technology Note for the ″development″, ″production″ or ″use″ of goods specified in Category 0, *insofar as it relates to 0C001 or to those items of 0C002 that are excluded from Annex IV*.
—	1A102	Resaturated pyrolised carbon-carbon components designed for space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.
—	1C351	Human pathogens, zoonoses and ″toxins″.
—	1C352	Animal pathogens.
—	1C353	Genetic elements and genetically modified organisms.
—	1C354	Plant pathogens.
—	7E104	″Technology″ for the integration of the flight control, guidance, and propulsion data into a flight management system for optimisation of rocket system trajectory.
—	9A009.a.	Hybrid rocket propulsion systems with total impulse capacity exceeding 1,1 MNs.
—	9A117	Staging mechanisms, separation mechanisms, and interstages, usable in ″missiles″.

Part 3

This export authorisation is valid throughout the Community for exports to the following destinations:

— Australia

— Canada

— Japan

— New Zealand

— Norway

— Switzerland

— United States of America

Note: Parts 2 and 3 may be amended only in conformity with the relevant obligations and commitments that each Member State has accepted as a member of the international non-proliferation regimes and export control arrangements, and in conformity with the public security interests of each Member State as reflected in its responsibility for deciding on applications for authorisations to export dual-use items under Article 6(2) of this Regulation.

Conditions and requirements for use of this authorisation

1. This general authorisation may not be used if the exporter has been informed by the competent authorities of the Member State in which he is established that the items in question are or may be intended, in their entirety or in part, for use in connection with the development, production, handling, operation, maintenance, storage, detection, identification or dissemination of chemical, biological or nuclear weapons or other nuclear explosive devices or the development, production, maintenance or storage of missiles capable of delivering such weapons, or if the exporter is aware that the items in question are intended for such use.

2. This general authorisation may not be used if the exporter has been informed by the competent authorities of the Member State in which he is established that the items in question are or may be intended for a military end-use as defined in Article 4(2) of the Regulation in a country subject to an EU, OSCE or UN arms embargo, or if the exporter is aware that the items in question are intended for such use.

3. This general authorisation may not be used when the relevant items are exported to a customs free zone or free warehouse which is located in a destination covered by this authorisation.

4. The registration and reporting requirements attached to the use of this general authorisation, and the additional information that the Member State from which the export is made might require on items exported under this authorisation, are defined by Member States. These requirements must be based on those defined for the use of general export authorisations granted by those Member States which provide for such authorisations.

ANNEX III a

(Model form)

(Referred to in Article 10(1))

EUROPEAN COMMUNITY — EXPORT OF DUAL-USE ITEMS (Reg. (EC) No . . .)

LICENCE

1	1. Exporter No	2. Identification number	3. Expiry date *(if applicable)*	
		4. Contact point details		
	5. Consignee	6. Issuing authority		
	7. Agent/Representative (if different from exporter) No			
		8. Country of origin *(if applicable)*		Code (1)
		9. Country of consignment *(if applicable)*		Code (1)
	10. End-user (if different from consignee)	11. Member State of current or future location of the items		Code (1)
		12. Member State of intended entry into the customs export procedure		Code (1)
1		13. Country of final destination		Code (1)
	14. Description of the items (2)	15. Commodity code *(if applicable)*		16. Control list No
		17. Currency and Value	18. Quantity of the items *(if applicable)*	
	19. End-use	20. Contract date *(if applicable)*	21. Customs export procedure	
	22. Additional information required by national legislation (to be specified on the form)			
	Available for pre-printed information At discretion of Member States	For completion by issuing authority Signature Stamp Issuing Authority Date		

(1) See Regulation (EC) No 1172/95 (OJ L 118, 25.5.1995, p. 10), as subsequently amended.

(2) If needed, this description may be given in one or more attachments to this form (1bis). In this case, indicate the exact number of attachments in this box).

EUROPEAN COMMUNITY

EXPORT OF DUAL-USE ITEMS (Reg. (EC) No . . .)

1 *bis*	1. Exporter	2. Identification number	
LICENCE			

14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items
14. Description of the items	15. Commodity code	16. Control list No
	17. Currency and value	18. Quantity of the items

Note: In part 1 of column 24, write the quantity still available and in part 2 of column 24, write the quantity deducted on this occasion.

23. Net quantity/value (Net mass/other unit with indication of unit)		26. Customs document (Type and number) or extract (No) and date of deduction	27. Member State, name and signature, stamp of deduction
24. In numbers	25. In words for quantity/value deducted		
1			
2			
1			
2			
1			
2			
1			
2			
1			
2			
1			
2			
1			
2			
1			
2			

ANNEX III b

COMMON ELEMENTS FOR PUBLICATION OF GENERAL EXPORT AUTHORISATIONS

(referred to in Article 10(3))

1. Title of general export authorisation

2. Authority issuing the authorisation

3. EC validity. The following text shall be used:

   'This is a general export authorisation under the terms of Article 6(2) of Regulation (EC) No 1334/2000. This authorisation, in accordance with Article 6(2) of that Regulation, is valid in all Member States of the European Community'

4. Items concerned: the following introductory text shall be used:

   'This export authorisation covers the following items'

5. Destinations concerned: The following introductory text shall be used:

   'This export authorisation is valid for exports to the following destinations'

6. Conditions and requirements

ANNEX IV

(List referred to in Article 21(1) of Regulation (EC) No 1334/2000)

The entries do not always cover the complete description of the item and the related notes in Annex I [1] **. Only Annex I provides the complete description of the items.**

The mention of an item in this Annex does not affect the application of the provisions concerning mass-market products in Annex I.

Part I

(Possibility of National General Authorisation for intra-Community trade)

Items of stealth technology

1C001 Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers.

N.B.: SEE ALSO 1C101

1C101 Materials or devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures; other than those specified in 1C001, usable in 'missiles', ″missile″ subsystems or unmanned aerial vehicles specified in 9A012.

Note: 1C101 does not control materials if such goods are formulated solely for civil applications.

Technical note:

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

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

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.

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 specially designed for radar cross-section measurement usable for ″missiles″ and their subsystems.

Items of the Community strategic control

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

1E201 ″Technology″ according to the General Technology Note for the ″use″ of goods specified in 1C239.

[1] The differences in the wordings/scopes between Annex I and Annex IV are indicated with bold italic text.

3A229 Firing sets and equivalent high-current pulse generators, as follows …

N.B.: SEE ALSO MILITARY GOODS CONTROLS

3A232 Detonators and multipoint initiation systems, as follows …

N.B.: SEE ALSO MILITARY GOODS CONTROLS

3E201 ″Technology″ according to the General Technology Note for the ″use″ of equipment specified in 3A229 or 3A232.

6A001 Acoustics, limited to the following:

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. Hydrophones … Incorporating …

6A001.a.2.a.3. Hydrophones … Having any …

6A001.a.2.a.6. 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;

6D003.a. ″Software″ for the ″real time processing″ of acoustic data;

8A002.o.3. Noise reduction systems designed for use on vessels of 1 000 tonnes displacement or more, as follows:

(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;

8E002.a. ″Technology″ for the ″development″, ″production″, repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction.

Items of the Community strategic control — Cryptography — 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.

Items of the MTCR technology

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***.

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″ to the General Technology Note for the ″use″ of equipment specified in 7A117, 7B003, 7B103 and 7D101 ***above***.

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 °/s^2 or more.

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″, other than those specified 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, other than those specified 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, other than those specified 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 Re-entry vehicles, usable in ″missiles″, and equipment designed or modified therefor, as follows, ***except for re-entry vehicles designed for non-weapon payloads***:

a. re-entry vehicles;

b. heat shields and components therefor fabricated of ceramic or ablative materials;

c. heat sinks and components therefor fabricated of lightweight, high-heat capacity materials;

d. electronic equipment specially designed for re-entry 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, other than those specified in 9A005 or 9A007.a. ***above***.
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***.
9D101	″Software″ specially designed for the ″use″ of goods specified in 9B116 ***above***.
9E001	″Technology″ according to the General Technology Note for the ″development″ of equipment or ″software″ specified in 9A004, 9A005, 9A007.a., 9A008.d., 9B115, 9B116 or 9D101 ***above***.
9E002	″Technology″ according to the General Technology Note for the ″production″ of equipment specified in: 9A004, 9A005, 9A007.a., 9A008.d., 9B115 or 9B116 ***above***. *Note: for ″technology″ for the repair of controlled structures, laminates or materials, see 1E002.f.*
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***.

— Exemptions:

Annex IV does not control the following items of the MTCR technology:

1. that are transferred on the basis of orders pursuant to a contractual relationship placed by the European Space Agency (ESA) or that are transferred by ESA to accomplish its official tasks;

2. that are transferred on the basis of orders pursuant to a contractual relationship placed by a Member State's national space organisation or that are transferred by it to accomplish its official tasks;

3. that are transferred on the basis of orders pursuant to a contractual relationship placed in connection with a Community space launch development and production programme signed by two or more European governments;

4. that are transferred to a State-controlled space launching site in the territory of a Member State, unless that Member State controls such transfers within the terms of this Regulation.

Part II

(No National General Authorisation for intra-Community trade)

Items of the CWC (Chemical Weapons Convention)

1C351.d.4.	Ricin
1C351.d.5.	Saxitoxin

Items of the NSG technology

All Category 0 of Annex I is included in Annex IV, **subject to the following**:

— 0C001: this item **is not** included in Annex IV.

— 0C002: this item **is not** included in Annex IV, **with the exception of** special fissile materials as follows:

a. separated plutonium;

b. ″uranium enriched in the isotopes 233 or 235″ to more than 20 %.

— 0D001 (software) **is** included in Annex IV **except insofar as it relates to 0C001 or to those items of 0C002 that are excluded from Annex IV**.

— 0E001 (technology) **is** included in Annex IV **except insofar as these related to 0C001 or to those items of 0C002 that are excluded from Annex IV**.

N.B.: For **0C003** and **0C004**, only if for use in a ″nuclear reactor″ (within 0A001.a.).

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.

1C012 Materials as follows:

Technical note:

These materials are typically used for nuclear heat sources.

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.

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.

1C233 Lithium enriched in the lithium-6 (^{6}Li) 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 1 000, and products or devices containing any of the foregoing.

Note: 1C235 does not control a product or device containing less than 1,48 × 10^3 GBq (40 Ci) of tritium.

1E001 ″Technology″ according to the General Technology Note for the ″development″ or ″production″ of equipment or materials specified in 1C012.b.

1E201 ″Technology″ according to the General Technology Note for the ″use″ of goods specified in 1B226, 1B231, 1B233, 1C233 or 1C235.

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.

6A203 Cameras and components, other than those specified in 6A003, as follows:

a. mechanical rotating mirror cameras, as follows, and specially designed components therefor:

1. framing cameras with recording rates greater than 225 000 frames per second;

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 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.'