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ANNEX

ANNEX

to the

Commission Delegated Regulation

**amending Regulation (EU) 2021/821 of the European Parliament and of the Council as
regards the list of dual-use items subject to controls on export**

ANNEX

‘ANNEX I

LIST OF DUAL-USE ITEMS REFERRED TO IN ARTICLE 3 OF THIS REGULATION

The list of dual-use items contained in this Annex implements internationally agreed controls of dual-use items including the Australia Group¹, the Missile Technology Control Regime (MTCR)², the Nuclear Suppliers Group (NSG)³, the Wassenaar Arrangement⁴ and the Chemical Weapons Convention (CWC)⁵.

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¹ <https://www.australiagroup.net/>

² <http://mtr.info/>

³ <http://www.nuclearsuppliersgroup.org/>

⁴ <http://www.wassenaar.org/>

⁵ <https://www.opcw.org/chemical-weapons-convention>

PART I - General Notes, Acronyms and Abbreviations, and Definitions

GENERAL NOTES TO ANNEX I

1. For control of goods which are designed or modified for military use, see the Common Military List of the European Union ⁶ and 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.
4. In some instances, chemicals are listed by name and Chemical Abstracts Service (CAS) Registry Number. The list applies to chemicals of the same structural formula (including hydrates, isotopically-labelled forms or all possible stereoisomers) regardless of name or CAS Registry Number. CAS Registry Numbers are shown to assist in identifying a particular chemical or mixture, irrespective of nomenclature. CAS Registry Numbers cannot be used as unique identifiers because some forms of the listed chemical have different CAS Registry Numbers, and mixtures containing a listed chemical may also have different CAS Registry Numbers.

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.)

⁶ Common Military List of the European Union (equipment covered by Council Common Position 2008/944/CFSP defining common rules governing the control of exports of military technology and equipment).

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) or repair of those goods which are not controlled or whose export has been authorised.

Note: This does not release such "technology" specified in 1E002.e., 1E002.f., 8E002.a. and 8E002.b.

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

NUCLEAR SOFTWARE NOTE (NSN)

(This note overrides any control within section D of Category 0)

Section D of Category 0 of this list does not control "software" which is the minimum necessary "object code" for the installation, operation, maintenance (checking) or repair of those items whose export has been authorised.

The approval of goods for export also authorises the export to the same end-user of the minimum necessary "object code" for the installation, operation, maintenance (checking) or repair of the goods

Note: The Nuclear Software Note does not release "software" specified in Category 5, Part 2 ("Information Security").

GENERAL SOFTWARE NOTE (GSN)

(This note overrides any control within section D of Categories 1 to 9.)

Categories 1 to 9 of this list do not control "software" which is any of the following:

- 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 call transactions; and
 2. Designed for installation by the user without further substantial support by the supplier;

Note: Entry a. of the General Software Note does not release "software" specified in Category 5, Part 2 ("Information Security").

- b. "In the public domain"; or
- c. The minimum necessary "object code" for the installation, operation, maintenance (checking) or repair of those items whose export has been authorised.

Note: Entry c. of the General Software Note does not release "software" specified in Category 5, Part 2 ("Information Security").

GENERAL "INFORMATION SECURITY" NOTE (GISN)

"Information security" items or functions should be considered against the provisions in Category 5, Part 2, even if they are components, "software" or functions of other items.

EDITORIAL PRACTICES IN THE *OFFICIAL JOURNAL OF THE EUROPEAN UNION*

In accordance with the rules set out in the Interinstitutional style guide, for texts in English published in the *Official Journal of the European Union*:

- a comma is used to separate the whole number from decimals,
- whole numbers are presented in series of three, each series being separated by a thin space.

The text reproduced in this Annex follows the above-described practice.

ACRONYMS AND ABBREVIATIONS USED IN THIS ANNEX

For acronyms and abbreviations used as defined terms, see 'Definitions of Terms used in this Annex'.

ACRONYMS AND ABBREVIATIONS

ABEC	Annular Bearing Engineers Committee
ABMA	American Bearing Manufacturers Association
ADC	Analogue-to-Digital Converter
AGMA	American Gear Manufacturers Association
AHRS	Attitude and Heading Reference Systems
AISI	American Iron and Steel Institute
ALE	Atomic Layer Epitaxy
ALU	Arithmetic Logic Unit
ANSI	American National Standards Institute
APP	Adjusted Peak Performance
APU	Auxiliary Power Unit
ASLR	Address Space Layout Randomisation
ASTM	American Society for Testing and Materials
ATC	Air Traffic Control
AV	Antivirus
BJT	Bipolar Junction Transistors
BPP	Beam Parameter Product
BSC	Base Station Controller
CAD	Computer-Aided-Design
CAS	Chemical Abstracts Service
CCD	Charge Coupled Device
CDU	Control and Display Unit
CEP	Circular Error Probable
CMM	Coordinate Measuring Machine
CMOS	Complementary Metal Oxide Semiconductor
CNTD	Controlled Nucleation Thermal Deposition
CPLD	Complex Programmable Logic Device
CPU	Central Processing Unit
CVD	Chemical Vapour Deposition
CW	Chemical Warfare

ACRONYMS AND ABBREVIATIONS

CW (for lasers)	Continuous Wave
DAC	Digital-to-Analogue Converter
DANL	Displayed Average Noise Level
DBRN	Data-Base Referenced Navigation
DDS	Direct Digital Synthesizer
DEP	Data Execution Prevention
DMA	Dynamic Mechanical Analysis
DME	Distance Measuring Equipment
DMOSFET	Diffused Metal Oxide Semiconductor Field Effect Transistor
EB	Exploding Bridge
EB-PVD	Electron Beam Physical Vapour Deposition
EBW	Exploding Bridge Wire
ECAD	Electronic Computer-Aided Design
ECM	Electro-Chemical Machining
EDM	Electrical Discharge Machines
EFI	Exploding Foil Initiators
EIRP	Effective Isotropic Radiated Power
EMP	Electromagnetic Pulse
ENOB	Effective Number of Bits
ERF	Electrorheological Finishing
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
ETO	Emitter Turn-Off Thyristor
ETSI TS	European Telecommunications Standards Institute Technical Specification
ETT	Electrical Triggering Thyristor
EU	European Union
EUV	Extreme Ultraviolet
FADEC	Full Authority Digital Engine Control
FFT	Fast Fourier Transform
FOV	Field of View
FPGA	Field Programmable Gate Array
FPIC	Field Programmable Interconnect

ACRONYMS AND ABBREVIATIONS

FPLA	Field Programmable Logic Array
FPLD	Field Programmable Logic Device
FPO	Floating Point Operation
FWHM	Full-Width Half-Maximum
GAAFET	Gate-All-Around Field-Effect Transistor
GDSII	Geometrical Database Standard II
GLONASS	Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GTO	Gate Turn-off Thyristor
HBT	Heterojunction Bipolar Transistor
HDMI	High-Definition Multimedia Interface
HEMT	High Electron Mobility Transistor
ICAO	International Civil Aviation Organization
IDS	Intrusion Detection System
IEC	International Electro-technical Commission
IED	Improvised Explosive Device
IEEE	Institute of Electrical and Electronic Engineers
IFOV	Instantaneous Field of View
IGBT	Insulated Gate Bipolar Transistor
IGCT	Integrated Gate Commutated Thyristor
IHO	International Hydrographic Organization
ILS	Instrument Landing System
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IP	Internet Protocol
IPS	Intrusion Prevention System
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere

ACRONYMS AND ABBREVIATIONS

ISAR	Inverse Synthetic Aperture Radar
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JFET	Junction Field Effect Transistor
JT	Joule-Thomson
JTAG	Joint Test Action Group
LIDAR	Light Detection and Ranging
LIDT	Laser Induced Damage Threshold
LOA	Length Overall
LOB	Line of Bearing
LRU	Line Replaceable Unit
LTT	Light Triggering Thyristor
LUT	Lookup Table
MCT	MOS Controlled Thyristors
MLS	Microwave Landing Systems
MMIC	Monolithic Microwave Integrated Circuit
MOCVD	Metal Organic Chemical Vapour Deposition
MOS	Metal Oxide Semiconductor
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
MPM	Microwave Power Module
MRF	Magnetorheological Finishing
MRF	Minimum Resolvable Feature size
MRI	Magnetic Resonance Imaging
MTBF	Mean-Time-Between-Failures
MTTF	Mean-Time-To-Failure
NA	Numerical Aperture
NDT	Non-Destructive Test
NEQ	Net Explosive Quantity
NIJ	National Institute of Justice
OAM	Operations, Administration or Maintenance
OSI	Open Systems Interconnection
PAI	Polyamide-imides
PAR	Precision Approach Radar

ACRONYMS AND ABBREVIATIONS

PCL	Passive Coherent Location
PDK	Process Design Kit
PIN	Personal Identification Number
PMAC	Permanent Magnet Alternating Current
PMR	Private Mobile Radio
PSP	Personal Security Products
PVD	Physical Vapour Deposition
ppm	parts per million
QAM	Quadrature-Amplitude-Modulation
QE	Quantum Efficiency
QLAs	Quantum-Limited Amplifiers
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
RAP	Reactive Atom Plasmas
RCA	Riot Control Agent
RF	Radio Frequency
rms	root mean square
RNC	Radio Network Controller
RNSS	Regional Navigation Satellite System
ROIC	Read-Out Integrated Circuit
RTL	Register Transfer Level
S-FIL	Step and Flash Imprint Lithography
SAR	Synthetic Aperture Radar
SAS	Synthetic Aperture Sonar
SCR	Silicon Controlled Rectifier
SDR	Software Defined Radio
SEM	Scanning Electron Microscope
SFDR	Spurious Free Dynamic Range
SHPL	Super High Powered Laser
SLAR	Sidelooking Airborne Radar
SOI	Silicon-on-Insulator
SQUID	Superconducting Quantum Interference Device

ACRONYMS AND ABBREVIATIONS

SRA	Shop Replaceable Assembly
SRAM	Static Random Access Memory
SSB	Single Sideband
SSR	Secondary Surveillance Radar
SSS	Side Scan Sonar
TE-PVD	Thermal Evaporation-Physical Vapour Deposition
TIMSI	Temporary International Mobile Subscriber Identity
TIR	Total Indicated Reading
TVR	Transmitting Voltage Response
TWPAs	Travelling Wave Parametric Amplifiers
u	Atomic Mass Unit
UV	Ultraviolet
VJFET	Vertical Junction Field Effect Transistor
VOR	Very High Frequency Omni-directional Range
WHO	World Health Organization
WLAN	Wireless Local Area Network
3GPP TS	Third Generation Partnership Project Technical Specification

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 3 6 7), 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) is a minimum (single) element of the solid-state array which has a photoelectric transfer function when exposed to light (electromagnetic) radiation.

"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 10^{12} adjusted floating point operations per second.

N.B. See Category 4, Technical Note.

"Aircraft" (1 6 7 9) means a fixed wing, swivel wing, rotary wing (helicopter), tilt rotor or tilt-wing airborne vehicle.

N.B. See also "civil aircraft".

"Airship" (9) means a power-driven airborne vehicle that is kept buoyant by a body of gas (usually helium, formerly hydrogen) which is lighter than air.

"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 or measuring errors for the particular coordinate measuring machine are considered.

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

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

"Angular position deviation" (2) means the maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position.

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

"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.

"Authentication" (5) means verifying the identity of a user, process or device, often as a prerequisite to allowing access to resources in an information system. This includes verifying the origin or content of a message or other information, and 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.

"Average output power" (6) means the total "laser" output energy, in joules, divided by the period over which a series of consecutive pulses is emitted, in seconds. For a series of uniformly spaced pulses it is equal to the total "laser" output energy in a single pulse, in joules, multiplied by the pulse frequency of the "laser", in Hertz.

"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 the average over a specified time of accelerometer output, measured at specified operating conditions, that has no correlation with input acceleration or rotation. "Bias" is expressed in g or in metres per second squared (g or m/s²). (IEEE 528-2001) (Micro g equals 1x10⁻⁶ g).

"Bias" (gyro) (7) means the average over a specified time of gyro output measured at specified operating conditions that has no correlation with input rotation or acceleration. "Bias" is typically expressed in degrees per hour (deg/hr). (IEEE 528-2001).

"Biological agents" (1) are pathogens or toxins, selected or modified (such as altering purity, shelf life, virulence, dissemination characteristics, or resistance to UV radiation) to produce casualties in humans or animals, degrade equipment or damage crops or the environment.

"Charge multiplication" (6) means a form of electronic image amplification defined as the generation of charge carriers as a result of an impact ionisation gain process. "Charge multiplication" sensors may take the form of an image intensifier tube, solid-state detector or "focal plane array"

"CEP" (7) means "Circular Error Probable" - In a circular normal distribution, the radius of the circle containing 50% of the individual measurements being made, or the radius of the circle within which there is a 50% probability of being located.

"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 3 4 7) means those "aircraft" listed by designation in published airworthiness certification lists by the civil aviation authorities of one or more Member States or Wassenaar Arrangement Participating States to fly commercial civil internal and external routes or for legitimate civil, private or business use.

N.B. See also "aircraft".

"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 the 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.

"III/V compounds" (3 6) means polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleev's periodic classification table (e.g., gallium arsenide, gallium-aluminium arsenide, indium phosphide).

"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. (Reference: ISO/DIS-2806:1980).

"Critical temperature" (1 3 5) (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.

"Cryptographic activation" (5) means any technique that specifically activates or enables cryptographic capability of an item, by means of a mechanism implemented by the manufacturer of the item, where this mechanism is uniquely bound to any of the following:

1. A single instance of the item; or
2. One customer, for multiple instances of the item.

Technical Notes:

1. *"Cryptographic activation" techniques and mechanisms may be implemented as hardware, "software" or "technology".*
2. *Mechanisms for "cryptographic activation" can, for example, be serial number-based licence keys or authentication instruments such as digitally signed certificates.*

"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.

Notes:

1. *"Cryptography" does not include 'fixed' data compression or coding techniques.*
2. *"Cryptography" includes decryption.*

Technical Notes:

1. *'Secret parameter': a constant or key kept from the knowledge of others or shared only within a group.*
2. *'Fixed': the coding or compression algorithm cannot accept externally supplied parameters (e.g., cryptographic or key variables) and cannot be modified by the user.*

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

"Cyber incident response" (4) means the process of exchanging necessary information on a cybersecurity incident with individuals or organisations responsible for conducting or coordinating remediation to address the cybersecurity incident.

"Data device" (def) means equipment capable of transmitting or receiving sequences of digital information.

"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.

"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) means a solid-state joining of at least two separate pieces of metals into a single piece with a joint strength equivalent to that of the weakest material, wherein the principal mechanism is interdiffusion of atoms across the interface.

"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" (def) 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".*

"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 528-2001).

"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) 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.*

"Energetic materials" (1) means substances or mixtures that react chemically to release energy required for their intended application. "Explosives", pyrotechnics and propellants are subclasses of energetic materials.

"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.

"Equivalent standards" (1) means comparable national or international standards recognised by one or more Member States or Wassenaar Arrangement Participating States and applicable to the relevant entry.

"Explosives" (1) means solid, liquid or gaseous substances or mixtures of substances which, in their application as primary, booster, or main charges in warheads, demolition and other applications, are required to detonate.

"Extreme Ultraviolet" ("EUV") (3) refers to electromagnetic spectrum wavelengths greater than 5 nm and less than 124 nm.

"FADEC Systems" (9) means Full Authority Digital Engine Control Systems – A digital electronic control system for a gas turbine engine that is able to autonomously control the engine throughout its whole operating range from demanded engine start until demanded engine shut-down, in both normal and fault conditions.

"Fibrous or filamentary materials" (0 1 8 9) 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.

"Fly-by-light system" (7) means a primary digital flight control system employing feedback to control the "aircraft" during flight, where the commands to the effectors/actuators are optical signals.

"Fly-by-wire system" (7) means a primary digital flight control system employing feedback to control the "aircraft" during flight, where the commands to the effectors/actuators are electrical signals.

"Focal plane array" (6 8) 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 5) means the "instantaneous bandwidth" divided by the centre frequency, expressed as a percentage.

"Frequency hopping" (5 6) 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) means the time (i.e., delay) taken by a signal when switched from an initial specified output frequency, to arrive at or within any of the following:

- a. ± 100 Hz of a final specified output frequency of less than 1 GHz; or
- b. $\pm 0,1$ part per million of a final specified output frequency equal to or greater than 1 GHz.

"Fuel cell" (8) is an electrochemical device that converts chemical energy directly into Direct Current (DC) electricity by consuming fuel from an external source.

"Fusible" (1) means capable of being cross-linked or polymerized further (cured) by the use of heat, radiation, catalysts, etc., or that can be melted without pyrolysis (charring).

"Gate-All-Around Field-Effect Transistor" ("GAAFET") (3) means a device having a single or multiple semiconductor conduction channel element(s) with a common gate structure that surrounds and controls current in all of the semiconductor conduction channel elements.

N.B. This definition includes nanosheet or nanowire field-effect and surrounding gate transistors and other "GAAFET" semiconductor channel element structures.

"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.

"Hard selectors" (5) means data or set of data, related to an individual (e.g., family name, given name, e-mail, street address, phone number or group affiliations).

"High output diesel engines" (9) means 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.

"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" (GSN GISN 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", "cryptographic activation", 'cryptanalysis', protection against compromising emanations and computer security.

Technical Note:

'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.

"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.

"Interleaved Analogue-to-Digital Converter (ADC)" (3) means devices that have multiple ADC units that sample the same analogue input at different times such that when the outputs

are aggregated, the analogue input has been effectively sampled and converted at a higher sampling rate.

"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".

"Intrusion software" (4 5) means "software" specially designed or modified to avoid detection by 'monitoring tools', or to defeat 'protective countermeasures', of a computer or network-capable device, and performing any of the following:

- a. The extraction of data or information, from a computer or network-capable device, or the modification of system or user data; or
- b. The modification of the standard execution path of a program or process in order to allow the execution of externally provided instructions.

Notes:

1. *"Intrusion software" does not include any of the following:*
 - a. *Hypervisors, debuggers or Software Reverse Engineering (SRE) tools;*
 - b. *Digital Rights Management (DRM) "software"; or*
 - c. *"Software" designed to be installed by manufacturers, administrators or users, for the purposes of asset tracking or recovery.*
2. *Network-capable devices include mobile devices and smart meters.*

Technical Notes:

1. *'Monitoring tools': "software" or hardware devices, that monitor system behaviours or processes running on a device. This includes antivirus (AV) products, end point security products, Personal Security Products (PSP), Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS) or firewalls.*
2. *'Protective countermeasures': techniques designed to ensure the safe execution of code, such as Data Execution Prevention (DEP), Address Space Layout Randomisation (ASLR) or sandboxing.*

"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 1 2 3 5 6 7 8 9) is an item that produces spatially and temporally coherent light through amplification by stimulated emission of radiation.

N.B. See also "CW laser";

"Super High Power Laser".

"Library" (1 5) (parametric technical database) means a collection of technical information, reference to which may enhance the performance of relevant systems, equipment or components.

"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 5) 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).

"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.

"Materials resistant to corrosion by UF₆" (0) include copper, copper alloys, stainless steel, aluminium, aluminium oxide, aluminium alloys, nickel or alloys containing 60% or more nickel by weight and fluorinated hydrocarbon polymers.

"Maintenance Level I" (7) means 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.

"Maintenance Level II" (7) means 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. "Maintenance Level II" does not include the disassembly or repair of specified accelerometers or gyro sensors.

"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).

"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, mycoplasmas, 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 2 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.

"Monolithic Microwave Integrated Circuit" ("MMIC") (3 5) means a "monolithic integrated circuit" that operates at microwave or millimetre wave frequencies.

"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".

"Multiple channel Analogue-to-Digital Converter (ADC)" (3) means devices that integrate more than one ADC, designed so that each ADC has a separate analogue input.

"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.

"Non-repetitive pulsed" (6) means "lasers" that produce either a single output pulse or that have a time interval between pulses exceeding one minute.

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

"Nuclear reactor" (0) means a complete reactor capable of operation so as to maintain a controlled self-sustaining fission chain reaction. A "nuclear reactor" includes all 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 (Reference: ISO 2382:2015).

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

"Operations, Administration or Maintenance" ("OAM") (5) means performing one or more of the following tasks:

- a. Establishing or managing any of the following:
 1. Accounts or privileges of users or administrators;
 2. Settings of an item; or
 3. Authentication data in support of the tasks described in points a.1. or a.2.;
- b. Monitoring or managing the operating condition or performance of an item; or
- c. Managing logs or audit data in support of any of the tasks described in points a. or b.

Note: "OAM" does not include any of the following tasks or their associated key management functions:

- a. Provisioning or upgrading any cryptographic functionality that is not directly related to establishing or managing authentication data in support of the tasks described in points a.1. or a.2. above; or*
- b. Performing any cryptographic functionality on the forwarding or data plane of an item.*

"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).

"Participating State" (7 9) is a state participating in the Wassenaar Arrangement. (See www.wassenaar.org)

"Peak power" (6) means the highest power attained in the "pulse duration".

"Personal area network" (5) means a data communication system having all of the following characteristics:

- a. Allows an arbitrary number of independent or interconnected "data devices" to communicate directly with each other; and
- b. Is confined to the communication between devices within the immediate physical vicinity of an individual person or device controller (e.g., single room, office, or automobile).

Technical Note:

The "local area network" extends beyond the geographical area of the "personal area network".

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

"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 "production equipment" and specially designed software therefor integrated into installations for "development" or for one or more phases of "production".

"Program" (1 7) 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 and means the time between the half-power points on the leading edge and trailing edge of an individual pulse.

"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).

"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.

"Radiant sensitivity" (6) is Radiant sensitivity (mA/W) = 0,807 x (wavelength in nm) x Quantum Efficiency (QE).

Technical Note:

QE is usually expressed as a percentage; however, for the purposes of this formula QE is expressed as a decimal number less than one, e.g., 78% is 0,78.

"Real-time processing" (6) 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.

"Refractory metals and alloys" (1 2) are metals and alloys of niobium, molybdenum, tungsten and tantalum.

"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 528-2001 (one sigma standard deviation))

"Required" (GTN 3 5 6 7 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.

"Riot Control Agents" ("RCAs") (1) means substances which, under the expected conditions of use for riot control purposes, produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure.

Note: "RCAs" include:

1. α -Bromobenzeneacetonitrile, (Bromobenzyl cyanide) (CA) (CAS 5798-79-8);
2. [(2-chlorophenyl) methylene] propanedinitrile, (o-Chlorobenzylidenemalononitrile) (CS) (CAS 2698-41-1);
3. 2-Chloro-1-phenylethanone, Phenylacetyl chloride (*o*-chloroacetophenone) (CN) (CAS 532-27-4);
4. Dibenz-(b,f)-1,4-oxazepine, (CR) (CAS 257-07-8);
5. 10-Chloro-5,10-dihydrophenarsazine, (Phenarsazine chloride), (Adamsite), (DM) (CAS 578-94-9);
6. N-Nonanoylmorpholine, (MPA) (CAS 5299-64-9).

Technical Note:

Tear gases are a subset of "riot control agents".

"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.*

"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.

"Sample rate" (3) for an Analogue-to-Digital Converter (ADC) means the maximum number of samples that are measured at the analogue input over a period of one second, except for oversampling ADCs. For oversampling ADCs the "sample rate" is taken to be its output word rate. "Sample rate" may also be referred to as sampling rate, usually specified in Mega Samples Per Second (MSPS) or Giga Samples Per Second (GSPS), or conversion rate, usually specified in Hertz (Hz).

"Satellite" (5 9) means a "spacecraft", other than a "space vehicle", designed to operate in orbit around Earth or another celestial body; "satellites" include orbital space stations.

"Satellite navigation system" (5 7) means a system consisting of ground stations, a constellation of "satellites", and receivers, that enables receiver locations to be calculated on the basis of signals received from the "satellites". It includes Global Navigation Satellite Systems (GNSS) and Regional Navigation Satellite Systems (RNSS).

"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.

"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 "programs" or 'microprograms' fixed in any tangible medium of expression.

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

"Source code" (or source language) (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" (5 9) means a craft designed to operate in, persist in or transit through space in the form of a "satellite", "space probe", or "space vehicle".

Note: "Spacecraft" does not include landers, rovers, or other craft, limited by design to operate on or beneath the surface of, or in the atmosphere of an extra-terrestrial celestial body, or "sub-orbital craft".

"Spacecraft bus" (9) means equipment that provides the support infrastructure of the "spacecraft" and location for the "spacecraft mission equipment".

"Spacecraft mission equipment" (9) means equipment designed to be located on a "spacecraft bus", and to perform a mission in space or to enable the "spacecraft" to perform its mission (e.g., communications, observation, science, transport).

Technical Note:

"Spacecraft mission equipment" is sometimes referred to as a spacecraft payload.

"Space probe" (9) means a "spacecraft", other than a "satellite" or "space vehicle", designed not to return to Earth.

"Space vehicle" (9) means a "spacecraft" designed to provide transport for cargo or passengers.

Note: "Space vehicles" include craft designed to safely return to Earth.

"Space-qualified" (3 6 7) means designed, manufactured or qualified through successful testing, for operation at altitudes greater than 100 km above the surface of the Earth.

N.B. *A determination that a specific item is "Space-qualified" by virtue of testing does not mean that other items in the same production run or model series are "Space-qualified" if not individually tested.*

"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 $(296 \pm 2) \text{ K}$ ($(23 \pm 2)^\circ\text{C}$) and a relative humidity of $(50 \pm 5)\%$.

"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 $(296 \pm 2) \text{ K}$ ($(23 \pm 2)^\circ\text{C}$) and a relative humidity of $(50 \pm 5)\%$.

"Spinning mass gyros" (7) means gyros which use a continually rotating mass to sense angular motion.

"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)

"Steady state mode" (9) defines engine operation conditions, where the engine parameters, such as thrust/power, rpm and others, have no appreciable fluctuations, when the ambient air temperature and pressure at the engine inlet are constant.

"Strong mechanical bond" (9) means a bond having a bond strength equal to or greater than propellant strength.

"Sub-orbital craft" (9) means a craft having an enclosure designed for the transport of people or cargo which is designed to:

- a. Operate above the stratosphere;
- b. Only perform a non-orbital trajectories; and
- c. Land back on Earth with the people or cargo intact.

"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" (3 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 a stress rupture life greater than 1 000 hours at 400 MPa and an ultimate tensile strength greater than 850 MPa, at 922 K (649°C) or higher.

"Superconductive" (1 3 5 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.

"Tape" (1) is a material constructed of interlaced or unidirectional "monofilaments", 'strands', 'rovings', "tows", or "yarns", etc., usually pre-impregnated 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, algorithms, 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).

"Time-to-steady-state registration" (6) (also referred to as the gravimeter's response time) is the time over which the disturbing effects of platform induced accelerations (high frequency noise) are reduced.

"Tip shroud" (9) means a stationary ring component (solid or segmented) attached to the inner surface of the engine turbine casing or a feature at the outer tip of the turbine blade, which primarily provides a gas seal between the stationary and rotating components.

"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".

"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".

"Unidirectional positioning repeatability" (2) means the smaller of values $R_{\uparrow}$ and $R_{\downarrow}$ (forward and backward), as defined by 3.21 of ISO 230-2:2014 or national equivalents, of an individual machine tool axis.

"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 "programs" by means other than:

- a. A physical change in wiring or interconnections; or
- b. The setting of function controls including entry of parameters.

"Vaccine" (1) is a medicinal product in a pharmaceutical formulation licensed by, or having marketing or clinical trial authorisation from, the regulatory authorities of either the country of manufacture or of use, which is intended to stimulate a protective immunological response in humans or animals in order to prevent disease in those to whom or to which it is administered.

"Vacuum electronic devices" (3) means electronic devices based on the interaction of an electron beam with an electromagnetic wave propagating in a vacuum circuit or interacting with radio-frequency vacuum cavity resonators. "Vacuum electronic devices" include klystrons, travelling-wave tubes, and their derivatives.

"Vulnerability disclosure" (4) means the process of identifying, reporting or communicating a vulnerability to, or analysing a vulnerability with, individuals or organisations responsible for conducting or coordinating remediation for the purposes of resolving the vulnerability.

"Wall-plug efficiency" (6) means 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.

"Yarn" (1) is a bundle of twisted 'strands'.

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

PART II - Category 0

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";
- b. Metal vessels, or major shop-fabricated parts therefor, including the reactor vessel head for a reactor pressure vessel, specially designed or prepared to contain the core of a "nuclear reactor";
- 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 both fuel elements and the primary coolant in a "nuclear reactor";
- f. Zirconium metal tubes or zirconium alloy tubes (or assemblies of tubes) specially designed or prepared for use as fuel cladding in a "nuclear reactor", and in quantities exceeding 10 kg;

N.B. For zirconium pressure tubes see 0A001.e. and for calandria tubes see 0A001.h.

0A001 continued

- g. Coolant pumps or circulators 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, calandria tubes, thermal shields, baffles, core grid plates, and diffuser plates;

Technical 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 as follows:
 - 1. Steam generators specially designed or prepared for the primary, or intermediate, coolant circuit of a "nuclear reactor";
 - 2. Other heat exchangers specially designed or prepared for use in the primary coolant circuit of a "nuclear reactor";

Note: *0A001.i. does not control heat exchangers for the supporting systems of the reactor, e.g., the emergency cooling system or the decay heat cooling system.*

- j. Neutron detectors specially designed or prepared for determining neutron flux levels within the core of a "nuclear reactor";

0A001 continued

- k. 'External thermal shields' specially designed or prepared for use in a "nuclear reactor" for the reduction of heat loss and also for the containment vessel protection.

Technical Note:

In 0A001.k. 'external thermal shields' means major structures placed over the reactor vessel which reduce heat loss from the reactor and reduce temperature within the containment vessel.

0B Test, Inspection and Production Equipment

0B001 Plant for the separation of isotopes of "natural uranium", "depleted uranium" or "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", or "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 plant;
 - 7. Molecular "laser" isotope separation plant;
 - 8. Plasma separation plant;
 - 9. Electro magnetic separation plant;

0B001 continued

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

Technical Note:

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

- 1. Maraging steel capable of an ultimate tensile strength of 1,95 GPa or more;*
- 2. Aluminium alloys capable of an ultimate tensile strength of 0,46 GPa or more; or*
- 3. "Fibrous or filamentary materials" with a "specific modulus" of more than $3,18 \times 10^6 \text{ m}$ and a "specific tensile strength" greater than $7,62 \times 10^4 \text{ m}$;*

0B001.b. continued

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 650 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 650 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 650 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 650 mm diameter to fit the ends of a rotor tube, made from 'high strength-to-density ratio materials';
7. Magnetic suspension bearings as follows:
 - a. Bearing assemblies consisting of an annular magnet suspended within a housing made of or protected by "materials resistant to corrosion by UF₆" containing a damping medium and having the magnet coupling with a pole piece or second magnet fitted to the top cap of the rotor;
 - b. Active magnetic bearings specially designed or prepared for use with gas centrifuges;
8. Specially prepared bearings comprising a pivot-cup assembly mounted on a damper;

0B001.b. continued

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 at a frequency of 600 Hz or more and a power of 40 VA or more;
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 that are parallel to each other and perpendicular to the cylinder's longitudinal axis to within 0,05° or less;
12. Scoops consisting of specially designed or prepared tubes for the extraction of UF₆ gas from within the rotor tube by a Pitot tube action and capable of being fixed to the central gas extraction system;
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. A multiphase frequency output of 600 Hz or greater; and
 - b. High stability (with frequency control better than 0,2%);

0B001.b. continued

14. Shut-off and control valves as follows:
 - a. Shut-off valves specially designed or prepared to act on the feed, product or tails UF_6 gaseous streams of an individual gas centrifuge;
 - b. Bellows-sealed valves, shut-off or control, made of or protected by "materials resistant to corrosion by UF_6 ", with an inside diameter of 10 mm to 160 mm, specially designed or prepared for use in main or auxiliary systems of gas centrifuge enrichment plants;
- 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 or gas blowers with a suction volume capacity of 1 m³/min or more of UF_6 , with a discharge pressure up to 500 kPa, and having a pressure ratio of 10:1 or less, and 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 cm³/min.;
 5. Heat exchangers made of or protected by "materials resistant to corrosion by UF_6 ", and designed for a leakage pressure rate of less than 10 Pa per hour under a pressure differential of 100 kPa;
 6. Bellows-sealed valves, manual or automated, shut-off or control, made of or protected by "materials resistant to corrosion by UF_6 ";

- 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. Cylindrical or conical tubes, (vortex tubes), made of or protected by "materials resistant to corrosion by UF_6 " and with one or more tangential inlets;
 - 3. Compressors or gas blowers 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. Separation element housings, made of or protected by "materials resistant to corrosion by UF_6 " to contain vortex tubes or separation nozzles;
 - 6. Bellows-sealed valves, manual or automated, shut-off or control, made of or protected by "materials resistant to corrosion by UF_6 ", with a diameter of 40 mm or more;
 - 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 freezing out UF_6 ;

- 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 s or less and resistant to concentrated hydrochloric acid (e.g. made of or protected by suitable plastic materials such as fluorinated hydrocarbon polymers or glass);
 - 2. Fast-exchange liquid-liquid centrifugal contactors with stage residence time of 30 s or less and resistant to concentrated hydrochloric acid (e.g. made of or protected by suitable plastic materials such as fluorinated hydrocarbon 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} ;

0B001 continued

- 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 s 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 laser-based separation processes using atomic vapour laser isotope separation, as follows:
 - 1. Uranium metal vaporisation systems designed to achieve a delivered power of 1 kW or more on the target for use in laser enrichment;

0B001.g. continued

2. Liquid or vapour uranium metal handling systems specially designed or prepared for handling molten uranium, molten uranium alloys or uranium metal vapour for use in laser enrichment, and specially designed components therefor;

N.B. SEE ALSO 2A225.

3. Product and tails collector assemblies for collecting uranium metal in liquid or solid form, made of or protected by 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 specially designed or prepared for the separation of uranium isotopes with a spectrum frequency stabilisation for operation over extended periods of time;

N.B. SEE ALSO 6A005 AND 6A205.

- h. Equipment and components, specially designed or prepared for laser-based separation processes using molecular laser isotope separation, 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. Product or tails collector components or devices specially designed or prepared for collecting uranium material or uranium tails material following illumination with laser light, made of "materials resistant to corrosion by 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);

0B001.h. continued

5. Process systems for separating UF₆ from carrier gas (e.g. nitrogen, argon or other gas) 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. UF₆ cold traps capable of freezing out UF₆;
6. "Lasers" or "laser" systems specially designed or prepared for the separation of uranium isotopes with a spectrum frequency stabilisation for operation over extended periods of time;

N.B. SEE ALSO 6A005 AND 6A205.

- i. Equipment and components, specially designed or prepared for plasma separation process, as follows:
 1. Microwave power sources and antennae for producing or accelerating ions, with an output frequency greater than 30 GHz and mean power output greater than 50 kW;
 2. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power;
 3. Uranium plasma generation systems;
 4. Not used;
 5. Product and tails collector assemblies for uranium metal in solid form, 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);

0B001 continued

j. Equipment and components, specially designed or prepared for electromagnetic separation process, as follows:

1. Ion sources, single or multiple, consisting of a vapour source, ioniser, and beam accelerator made of suitable non-magnetic materials (e.g. graphite, stainless steel, or copper) and capable of providing a total ion beam current of 50 mA or greater;
2. Ion collector plates for collection of enriched or depleted uranium ion beams, consisting of two or more slits and pockets and made of suitable non-magnetic materials (e.g. graphite or stainless steel);
3. Vacuum housings for uranium electromagnetic separators made of non-magnetic materials (e.g. stainless steel) and designed to operate at pressures of 0,1 Pa or lower;
4. Magnet pole pieces with a diameter greater than 2 m;
5. High voltage power supplies for ion sources, having all of the following characteristics:
 - a. Capable of continuous operation;
 - b. Output voltage of 20 000 V or greater;
 - c. Output current of 1 A or greater; and
 - d. Voltage regulation of better than 0,01% over a period of 8 hours;

N.B. SEE ALSO 3A227.

6. Magnet power supplies (high power, direct current) having all of the following characteristics:
 - a. Capable of continuous operation with a current output of 500 A or greater at a voltage of 100 V or greater; and
 - b. Current or voltage regulation better than 0,01% over a period of 8 hours.

N.B. SEE ALSO 3A226.

0B002 Specially designed or prepared auxiliary systems, equipment and components as follows, for isotope separation plant specified in 0B001, made of or protected by "materials resistant to corrosion by UF₆":

- a. Feed autoclaves, ovens or systems used for passing UF₆ to the enrichment process;
- b. Desublimers or cold traps, used to remove UF₆ from the enrichment process for subsequent transfer upon heating;
- c. Product and tails stations for transferring UF₆ into containers;
- d. Liquefaction or solidification stations used to remove UF₆ from the enrichment process by compressing, cooling and converting UF₆ to a liquid or solid form;
- e. Piping systems and header systems specially designed or prepared for handling UF₆ within gaseous diffusion, centrifuge or aerodynamic cascades;
- f. Vacuum systems and pumps as follows:
 1. Vacuum manifolds, vacuum headers or vacuum pumps having a suction capacity of 5 m³/minute or more;
 2. Vacuum pumps specially designed for use in UF₆ bearing atmospheres made of, or protected by, "materials resistant to corrosion by UF₆"; or
 3. Vacuum systems consisting of vacuum manifolds, vacuum headers and vacuum pumps, and designed for service in UF₆-bearing atmospheres;
- g. UF₆ mass spectrometers/ion sources capable of taking on-line samples from UF₆ gas streams and having all of the following characteristics:
 1. Capable of measuring ions of 320 atomic mass units or greater and having a resolution of better than 1 part in 320;
 2. Ion sources constructed of or protected by nickel, nickel-copper alloys with a nickel content of 60% or more by weight, or nickel-chrome alloys;
 3. Electron bombardment ionisation sources; and
 4. Having a collector system suitable for isotopic analysis.

- 0B003 Plant for the conversion of uranium and equipment specially designed or prepared therefor, as follows:
- Systems for the conversion of uranium ore concentrates to UO_3 ;
 - Systems for the conversion of UO_3 to UF_6 ;
 - Systems for the conversion of UO_3 to UO_2 ;
 - Systems for the conversion of UO_2 to UF_4 ;
 - Systems for the conversion of UF_4 to UF_6 ;
 - Systems for the conversion of UF_4 to uranium metal;
 - Systems for the conversion of UF_6 to UO_2 ;
 - Systems for the conversion of UF_6 to UF_4 ;
 - 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:
- Plant for the production of heavy water, deuterium or deuterium compounds, as follows:
 - Water-hydrogen sulphide exchange plants;
 - Ammonia-hydrogen exchange plants;
 - Combined Electrolysis and Catalytic Exchange (CECE) plants;
 - Combined Industrial Reforming and Catalytic Exchange (CIRCE) plants;
 - Bithermal Hydrogen-Water exchange (BHW) plants;
 - Equipment and components, as follows:
 - Water-hydrogen sulphide exchange towers with diameters of 1,5 m or more, capable of operating at pressures greater than or equal to 2 MPa;
 - 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% by weight hydrogen sulphide, H_2S) with a throughput capacity greater than or equal to $5 \text{ m}^3/\text{s}$ 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 or greater 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 utilising the ammonia-hydrogen exchange process;
6. Not used;
7. Catalytic burners for the conversion of enriched deuterium gas into heavy water utilising the ammonia-hydrogen exchange process;
8. Complete heavy water finishing units, upgrade systems, or columns with diameters of 0,1 m or greater therefor, for the upgrade of heavy water to reactor-grade deuterium concentration;
9. Ammonia synthesis converters or synthesis units specially designed or prepared for heavy water production utilising the ammonia-hydrogen exchange process.
10. Complete columns or towers specially designed or prepared for hydrogen isotope exchange having all of the following:
 1. Packed with random or structured wet-proofed platinised catalysts;
 2. Constructed of carbon steel or stainless steel;
 3. Capable of operating with pressure in the range of 0,1 to 4 MPa;
and
 4. Capable of operating at temperatures in the range of 293 K (20°C) to 473 K (200°C).

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

Technical Note:

Specially designed or prepared equipment for the fabrication of "nuclear reactor" fuel elements includes equipment which:

- 1. Normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;*
- 2. Seals the nuclear materials within the cladding;*
- 3. Checks the integrity of the cladding or the seal;*
- 4. Checks the finish treatment of the sealed fuel; or*
- 5. Is used for assembling reactor elements.*

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 decladding equipment and chopping or shredding machines, i.e., remotely operated equipment to cut, chop or shear irradiated "nuclear reactor" fuel assemblies, bundles or rods;*
- c. *Dissolver vessels or dissolvers employing mechanical devices 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, operated and maintained;*
- d. *Solvent extractors, such as packed or pulsed columns, mixer settlers or centrifugal contractors, resistant to the corrosive effects of nitric acid and 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;*

Technical 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. *Neutron measurement systems specially designed or prepared for integration and use with automated process control systems in a plant for 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 having a purity level better than 5 parts per million 'boron equivalent' and with a density greater than 1,50 g/cm³ for use in a "nuclear reactor", in quantities exceeding 1 kg.

N.B. SEE ALSO 1C107.

Note 1: For the purpose of export control, the competent authorities of the Member State in which the exporter is established will determine whether or not the exports of graphite meeting the above specifications are for "nuclear reactor" use. 0C004 does not control graphite having a purity level better than 5 ppm (parts per million) boron equivalent and with a density greater than 1,50 g/cm³ not for use in a "nuclear reactor".

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 x concentration of element Z in ppm;

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

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 UF₆ (e.g. nickel or alloys containing 60% by weight or more nickel, aluminium oxide and fully fluorinated hydrocarbon polymers), having a purity of 99,9% by weight or more and a particle size less than 10 µm measured by 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.

PART III - Category 1

CATEGORY 1 – SPECIAL MATERIALS AND RELATED EQUIPMENT

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. Not used;
- c. Not used.

1A002 "Composite" structures or laminates, as follows:

N.B. SEE ALSO 1A202, 9A010 and 9A110.

- a. Made from any of the following:
 1. An organic "matrix" and "fibrous or filamentary materials" specified in 1C010.c. or 1C010.d.: or
 2. Prepregs or preforms specified in 1C010.e.;
- b. Made from a metal or carbon "matrix", and any of the following:
 1. Carbon "fibrous or filamentary materials" having all of the following:
 - 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.

1A002 continued

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, having all of the following:

- a. An area not exceeding 1 m²;
- b. A length not exceeding 2,5 m; and
- c. A width exceeding 15 mm.

Note 2: 1A002 does not control semi-finished items specially designed for purely civilian applications as follows:

- a. Sporting goods;
- b. Automotive industry;
- c. Machine tool industry;
- d. Medical applications.

Note 3: 1A002.b.1. does not control semi-finished items containing a maximum of two dimensions of interwoven filaments and specially designed for applications as follows:

- a. Metal heat-treatment furnaces for tempering metals;
- b. Silicon boule production equipment.

Note 4: 1A002 does not control finished items specially designed for a specific application.

Note 5: 1A002.b.1. does not control mechanically chopped, milled, or cut carbon "fibrous or filamentary materials" 25,0 mm or less in length.

1A003 Manufactures of non-"fusible" aromatic polyimides in film, sheet, tape or ribbon form having any of the following:

- a. 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.

N.B. For "fusible" aromatic polyimides in any form, see 1C008.a.3.

1A004 Protective and detection equipment and components not specially designed for military use, as follows:

N.B. SEE ALSO MILITARY GOODS CONTROLS, 2B351 AND 2B352.

1A004 continued

- a. Full face masks, filter canisters and decontamination equipment therefor, designed or modified for defence against any of the following, and specially designed components therefor:

Note: 1A004.a. includes Powered Air Purifying Respirators (PAPR) that are designed or modified for defence against agents or materials, listed in 1A004.a.

Technical Note:

For the purposes of 1A004.a.:

1. Full face masks are also known as gas masks.
2. Filter canisters include filter cartridges.
1. "Biological agents";
2. 'Radioactive materials';
3. Chemical Warfare (CW) agents; or
4. "Riot Control Agents" ("RCAs");

1A004 continued

- b. Protective suits, gloves and shoes, specially designed or modified for defence against any of the following:
 - 1. "Biological agents";
 - 2. 'Radioactive materials'; or
 - 3. Chemical Warfare (CW) agents;
- c. Detection systems, specially designed or modified for detection or identification of any of the following, and specially designed components therefor:
 - 1. "Biological agents";
 - 2. 'Radioactive materials'; or
 - 3. Chemical Warfare (CW) agents;

Note: 1A004.c. does not control detection systems limited to the detection of any of the following:

- a. Cyanogen chloride (CAS 506-77-4);
- b. Hydrocyanic acid (CAS 74-90-8);
- c. Chlorine (CAS 7782-50-5);
- d. Carbonyl chloride (phosgene) (CAS 75-44-5);
- e. Diphosgene (trichloromethyl-chloroformate) (CAS 503-38-8);
- f. Xylyl bromide, ortho: (CAS 89-92-9), meta: (CAS 620-13-3), para: (CAS 104-81-4);
- g. Benzyl bromide (CAS 100-39-0);
- h. Benzyl iodide (CAS 620-05-3);
- i. Bromo acetone (CAS 598-31-2);
- j. Cyanogen bromide (CAS 506-68-3);
- k. Bromo methylethylketone (CAS 816-40-0);
- l. Chloro acetone (CAS 78-95-5);
- m. Ethyl iodoacetate (CAS 623-48-3);
- n. Iodo acetone (CAS 3019-04-3);
- o. Chloropicrin (CAS 76-06-2).

- d. Electronic equipment designed for automatically detecting or identifying the presence of "explosives" residues and utilising 'trace detection' techniques (e.g., surface acoustic wave, ion mobility spectrometry, differential mobility spectrometry, mass spectrometry).

Technical Note:

For the purposes of 1A004.d., 'trace detection' is defined as the capability to detect less than 1 ppm vapour, or 1 mg solid or liquid.

Note 1: 1A004.d. does not control equipment specially designed for laboratory use.

Note 2: 1A004.d. does not control non-contact walk-through security portals.

Note: 1A004 does not control:

- a. Personal radiation monitoring dosimeters;

b. Occupational health or safety equipment limited by design or function to protect against hazards specific to residential safety or civil industries, including:

- 1. mining;*
- 2. quarrying;*
- 3. agriculture;*
- 4. pharmaceutical;*
- 5. medical;*
- 6. veterinary;*
- 7. environmental;*
- 8. waste management;*
- 9. food industry.*

Technical Notes:

1. *1A004 includes equipment and components that have been identified, successfully tested to national standards or otherwise proven effective, for the detection of or defence against 'radioactive materials', 'biological agents', Chemical Warfare (CW) agents, 'simulants' or "Riot Control Agents" ("RCAs"), even if such equipment or components are used in civil industries such as mining, quarrying, agriculture, pharmaceuticals, medical, veterinary, environmental, waste management, or the food industry.*
2. *'Simulant' is a substance or material that is used in place of toxic agent (chemical or biological) in training, research, testing or evaluation.*
3. *For the purposes of 1A004, 'radioactive materials' are those selected or modified to increase their effectiveness in producing casualties in humans or animals, degrading equipment or damaging crops or the environment.*

1A005 Body armour and components therefor, as follows:

N.B. SEE ALSO MILITARY GOODS CONTROLS.

- a. Soft body armour not manufactured to military standards or specifications, or to their equivalents, and specially designed components therefor;
- b. Hard body armour plates providing ballistic protection equal to or less than level IIIA (NIJ 0101.06, July 2008), or "equivalent standards".

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

Note 1: 1A005 does not control body armour when accompanying its 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.

Note 3: 1A005 does not control body armour designed to provide protection only from knife, spike, needle or blunt trauma.

1A006 Equipment, specially designed or modified for the disposal of Improvised Explosive Devices (IEDs), as follows, and specially designed components and accessories therefor:

N.B. SEE ALSO MILITARY GOODS CONTROLS.

- a. Remotely operated vehicles;
- b. 'Disruptors'.

Technical Note:

For the purposes of 1A006.b. 'disruptors' are devices specially designed for the purpose of preventing the operation of an explosive device by projecting a liquid, solid or frangible projectile.

Note: 1A006 does not control equipment when accompanying its operator.

1A007 Equipment and devices, specially designed to initiate charges and devices containing "energetic materials", by electrical means, as follows:

N.B. SEE ALSO MILITARY GOODS CONTROLS, 3A229 AND 3A232.

Technical Note:

For the purposes of 1A007, the word initiator or igniter is sometimes used in place of the word detonator.

- a. Explosive detonator firing sets designed to drive explosive detonators specified in 1A007.b.;
- b. Electrically driven explosive detonators as follows:
 - 1. Exploding Bridge (EB);
 - 2. Exploding Bridge Wire (EBW);
 - 3. Slapper;
 - 4. Exploding Foil Initiators (EFI).

Technical Note:

For the purposes of 1A007.b., the detonators of concern all utilise a small electrical conductor (bridge, bridge wire or foil) that explosively vaporises when a fast, high-current electrical pulse is passed through it. In non-slapper types, the exploding conductor starts a chemical detonation in a contacting high explosive material such as PETN (pentaerythritoltetranitrate). In slapper detonators, the explosive vaporisation 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 magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator.

1A008 Charges, devices and components, as follows:

- a. 'Shaped charges' having all of the following:
 - 1. Net Explosive Quantity (NEQ) greater than 90 g; and
 - 2. Outer casing diameter equal to or greater than 75 mm;

Technical Note:

For the purposes of 1A008.a., 'shaped charges' are explosive charges shaped to focus the effects of the explosive blast.

- b. Linear shaped cutting charges having all of the following, and specially designed components therefor:
 - 1. An explosive load greater than 40 g/m; and
 - 2. A width of 10 mm or more;
- c. Detonating cord with explosive core load greater than 64 g/m;
- d. Cutters, other than those specified in 1A008.b., and severing tools, having a Net Explosive Quantity (NEQ) greater than 3,5 kg.

1A102 Resaturated pyrolysed 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 thin-walled tubes and having all of the following characteristics:

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

- a. An inside diameter of between 75 mm and 650 mm;
- b. A thickness of 12 mm or less; and
- c. 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 Wet-proofed platinised catalysts specially designed or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of tritium from water or for the production or upgrading of heavy water.

Technical Note:

In heavy water moderated reactors, upgraders maintain the heavy water concentration in the reactor core. Wet-proofed platinised catalysts can also be used to upgrade 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 m²;
 - b. A density greater than 3 g/cm³; and
 - c. A thickness of 100 mm or greater.

Technical Note:

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

1B Test, Inspection and Production Equipment

- 1B001 Equipment designed for the "production" of "composite" structures or laminates or "fibrous or filamentary materials", as follows, and specially designed components and accessories therefor:

N.B. SEE ALSO 1B101, 1B201 AND 1B501.

- a. Filament winding machines, of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more 'primary servo positioning' axes, specially designed for the manufacture of "composite" structures or laminates, from "fibrous or filamentary materials";
- b. 'Tape-laying machines', of which the motions for positioning and laying tape are coordinated and programmed in five or more 'primary servo positioning' 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.

1B001.b. continued

Technical Note:

For the purposes of 1B001.b., 'tape-laying machines' have the ability to lay one or more 'filament bands' limited to widths greater than 25,4 mm and less than or equal to 304,8 mm, and to cut and restart individual 'filament band' courses during the laying process.

- c. Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, specially designed or modified for weaving, interlacing or braiding fibres, for "composite" structures;

Technical Note:

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

- d. Equipment specially designed or modified for the "production" of "fibrous or filamentary materials" specified in 1C010, 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 (CVD) 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 specially designed or modified for the "production" of prepregs by the 'hot melt method';

Technical Note

For the purposes of 1B001.e., the 'hot melt method' is the process of applying pressure and heat to impregnate "fibrous or filamentary materials" with resin that has been pre-laminated onto a carrier substrate, such as film or paper.

1B001 continued

- 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 or receivers are simultaneously coordinated and programmed in four or more axes to follow the three dimensional contours of the component under inspection;
- g. 'Tow-placement machines', of which the motions for positioning and laying tows are coordinated and programmed in two or more 'primary servo positioning' axes, specially designed for the manufacture of "composite" airframe or 'missile' structures.

Technical Note:

For the purposes of 1B001.g., 'tow-placement machines' have the ability to place one or more 'filament bands' having widths less than or equal to 25,4 mm, and to cut and restart individual 'filament band' courses during the placement process.

Technical Notes:

For the purpose of 1B001:

- 1. *'Primary servo positioning' is the positioning, under computer "program" direction, of the end effector (i.e., head) in space relative to the work piece at the correct orientation and direction to achieve the desired process.*
- 2. *A 'filament band' is a single continuous width of fully or partially resin-impregnated tape, tow or fibre. Fully or partially resin-impregnated 'filament bands' include those coated with dry powder that tacks upon heating.*

1B002 Equipment designed to produce metal alloy powder or particulate materials, and having all of the following:

- a. Specially designed to avoid contamination; and
- b. 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, aluminium or their alloys, specially designed for the manufacture of any of the following:

- a. Airframe or aerospace structures;
- b. "Aircraft" or aerospace engines; or
- c. Specially designed components for structures specified in 1B003.a. or for engines specified in 1B003.b.

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 or fibre placement 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;

1B101 continued

- 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 prepreps 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, spheroidal 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 organization of the process in an argon-water environment;*
- b. Electrobust equipment usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon-water environment;*
- c. Equipment usable for the "production" of spherical aluminium powders by powdering a melt in an inert medium (e.g. nitrogen).*

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

- a. "Production equipment" for the "production", handling or acceptance testing of liquid propellants or propellant constituents specified in 1C011.a., 1C011.b., 1C111 or in the Military Goods Controls;
- 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 having all of the following, and specially designed components therefor:
- a. Designed or modified for mixing under vacuum in the range of zero to 13,326 kPa;
 - b. Capable of controlling the temperature of the mixing chamber;
 - c. A total volumetric capacity of 110 litres or more; and
 - d. At least one 'mixing/kneading shaft' mounted off centre.
- Note: In 1B117.d. the term 'mixing/kneading shaft' does not refer to deagglomerators or knife-spindles.*
- 1B118 Continuous mixers having all of the following, and specially designed components therefor:
- a. Designed or modified for mixing under vacuum in the range of zero to 13,326 kPa;
 - b. Capable of controlling the temperature of the mixing chamber;
 - c. any of the following:
 1. Two or more mixing/kneading shafts; or
 2. All of the following:
 - a. A single rotating and oscillating shaft with kneading teeth/pins; and
 - b. Kneading teeth/pins 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 tubes with an internal diameter between 75 and 650 mm and lengths of 300 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.

- 1B228 Hydrogen-cryogenic distillation columns having all of the following characteristics:
- a. Designed for operation with internal temperatures in the range of 15 K (-258°C) to 35 K (-238°C);
 - b. Designed for operation at internal pressures in the range of 0,1 MPa to 1 MPa;
 - c. Constructed of either:
 1. Austenitic stainless steel; or
 2. Equivalent materials which are both cryogenic and hydrogen (H₂)-compatible between 15 K (-258°C) and 35 K (-238°C); and
 - d. With internal diameters of 30 cm or greater and 'effective lengths' of 4 m or greater.

Technical Note 1:

In 1B228 'effective length' means the active height of packing material in a packed-type column, or the active height of internal contactor plates in a plate-type column.

Technical Note 2:

Equivalent materials could include, but are not limited to the following materials:

- a. *aluminium,*
 - b. *aluminium alloys,*
 - c. *copper alloys,*
 - d. *nickel alloys, and*
 - e. *titanium alloys.*
- 1B230 Pumps capable of circulating solutions of concentrated or dilute potassium amide catalyst in liquid ammonia (KNH₂/NH₃), having all of the following characteristics:
- a. Airtight (i.e., hermetically sealed);
 - b. A capacity greater than 8,5 m³/h; and
 - c. Either of the following characteristics:
 1. For concentrated potassium amide solutions (1% or greater), an operating pressure of 1,5 to 60 MPa; or
 2. For dilute potassium amide solutions (less than 1%), an operating pressure of 20 to 60 MPa.

- 1B231 Tritium facilities or plants, and equipment therefor, as follows:
- a. Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium;
 - b. Equipment for tritium facilities or plants, as follows:
 1. Hydrogen or helium refrigeration units capable of cooling to 23 K (-250°C) or less, with heat removal capacity greater than 150 W;
 2. Hydrogen isotope storage or hydrogen isotope 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 in the range 15 K (-258°C) to 35 K (-238°C); and
 - b. Designed for a throughput of hydrogen or helium gas of 1 000 kg/h or greater.
- 1B233 Lithium isotope separation facilities or plants, and systems and equipment therefor, as follows:
- a. Facilities or plants for the separation of lithium isotopes;
 - b. Equipment for the separation of lithium isotopes based on the lithium-mercury amalgam process, 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;
 - c. Ion exchange systems specially designed for lithium isotope separation, and specially designed components therefor;
 - d. Chemical exchange systems (employing crown ethers, cryptands, or lariat ethers), specially designed for lithium isotope separation, and specially designed components therefor.

- 1B234 High explosive containment vessels, chambers, containers and other similar containment devices designed for the testing of high explosives or explosive devices and having both of the following characteristics:

N.B. SEE ALSO MILITARY GOODS CONTROLS.

- a. Designed to fully contain an explosion equivalent to 2 kg of trinitrotoluene (TNT) or greater; and
- b. Having design elements or features enabling real time or delayed transfer of diagnostic or measurement information.

- 1B235 Target assemblies and components for the production of tritium as follows:

- a. Target assemblies made of or containing lithium enriched in the lithium-6 isotope specially designed for the production of tritium through irradiation, including insertion in a nuclear reactor;
- b. Components specially designed for the target assemblies specified in 1B235.a.

Technical Note:

Components specially designed for target assemblies for the production of tritium may include lithium pellets, tritium getters, and specially-coated cladding.

- 1B501 Equipment designed for the "production" of "composite" structures or laminates or "fibrous or filamentary materials", as follows, and specially designed components and accessories therefor:

- d. Equipment specially designed or modified for the "production" of "fibrous or filamentary materials" specified in 1C010, as follows:
 2. Equipment, not specified in 1B001.d.2., for the "production" of multiple parallel silicon carbide fibres by "'laser"-driven CVD'.

Technical Note

For the purposes of 1B501.d.2., "'laser"-driven CVD' uses a "laser" as the energy source, resulting in the fibre's unsupported growth.

- 1B504 Additive manufacturing equipment designed or modified to produce explosive, pyrotechnic or propellant devices or shapes from "energetic materials", and having one or more ultrasonic extruders or nozzles.

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 absorbing electromagnetic radiation, 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:
 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 $\pm 15\%$ 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 $\pm 15\%$ of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527°C);

Technical Note:

For the purposes of 1C001.a. Note: 1.c.1., absorption test samples 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 Note 1 continued

2. Tensile strength less than $7 \times 10^6 \text{ N/m}^2$; and
3. Compressive strength less than $14 \times 10^6 \text{ N/m}^2$;
- d. Planar absorbers made of sintered ferrite, having all of the following:
 1. A specific gravity exceeding 4,4; and
 2. A maximum operating temperature of 548 K (275°C) or less;
- e. Planar absorbers having no magnetic loss and fabricated from 'open-cell foam' plastic material with a density of $0,15 \text{ g/cm}^3$ or less.

Technical Note:

For the purposes of 1C001.a. Note 1.e., 'open-cell foams' are flexible and porous materials, having an inner structure open to the atmosphere. 'Open-cell foams' are also known as reticulated foams.

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

- b. Materials not transparent to visible light and specially designed for absorbing near-infrared radiation having a wavelength exceeding 810 nm but less than 2 000 nm (frequencies exceeding 150 THz but less than 370 THz);

Note: *1C001.b. does not control materials specially designed or formulated for any of the following applications:*

- a. "Laser" marking of polymers; or
- b. "Laser" welding of polymers.

1C001 continued

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

Note: 1C001.c. does not control materials in a liquid form.

Technical Note:

For the purposes of 1C001.c., '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, specially formulated for coating purposes.

Technical Note:

For the purposes of 1C002, metal alloys are those containing a higher percentage by weight of the stated metal than of any other element.

a. Aluminides, as follows:

1. Nickel aluminides containing a minimum of 15% by weight aluminium, a maximum of 38% by weight aluminium and at least one additional alloying element;
2. Titanium aluminides containing 10% by weight or more aluminium and at least one additional alloying element;

1C002 continued

- b. Metal alloys, as follows, made from the powder or particulate material specified in 1C002.c.:
 - 1. Nickel alloys having any of the following:
 - 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 having any of the following:
 - 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 having any of the following:
 - 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 having any of the following:
 - a. A tensile strength of 240 MPa or more at 473 K (200°C); or
 - b. A tensile strength of 415 MPa or more at 298 K (25°C);
 - 5. Magnesium alloys having all of the following:
 - 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;

Technical Notes:

For the purposes of 1C002.b.:

- 1. *'Stress-rupture life' should be measured in accordance with ASTM standard E-139 or national equivalents.*
- 2. *'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 ratio is defined as maximum stress minus minimum stress divided by maximum stress.*

1C002 continued

- c. Metal alloy powder or particulate material, having all of the following:
 - 1. Made from any of the following composition systems:

Technical Note:

For the purposes of 1C002.c.1., X equals one or more alloying elements.

- a. Nickel alloys (Ni-Al-X, Ni-X-Al) qualified for turbine engine parts or components, i.e., with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100 µm in 10⁹ alloy particles;

Note: 1C002.c.1.a. includes nickel alloys qualified for aero, aero-derivative, industrial or marine gas turbine engines.

- b. Niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);
 - c. Titanium alloys (Ti-Al-X or Ti-X-Al);
 - d. Aluminium alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); or
 - e. Magnesium alloys (Mg-Al-X or Mg-X-Al);
- 2. Made in a controlled environment by any of the following processes:
 - a. 'Vacuum atomisation';
 - b. 'Gas atomisation';
 - c. 'Rotary atomisation';
 - d. 'Splat quenching';
 - e. 'Melt spinning' and 'comminution';
 - f. 'Melt extraction' and 'comminution';
 - g. 'Mechanical alloying';
 - h. 'Plasma atomisation'; or
 - i. 'Ultrasonic atomisation'; and
 - 3. Capable of forming materials specified in 1C002.a. or 1C002.b.;

1C002 continued

- d. Alloyed materials having all of the following:
 - 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'.

Technical Notes:

For the purposes of 1C002:

- 1. *'Vacuum atomisation' is a process to reduce a molten stream of metal to droplets of a diameter of 500 µm or less by the rapid evolution of a dissolved gas upon exposure to a vacuum.*
- 2. *'Gas atomisation' is a process to reduce a molten stream of metal alloy to droplets of 500 µm diameter or less by a high pressure gas stream.*
- 3. *'Rotary atomisation' is a process to reduce a stream or pool of molten metal to droplets to a diameter of 500 µm or less by centrifugal force.*
- 4. *'Splat quenching' is a process to 'solidify rapidly' a molten metal stream impinging upon a chilled block, forming a flake-like product.*
- 5. *'Melt spinning' is a process to 'solidify rapidly' a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod-like product.*
- 6. *'Comminution' is a process to reduce a material to particles by crushing or grinding.*
- 7. *'Melt extraction' is 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.*

1C002 continued

8. *'Mechanical alloying' is 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.*
9. *'Plasma atomisation' is a process to reduce a molten stream or solid metal to droplets of 500 μm diameter or less, using plasma torches in an inert gas environment.*
10. *'Ultrasonic atomisation' is a process to reduce a molten stream of metal alloy to droplets of 500 μm diameter or less by ultrasonic vibration.*
11. *For the purposes of 1C002 Technical Notes, 'solidify rapidly' is a process involving the solidification of molten material at cooling rates exceeding 1 000 K/s.*

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

- a. Initial relative permeability of 120 000 or more and a thickness of 0,05 mm or less;

Technical Note:

For the purposes of 1C003.a., measurement of initial relative permeability must be performed on fully annealed materials.

- b. Magnetostrictive alloys having any of the following:

- 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:

- 1. A composition having a minimum of 75% by weight 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:

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

- 1C004 Uranium titanium alloys or tungsten alloys with a "matrix" based on iron, nickel or copper, having all of the following:
- a. A density exceeding 17,5 g/cm³;
 - b. An elastic limit exceeding 880 MPa;
 - c. An ultimate tensile strength exceeding 1 270 MPa; and
 - d. An elongation exceeding 8%.
- 1C005 "Superconductive" "composite" conductors in lengths exceeding 100 m or with a mass exceeding 100 g, as follows:
- a. "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 $0,28 \times 10^{-4} \text{ mm}^2$ (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 (-263,3°C); and
 2. Remaining in the "superconductive" state at a temperature of 4,2 K (-268,95°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/mm² on overall cross-section of the conductor;
 - c. "Superconductive" "composite" conductors consisting of one or more "superconductive" 'filaments' which remain "superconductive" above 115 K (-158,15°C).

Technical Note:

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

1C006 Fluids and lubricating materials, as follows:

- a. Not used;
- b. Lubricating materials containing, as their principal ingredients, phenylene or alkylphenylene ethers or thio-ethers, or their mixtures, containing more than two ether or thio-ether functions or mixtures thereof;
- c. Damping or flotation fluids having all of the following:
 - 1. Purity exceeding 99,8%;
 - 2. Containing less than 25 particles of 200 µm or larger in size per 100 ml;
and
 - 3. Made from at least 85% of any of the following:
 - a. Dibromotetrafluoroethane (CAS 25497-30-7, 124-73-2, 27336-23-8);
 - b. Polychlorotrifluoroethylene (oily and waxy modifications only); or
 - c. Polybromotrifluoroethylene;

1C006 continued

- d. Fluorocarbon fluids designed for electronic cooling and having all of the following:
 - 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.

Note: 1C006.d. does not control materials specified and packaged as medical products.

1C007 Ceramic powders, ceramic-"matrix" "composite" materials and 'precursor materials', as follows:

N.B. SEE ALSO 1C107 AND 1C507.

- a. Ceramic powders of titanium diboride (TiB₂) (CAS 12045-63-5) 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. Not used;
- c. Ceramic-"matrix" "composite" materials as follows:
 - 1. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with any of the following:
 - a. Continuous fibres having all of the following:
 - 1. Being made from any of the following materials:
 - a. Al₂O₃ (CAS 1344-28-1); or
 - b. Si-C-N; and
 - 2. Having all of the following:
 - a. Tensile strength equal to or greater than 700 MPa at 1 273 K (1 000°C); and
 - b. Tensile creep resistance equal to or less than 1% creep strain at 100 MPa load and 1 273 K (1 000°C) for 100 hours.
 - b. Fibres having all of the following:
 - 1. Being 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 $12,7 \times 10^3$ m;
 - 2. Ceramic "matrix" "composite" materials, with a "matrix" formed of carbides or nitrides of silicon, zirconium or boron;
- d. Not used;

1C007 continued

- e. 'Precursor materials' specially designed for the "production" of materials specified in 1C007.c., as follows:
 - 1. Polydiorganosilanes;
 - 2. Polysilazanes;
 - 3. Polycarbosilazanes;
- f. Not used.

Technical Note:

For the purposes of 1C007, 'precursor materials' are special purpose polymeric or metallo-organic materials used for the "production" of silicon carbide, silicon nitride, or ceramics with silicon, carbon and nitrogen.

1C008 Non-fluorinated polymeric substances as follows:

a. Imides, as follows:

1. Bismaleimides;
2. Aromatic polyamide-imides (PAI) having a 'glass transition temperature (T_g)' exceeding 563 K (290°C);
3. Aromatic polyimides having a 'glass transition temperature (T_g)' exceeding 505 K (232°C);
4. Aromatic polyetherimides having a 'glass transition temperature (T_g)' exceeding 563 K (290°C);

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

N.B. For non-"fusible" aromatic polyimides in film, sheet, tape or ribbon form, see 1A003.

1C008 continued

- b. Not used;
- 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 563 K (290°C).

Technical Notes:

1. *For the purposes of 1C008.a.2. thermoplastic materials, 1C008.a.4. materials and 1C008.f. materials, the 'glass transition temperature (T_g)' is determined using the method described in ISO 11357-2:1999 or national equivalents*
2. *For the purposes of 1C008.a.2. thermosetting materials and 1C008.a.3. materials, the 'glass transition temperature (T_g)' is determined using the 3-point bend method described in ASTM D 7028-07 or equivalent national standard. The test is to be performed using a dry test specimen which has attained a minimum of 90% degree of cure as specified in ASTM E 2160-04 or equivalent national standard, and was cured using the combination of standard- and post-cure processes that yield the highest T_g .*

1C009 Unprocessed fluorinated compounds as follows:

- a. Not used;
- 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", as follows:

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

Technical Notes:

1. For the purposes of calculating "specific tensile strength", "specific modulus" or specific weight of "fibrous or filamentary materials" in 1C010.a., 1C010.b., 1C010.c. or 1C010.e.1.b., the tensile strength and modulus should be determined by using Method A described in ISO 10618:2004 or national equivalents.
 2. For the purposes of assessing the "specific tensile strength", "specific modulus" or specific weight of non-unidirectional "fibrous or filamentary materials" (e.g., fabrics, random mats or braids) in 1C010, this is to be based on the mechanical properties of the constituent unidirectional monofilaments (e.g., monofilaments, yarns, rovings or tows) prior to processing into the non-unidirectional "fibrous or filamentary materials".
- a. Organic "fibrous or filamentary materials", having all of the following:
 1. "Specific modulus" exceeding $12,7 \times 10^6$ m; and
 2. "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. "Specific modulus" exceeding $14,65 \times 10^6$ m; and

1C010.b. continued

2. "Specific tensile strength" exceeding $26,82 \times 10^4$ m;

Note: 1C010.b. does not control:

- a. "Fibrous or filamentary materials", for the repair of "civil aircraft" structures or laminates, having all of the following:
 1. An area not exceeding 1 m^2 ;
 2. A length not exceeding 2,5 m; and
 3. A width exceeding 15 mm;
 - b. Mechanically chopped, milled or cut carbon "fibrous or filamentary materials" 25,0 mm or less in length.
- c. Inorganic "fibrous or filamentary materials", having all of the following:
 1. Having any of the following:
 - a. Composed of 50% or more by weight silicon dioxide and having a "specific modulus" exceeding $2,54 \times 10^6$ m; or
 - b. Not specified in 1C010.c.1.a. and having a "specific modulus" exceeding $5,6 \times 10^6$ m; and
 2. Melting, softening, decomposition or sublimation point exceeding 1 922 K (1 649°C) in an inert environment;

Note: 1C010.c. does not control:

- a. Discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random mat form, containing 3% by weight or more silica, with a "specific modulus" of less than 10×10^6 m;
- b. Molybdenum and molybdenum alloy fibres;
- c. Boron fibres;
- d. Discontinuous ceramic fibres with a melting, softening, decomposition or sublimation point lower than 2 043 K (1 770°C) in an inert environment.

1C010 continued

- d. "Fibrous or filamentary materials", having any of the following:
 - 1. Composed of any of the following:
 - a. Polyetherimides specified in 1C008.a.; or
 - b. Materials specified in 1C008.d. 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.;

Technical Note:

For the purposes of 1C010.d.2., 'commingled' is filament to filament blending of thermoplastic fibres and reinforcement fibres in order to produce a fibre reinforcement "matrix" mix in total fibre form.

- e. Fully or partially resin-impregnated or pitch-impregnated "fibrous or filamentary materials" (prepregs), metal or carbon-coated "fibrous or filamentary materials" (preforms) or 'carbon fibre preforms', having all of the following:
 - 1. Having any of the following:
 - a. Inorganic "fibrous or filamentary materials" specified in 1C010.c.; or
 - b. Organic or carbon "fibrous or filamentary materials", having all of the following:
 - 1. "Specific modulus" exceeding $10,15 \times 10^6$ m; and
 - 2. "Specific tensile strength" exceeding $17,7 \times 10^4$ m; and
 - 2. Having any of the following:
 - a. Resin or pitch, specified in 1C008 or 1C009.b.;
 - b. 'Dynamic Mechanical Analysis glass transition temperature (DMA T_g)' equal to or exceeding 453 K (180°C) and having a phenolic resin; or

1C010.e.2. continued

- c. 'Dynamic Mechanical Analysis glass transition temperature (DMA T_g)' equal to or exceeding 505 K (232°C) and having a resin or pitch, not specified in 1C008 or 1C009.b., and not being a phenolic resin.

Note 1: Metal or carbon-coated "fibrous or filamentary materials" (preforms) or 'carbon fibre preforms', not impregnated with resin or pitch, are specified by "fibrous or filamentary materials" in 1C010.a., 1C010.b. or 1C010.c.

Note 2: 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, having all the following:
 - 1. An area not exceeding 1 m²;
 - 2. A length not exceeding 2,5 m; and
 - 3. A width exceeding 15 mm.
- b. Fully or partially resin-impregnated or pitch-impregnated mechanically chopped, milled or cut carbon "fibrous or filamentary materials" 25,0 mm or less in length when using a resin or pitch other than those specified in 1C008 or 1C009.b.

Technical Notes:

- 1. For the purposes of 1C010.e. and Note 1, 'carbon fibre preforms' are 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".
- 2. For the purposes of 1C010.e.2. materials, 'Dynamic Mechanical Analysis glass transition temperature (DMA T_g)' is determined using the method described in ASTM D 7028-07, or equivalent national standard, on a dry test specimen. In the case of thermoset materials, degree of cure of a dry test specimen shall be a minimum of 90% as defined by ASTM E 2160-04 or equivalent national standard.

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 thereof;

Technical Note:

For the purposes of 1C011.a., the natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.

Note: *The metals or alloys specified in 1C011.a. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.*

- b. Boron or boron alloys, with a particle size of 60 µm or less, as follows:

1. Boron with a purity of 85% by weight or more;
2. Boron alloys with a boron content of 85% by weight or more;

Note: *The metals or alloys specified in 1C011.b. are controlled whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.*

- c. Guanidine nitrate (CAS 506-93-4);
- d. Nitroguanidine (NQ) (CAS 556-88-7);
- e. Iodine pentafluoride (CAS 7783-66-6).

N.B. *For metal powders mixed with other substances to form a mixture formulated for military purposes, see Military Goods Controls.*

1C012 Materials as follows:

Technical Note:

For the purposes of 1C012., 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.

- 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 or 9A112.a.

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 pyrolised 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/cm³ or greater, measured at 288 K (15°C), and having a grain size of 100 µm or less, usable for rocket nozzles and re-entry vehicle nose tips, which can be machined to any of the following products:

1. Cylinders having a diameter of 120 mm or greater and a length of 50 mm or greater;
2. Tubes having an inner diameter of 65 mm or greater and a wall thickness of 25 mm or greater and a length of 50 mm or greater; or
3. Blocks having a size of 120 mm x 120 mm x 50 mm or greater;

N.B. See also 0C004.

b. Pyrolytic or fibrous reinforced graphites, usable for rocket nozzles and reentry 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;

1C107 continued

- 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;
- f. Bulk machinable ceramic composite materials consisting of an 'Ultra High Temperature Ceramic (UHTC)' matrix with a melting point equal to or greater than 3 000°C and reinforced with fibres or filaments, usable for missile components (such as nose-tips, re-entry vehicles, leading edges, jet vanes, control surfaces or rocket motor throat inserts) in "missiles", space launch vehicles specified in 9A004, sounding rockets specified in 9A104 or 'missiles'.

Note: 1C107.f. does not control 'Ultra High Temperature Ceramic (UHTC)' materials in non-composite form.

Technical Note 1:

In 1C107.f. 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

Technical Note 2:

'Ultra High Temperature Ceramics (UHTC)' includes:

- 1. Titanium diboride (TiB_2);
- 2. Zirconium diboride (ZrB_2);
- 3. Niobium diboride (NbB_2);
- 4. Hafnium diboride (HfB_2);
- 5. Tantalum diboride (TaB_2);
- 6. Titanium carbide (TiC);
- 7. Zirconium carbide (ZrC);
- 8. Niobium carbide (NbC);
- 9. Hafnium carbide (HfC);
- 10. Tantalum carbide (TaC).

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

a. Propulsive substances:

1. Spherical or spheroidal aluminium powder other than that specified in the Military Goods Controls, in particle size 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 2591-1:1988 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 powders, other than that specified in the Military Goods Controls, as follows:

a. Metal powders of zirconium, beryllium or magnesium, or alloys of these metals, if at least 90% of the total particles by particle volume or weight are made up of particles of less than 60 μm (determined by measurement techniques such as using a sieve, laser diffraction or optical scanning), whether spherical, atomised, spheroidal, flaked or ground, consisting 97% by weight or more of any of the following:

1. Zirconium;
2. Beryllium; or
3. Magnesium;

Technical Note:

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

1C111.a.2. continued

- b. Metal powders of either boron or boron alloys with a boron content of 85% or more by weight, if at least 90% of the total particles by particle volume or weight are made up of particles of less than 60 µm (determined by measurement techniques such as using a sieve, laser diffraction or optical scanning), whether spherical, atomised, spheroidal, flaked or ground;

Note: 1C111a.2.a. and 1C111a.2.b. controls powder mixtures with a multimodal particle distribution (e.g. mixtures of different grain sizes) if one or more modes are controlled.

- 3. Oxidiser substances usable in liquid propellant rocket engines as follows:
 - a. Dinitrogen trioxide (CAS 10544-73-7);
 - b. Nitrogen dioxide (CAS 10102-44-0)/dinitrogen tetroxide (CAS 10544-72-6);
 - c. Dinitrogen pentoxide (CAS 10102-03-1);
 - d. Mixed Oxides of Nitrogen (MON);

Technical Note:

Mixed Oxides of Nitrogen (MON) are solutions of Nitric Oxide (NO) in Dinitrogen Tetroxide/Nitrogen Dioxide (N₂O₄/NO₂) that can be used in missile systems. There are a range of compositions that can be denoted as MON_i or MON_{ij}, 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.

1C111.a. continued

4. Hydrazine derivatives as follows:

N.B. *SEE ALSO MILITARY GOODS CONTROLS.*

- a. Trimethylhydrazine (CAS 1741-01-1);
- b. Tetramethylhydrazine (CAS 6415-12-9);
- c. N,N-Diallylhydrazine (CAS 5164-11-4);
- d. Allylhydrazine (CAS 7422-78-8);
- e. Ethylene dihydrazine (CAS 6068-98-0);
- f. Monomethylhydrazine dinitrate;
- g. Unsymmetrical dimethylhydrazine nitrate;
- h. Hydrazinium azide (CAS 14546-44-2);
- i. 1,1-Dimethylhydrazinium azide (CAS 227955-52-4) / 1,2-Dimethylhydrazinium azide (CAS 299177-50-7);
- j. Hydrazinium dinitrate (CAS 13464-98-7);
- k. Diimido oxalic acid dihydrazine (CAS 3457-37-2);
- l. 2-hydroxyethylhydrazine nitrate (HEHN);
- m. See Military Goods Controls for Hydrazinium perchlorate;
- n. Hydrazinium diperchlorate (CAS 13812-39-0);
- o. Methylhydrazine nitrate (MHN) (CAS 29674-96-2);
- p. 1,1-Diethylhydrazine nitrate (DEHN) / 1,2-Diethylhydrazine nitrate (DEHN) (CAS 363453-17-2);
- q. 3,6-Dihydrazino tetrazine nitrate (1,4-dihydrazine nitrate) (DHTN);

1C111.a. continued

5. High energy density materials, other than that specified in the Military Goods Controls, usable in 'missiles' or unmanned aerial vehicles specified in 9A012 or 9A112.a.;
 - a. Mixed fuel that incorporate both solid and liquid fuels, such as boron slurry, having a mass-based energy density of 40×10^6 J/kg or greater;
 - b. Other high energy density fuels and fuel additives (e.g., cubane, ionic solutions, JP-10) having a volume-based energy density of $37,5 \times 10^9$ J/m³ or greater, measured at 20°C and one atmosphere (101,325 kPa) pressure;

Note: 1C111.a.5.b. does not control fossil refined fuels and biofuels produced from vegetables, including fuels for engines certified for use in civil aviation, unless specially formulated for 'missiles' or unmanned aerial vehicles specified in 9A012 or 9A112.a..

Technical Note:

In 1C111.a.5. 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

6. Hydrazine replacement fuels as follows:
 - a. 2-Dimethylaminoethylazide (DMAZ) (CAS 86147-04-8);

1C111 continued

b. Polymeric substances:

1. Carboxy-terminated polybutadiene (including carboxyl-terminated polybutadiene) (CTPB);
2. Hydroxy-terminated polybutadiene (including hydroxyl-terminated polybutadiene) (HTPB) (CAS 69102-90-5), other than that specified in the Military Goods Controls;
3. Polybutadiene-acrylic acid (PBAA);
4. Polybutadiene-acrylic acid-acrylonitrile (PBAN) (CAS 25265-19-4 / CAS 68891-50-9);
5. Polytetrahydrofuran polyethylene glycol (TPEG);

Technical Note:

Polytetrahydrofuran polyethylene glycol (TPEG) is a block co-polymer of poly 1,4-Butanediol (CAS 110-63-4) and polyethylene glycol (PEG) (CAS 25322-68-3).

6. SEE MILITARY GOODS CONTROLS FOR polyglycidyl nitrate (PGN or poly-GLYN) (CAS 27814-48- 8).

c. Other propellant additives and agents:

1. SEE MILITARY GOODS CONTROLS FOR Carboranes, decaboranes, pentaboranes and derivatives thereof;
2. Triethylene glycol dinitrate (TEGDN) (CAS 111-22-8);
3. 2-Nitrodiphenylamine (CAS 119-75-5);
4. SEE MILITARY GOODS CONTROLS FOR trimethylolethane trinitrate (TMETN) (CAS 3032-55-1);
5. Diethylene glycol dinitrate (DEGDN) (CAS 693-21-0);
6. Ferrocene derivatives as follows:

1C111.c.6. continued

- a. SEE MILITARY GOODS CONTROLS FOR catocene (CAS 37206-42-1);
- b. SEE MILITARY GOODS CONTROLS FOR Ethyl ferrocene (CAS 1273-89-8);
- c. SEE MILITARY GOODS CONTROLS FOR n-Propyl ferrocene (CAS 1273-92-3)/iso-propyl ferrocene (CAS 12126-81-7);
- d. SEE MILITARY GOODS CONTROLS FOR n-butyl ferrocene (CAS 31904-29-7);
- e. SEE MILITARY GOODS CONTROLS FOR Pentyl ferrocene (CAS 1274-00-6);
- f. SEE MILITARY GOODS CONTROLS FOR Dicyclopentyl ferrocene (CAS 125861-17-8);
- g. SEE MILITARY GOODS CONTROLS FOR Dicyclohexyl ferrocene;
- h. SEE MILITARY GOODS CONTROLS FOR Diethyl ferrocene (CAS 1273-97-8);
- i. SEE MILITARY GOODS CONTROLS FOR Dipropyl ferrocene;
- j. SEE MILITARY GOODS CONTROLS FOR Dibutyl ferrocene (CAS 1274-08-4);
- k. SEE MILITARY GOODS CONTROLS FOR Dihexyl ferrocene (CAS 93894-59-8);
- l. SEE MILITARY GOODS CONTROLS FOR Acetyl ferrocene (CAS 1271-55-2) / 1,1'-diacetyl ferrocene (CAS 1273-94-5);
- m. SEE MILITARY GOODS CONTROLS FOR Ferrocene carboxylic acid (CAS 1271-42-7) / 1,1'-Ferrocenedicarboxylic acid (CAS 1293-87-4);

1C111.c.6. continued

- n. SEE MILITARY GOODS CONTROLS FOR butacene (CAS 125856-62-4);
- o. Other ferrocene derivatives usable as rocket propellant burning rate modifiers, other than those specified in the Military Goods Controls.

Note: 1C111.c.6.o. does not control ferrocene derivatives that contain a six carbon aromatic functional group attached to the ferrocene molecule.

- 7. 4,5-Diazidomethyl-2-methyl-1,2,3-triazole (iso-DAMTR), other than that specified in the Military Goods Controls.

1C111 continued

- d. 'Gel propellants', other than that specified in the Military Goods Controls, specifically formulated for use in 'missiles'.

Technical Notes:

1. In 1C111.d. a 'gel propellant' is a fuel or oxidiser formulation using a gellant such as silicates, kaolin (clay), carbon or any polymeric gellant.
2. In 1C111.d. a 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

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

1C116 Maraging steels, useable in 'missiles', having all of the following:

N.B. SEE ALSO 1C216.

- a. Having an ultimate tensile strength, measured at 293 K (20°C), equal to or greater than:
 - 1. 0,9 GPa in the solution annealed stage; or
 - 2. 1,5 GPa in the precipitation hardened stage; and
- b. Any of the following forms:
 - 1. Sheet, plate or tubing with a wall or plate thickness equal to or less than 5,0 mm;
 - 2. Tubular forms with a wall thickness equal to or less than 50 mm and having an inner diameter equal to or greater than 270 mm.

Technical Note 1:

Maraging steels are iron alloys:

- 1. *Generally characterised by high nickel content, carbon content of less than or equal to 0,03% by weight, and the use of substitutional elements or precipitates to produce strengthening and age-hardening of the alloy; and*
- 2. *Subjected to heat treatment cycles to facilitate the martensitic transformation process (solution annealed stage) and subsequently age hardened (precipitation hardened stage).*

Technical Note 2:

In 1C116 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

1C117 Materials for the fabrication of 'missiles' components as follows:

- a. Tungsten and alloys in particulate form with a tungsten content of 97% by weight or more and a particle size of 50×10^{-6} m (50 μ m) or less;
- b. Molybdenum and alloys in particulate form with a molybdenum content of 97% by weight or more and a particle size of 50×10^{-6} m (50 μ m) or less;
- c. Tungsten materials in solid form having all of the following:
 1. Any of the following material compositions:
 - a. Tungsten and alloys containing 97% by weight or more of tungsten;
 - b. Copper infiltrated tungsten containing 80% by weight or more of tungsten; or
 - c. Silver infiltrated tungsten containing 80% by weight or more of tungsten; and
 2. Able to be machined to any of the following products:
 - a. Cylinders having a diameter of 120 mm or greater and a length of 50 mm or greater;
 - b. 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
 - c. Blocks having a size of 120 mm by 120 mm by 50 mm or greater.

Technical Note:

In 1C117 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

- 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% by weight of chromium and 4,5 - 7,0% by weight of nickel;
 - 2. Having a titanium content of greater than 0,10% by weight; and
 - 3. A ferritic-austenitic microstructure (also referred to as a two-phase microstructure) of which at least 10% by volume (according to ASTM E-1181-87 or national equivalents) is austenite; 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 preregs, 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 $23,5 \times 10^4$ m or greater;

Note: 1C210.a. does not control aramid 'fibrous or filamentary materials' having 0,25% by weight or more 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 $7,62 \times 10^4$ m or greater;

c. Thermoset resin impregnated continuous "yarns", "rovings", "tows" or "tapes" with a width of 15 mm or less (preregs), 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 1 950 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, other than that specified in 1C117, 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 ppm by weight of metallic impurities other than magnesium; and
- b. Containing less than 10 ppm by weight of boron.

- 1C228 Magnesium having both of the following characteristics:
- Containing less than 200 ppm by weight of metallic impurities other than calcium; and
 - Containing less than 10 ppm by weight of boron.
- 1C229 Bismuth having both of the following characteristics:
- A purity of 99,99% or greater by weight; and
 - Containing less than 10 ppm 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, other than that specified in the Military Goods Controls.
- N.B. SEE ALSO MILITARY GOODS CONTROLS.*
- Note: 1C230 does not control the following:*
- Metal windows for X-ray machines, or for bore-hole logging devices;*
 - Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits;*
 - Beryl (silicate of beryllium and aluminium) in the form of emeralds or aquamarines.*
- 1C231 Hafnium metal, alloys containing more than 60% hafnium by weight, hafnium compounds containing more than 60% hafnium by weight, manufactures thereof, and waste or scrap of any of the foregoing.
- 1C232 Helium-3 (^3He), mixtures containing helium-3, and products or devices containing any of the foregoing.
- Note: 1C232 does not control a product or device containing less than 1 g of helium-3.*

- 1C233 Lithium enriched in the lithium-6 (^6Li) isotope to greater than its natural isotopic abundance, and products or devices containing enriched lithium, as follows: elemental lithium, alloys, compounds, mixtures containing lithium, manufactures thereof, waste or scrap of any of the foregoing.

Note: 1C233 does not control thermoluminescent dosimeters.

Technical Note:

The natural isotopic abundance of lithium-6 is approximately 6,5 weight per cent (7,5 atom per cent).

- 1C234 Zirconium with a hafnium content of less than 1 part hafnium to 500 parts zirconium by weight, as follows: metal, alloys containing more than 50% zirconium by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing, other than those specified in 0A001.f.

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 $1,48 \times 10^3 \text{ GBq}$ (40 Ci) of tritium.

- 1C236 'Radionuclides' appropriate for making neutron sources based on alpha-n reaction, other than those specified in 0C001 and 1C012.a., in the following forms:

- a. Elemental;
- b. Compounds having a total activity of 37 GBq/kg (1 Ci/kg) or greater;
- c. Mixtures having a total 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 activity.

Technical Note:

In 1C236 'radionuclides' are any of the following:

- Actinium-225 (^{225}Ac)
- Actinium-227 (^{227}Ac)
- Californium-253 (^{253}Cf)
- Curium-240 (^{240}Cm)
- Curium-241 (^{241}Cm)
- Curium-242 (^{242}Cm)

1C236 Technical Note continued

- Curium-243 (^{243}Cm)
- Curium-244 (^{244}Cm)
- Einsteinium-253 (^{253}Es)
- Einsteinium-254 (^{254}Es)
- Gadolinium-148 (^{148}Gd)
- Plutonium-236 (^{236}Pu)
- Plutonium-238 (^{238}Pu)
- Polonium-208 (^{208}Po)
- Polonium-209 (^{209}Po)
- Polonium-210 (^{210}Po)
- Radium-223 (^{223}Ra)
- Thorium-227 (^{227}Th)
- Thorium-228 (^{228}Th)
- Uranium-230 (^{230}U)
- Uranium-232 (^{232}U)

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 $1,8 \text{ g/cm}^3$ 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 µm measured by American Society for Testing and Materials (ASTM) B330 standard;
- b. Porous nickel metal produced from materials specified in 1C240.a.

Note: 1C240 does not control the following:

- a. Filamentary nickel powders;*
- b. Single porous nickel sheets with an area of 1 000 cm² per sheet or less.*

Technical Note:

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

1C241 Rhenium, and alloys containing 90% by weight or more rhenium; and alloys of rhenium and tungsten containing 90% by weight or more of any combination of rhenium and tungsten, other than those specified in 1C226, having both of the following characteristics:

- a. In forms with a hollow cylindrical symmetry (including cylinder segments) with an inside diameter between 100 and 300 mm; and
- b. A mass greater than 20 kg.

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 (CAS 111-48-8);
2. Phosphorus oxychloride (CAS 10025-87-3);
3. Dimethyl methylphosphonate (CAS 756-79-6);
4. SEE MILITARY GOODS CONTROLS for Methyl phosphonyl difluoride (CAS 676-99-3);
5. Methyl phosphonyl dichloride (CAS 676-97-1);
6. Dimethyl phosphite (DMP) (CAS 868-85-9);
7. Phosphorus trichloride (CAS 7719-12-2);
8. Trimethyl phosphite (TMP) (CAS 121-45-9);
9. Thionyl chloride (CAS 7719-09-7);
10. 3-Hydroxy-1-methylpiperidine (CAS 3554-74-3);
11. N,N-Diisopropyl-(beta)-aminoethyl chloride (CAS 96-79-7);
12. N,N-Diisopropyl-(beta)-aminoethane thiol (CAS 5842-07-9);
13. 3-Quinuclidinol (CAS 1619-34-7);
14. Potassium fluoride (CAS 7789-23-3);
15. 2-Chloroethanol (CAS 107-07-3);
16. Dimethylamine (CAS 124-40-3);
17. Diethyl ethylphosphonate (CAS 78-38-6);
18. Diethyl N,N-dimethylphosphoramidate (CAS 2404-03-7);
19. Diethyl phosphite (CAS 762-04-9);
20. Dimethylamine hydrochloride (CAS 506-59-2);
21. Ethyl phosphinyl dichloride (CAS 1498-40-4);
22. Ethyl phosphonyl dichloride (CAS 1066-50-8);
23. SEE MILITARY GOODS CONTROLS for Ethyl phosphonyl difluoride (CAS 753-98-0);
24. Hydrogen fluoride (CAS 7664-39-3);
25. Methyl benzilate (CAS 76-89-1);

1C350 continued

26. Methyl phosphinyl dichloride (CAS 676-83-5);
27. N,N-Diisopropyl-(beta)-amino ethanol (CAS 96-80-0);
28. Pinacolyl alcohol (CAS 464-07-3);
29. SEE MILITARY GOODS CONTROLS for O-Ethyl O-2-diisopropylaminoethyl methylphosphonite (QL) (CAS 57856-11-8);
30. Triethyl phosphite (CAS 122-52-1);
31. Arsenic trichloride (CAS 7784-34-1);
32. Benzilic acid (CAS 76-93-7);
33. Diethyl methylphosphonite (CAS 15715-41-0);
34. Dimethyl ethylphosphonate (CAS 6163-75-3);
35. Ethyl phosphinyl difluoride (CAS 430-78-4);
36. Methyl phosphinyl difluoride (CAS 753-59-3);
37. 3-Quinuclidone (CAS 3731-38-2);
38. Phosphorus pentachloride (CAS 10026-13-8);
39. Pinacolone (CAS 75-97-8);
40. Potassium cyanide (CAS 151-50-8);
41. Potassium bifluoride (CAS 7789-29-9);
42. Ammonium hydrogen fluoride or ammonium bifluoride (CAS 1341-49-7);
43. Sodium fluoride (CAS 7681-49-4);
44. Sodium bifluoride (CAS 1333-83-1);
45. Sodium cyanide (CAS 143-33-9);
46. Triethanolamine (CAS 102-71-6);
47. Phosphorus pentasulphide (CAS 1314-80-3);
48. Di-isopropylamine (CAS 108-18-9);
49. Diethylaminoethanol (CAS 100-37-8);

1C350 continued

50. Sodium sulphide (CAS 1313-82-2);
51. Sulphur monochloride (CAS 10025-67-9);
52. Sulphur dichloride (CAS 10545-99-0);
53. Triethanolamine hydrochloride (CAS 637-39-8);
54. N,N-Diisopropyl-(beta)-aminoethyl chloride hydrochloride (CAS 4261-68-1);
55. Methylphosphonic acid (CAS 993-13-5);
56. Diethyl methylphosphonate (CAS 683-08-9);
57. N,N-Dimethylaminophosphoryl dichloride (CAS 677-43-0);
58. Triisopropyl phosphite (CAS 116-17-6);
59. Ethyldiethanolamine (CAS 139-87-7);
60. O,O-Diethyl phosphorothioate (CAS 2465-65-8);
61. O,O-Diethyl phosphorodithioate (CAS 298-06-6);
62. Sodium hexafluorosilicate (CAS 16893-85-9);
63. Methylphosphonothioic dichloride (CAS 676-98-2);
64. Diethylamine (CAS 109-89-7);
65. N,N-Diisopropylaminoethanethiol hydrochloride (CAS 41480-75-5);
66. Methyl dichlorophosphate (CAS 677-24-7);
67. Ethyl dichlorophosphate (CAS 1498-51-7);
68. Methyl difluorophosphate (CAS 22382-13-4);
69. Ethyl difluorophosphate (CAS 460-52-6);
70. Diethyl chlorophosphite (CAS 589-57-1);
71. Methyl chlorofluorophosphate (CAS 754-01-8);
72. Ethyl chlorofluorophosphate (CAS 762-77-6);
73. N,N-Dimethylformamidine (CAS 44205-42-7);
74. N,N-Diethylformamidine (CAS 90324-67-7);
75. N,N-Dipropylformamidine (CAS 48044-20-8);
76. N,N-Diisopropylformamidine (CAS 857522-08-8);
77. N,N-Dimethylacetamidine (CAS 2909-14-0);
78. N,N-Diethylacetamidine (CAS 14277-06-6);
79. N,N-Dipropylacetamidine (CAS 1339586-99-0);
80. N,N-Dimethylpropanamidine (CAS 56776-14-8);
81. N,N-Diethylpropanamidine (CAS 84764-73-8);
82. N,N-Dipropylpropanamidine (CAS 1341496-89-6);
83. N,N-Dimethylbutanamidine (CAS 1340437-35-5);
84. N,N-Diethylbutanamidine (CAS 53510-30-8);
85. N,N-Dipropylbutanamidine (CAS 1342422-35-8);
86. N,N-Diisopropylbutanamidine (CAS 1315467-17-4);
87. N,N-Dimethylisobutanamidine (CAS 321881-25-8);
88. N,N-Diethylisobutanamidine (CAS 1342789-47-2);
89. N,N-Dipropylisobutanamidine (CAS 1342700-45-1);
90. Dipropylamine (CAS 142-84-7);
91. 1,1,3,3-Tetraethylguanidine (CAS 13439-87-7).

1C350 continued

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, .63 and .65 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, .63 and .65 in which no individually specified chemical constitutes more than 30% by the weight of the mixture.*

Note 3: *1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in entries 1C350.2, .6, .7, .8, .9, .10, .14, .15, .16, .19, .20, .24, .25, .30, .37, .38, .39, .40, .41, .42, .43, .44, .45, .46, .47, .48, .49, .50, .51, .52, .53, .58, .59, .60, .61, .62, .64, .66, .67, .68, .69, .70, .71, .72, .73, .74, .75, .76, .77, .78, .79, .80, .81, .82, .83, .84, .85, .86, .87, .88, .89 and .90 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 and animal pathogens 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. African horse sickness virus;
 2. African swine fever virus;
 3. Andes virus;
 4. Avian influenza virus, which are:
 - a. Uncharacterised; or
 - b. Defined in Annex I(2) EC Directive 2005/94/EC (O.J. L.10 14.1.2006 p.16) 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 of the subtypes H5 or H7 with genome sequences codified for multiple basic amino acids at the cleavage site of the haemagglutinin molecule similar to that observed for other HPAI viruses, indicating that the haemagglutinin molecule can be cleaved by a host ubiquitous protease;
 5. Bluetongue virus;
 6. Chapare virus;
 7. Chikungunya virus;
 8. Choclo virus;
 9. Crimean-Congo hemorrhagic fever virus;
 10. Not used;
 11. Dobrava-Belgrade virus;
 12. Eastern equine encephalitis virus;
 13. Ebolavirus: all members of the Ebolavirus genus;
 14. Foot-and-mouth disease virus;
 15. Goatpox virus;
 16. Guanarito virus;
 17. Hantaan virus;
 18. Hendra virus (Equine morbillivirus);
 19. Suid herpesvirus 1 (Pseudorabies virus; Aujeszky's disease);

1C351.a. continued

20. Classical swine fever virus (Hog cholera virus);
21. Japanese encephalitis virus;
22. Junin virus;
23. Kyasanur Forest disease virus;
24. Laguna Negra virus;
25. Lassa virus;
26. Louping ill virus;
27. Lujo virus;
28. Lumpy skin disease virus;
29. Lymphocytic choriomeningitis virus;
30. Machupo virus;
31. Marburgvirus: all members of the Marburgvirus genus;
32. Monkeypox virus;
33. Murray Valley encephalitis virus;
34. Newcastle disease virus;
35. Nipah virus;
36. Omsk hemorrhagic fever virus;
37. Oropouche virus;
38. Peste-des-petits-ruminants virus;
39. Swine vesicular disease virus;
40. Powassan virus;
41. Rabies virus and all other members of the Lyssavirus genus;
42. Rift Valley fever virus;
43. Rinderpest virus;
44. Rocio virus;
45. Sabia virus;
46. Seoul virus;
47. Sheeppox virus;
48. Sin Nombre virus;
49. St. Louis encephalitis virus;
50. Porcine Teschovirus;

1C351.a. continued

51. Tick-borne encephalitis virus (Far Eastern subtype);
 52. Variola virus;
 53. Venezuelan equine encephalitis virus;
 54. Vesicular stomatitis virus;
 55. Western equine encephalitis virus;
 56. Yellow fever virus;
 57. Severe acute respiratory syndrome-related coronavirus (SARS-related coronavirus);
 58. Reconstructed 1918 influenza virus;
 59. Middle East respiratory syndrome-related coronavirus (MERS-related coronavirus);
- b. Not used;
- 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. *Burkholderia mallei* (*Pseudomonas mallei*);
 6. *Burkholderia pseudomallei* (*Pseudomonas pseudomallei*);
 7. *Chlamydia psittaci* (*Chlamydophila psittaci*);
 8. *Clostridium argentinense* (formerly known as *Clostridium botulinum* Type G), botulinum neurotoxin producing strains;
 9. *Clostridium baratii*, botulinum neurotoxin producing strains;
 10. *Clostridium botulinum*;
 11. *Clostridium butyricum*, botulinum neurotoxin producing strains;
 12. *Clostridium perfringens* epsilon toxin producing types;
 13. *Coxiella burnetii*;
 14. *Francisella tularensis*;

1C351.c. continued

15. *Mycoplasma capricolum* subspecies *capripneumoniae* (strain F38);
16. *Mycoplasma mycoides* subspecies *mycoides* SC (small colony);
17. *Rickettsia prowazekii*;
18. *Salmonella enterica* subspecies *enterica* serovar Typhi (*Salmonella typhi*);
19. Shiga toxin producing *Escherichia coli* (STEC) of serogroups O26, O45, O103, O104, O111, O121, O145, O157, and other shiga toxin producing serogroups;

Note:

Shiga toxin producing Escherichia coli (STEC) includes inter alia enterohaemorrhagic E. coli (EHEC), verotoxin producing E. coli (VTEC) or verocytotoxin producing E. coli (VTEC).

20. *Shigella dysenteriae*;
21. *Vibrio cholerae*;
22. *Yersinia pestis*;

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- d. "Toxins", as follows, and "sub-unit of toxins" thereof:
1. Botulinum neurotoxins;
 2. Clostridium perfringens alpha, beta 1, beta 2, epsilon and iota toxins;
 3. Conotoxins;
 4. Ricin;
 5. Saxitoxin;
 6. Shiga toxins (shiga-like toxins, verotoxins and verocytotoxins)
 7. Staphylococcus aureus enterotoxins, hemolysin alpha toxin, and toxic shock syndrome toxin (formerly known as Staphylococcus enterotoxin F);
 8. Tetrodotoxin;
 9. Not used;
 10. Microcystins (Cyanginosins);
 11. Aflatoxins;
 12. Abrin;
 13. Not used;
 14. Diacetoxyscirpenol;
 15. T-2 toxin;
 16. HT-2 toxin;
 17. Modeccin;
 18. Volkensin;
 19. Viscumin (Viscum Album Lectin 1);
 20. Brevetoxins;
 21. Gonyautoxins;
 22. Nodularins;
 23. Palytoxin;
 24. Neosaxitoxin (NEO).

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

1. Are pharmaceutical formulations designed for human administration in the treatment of medical conditions;
2. Are pre-packaged for distribution as medical products;
3. Are authorised by a state authority to be marketed as medical products.

1C351 continued

- 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".

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

- a. Any 'genetically-modified organism' which contains, or 'genetic element' that codes for, any of the following:
 - 1. Any gene, genes, translated product or translated products, specific to any virus specified in 1C351.a. or 1C354.a.;
 - 2. Any gene or genes specific to any bacterium specified in 1C351.c. or 1C354.b. or fungus specified in 1C351.e. or 1C354.c., and which is any of the following:
 - a. In itself or through its transcribed or translated products represents a significant hazard to human, animal or plant health; or
 - b. Could 'endow or enhance pathogenicity'; or
 - 3. Any "toxins" specified in 1C351.d. or "sub-units of toxins" therefor;
- b. Not used.

Technical Notes:

1. *'Genetically-modified organisms' include organisms in which the nucleic acid sequences have been created or altered by deliberate molecular manipulation.*
2. *'Genetic elements' include inter alia chromosomes, genomes, plasmids, transposons, vectors and inactivated organisms containing recoverable nucleic acid fragments, whether genetically modified or unmodified, or chemically synthesised in whole or in part. For the purposes of the genetic elements control, nucleic acids from an inactivated organism, virus, or sample are considered recoverable if the inactivation and preparation of the material is intended or known to facilitate isolation, purification, amplification, detection, or identification of nucleic acids.*
3. *'Endow or enhance pathogenicity' is defined as when the insertion or integration of the nucleic acid sequence or sequences is/are likely to enable or increase a recipient organism's ability to be used to deliberately cause disease or death. This might include alterations to, inter alia: virulence, transmissibility, stability, route of infection, host range, reproducibility, ability to evade or suppress host immunity, resistance to medical countermeasures, or detectability.*

Note 1: *1C353 does not control nucleic acid sequences of shiga toxin producing Escherichia coli of serogroups O26, O45, O103, O104, O111, O121, O145, O157, and other shiga toxin producing serogroups, other than those genetic elements coding for shiga toxin, or for its subunits.*

Note 2: *1C353 does not control "vaccines".*

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. Andean potato latent virus (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 citri* pv. *citri* (*Xanthomonas axonopodis* pv. *citri*, *Xanthomonas campestris* pv. *citri*);
 - 3. *Xanthomonas oryzae* pv. *oryzae* (*Pseudomonas campestris* pv. *oryzae*);
 - 4. *Clavibacter michiganensis* subsp. *sepedonicus* (*Clavibacter sepedonicus*, *Clavibacter michiganense* subsp. *sepedonicus*, *Corynebacterium michiganensis* subsp. *sepedonicum* or *Corynebacterium sepedonicum*);
 - 5. *Ralstonia solanacearum*, race 3, biovar 2;
- 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 kahawae* (*Colletotrichum coffeanum* var. *virulans*);
 - 2. *Bipolaris oryzae* (*Cochliobolus miyabeanus*, *Helminthosporium oryzae*);
 - 3. *Pseudocercospora ulei* (*Microcyclus ulei*, *Dothidella ulei*);
 - 4. *Puccinia graminis* ssp. *graminis* var. *graminis* / *Puccinia graminis* ssp. *graminis* var. *stakmanii* (*Puccinia graminis* [syn. *Puccinia graminis* f. sp. *tritici*]);
 - 5. *Puccinia striiformis* (syn. *Puccinia glumarum*);
 - 6. *Magnaporthe oryzae* (*Pyricularia oryzae*);
 - 7. *Peronosclerospora philippinensis* (*Peronosclerospora sacchari*);
 - 8. *Sclerophthora rayssiae* var. *zeae*;
 - 9. *Synchytrium endobioticum*;
 - 10. *Tilletia indica*;
 - 11. *Thecaphora solani*.

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 (CAS 78-53-5) and corresponding alkylated or protonated salts;
2. PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene (CAS 382-21-8);
3. SEE MILITARY GOODS CONTROLS FOR BZ: 3-Quinuclidinyl benzilate (CAS 6581-06-2);
4. Phosgene: Carbonyl dichloride (CAS 75-44-5);
5. Cyanogen chloride (CAS 506-77-4);
6. Hydrogen cyanide (CAS 74-90-8);
7. Chloropicrin: Trichloronitromethane (CAS 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.

1C450 continued

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 (CAS 944-22-9);

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 (CAS 96-80-0) and N,N-Diethylaminoethanol (CAS 100-37-8) which are specified in 1C350;

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

- a. N,N-Dimethylaminoethanol (CAS 108-01-0) and corresponding protonated salts;
- b. Protonated salts of N,N-Diethylaminoethanol (CAS 100-37-8);

1C450.b. continued

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 (CAS 5842-07-9) and N,N-Diisopropylaminoethanethiol hydrochloride (CAS 41480-75-5) which are specified in 1C350;
7. See 1C350 for ethyldiethanolamine (CAS 139-87-7);
8. Methyldiethanolamine (CAS 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.

1C507 Ceramic powders, ceramic-"matrix" "composite" materials and 'precursor materials', as follows:

- c. Ceramic-"matrix" "composite" materials as follows:
 1. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with:
 - a. Continuous fibres, not specified in 1C007.c.1.a., having all of the following:
 1. Being made from any of the following Al_2O_3 -based materials or a combination thereof:
 - a. Al_2O_3 ; or
 - b. Mullite ($3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$); and
 2. Having all of the following:
 - a. Tensile strength equal to or greater than 700 MPa at 1 273 K (1 000°C); and

- b. Tensile creep resistance equal to or less than 1% creep strain at 100 MPa load and 1 273 K (1 000°C) for 100 hours.

1C513 'High-entropy alloy' or "refractory metal and alloy" powders, not specified in 1C002, having a surface modified with 'inoculants'.

Technical Notes:

For the purposes of 1C513.:

1. *'High-entropy alloys' are alloys having at least 5 principal metallic elements, each having concentration within the range of 5 to 35 atomic percent, from the following list: Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb, Mo, Hf, Ta or W.*
2. *'Inoculants' are additives that promote grain nucleation and increase the total area of grain boundaries to inhibit solidification defects.*

1D Software

- 1D001 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 1B001 to 1B003, 1B501 or 1B504.
- 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. or 1A004.d.
- 1D101 "Software" specially designed or modified for the operation or maintenance 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 1A002 to 1A005, 1A006.b., 1A007, 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 vinyl ether monomer;
- c. "Technology" for the design or "production" of the following ceramic powders or non-"composite" ceramic materials:
 1. Ceramic powders having all of the following:
 - 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. Any of the following total metallic impurities (excluding intentional additions):
 1. Less than 1 000 ppm for single oxides or carbides; or
 2. Less than 5 000 ppm for complex compounds or single nitrides; and

1E002.c.1. continued

- c. Being any of the following:
 - 1. Zirconia (CAS 1314-23-4) with an average particle size equal to or less than 1 μm and no more than 10% of the particles larger than 5 μm ; or
 - 2. Other ceramic powders with an average particle size equal to or less than 5 μm and no more than 10% of the particles larger than 10 μm ;
- 2. Non-"composite" ceramic materials composed of the materials specified in 1E002.c.1.;

Note: 1E002.c.2. does not control "technology" for abrasives.

- d. Not used;
- e. "Technology" for the installation, maintenance or repair of materials specified in 1C001;
- f. "Technology" for the repair of "composite" structures, laminates or materials specified in 1A002, 1C007.c. or 1C507.c.;

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" specially designed or modified to enable equipment to perform the functions of equipment specified in 1A004.c. or 1A004.d.

- 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" for 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, 1A007, 1A202, 1A225 to 1A227, 1B201, 1B225 to 1B235, 1C002.b.3. or .b.4., 1C010.b., 1C202, 1C210, 1C216, 1C225 to 1C241 or 1D201.
- 1E202 "Technology" according to the General Technology Note for the "development" or "production" of goods specified in 1A007, 1A202 or 1A225 to 1A227.
- 1E203 "Technology" according to the General Technology Note for the "development" of "software" specified in 1D201.

PART IV – Category 2

CATEGORY 2 - MATERIALS PROCESSING

2A Systems, Equipment and Components

N.B. For quiet running bearings, see the Military Goods Controls.

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

N.B. SEE ALSO 2A101.

- a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 or Class 2 (or national equivalents), or better, and having both 'rings' and 'rolling elements', made from monel or beryllium;

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

Technical Notes:

For the purposes of 2A001.a.:

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

- b. Not used;
- c. Active magnetic bearing systems using any of the following, and specially designed components therefor:
 - 1. Materials with flux densities of 2,0 T or greater and yield strengths greater than 414 MPa;
 - 2. All-electromagnetic 3D homopolar bias designs for actuators; or
 - 3. High temperature (450 K (177°C) and above) position sensors.

2A101 Radial ball bearings, other than those specified in 2A001, having all tolerances specified in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC-9 or other national equivalents), or better and having all of the following characteristics:

- a. An inner ring bore diameter between 12 mm and 50 mm;
- b. An outer ring outside diameter between 25 mm and 100 mm; and
- c. A width between 10 mm and 20 mm.

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 cm³ and 8 000 cm³; and
 - 2. Made of or coated with any of the following materials, or combination of the following materials, having an overall impurity level of 2% or less by weight:
 - a. Calcium fluoride (CaF₂);
 - b. Calcium zirconate (metazirconate) (CaZrO₃);
 - c. Cerium sulphide (Ce₂S₃);
 - d. Erbium oxide (erbia) (Er₂O₃);
 - e. Hafnium oxide (hafnia) (HfO₂);
 - f. Magnesium oxide (MgO);
 - g. Nitrided niobium-titanium-tungsten alloy (approximately 50% Nb, 30% Ti, 20% W);
 - h. Yttrium oxide (yttria) (Y₂O₃); or
 - i. Zirconium oxide (zirconia) (ZrO₂);
- b. Crucibles having both of the following characteristics:
 - 1. A volume of between 50 cm³ and 2 000 cm³; and
 - 2. Made of or lined with tantalum, having a purity of 99,9% or greater by weight;
- c. Crucibles having all of the following characteristics:
 - 1. A volume of between 50 cm³ and 2 000 cm³;
 - 2. Made of or lined with tantalum, having a purity of 98% or greater by weight; and
 - 3. Coated with tantalum carbide, nitride, boride, or any combination thereof.

2A226 Valves having all of the following characteristics:

- a. A 'nominal size' of 5 mm or greater;
- b. Having a bellows seal; and
- c. Wholly made of or lined with aluminium, aluminium alloy, nickel, or nickel alloy containing more than 60% nickel by weight.

Technical Note:

For valves with different inlet and outlet diameters, the 'nominal size' in 2A226 refers to the smallest diameter.

2B Test, Inspection and Production Equipment

Technical Notes:

1. *For the purposes of 2B, 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. *Wheel-dressing systems in grinding machines;*
 - b. *Parallel rotary axes designed for mounting of separate workpieces;*
 - c. *Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.*
3. *For the purposes of 2B, axis nomenclature shall be in accordance with ISO 841:2001, Industrial automation systems and integration - Numerical control of machines - Coordinate system and motion nomenclature.*
4. *For the purposes of 2B001 to 2B009, a "tilting spindle" is counted as a rotary axis.*
5. *For the purposes of 2B, 'stated "unidirectional positioning repeatability"' may be used for each machine tool model as an alternative to individual machine tests and is determined as follows:*

2B Technical Note 5 continued

- a. *Select five machines of a model to be evaluated;*
- b. *Measure the linear axis repeatability ($R_{\uparrow}, R_{\downarrow}$) according to ISO 230-2:2014 and evaluate "unidirectional positioning repeatability" for each axis of each of the five machines;*
- c. *Determine the arithmetic mean value of the "unidirectional positioning repeatability"-values for each axis of all five machines together. These arithmetic mean values of "unidirectional positioning repeatability" ($\overline{UPR}$) become the stated value of each axis for the model ($\overline{UPR}_x, \overline{UPR}_y, \dots$);*
- d. *Since the Category 2 list refers to each linear axis there will be as many 'stated "unidirectional positioning repeatability" values as there are linear axes;*
- e. *If any axis of a machine model not specified in 2B001.a. to 2B001.c. has a 'stated "unidirectional positioning repeatability" equal to or less than the specified "unidirectional positioning repeatability" of each machine tool model plus $0,7 \mu\text{m}$, the builder should be required to reaffirm the accuracy level once every eighteen months.*
6. *For the purposes of 2B001.a. to 2B001.c., measurement uncertainty for the "unidirectional positioning repeatability" of machine tools, as defined in the ISO 230-2:2014 or national equivalents, shall not be considered.*
7. *For the purposes of 2B001.a. to 2B001.c., the measurement of axes shall be made according to test procedures in 5.3.2. of ISO 230-2:2014. Tests for axes longer than 2 meters shall be made over 2 m segments. Axes longer than 4 m require multiple tests (e.g., two tests for axes longer than 4 m and up to 8 m, three tests for axes longer than 8 m and up to 12 m), each over 2 m segments and distributed in equal intervals over the axis length. Test segments are equally spaced along the full axis length, with any excess length equally divided at the beginning, in between, and at the end of the test segments. The smallest "unidirectional positioning repeatability"-value of all test segments is to be reported.*

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", as follows:

N.B. SEE ALSO 2B201.

Note 1: 2B001 does not control special purpose machine tools limited to the manufacture of gears. For such machines see 2B003.

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

- a. Crankshafts or camshafts;
- b. Tools or cutters;
- c. Extruder worms;
- d. Engraved or faceted jewellery parts; or
- e. Dental prostheses.

Note 3: A machine tool having at least two of the three turning, milling or grinding capabilities (e.g., a turning machine with milling capability), must be evaluated against each applicable entry 2B001.a., b. or c.

Note 4: A machine tool having an additive manufacturing capability in addition to a turning, milling or grinding capability must be evaluated against each applicable entry 2B001.a., .b. or .c.

N.B. For optical finishing machines, see 2B002.

2B001 continued

- a. Machine tools for turning having two or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
 - 1. "Unidirectional positioning repeatability" equal to or less (better) than 0,9 μm along one or more linear axis with a travel length less than 1,0 m; or
 - 2. "Unidirectional positioning repeatability" equal to or less (better) than 1,1 μm along one or more linear axis with a travel length equal to or greater than 1,0 m;

Note 1: 2B001.a. does not control turning machines specially designed for producing contact lenses, having all of the following:

- a. Machine controller limited to using ophthalmic based software for part programming data input; and
- b. No vacuum chucking.

Note 2: 2B001.a. does not control bar machines (Swissturn), limited to machining only bar feed thru, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling or milling capabilities for machining parts with diameters less than 42 mm.

- b. Machine tools for milling having any of the following:
 - 1. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control" having any of the following:
 - a. "Unidirectional positioning repeatability" equal to or less (better) than 0,9 μm along one or more linear axis with a travel length less than 1,0 m; or
 - b. "Unidirectional positioning repeatability" equal to or less (better) than 1,1 μm along one or more linear axis with a travel length equal to or greater than 1,0m;
 - 2. Five or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
 - a. "Unidirectional positioning repeatability" equal to or less (better) than 0,9 μm along one or more linear axis with a travel length less than 1,0 m;
 - b. "Unidirectional positioning repeatability" equal to or less (better) than 1,4 μm along one or more linear axis with a travel length equal to or greater than 1 m and less than 4 m; or
 - c. "Unidirectional positioning repeatability" equal to or less (better) than 6,0 μm (along one or more linear axis with a travel length equal to or greater than 4 m;

2B001.b. continued

3. A "unidirectional positioning repeatability" for jig boring machines, equal to or less (better) than 1,1 μm along one or more linear axis; or
4. Fly cutting machines having all of the following:
 - a. Spindle 'run-out' and 'camming' less (better) than 0,0004 mm Total Indicated Reading (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;

Technical Notes:

For the purposes of 2B001.b.4.a.:

1. *'Run-out' (out-of-true running) is the 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 (ISO 230-1:2012).*
2. *'Camming' (axial displacement) is 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 (ISO 230-1:2012).*

- c. Machine tools for grinding having any of the following:
 1. Having all of the following:
 - a. "Unidirectional positioning repeatability" equal to or less (better) than 1,1 μm along one or more linear axis; and
 - b. Three or four axes which can be coordinated simultaneously for "contouring control"; or
 2. Five or more axes which can be coordinated simultaneously for "contouring control" having any of the following:
 - a. "Unidirectional positioning repeatability" equal to or less (better) than 1,1 μm along one or more linear axis with a travel length less than 1 m;
 - b. "Unidirectional positioning repeatability" equal to or less (better) than 1,4 μm along one or more linear axis with a travel length equal to or greater than 1 m and less than 4 m; or
 - c. "Unidirectional positioning repeatability" equal to or less (better) than 6,0 μm along one or more linear axis with a travel length equal to or greater than 4 m;

2B001.c. continued

Note: 2B001.c. does not control grinding machine as follows:

- a. Cylindrical external, internal, and external-internal grinding machines, having all of the following:
 1. Limited to cylindrical grinding; and
 2. Limited to a maximum workpiece capacity of 150 mm outside diameter or length;
 - b. Machines designed specifically as jig grinders that do not have a z-axis or a w-axis, with a "unidirectional positioning repeatability" less (better) than 1,1 μm ;
 - c. 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:
 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. At least two rotary axes having all of the following:
 - a. Can be coordinated simultaneously for "contouring control"; and
 - b. 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 5m.

2B002 Numerically controlled optical finishing machine tools equipped for selective material removal 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. Four 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');
 - 3. 'Energetic particle beam finishing';
 - 4. 'Inflatable membrane tool finishing'; or
 - 5. 'Fluid jet finishing'.

2B002 continued

Technical Notes:

For the purposes of 2B002:

1. 'MRF' is a material removal process using an abrasive magnetic fluid whose viscosity is controlled by a magnetic field.
2. 'ERF' is a removal process using an abrasive fluid whose viscosity is controlled by an electric field.
3. 'Energetic particle beam finishing' uses Reactive Atom Plasmas (RAP) or ion-beams to selectively remove material.
4. 'Inflatable membrane tool finishing' is a process that uses a pressurized membrane that deforms to contact the workpiece over a small area.
5. 'Fluid jet finishing' makes use of a fluid stream for material removal.

2B003 "Numerically controlled" machine tools, specially designed for the shaving, finishing, grinding or honing of hardened ($R_c=40$ or more) spur, helical and double-helical gears having all of the following:

- a. A pitch diameter exceeding 1 250 mm;
- b. A face width of 15% of pitch diameter or larger; and
- c. A finished quality of American Gear Manufacturers Association (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. Having 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.

2B004 continued

Technical Note:

For the purposes of 2B004, 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 substrates specified in column 2, by processes shown in column 1 in the Table following 2E503, 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. A 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. Having 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 and 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 photoluminescence 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:
 - 1. Operating at reduced pressure controlled atmosphere (equal to or less than 10 kPa measured above and within 300 mm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 0,01 Pa prior to the spraying process; or
 - 2. Incorporating *in situ* coating thickness control;
- e. Sputter deposition production equipment capable of current densities of 0,1 mA/mm² or higher at a deposition rate of 15 µm/h or more;
- f. Cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;
- g. Ion plating production equipment capable of 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 (CVD), cathodic arc, sputter deposition, ion plating or ion implantation equipment, specially designed for cutting or machining tools.

2B006 Dimensional inspection or measuring systems, equipment, position feedback units and "electronic assemblies", as follows:

- a. Computer controlled or "numerical controlled" Coordinate Measuring Machines (CMM), having a three dimensional (volumetric) maximum permissible error of length measurement ($E_{0,MPE}$) at any point within the operating range of the machine (i.e., within the length of axes) equal to or less (better) than $(1,7 + L/1\ 000)\ \mu\text{m}$ (L is the measured length in mm), according to ISO 10360-2:2009;

Technical Note:

For the purposes of 2B006.a., the $E_{0,MPE}$ of the most accurate configuration of the CMM specified by the manufacturer (e.g., best of the following: probe, stylus length, motion parameters, environment) and with "all compensations available" shall be compared to the $1,7+L/1\ 000\ \mu\text{m}$ threshold.

N.B. SEE ALSO 2B206.

- b. Linear displacement measuring instruments or systems, linear position feedback units, and "electronic assemblies", as follows:

Note: *Interferometer and optical-encoder measuring systems containing a "laser" are only specified in 2B006.b.3 and 2B206.c.*

1. 'Non-contact type measuring systems' with a 'resolution' equal to or less (better) than $0,2\ \mu\text{m}$ within 0 to 0,2 mm of the 'measuring range';

2B006.b. continued

Technical Notes:

For the purposes of 2B006.b.1.:

1. *'Non -contact type measuring systems' are designed to measure the distance between the probe and measured object along a single vector, where the probe or measured object is in motion.*
2. *'Measuring range' means the distance between the minimum and maximum working distance.*
2. Linear position feedback units specially designed for machine tools and having an overall "accuracy" less (better) than $(800 + (600 \times L/1\ 000))$ nm (L equals effective length in mm);
3. Measuring systems having all of the following:
 - a. Containing a "laser";
 - b. A 'resolution' over their full scale of 0,200 nm or less (better); and
 - c. Capable of achieving a "measurement uncertainty" equal to or less (better) than $(1,6 + L/2\ 000)$ nm (L is the measured length in mm) at any point within a measuring range, when compensated for the refractive index of air and measured over a period of 30 seconds at a temperature of $20 \pm 0,01^\circ\text{C}$;
4. "Electronic assemblies" specially designed to provide feedback capability in systems specified in 2B006.b.3.;

Technical Note:

For the purposes of 2B006.b., 'resolution' is the least increment of a measuring device; on digital instruments, the least significant bit.

2B006 continued

- c. Rotary position feedback units specially designed for machine tools or angular displacement measuring instruments, having an angular position "accuracy" equal to or less (better) than 0,9 second of arc;

Note: 2B006.c. does not control optical instruments, such as autocollimators, using collimated light (e.g. "laser" light) to detect angular displacement of a mirror.

- d. Equipment for measuring surface roughness (including surface defects), by measuring optical scatter with a sensitivity of 0,5 nm or less (better).

Note: 2B006 includes machine tools, other than those specified in 2B001, that can be used as measuring machines if they meet or exceed the criteria specified for 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. Not used;
- b. Specially designed to comply with national safety standards applicable to potentially explosive munitions environments;

Note: 2B007.b. does not control "robots" specially designed for paint-spraying booths.

- 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 'Compound rotary tables' and "tilting spindles", specially designed for machine tools, as follows:

- a. Not used;
- b. Not used;
- c. 'Compound rotary tables' having all of the following:
 - 1. Designed for machine tools for turning, milling or grinding; and
 - 2. Two rotary axes designed to be coordinated simultaneously for "contouring control";

Technical Note:

For the purposes of 2B008.c., a 'compound rotary table' is a table allowing the workpiece to rotate and tilt about two non-parallel axes.

- d. "Tilting spindles" having all of the following :
 - 1. Designed for machine tools for turning, milling or grinding; and
 - 2. Designed to be coordinated simultaneously for "contouring control".

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. Three or more axes which can be coordinated simultaneously for "contouring control"; and
- b. A roller force more than 60 kN.

Technical Note:

For the purposes of 2B009, machines combining the function of spin-forming and flow-forming are 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, usable in the "production" of propulsion components and equipment (e.g. motor cases and interstages) for "missiles", and specially designed components as follows:
N.B. SEE ALSO 2B209.
- a. Flow-forming machines having all of the following:
 1. Equipped with, or, according to the manufacturer's technical specification, are capable of being equipped with "numerical control" units or computer control; and
 2. 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.

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 incorporating a digital controller' and employing feedback or closed loop techniques, capable of vibrating a system at an acceleration equal to or greater than 10 g rms between 20 Hz and 2 kHz while imparting forces equal to or greater than 50 kN, measured 'bare table';

Technical Note:

In 2B116.a., 'vibration test systems incorporating a digital controller' are those systems, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

- b. Digital controllers, combined with specially designed vibration test software, with a 'real-time control bandwidth' greater than 5 kHz designed for use with systems specified in 2B116.a.;

Technical Note:

In 2B116.b., 'real-time control bandwidth' means the maximum rate at which a controller can execute complete cycles of sampling, processing data and transmitting control signals.

- 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 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 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 reentry vehicle nose tips.

2B119 Balancing machines and related equipment, as follows:

N.B. SEE ALSO 2B219.

- a. Balancing machines having all of 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 or more axes;
- b. Designed or modified to incorporate slip rings or integrated non-contact devices capable of transferring electrical power, signal information, or both; and
- c. Having any of the following characteristics:
 - 1. For any single axis having all of the following:
 - a. Capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and
 - b. A rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0,6 degrees/s;
 - 2. Having a worst-case rate stability equal to or better (less) than plus or minus 0,05% averaged over 10 degrees or more; or
 - 3. A positioning "accuracy" equal to or less (better) than 5 arc second.

Note 1: 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.

Note 2: Motion simulators or rate tables specified in 2B120 remain controlled whether or not slip rings or integrated non-contact devices are fitted at time of export.

- 2B121 Positioning tables (equipment capable of precise rotary positioning in any axes), other than those specified in 2B120, having all of the following characteristics:
- a. Two or more axes; and
 - b. A positioning "accuracy" equal to or less (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 greater than 100 g and designed or modified to incorporate slip rings or integrated non-contact devices capable of transferring electrical power, signal information, or both.

Note: Centrifuges specified in 2B122 remain controlled whether or not slip rings or integrated non-contact devices are fitted at time of export.

- 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:

Technical Note:

Stated positioning accuracy levels derived under the following procedures from measurements made according to ISO 230-2:1988⁷ or national equivalents may be used for each machine tool model if provided to, and accepted by, national authorities instead of individual machine tests. Determination of stated positioning accuracy:

- a. *Select five machines of a model to be evaluated;*
- b. *Measure the linear axis accuracies according to ISO 230-2:1988⁷;*
- c. *Determine the accuracy values (A) for each axis of each machine. The method of calculating the accuracy value is described in the ISO 230-2:1988⁷ standard;*
- d. *Determine the average accuracy value of each axis. This average value becomes the stated positioning accuracy of each axis for the model ($\bar{A}_x \bar{A}_y \dots$);*
- e. *Since item 2B201 refers to each linear axis, there will be as many stated positioning accuracy values as there are linear axes;*

⁷

Manufacturers calculating positioning accuracy in accordance with ISO 230-2:1997 or 2006 should consult the competent authorities of the Member State in which they are established.

2B201 continued

f. If any axis of a machine tool not specified in 2B201.a., 2B201.b. or 2B201.c. has a stated positioning accuracy of 6 μm or better (less) for grinding machines, and 8 μm or better (less) for milling and turning machines, both according to ISO 230-2:1988⁶, then the builder should be required to reaffirm the accuracy level once every eighteen months.

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 230-2:1988⁶ or national equivalents along any linear axis;
2. Two or more contouring rotary axes; or
3. Five or more axes which can be coordinated simultaneously for "contouring control";

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 230-2:1988⁶ or national equivalents along any linear axis;
2. Two or more contouring rotary axes; or
3. Five or more axes which can be coordinated simultaneously for "contouring control";

2B201.b. continued

Note: 2B201.b. does not control grinding machines as follows:

- 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 230-2:1988⁶ or national equivalents.
- c. Machine tools for turning, that have positioning accuracies with "all compensations available" better (less) than 6 μm according to ISO 230-2:1988⁶ along any linear axis (overall positioning) for machines capable of machining diameters greater than 35 mm;

Note: 2B201.c. does not control bar machines (Swissturn), limited to machining only bar feed thru, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm.

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 2B201.a., .b. or .c.

Note 3: 2B201.a.3. and 2B201.b.3. include machines based on a parallel linear kinematic design (e.g., hexapods) that have 5 or more axes none of which is a rotary axis.

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 coordinate measuring machines (CMM) having either of the following characteristics:
 - 1. Having only two axes and having a maximum permissible error of length measurement along any axis (one dimensional), identified as any combination of $E_{0x,MPE}$, $E_{0y,MPE}$, or $E_{0z,MPE}$, equal to or less (better) than $(1,25 + L/1\ 000) \mu\text{m}$ (where L is the measured length in mm) at any point within the operating range of the machine (i.e., within the length of the axis), according to ISO 10360-2:2009; or

2B206.a. continued

2. Three or more axes and having a three dimensional (volumetric) maximum permissible error of length measurement ($E_{0,MPE}$) equal to or less (better) than $(1,7 + L/800) \mu\text{m}$ (where L is the measured length in mm) at any point within the operating range of the machine (i.e., within the length of the axis), according to ISO 10360-2:2009;

Technical Note:

The $E_{0,MPE}$ of the most accurate configuration of the CMM specified according to ISO 10360-2:2009 by the manufacturer (e.g., best of the following: probe, stylus, length, motion parameters, environments) and with all compensations available shall be compared to the $(1,7 + L/800) \mu\text{m}$ threshold.

- 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 $3,5 \mu\text{m}$ per 5 mm; and
 2. "Angular position deviation" equal to or less than $0,02^\circ$;
- c. 'Linear displacement' measuring systems having all of the following characteristics:

Technical Note:

For the purpose of 2B206.c. 'linear displacement' means the change of distance between the measuring probe and the measured object.

1. Containing a "laser"; and
2. Capable of maintaining, for at least 12 hours, over a temperature range of $\pm 1 \text{ K}$ ($\pm 1^\circ\text{C}$); around a standard temperature and standard pressure, all of the following:
 - a. A 'resolution' over their full scale of $0,1 \mu\text{m}$ or better; and

Technical Note:

For the purpose of 2B206.c.2.a. 'resolution' is the least increment of a measuring device; on digital instruments, the least significant bit.

- b. With a "measurement uncertainty" equal to or better (less) than $(0,2 + L/2\ 000) \mu\text{m}$ (L is the measured length in mm).

Note: 2B206.c. does not control measuring interferometer systems, without closed or open loop feedback, containing a laser to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment.

2B206 continued

- d. Linear variable differential transformer (LVDT) systems having both of the following characteristics:

Technical Note:

For the purpose of 2B206.d. 'linear displacement' means the change of distance between the measuring probe and the measured object.

1. Having any of the following:
 - a. "Linearity" equal to or less (better) than 0,1% measured from 0 to the full operating range, for LVDTs with an operating range up to 5 mm; or
 - b. "Linearity" equal to or less (better) than 0,1% measured from 0 to 5 mm for LVDTs with an operating range greater than 5 mm; and
2. Drift equal to or better (less) than 0,1% per day at a standard ambient test room temperature ± 1 K ($\pm 1^\circ\text{C}$).

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:

All parameters of measurement values in 2B206 represent plus/minus i.e., not total band.