Based on Article 5 of the Law on Export and Import of Dual-Use Goods ("Official Gazette PC", no. 95/13 and 77/19) and Article 17, paragraph 1 and Article 43, paragraph 1 of the Law on Government ("Official glasnik RS", no. 55/05, 71/05 - correction, 101/07, 65/08, 16/11, 68/12 - US, 72/12, 7/14 - US, 44/14 and 30/ 18 - dr. law),

The government brings

THE DECISION

on establishing the National Control List of dual-purpose goods

"Official Gazette of RS", number 31 of April 11, 2024.

1. This decision establishes the National Control List of dual-use goods.

2. The national checklist from point 1 of this decision is printed with this decision and constitutes its component.

3. On the day of entry into force of this decision, the Decision on establishing the National Control Board ceases to be valid lists of dual-use goods ("Official Gazette PC", number 30/23).

4. This decision enters into force on the eighth day from the day of its publication in the "Official Gazette of the Republic of Serbia".

05 number 335-2826/2024-1

In Belgrade, April 5, 2024

Government

First Deputy Prime Minister,

Ivica Dacic, s.r.

NATIONAL CHECKLIST OF DUAL PURPOSE GOODS

This list is fully compliant with European Regulation 2021/821 of May 20, 2021 *(Regulation EU of the European Parliament and the Council (EU) 2021/821 of 20 May 2021), as well as with Commission Delegated Regulation 2023/2616 of 15 September 2023 amending Regulation 2021/821 of the European Parliament and the Council regarding with the List of dual-use goods (Commission Delegated Regulation (EU) 2023/2616 of 15 September 2023 amending Regulation (EU) 2021/821 of the European Parliament and of the Council as regards the list of dual-use items),* and in it are implemented internationally agreed controls on dual-use goods including the Wassenaar Arrangement , the Missile Technology Control Regime *(MTCR),* the Nuclear Suppliers Group *(NSG), the Australia Group* and the Convention on chemical weapons *(the Chemical Weapons Convention - CWC).*

GENERAL REMARKS

1. For the control of goods manufactured or modified for military use, see the current National Armaments and Military Equipment Control List. The notes in this list given under the title "See also National Control List of Arms and Military Equipment (NKL NVO)" refer to this list.

2. The subject of the control provided by this list is the export and import of goods that are not subject to control (including plants), when they contain one or more components that are subject to control and represent an essential element of those goods and it is possible to separate them and use them for other purposes.

NB: In assessing whether the component(s) subject to control can be considered an essential element, it is necessary to take into account the factors of quantity, value and technological know-how, so-called. know-how, as well as other specific circumstances that can declare the controlled component (or components) an essential element of the goods to be procured.

3. The goods listed in this list include both new and used goods.

4. In some cases, chemicals are listed by name and CAS number. The list refers to chemicals with the same structural formula (including hydrates and isotopically labeled forms or all possible stereoisomers), regardless of name or CAS number. CAS numbers are shown to help identify a given chemical or mixture, independent of nomenclature. The CAS number cannot be used as a unique identifier because some forms of listed chemicals have different CASs

numbers, and mixtures containing those chemicals may also have different CAS numbers.

NOTE ON NUCLEAR TECHNOLOGY (NTN)
(To be interpreted with section E Category 0)

"Technology" that is directly related to any of the goods subject to control in Category 0, controlled in accordance with the provisions of Category 0.

The "technology" necessary for the "development", "production" or "use" of the controlled goods remains under control, even when applied to goods that are not subject to that control.

The license to export the goods also implies that the minimum "technology" required for the installation, operation, maintenance and overhaul of the goods can be exported to the same end user.

Control of the transfer of "technology" does not apply to information that is of "public importance", nor to "basic scientific research".

GENERAL TECHNOLOGY NOTE (GTN)
(To be interpreted with Section E Category 1 to 9)

Export of "technology" "necessary" for the "development", "production" or "use" of subject goods controlled in Categories from 1 to 9, is controlled in accordance with the provisions of Categories from 1 to 9.

"Technology" necessary" for the "development", "production" or "use" of controlled goods remains under control, even when applied to goods that are not subject to that control.

The control does not refer to that "technology" which is the minimum required for installation, operation, maintenance (checking) and overhaul of those goods that are not subject to control or whose export is approved.

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

Control of the transfer of "technology" does not apply to information that is "public good", nor to "basic scientific research" nor to the minimum information necessary for the use of a patent.

NUCLEAR SOFTWARE GENERAL NOTICE (NSN)

(This note supersedes any control under Section D Category 0).

Section D Categories 0 do not control "software" that is the minimum "object code" required for installation, operation, maintenance (checking) or repair of goods whose export has been approved.

The authorization to export the goods also authorizes the export for the same end user of the minimum "object code" required for the installation, operation, maintenance (checking) or repair of the goods.

Note: The Nuclear Software Note does not apply to "software" listed in Category 5 - Part 2 ("Information Protection").

GENERAL SOFTWARE NOTICE (GSN)

(This note supersedes any control under Section D Category 1 through 9)

Categories 1 to 9 do not control "software" that is any of the following:

a. Publicly available because:

1. Retail sales from the warehouse and without restrictions in the following ways:

a. By direct purchase;

b. By ordering through the mail;

c. By ordering electronically, or

d. By ordering via phone call; and

2. Designed for installation by the user without further substantial assistance from the manufacturer;

Note: Item a. The general notices accompanying the software do not apply to the "software" listed in category 5 - Part 2 ("Information Protection").

b. "Public good"; or

c. The minimum necessary "object code" for installation, operation, maintenance (checking) or repair

those products whose export is approved.

Note: Item c. The general notices accompanying the software do not apply to the "software" referred to in

category 5 - Part 2 ("Information Protection").

GENERAL NOTICE WITH "PROTECTED INFORMATION" (GISN)

Products or functions related to "information protection" should be considered based on the provisions of the Part 2. - categories 5. even though they are components, software or functions of other products.

ACRONYMS AND ABBREVIATIONS USED IN THIS LIST

Acronyms or abbreviations used as defined terms can be found in the title section 'Definitions of terms used in this list'.

Acronym or Abbreviation	**Meaning**
ABC	Annual Bearing Engineers Committee - Annual gathering of engineers
ABMA	Army Ballistic Missile Agency - Administration for ballistic missiles of the US Army
ADC	Analogue-to-Digital Converter - Analogue-to-digital converter
AGMA	American Gear 'Manufacturers' Association
AHRS	Attitude and Heading Reference Systems - systems for determining position and guidance
AISI	American Iron and Steel Institute - American Institute for Iron and Steel
BUT	Atomic Layer Epitaxy - atomic layer epitaxy
ALU	Arithmetic Logic Unit - arithmetic logic unit
ANSI	American National Standards Institute - American state institute for standards
app	Adjusted Peak Performance - corrected maximum ability
APU	Auxiliary Power Unit – auxiliary power units
ASTM	American Society for Testing and Materials - American Society for Testing and Materials
ATC	Air Traffic Control - air traffic control
BJT	Bipolar Junction Transistors - Bipolar transistor
BPP	Beam Parameter Product – beam parameter product
BSC	Base Station Controller - Base station controller
CAD	Computer-Aided-Design - computer design
LESSON	Chemical Abstracts Service - Reference archive of chemical substances
CCD	Charge Coupled Device – charging of the connected device
CDU	Control and Display Unit - control unit with terminal
CEP	Circular Error Probable - the probability of a radial error
CMM	Coordinate Measuring Machine - coordinate measuring machine

CMOS	Complementary Metal Oxide Semiconductor – complementary metal-oxide-semiconductor technology
CNTD	Controlled Nucleation Thermal Deposition - controlled thermal deposition of nuclei crystallization
CPLD	Complex Programmable Logic Device - complex programmable logic device
CPU	Central Processing Unit - Central processing unit
CVD	Chemical Vapor Deposition – chemical deposition from the gas phase
CW	Chemical Warfare – chemical war
CW (for lasers)	Continuous Wave (for lasers)
DAC	Digital-to-Analogue Converter - Digital-analogue converter
DANL	Displayed Average Noise Level - displayed average noise level
DBRN	Data-Base Referenced Navigation - navigation with references based on data
DDS	Direct Digital Synthesizer - direct digital synthesizer
DMA	Dynamic Mechanical Analysis - dynamic mechanical analysis
DME	Distance Measuring Equipment - equipment for measuring distance
DMOSFET	Diffused Metal Oxide Semiconductor Field Effect Transistor - diffused metal oxide semiconductor field effect transistor
DS	Directionally Solidified
EB	Exploding Bridge - Explosive bridges
EB-PVD	Electron Beam Physical Vapor Deposition - physical deposition from the gas phase by a beam of electrons
EBW	Exploding bridge wire - Explosive wire bridges
ECAD	Computer aided design of electronic components
ECM	Electro-chemical machining
EDM	Electron Discharge Machines - machines with electric discharge
EFI	Exploding Foil Initiators - Explosive foil initiators
EIRP	Effective Isotropic Radiated Power - effective isotropic radiated power
EMP	Electromagnetic Pulse - Electromagnetic pulse
ENOB	Effective Number of Bits - Effective number of bits
ERF	Electrorheological Finishing - electrorheological finishing
ERP	Effective Radiated Power - effective radiated power
ESD	Electrostatic Discharge - Electrostatic discharge
THERE	Emitter Turn-Off Thyristor - ETO thyristor
ETT	Electrical Triggering Thyristor - electrical trigger triristor
EUV	Extreme Ultraviolet - Extreme ultraviolet

FADEC	Full Authority Digital Engine Control - Comprehensive digital engine control
FFT	Fast Fourier Transform – fast Fourier transform
FPGA	Field Programmable Gate Array - fields of programmable gates
FPIC	Field Programmable Interconnect - fields of programmable interconnects
FPLA	Field Programmable Logic Array - fields of programmable logic arrays
FPO	Floating Point Operation - floating point operation
FWHM	Full-Width Half Maximum – full width at half height
GAAFET	Field-effect transistor for channel control
GSM	Global System for Mobile Communications - global system for mobile communications
GLONASS	Global Navigation Satellite System - global navigation satellite system
GPS	Global Positioning System - global positioning system
GNSS	Global Navigation Satellite System - global navigation satellite systems
GTO	Gate Turn-off Thyristor - turn-off thyristors
HBT	Hetero-Bipolar Transistors - hetero-bipolar transistors
HDMI	High-Definition Multimedia Interface - High-definition multimedia interface
HEMT	Hight Electron Mobility Transistor - a transistor with high electron mobility
ICAO	International Civil Aviation Organisation aviation
IEC	International Electro-technical Commission - International Electro-technical Commission
IED	Improvised Explosive Device - improvised explosive devices
IEEE	Institute of Electrical and Electronic Engineers - Institute of Electrical Engineers i electronics
IFOV	Instantaneous-Field-Of-View – instantaneous field of view
IGBT	Insulated Gate Bipolar Transistor - bipolar transistor with an insulated gate
IGCT	Integrated Gate Commutated Thyristor - thyristors with integrated gates
IHO	International Hydrographic Organization - International Hydrographic Organization
ILS	Instrument Landing System - instrumentation system for landing
IMU	Inertial Measurement Unit - inertial measurement unit
INS	Inertial Navigation System - inertial navigation system
IP	Internet Protocol - internet protocol
IRS	Inertial Reference System - inertial reference system
IRU	Inertial Reference Unit - inertial reference unit
AND WITH	International Standard Atmosphere - standard atmosphere
ISAR	Inverse Synthetic Aperture Radar - radar with inverse synthetic aperture
	International Organization for Standardization - International Organization for Measures i

ISO	standards
ITU	International Telecommunication Union - International Federation for Telecommunications
JT	Joule-Thomson - Joule-Thomson
LIDAR	Light Detection and Ranging - detection and determination of distance by light radiation
LIDT	Laser Induced Damage Threshold – threshold (level) of laser radiation that causes damage
LOA	Length Overall - total length
LRU	Line Replaceable Unit – unit replaceable on the spot
LTT	Light Triggering Thyristor - A thyristor that triggers light
MLS	Microwave Landing Systems - systems for landing using microwaves
MMIC	Monolithic Microwave Integrated Circuit - Monolithic microwave integrated circuit
MOCVD	Metal Organic Chemical Vapor Deposition – organic chemical deposition of metals from gas phases
MOSFET	Metal-Oxide-Semiconductor Field Effect Transistor - Metal-oxide semiconductor transistor with field effect
MPM	Microwave Power Module - Microwave power modules
MRF	Magnetorheological Finishing - magnetorheological finishing
MRF	Minimum Resolvable Feature size – minimum resolvable element
MRI	Magnetic Resonance Imaging - image formation by magnetic resonance
MTBF	Mean-Time-Between-Failures – mean time between failures
MTTF	Mean-Time-To-Failure - mean time to failure
ON THE	Numerical Aperture - Numerical aperture
NDT	Non-Destructive Test - non-destructive analysis
NEQ	Net Explosive Quantity - Net mass of explosives
HIM	National Institute of justice - National Institute of Justice
OAM	Operation, Administration or Maintenance - operation, administration or maintenance
OSI	Open Systems Interconnection - interconnection of open systems
PAI	Polyamide-imides – Polyamide-imides
COUPLE	Precision Approach Radar - precision radar for guidance
PCL	Passive Coherent Location - Passive coherent location
PDK	Process Design Kit - Tool for process design
PIN	Personal Identification Number - personal identification number
PMR	Private Mobile Radio - private mobile radio networks
PVD	Physycal Vapor Deposition – physical deposition from the gas phase
ppm	parts per million - parts per million

QAM	Quadrature-Amplitude-Modulation – quadrature amplitude modulation
QE	Quantum Efficiency - Quantum efficiency
RAP	Reactive Atom Plasmas - reactive plasma atoms
RF	Radio Frequency – radio frequency
rms	Root mean square – square mean value
RNC	Radio Network Controller - radio network controller
RNSS	Regional Navigation Satellite System - Regional guided satellite system
ROIC	Read-out Integrated Circuit - Integrated circuit for reading
S-FIL	Step and Flash Imprint Lithography - tools for making step and flash lithography prints
SAR	Synthetic Aperture Radar - radar with synthetic aperture
SAS	Synthetic Aperture Sonar - sonar with a synthesized image
SC	Single Crystal – single crystal
SCR	Silicon Controlled Rectifier - silicon controlled rectifier
SFDR	Spurious Free Dynamic Range – harmonic distortion at the output
SHPL	Super High Powered Laser – Superpowerful laser
SLAR	Sidelooking Airborne Radar - side-search aircraft radar
SOI	Silicon-on-Insulator - silicon-on-insulator
SQUID	Superconducting Quantum Interferance Device - superconducting quantum membrane device
SRA	Shop Replaceable Assembly - replaceable assembly in the workshop
SHAME	Static Random Access Memory - static RAM memory
SSB	Single Sideband – one side band
SSR	Secondary Surveillance Radar - secondary surveillance radar
SSS	Side Scan Sonar - side sonar
TIR	total indicated reading – total required reading
TVR	Transmitting Voltage Response - voltage response of the transmitter
in	Atomic mass unit - Atomic mass unit
UPR	Undirectional Positioning Response - unidirectional positioning response
UV	Ultra Violet – ultraviolet
UTS	Ultimate Tensile Strength - maximum resistance to stretching
VJFET	Vertical Junction Field Effect Transistor - vertical junction field effect transistor
VOR	Very High Frequency Omni-directional Range - range with a very circular radiation pattern high frequency
WHO	World Health Organization - World Health Organization
WLAN	Wireless Local Area Network - wireless local network

NB	Nota Bene (lat.) – a special note
NKL NGO	National control list of weapons and military equipment, published with the Decision on determining the national control list of weapons and military equipment in the "Official Gazette of RS", number 39/23 of May 12, 2023

DEFINITIONS OF TERMS USED IN THIS LIST

Definitions of terms listed between 'single quotation marks' are given in the technical note next to the corresponding term.

The definitions of the terms mentioned between "double quotation marks" are given as follows:

NB: References concerning the category are given in parentheses after the term *being defined.*

"APP - Adjusted Peak Performance" (4) see **"Adjusted Peak Performance - PMP"**

NB: See Category 4, technical note.

"Disorder Control Agents/Substances" "Control Agents" (1) means substances which, under expected conditions of use for control purposes, produce irritation or paralysis in humans, which disappear within a short time after exposure ceases.

Technical note:

Tear gas is a subspecies of "riot control agents".

"Active pixel" (6)1 is the smallest (individual) element of a solid-state matrix array that performs the function of photoelectric transmission when exposed to light (electromagnetic) radiation.

"Active flight control systems" (7) are systems that prevent unwanted movement or loading of aircraft and missile structures, based on autonomous processing of output data from multiple sensors, and then generate the necessary preventive commands to perform automatic control.

"Signal analyzer" (3) means a device capable of measuring and displaying the fundamental properties of the single-frequency components of multi-frequency signals.

"Divided-system analog-to-digital converter (ADC)" (3) means a device having multiple analog-to-digital converter units that sample the same analog input at different times, so that after reducing the output signals, the input analog signal is effectively measured and converted at a higher sampling rate.

"Connecting analog-to-digital converter (ADC)" (3) means a device that has multiple ADC units that sample the same analog input at different times so that when the outputs are aggregated, the analog input is effectively sampled and converted at a higher sampling rate.

"Multi-channel Analog-to-Digital Converter (ADC)" (3) means a device that integrates more than of a single ADC, designed so that each ADC has a separate analog input.

"Asymmetric algorithm" (5) means a cryptographic algorithm that uses different mathematical codes for encryption and decryption.

NB: Usually "asymmetric algorithms" are used for code management.

"Authentication" (5) means verifying the identity of a user, process or device, often as a prerequisite for accessing resources in an information system. It includes checking the origin or content of a message or other information and all aspects of access control where there are no encrypted files or text, except as directly related to the protection of passwords, personal identification numbers or similar data, in order to prevent unauthorized access.

_____

1 (*) The numbers in parentheses correspond to the number or numbers of the category where the defined term is located.

"Throwout" (2) (out of straight travel) means the axial displacement for one revolution of the main spindle measured in a plane normal to the axis of the spindle at a point close to the external or internal surface under test (ref. ISO 230/1 1986, paragraph 5.63).

"Unmanned aerial vehicle (UAV)" (9) - means any aircraft capable of initiating flight and maintains controlled flight and navigation without the presence of humans in the cabin.

"Library" (1) (parametric technical database) means a collection of technical information, referring to which the operation of the corresponding systems, equipment or components can be improved.

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

"Digital transmission rate" (definition) means the total flow of bits of information that transmits directly to any type of media.

NB: See also under "Total digital bit rate".

"Sampling rate" (3) for an analog-to-digital converter (ADC) means the maximum number of samples measured at the analog input during a one-second period, excluding oversampling ADAMs. For primary ADC analysis the "sample" rate "can also be called the sampling rate, usually specified in Megasamples per second (MSPS) or Gigasamples per second (GSPS) or the conversion rate, usually specified in Hertz (Hz).

"Dispersion" (gyro) (7) represents the mean value of the gyroscope output at a given time, measured under specified operating conditions, which is functionally independent of input rotation or acceleration. "Dispersion" is usually expressed in degrees per hour (deg/hr). (IEEE STD 528.2001)

"Yaw rate" (gyro) (7) means the component of the gyroscope output that is functional independent of input rotation. It is expressed as angular velocity. (IEEE STD 528.2001)

"Total digital bit rate" (5) means the number of bits, including line coding, preparation, etc. in the unit of time that passes between the corresponding equipment in the digital transmission system.

NB: See also "digital bit rate".

"CEP" (7) "radial error probability" means under a normal circular distribution, the radius of the circle which contains 50% of the individual measurements made or the radius of the circle in which there is a 50% probability of locating.

"Civil aircraft" (1 3 4 7) means those "aircraft" listed in the published lists of the official civil aviation authorities of one or more EU member states or countries participating in the Wassenaar Arrangement that have permission to fly on commercial civil domestic and foreign flights or serve in legally permitted civil, private or business purposes.

NB: See also "aircraft".

"CW laser - laser with continuous radiation" (6) means a "laser" that gives continuous radiation output energy longer than 0.25 s.

"Diffusion bonding" (1 2) means the joining in the solid state of at least two separate pieces of metal into one unit whose strength is equal to the strength of the weakest material, whereby the main mechanism is the internal diffusion of atoms across the boundary surface.

"Digital computer" (4 5) means equipment that can, in the form of one or more discrete variables, to execute all of the above:

a. receives data;

b. stores data or instructions in fixed or variable storage devices;

c. processes data using a stored sequence of instructions that can be modified; and

d. provide output data.

NB: Modifications to the stored instruction set include the replacement of fixed devices for memorizing, but not physically changing the wiring or interconnections.

A "participating state" (7 9) is a state that adheres to the Wassenaar Agreement. (see www.wassenaar.org).

"States (non-) signatories to the Chemical Weapons 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)

"Effective gram" (0 1) of "special fissile materials" means:

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

b. for uranium enriched to 1 percent or more in the uranium-235 isotope, the weight of the element in grams multiplied by the square of its enrichment expressed as a decimal weight share;

c. for uranium enriched to less than 1 percent in the isotope uranium-235, the weight of the element in grams multiplied by 0.0001.

"Equivalent standards" (1) mean comparable national or international standards standards recognized by one or more EU member states or states participating in the Wassenaar Agreement and which apply to the corresponding entry.

"Eccentricity" (2) means the axial displacement in one revolution of the main spindle measured in a plane normal to the spindle face, at a point on the circumference of the spindle face (Reference: ISO230/1 1986, paragraph 5.61).

"Equivalent density" (6) means the optical mass per unit optical area projected onto the optical surface.

"Explosives" (1) are solid, liquid or gaseous substances or mixtures which, used for primary, initial or main charges in warheads, for demolition or other purposes, should cause detonation.

"Electronic assembly" (2 3 4) means a number of electronic components (eg 'circuit elements', 'discrete components', integrated circuits, etc.) connected together to perform specific functions, which are replaceable as a whole and usually can be disassembled.

NB 1: 'Circuit element': an individual active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

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

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

"Scale factor" (gyroscope or accelerometer) (7) means the ratio of the change in the output to the change in the input being measured. The scale factor is generally calculated as the slope of a straight line that can be fitted by a least-squares method to the input/output data by cyclically varying the input within its scope.

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

"Frequency hopping" (5 6) means a form of "spread spectrum" in which the transmission frequency of a single communication channel is changed in a random or pseudo-random sequence of discrete steps.

"Fuel cells" (8) are electrochemical devices/devices that use chemical energy directly convert to direct current (DC) using fuel from an external source.

"Chemical mixture" (1) means a solid, liquid or gaseous product composed of two or more components that do not react with each other under the storage conditions of the given mixture.

"Chemical laser" (6) means a "laser" in which the excited medium is created as a product of the output chemical reaction energy.

"Hybrid integrated circuit" (3) means any combination of integrated circuits, or an integrated circuit with 'circuit elements' or 'discrete components' connected together to perform specific functions, which has all of the following characteristics:

a. contains at least one non-hermetic device;

b. are connected by typical IC manufacturing methods;

c. it is replaceable as a whole; and

d. usually there is no possibility to disassemble it.

NB 1: 'Circuit element': an individual active or passive functional part of an electronic circuit, such as for example. one diode, one transistor, one resistor, one capacitor, etc.

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

An "immunotoxin" (1) is a combination of a single cell-specific monoclonal antibody and a "venom" or "poison subunits" that selectively affect infected cells.

"Pulsed laser" (6) means a "laser" with a "pulse duration" of less than or equal to 0.25 s.

"Multi-chip integrated circuit" (3) means two or more "monolithic integrated circuits" joined on a common "base".

"Film-type integrated circuit" (3) means an array of 'circuit elements' and metal connections formed by applying a thick or thin layer of film to an insulating "substrate".

NB: A 'circuit element' is an individual active or passive functional part of an electronic circuit such as, for example one diode, one transistor, one resistor, one capacitor etc.

"Insulation" (9) is applied to parts of the rocket engine, e.g. housing, nozzle, leads, stoppers casing parts, and includes sheets of cross-linked or partially cross-linked rubber compounds containing insulating or refractory material. It can also be found on strain relief terminal caps or dampers.

"Isolated live cultures" (1) include live cultures in inactive form and in dried form preparations.

"Isostatic presses" (2) mean the equipment used to pressurize a closed chamber by different means (gas, liquid, solid particles, etc.) in order to create equal pressure in all directions inside the chamber on the piece being processed or on the material.

"System status report" (6) means processed, matched (fusion of radar target data s position of the flight plan) and an updated report on the position of the aircraft during the flight available to air traffic controllers.

"Source code" (or source language) (6 7 9) is a convenient expression of one or more processes that the system for programming can convert it into a form suitable for implementation with appropriate equipment ("object code" (or object language)).

"Public domain" *(Notes, all)* as used herein means "technology" or "software" that has been made available without restrictions on its further use (copyright restrictions do not mean that the "technology" or "software" is not "public good").

"One-way positioning repeatability" (2) means the smaller of the Rÿ and Rÿ values (forward and back), as defined under 3.21 in ISO 230-2:2014 or the national equivalent for a single machine tool axis.

"Relaxation" (accelerometer) (7) means the mean value of the accelerometer output over a given time, measured under specified operating conditions, which is functionally independent of input rotation or acceleration. "Dispersion" is expressed in g or meters per second squared (g or m/s2). (IEEE STD 528.2001) (Micro g is equal to 1 x 10-6 g).

"Guidance package" (7) means systems that integrate the process of measuring and calculating the position and speed of the aircraft (ie navigation) with the process of computer calculation and sending commands to the flight control systems of the aircraft in order to correct the flight path.

"Composite" (1 2 6 8 9) means a "matrix" and one or more supplementary phases consisting of particles, threads, fibers or their combinations, which have one or more special purposes.

"Pulse compression" (6) means the encoding and processing of a long pulse of a radar signal into a form short, while preserving the values of high-pulse energy.

"Communication channel controller" (4) means a physical interface that controls the flow of synchronous or asynchronous digital information. It is an assembly that can be integrated into a computer or telecommunications equipment in order to provide access to communications.

"Network Access Controller" (4) means the physical interface to the distributed switch

network. It uses a common medium that operates at the same "digital bit rate" using arbitration (eg in terms of sign or bearer) for transmission. Independently of others, it selects data packets or groups of data (eg IEEE 802) addressed to it. It represents a circuit that can be built into a computer or telecommunications equipment in order to provide access to communications.

"Spacecraft payload" (9) means equipment attached to the "spacecraft body spacecraft", designed to perform missions in space (eg communication, observation, science).

"End effectors" (2) means grippers, 'active tool parts' as well as any other tool attached to the base at the end of the manipulative arm of the "robot".

NB: 'Active part of the tool' means a device for applying driving force, processing energy or sensitivity to the piece being processed.

"Cryptography" (5) means the discipline that brings together the principles, means and methods for data transformation in order to hide the content of the information, prevent undetected modifications or prevent its unauthorized use. "Cryptography" is limited to the transformation of information and uses one or more 'secret parameters' (eg crypto variables) or appropriate cipher management.

Note: 1. "Cryptography" does not include 'fixed' data compression or coding techniques.

2. "Cryptography" includes decryption.

Technical note

1. 'Secret parameter':

a constant or code known only to a limited number of insiders.

2. 'Fixed':

an encryption or compression algorithm that cannot accept externally supplied parameters (eg, cryptographic or key variables) or be changed by the user.

"Cryptographic activation" (5) means any technique that specifically activates or enables the device's cryptographic option through a mechanism implemented by the device manufacturer, if that mechanism is linked exclusively to any of the following:

1. One device; or

2. One customer, for multiple devices.

Technical note:

1. Techniques and mechanisms of "cryptographic activation" can be implemented as hardware, "software" or "technology".

2. "Cryptographic activation" mechanisms can be, for example, license keys on the basis serial number or an authorization instrument such as a digitally signed certificate.

"Quantum cryptography" (5) means a family of techniques for establishing a common code for "cryptography" by measuring the quantum-mechanical properties of a physical system (including those physical properties explicitly contained in quantum optics, quantum field theory, or quantum electrodynamics).

The "critical temperature" (1 3 5) (sometimes referring to the transformation temperature) of some of a specific "superconducting" material denotes the temperature at which the material loses all resistance to the flow of direct electric current.

"Laser" (0., 1., 2., 3., 5., 6., 7., 8., 9.) is a device that produces spatially and temporally coherent light that is amplified by stimulated emission of radiation.

See also: *NB:*	*"chemical laser";*
	"CW laser";
	"pulsed laser";
	"super powerful laser";

"Aircraft" (1 6 7 9) means an aircraft with fixed, movable, rotary wings

(helicopter) or rotating rotor or wings (for vertical take-off).

NB: See also "civilian aircraft".

"Flying objects lighter than air" (9) are balloons or "flying objects" lighter than air which are moved through the air by warm air or other lighter-than-air gases such as helium or hydrogen.

"Personal network" (5) is a data exchange system that has all of the following characteristics:

a. allows any number of independent, interconnected 'computing devices' to communicate directly with each other; and

b. it is limited to communication between devices in a geographic area in the immediate vicinity of a person or control device (eg room, office or car, and surrounding areas).

Technical note

1. 'Information device' means equipment capable of sending or receiving streams of information in digital form.

2. "Local network" extends beyond the geographical area of the "personal network".

"Linearity" (2) (usually expressed as a measure of non-linearity) indicates the largest deviation specific characteristics (average value on the reading scale), positive or negative, in relation to a straight line that is positioned in such a way as to equalize and minimize the maximum deviations.

"Local area network" (4 5) is a data communication system that has all of the following features:

a. allows any number of independent 'computing devices' to communicate directly with each other; and

b. it is limited to a medium-sized geographic area (eg office building, plant, center, warehouse).

NB: 'Information device' means equipment capable of sending or receiving streams of information in digital form.

"Magnetic gradiometers" (6) are instruments designed to detect spatial changes in magnetic fields originating from sources external to the instrument. They consist of several "magnetometers" and accompanying electronics whose output is a measure of the magnetic field gradient.

NB: See also "single magnetic gradiometer".

"Magnetometers" (6) are instruments designed to detect magnetic fields originating from sources external to the instrument. They consist of one magnetic field sensor and accompanying electronics whose output is a measure of the magnetic field.

"Maximum/pulse power" (6) means the highest power achieved for the "pulse duration".

"Materials resistant to corrosion by UF6" (0) include copper, copper alloys, stainless steel, aluminum, aluminum oxide, aluminum alloys, nickel or alloys with a mass fraction of nickel of 60% or more and fluorinated hydrocarbon polymers.

"Matrix" (1 2 8 9) means an extremely homogeneous phase that fills the space between particles, threads or fibers.

"Matrix detector" (6 8) means a linear or two-dimensional planar layer, or a combination of planar layers, individual detector elements, with or without readout electronics, operating in the focal plane.

NB: This does not include a set of individual detector elements or any detectors that consist of two, three or four elements provided that the delay time and integration are not included in the given element.

"Measurement uncertainty" (2) is a characteristic parameter that determines, with a probability of 95%, u in which range around the output value of the measurable variable is its exact value. It includes uncorrected systematic deviations, uncorrected retardation and random deviations (ref. ISO 10360-2).

"Microcomputer microcircuit" (3) means "monolithic integrated circuit" or "integrated circuit."
with multiple chips" containing an Arithmetic Logic Unit (ALU) capable of performing general instructions from internal memory on data from internal memory.

NB: Internal memory can be increased with external memory.

"Microprocessor microcircuit" (3) means "monolithic integrated circuit" or "integrated circuit."
multi-chip" that contains an Arithmetic Logic Unit (ALU) capable of executing a series of general instructions from external memory.

NB1.: "Microprocessor microcircuit" usually does not contain integrated user-accessible memory, although the memory present on the chip can be used to perform a logic function.

NB2.: This covers chipsets designed to work together to provide functioning of the "microprocessor microcircuit".

"Microorganisms" (1 2) means bacteria, viruses, mycoplasmas, rickettsiae, chlamydiae or fungi, in natural or modified form, either in the form of "isolated living cultures", or as material comprising living matter intentionally peeled or contaminated with these cultures.

"User-accessible programming capability" (6) means a user-enabled device
to introduce, modify or replace the "programs" in any way except:

a. by physically changing wires or interconnections; or

b. by adjusting function controls, which also refers to entering parameters.

A "monofilament" (1) or **filament** is the smallest part of a fiber, usually a few micrometers in diameter.

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

a. are formed by diffusion processes, implantation or deposition processes, in/on one semiconductor piece of material, the so-called 'chip';

b. they can be considered inseparable; and

c. perform circuit functions.

NB: A 'circuit element' is an individual active or passive functional part of an electronic circuit, such as for example one diode, one transistor, one resistor, one capacitor, etc.

"Monolithic microwave integrated circuit" ("MMIC") (3 5) means a "monolithic integrated circuit" operating at microwave or millimeter wave frequencies.

"Monospectral image sensors" (6) can receive data in the form of images from a single
discrete spectral range.

"Tilt spindle" (2) means a tool holder spindle which during machining changes the angular position of the center line relative to any other axis.

"Non-fluorinated" (1) means that it is possible to cross-link or further polymerize with the need for heat,
radiation, catalysts, etc., or that it is possible to melt without pyrolysis.

"Nuclear reactor" (0) means a complete reactor capable of operating to maintain a chain
controlled self-sustaining fission reaction. "Nuclear reactor" includes everything inside the reactor vessel or directly connected to it, the equipment that controls the power level in the core, as well as the components that normally contain, come into direct contact with it, or control the primary coolant of the reactor core.

"Numerical control" (2) means the automatic control of a process by the device it uses
numeric data usually entered while the operation is in progress (ref. ISO 2382).

"Object code" (GSN) means the form in which one or more processes are expressed ("source code"
(source language)), suitable for processing by computer equipment, which is compiled by a programming system.

"Shaped piece" (3 6) means a monolithic composition whose dimensions are suitable for production
optical elements such as mirrors or optical windows.

"Inner wall cladding" (9) refers to the interface between the solid propellant and

enclosures or insulating linings. It is usually a dispersion based on liquid polymers of refractory or insulating materials, such as, for example, carbon-filled hydroxy-terminated polybutadiene (HTPB) or other polymer with a vulcanizing coating added, sprayed or coated over the inside wall of the case.

"Signal processing" (3 4 5 6) means the processing of information-carrying signals obtained from the outside algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (eg fast Fourier transform or Walsh transform).

"Processing in real time" (6) means data processing by the computer system, while ensuring the required level of service, as a function of available resources within a guaranteed response time, regardless of system load, after stimulation by an external event.

"Response to cyber incidents" (4) means the procedure of exchanging necessary information about a cybersecurity incident with individuals or organizations responsible for conducting or coordinating the resolution of cyber incidents.

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

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

"Depleted uranium" (0) means uranium depleted in the isotope content of 235 relative to naturally occurring uranium.

"Basic element" (4), as specified in category 4, is "basic element" when its replacement value is greater than 35% of the total value of the system of which it is an element. The value of an element is the price that the manufacturer or system integrator paid for the given element. The total value is the customary price in the international market for individual buyers at the time of manufacture or determination of delivery.

"Basic scientific research" *(Notes, general and on nuclear technology)* means experimental or theoretical work, the main goal of which is the acquisition of new knowledge about the basic principles of phenomena or observable facts, and which is not primarily directed towards any particular practical goal.

"Basic gate propagation delay time" (3) indicates the value of the delay time due to propagation, which corresponds to the basic gate used in a "monolithic integrated circuit". For a 'family' of 'monolithic integrated circuits', this parameter can be more precisely defined as either the typical gate propagation delay time within a given 'family', or the typical gate propagation delay time within a given 'family'.

NB 1: Do not confuse "basic gate propagation delay time" with input/output by the delay time of a complex "monolithic integrated circuit".

NB 2: A 'family' consists of all integrated circuits to which all of the following apply includes their manufacturing methodology and specifications, except for their following functions:

a. common hardware and software architecture;

b. common design and production technology; and

c. common basic characteristics.

"Vulnerability disclosure" (4) is the process of identifying, reporting or communicating vulnerabilities or analyzing vulnerabilities to individuals or organizations responsible for implementing or coordinating remediation in order to resolve vulnerabilities.

"Poisons" (1 2) mean poisons in the form of deliberately isolated preparations or mixtures, regardless of the way they are obtained, with the exception of poisons that are contaminants of other materials such as pathological samples, crops, food products or seed stocks of "microorganisms".

"Tunable" (6) refers to the ability of the "laser" to produce continuous output at all wavelengths lengths in the range of several transitions in the "laser". A line-selective "laser" produces discrete wavelengths within a single laser pass and is not considered "tunable".

The "venom subunit" (1) is a structurally and functionally discrete component of the entire "venom".

"Substrate" (3) means a plate of base material with or without an interconnection scheme, on which

they can accommodate 'discrete components' or integrated circuits or both.

NB 1: 'Discrete component': a separately packaged 'circuit element' with its external connections.

NB 2: 'Circuit element': an individual active or passive functional part of an electronic circuit, such as for example. one diode, one transistor, one resistor, one capacitor, etc.

"Suitable for use in space" (3 6 7) means products designed, manufactured or certified based on successful testing for operation at altitudes greater than 100 km above the Earth's surface.

NB: Determining that an individual item is "suitable for use in space" based on testing does not means that other items in the same production run or serial model are also "suitable for use in space", as long as they are not individually tested.

"Set Maximum Performance - PMP" (4) is the set maximum speed at which a "digital computer" performs floating-point addition and multiplication operations with 64-bit or greater accuracy, expressed in Weighted TeraFLOPS (WT), in units of 1012 set operations

floating point per second.

NB: See Category 4, Technical Note.

"Image enhancement" (4) means the processing of externally derived carrier images using algorithms such as time compression, filtering, extraction, selection, correlation, convolution, or cross-domain transforms (eg, fast Fourier transform or Walsh transform). This does not include algorithms that use only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false coloring.

A "single magnetic gradiometer" (6) consists of a single magnetic field gradient sensor and accompanying electronics whose output is a measure of the magnetic field gradient.

NB: See also "magnetic gradiometer".

"Repeatability" (7) means the approximate agreement between repeated measurements of the same variable under under the same operating conditions when there are changes in conditions or non-operational periods between measurements (Reference: IEEE STD 528-2001 (1 sigma standard deviation)).

"Full flight control" (7) means the automatic management of changing "aircraft" state values and flight path to meet mission objectives in response to real-time changes in target, hazard, and other aircraft data.

A "yarn" (1) is a bundle of twisted 'cables'.

NB: A 'cable' is a bundle of "monofilaments" (usually over 200) arranged approximately parallel.

"Pre-separated" (1) means the application of any process intended to increase controlled isotope concentrations.

The "pre-yarn" (1) is a bundle (usually 12–120) of approximately parallel 'cables'.

NB: A 'cable' is a bundle of "monofilaments" (usually over 200) arranged approximately parallel.

"Natural uranium" (0) means uranium with mixtures of isotopes that exist in nature.

"Program" (6) means a sequence of instructions for executing a process or translating into a form suitable for electronic computer.

"Production equipment" (1 7 9) means tools, templates, auxiliary tools, mandrels, molds, dies, clamping tools, straightening mechanisms, test equipment, other machinery and parts therefor, limited to those specially designed or modified for "development" or for one or more stages of "production".

"Production facilities" (7 9) means "production equipment" and accompanying specially made software integrated into installations for "development" or for one or more phases of "production".

"Production" (Notes; general, on nuclear technology, all) means all stages of production as which are: construction, production engineering, manufacturing, installation, assembly, inspection, testing, quality assurance.

"Spread spectrum" (5) refers to a technique by which the energy in a relatively narrow band communication channel is spread over a much wider range of energies.

"Radar" of "extended spectrum" (6) - see "Radar extended spectrum".

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

"Operation, management or maintenance" ("OAM") (5) means performing one or more of the following tasks:

a. Establishing or managing any of the following:

1. User or administrator account or privilege;

2. Setting up the device; or

3. Data for authentication that serve as support for the tasks described in a.1. or a.2.;

b. Monitoring or managing operating conditions or device performance; or

c. Management of audit records or data in support of any of the tasks described under a. or b.

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

a. Providing or enhancing any cryptographic functionality not directly related to establishing authentication data that serves to support the tasks described in a.1. or a.2.; or

b. Performing any cryptographic functionality in the forwarding or data area of the device.

"Missiles" (1 3 6 7 9) means complete missile systems and unmanned aerial vehicles with a payload of at least 500 kg of payload and a range of at least 300 km.

"Allocated by ITU" (3 5) means the allocation of frequency bands in accordance with ITU Radio regulations for primary, permitted and secondary services.

NB: Additional and alternative allocations are not included.

"Fractional bandwidth" (3 5) means the "current bandwidth" divided by the center frequency, expressed as a percentage.

"Development" (Notes; general, about nuclear technology, everything) refers to all the stages that precede serial production, namely: design, design research, design analysis, design concepts, assembly and testing of prototypes, test production, design data, the process of transforming design data into a product, configuration design, integration and schematics.

"Steady state mode" (9) defines engine operating conditions, where engine parameters, such as thrust/power, revolutions per minute and others, do not fluctuate significantly, when ambient temperature and engine inlet pressure are constant.

"Registration time to steady state" (6.) (also called gravimetric response duration) is the time during which disturbing effects of platform-induced accelerations (high-frequency noise) decrease.

"Robot" (2 8) means a manipulative mechanism that can operate continuously or intermittently, with the use of sensors, and has all of the following characteristics:

a. it is multifunctional;

b. can position or orient materials, parts, tools or special devices with different movements in three-dimensional space;

c. contains three or more closed-loop or open-loop servos that can include step motors; and

d. has "user-accessible programming capability" via teach/repeat methods or via an electronic computer that can be a programmable logic controller, i.e. without mechanical intervention.

NB: The above definition does not include the following devices:

1. Manipulative mechanisms that are managed manually/ by teleoperator;

2. Manipulative mechanisms with a specific sequence of work operations representing devices which automatically move and function based on mechanically programmed movements. The program is mechanically limited by fixed stops, such as pins or teeth. The sequence of movements and the selection of paths/ angles are not variable and cannot be changed by mechanical, electronic or electrical means;

3. Manipulative mechanisms with a mechanically controlled variable sequence of work operations that represent devices that automatically move and function based on mechanically programmed movements. The program is mechanically limited by fixed but adjustable stops, such as pins or teeth. The sequence of movements and the selection of paths/ angles are variable within a fixed scheme of the program. Variations or modifications of the program scheme (eg changes of pins or replacement of teeth) in one or more axes of movement are performed only by mechanical operations;

4. Manipulative mechanisms with variable order without servo control which represent devices that move automatically and function based on mechanically programmed movements. The program is variable, but the sequence of movements is controlled only by a binary signal from a mechanically determined electrical binary device or adjustable stops;

5. Cranes of mechanical cranes defined as manipulative systems in the Cartesian coordinate system, made as an integral part of the vertical grid of warehouse containers and designed to access the contents of those containers for storage or search.

"Satellite navigation system" (5 7) means a system consisting of earth stations, a constellation of satellites and a receiver, which enables the calculation of the location of the receiver based on the signals received from the satellite. It includes Global Navigation Satellite Systems (GNSS) and Regional Navigation Satellite Systems (RNSS).

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

"Symmetrical algorithm" (5) means an encryption algorithm that uses an identical cipher and for encryption and decryption.

NB: "Symmetric algorithms" are usually used for data secrecy.

"Compensation systems" (6) consist of a primary scalar sensor, one or more reference sensors (eg vector "magnetometers") with software that reduce the rotational noise of the platform as a rigid body.

"Data-Based Referenced Navigation" (DBRN) **(7)** are systems that use various sources of integrated data previously obtained by geo-mapping to provide precise navigation information under dynamic conditions. Data sources include bathymetric maps, star maps, gravity maps, magnetic maps, or 3-D digital terrain maps.

"Circular counter-torque control or circular directional control systems" (7) are systems that use air blowing over those surfaces to increase or control the power generated by aerodynamic surfaces.

"Fly-by-light system" (7) means the primary digital flight control system used feedback for controlling the "aircraft" in flight, whose commands are units/actuators optical signals.

"Fly-by-wire system" (7) means the primary digital flight control system used feedback for controlling the "aircraft" in flight, whose commands to the units/actuators are electrical signals.

"Random Angular Shift" (7) means the angular error created in time due to the presence of white angular velocity noise (IEEE STD 528 – 2001).

"III/V mixtures" (3 6) represent polycrystalline or binary or complex single crystals products consisting of elements of group IIIA and VA from Mendeleev's periodic table (eg gallium arsenide, gallium-aluminum arsenide, indium phosphide).

"Software" (Notes; about software, all) means a collection of one or more "programs" or of 'microprograms' placed in any physical medium.

NB: "Microprogram" means a series of elementary instructions, stored in a separate memory, the execution of which is initiated by introducing a reference instruction into the instruction register.

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

a. extracting data or information from a computer or network-capable device, or modifying system or user data; or

b. modifying the standard execution path of a program or process to enable execution externally provided instructions.

Notes:

1. "Intrusion Software" does not include the following:

a. Hypervisors, debuggers or software reverse engineering tools (WED);

b. Digital Rights Management (DRM; or

c. "Software" designed to be installed by the manufacturer, administrator or user for tracking or asset recovery purposes.

2. Network-capable device includes mobile devices and smart meters.

Technical note

1. 'Monitoring devices': "software" or hardware devices that monitor the operation of a system or program on a device. This includes antivirus (AV) products, endpoint protection products, Personal Security Products (PSP), Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS)) or protect the wall.

2. *'Protective Countermeasures': techniques designed to ensure safe code execution, such as Data Execution Prevention (DEP), Address Space Layout Randomisation (ASLR), or sandbox testing.*

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

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

"Special fissile material" (0) means plutonium-239, uranium-233, "enriched uranium isotopes 235 or 233", as well as any material containing the aforementioned.

"Average output power" (6) means the total output energy of the "laser" expressed in J divided by the interval (period) during which a series of consecutive pulses is emitted in s. For a series of evenly spaced pulses, it is equal to the total "laser" output energy of one pulse, in J, multiplied by the repetition frequency of the "laser" pulses, in Hz.

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

"Suborbital spacecraft" (9) means a spacecraft that has an enclosed space intended for transportation people or cargo and designed to:

a. Fly above the stratosphere;

b. It flies in a non-orbital path; and

c. Land on the ground with people or cargo intact.

"Superalloys" (2 9) means alloys or compounds based on nickel, cobalt or iron which have a stress rupture of more than 1 000 hours at 400MPa and an ultimate tensile strength of more than 850 MPa at 922 K (649 °C) or more.

"Superplastic forming" (1 2) means the deformation process in which it is used

heat for metals that normally have low elongation values (less than 20%) at the breaking point at room temperature in a standard tensile test, to obtain during the process at least twice the elongation values given.

"Superconducting" (1 3 5 6 8) means materials, i.e. metals, alloys and compounds, which can lose all their electrical resistance, i.e. which can reach infinite electrical conductivity and conduct large amounts of electricity without Joule heating.

NB: The "superconducting" state of a material is individually characterized by a "critical temperature", a critical magnetic field, which is a function of temperature, and a critical current density, which, however, is a function of both magnetic field and temperature.

"Superpower laser" ("SHPL") (6) means a "laser" capable of producing an output power (total or any part) greater than 1 KJ for 50 ms or whose average power or continuous emission power exceeds 20 KW.

"All available compensation" (2) means that all possible measures have been considered which are available to the manufacturer to minimize all systematic positioning errors for each specific machine tool model, or to minimize all measurement errors for a specific coordinate measuring machine.

"Comprehensive digital engine control" - "FADEC systems" (Full Authority Digital Engine Control System) (9) means a digital electronic control system for gas turbines that can independently control the operation of the machine in the entire operating range, from the required start of operation to the required stop of operation, both under normal and fault conditions.

"Accuracy" (2 3 6 7 8), usually expressed as a measure of inaccuracy, denotes the largest deviation specific values, positive or negative, in relation to an accepted standard or exact value.

"Spacecraft body" (9) means the equipment that provides the supporting infrastructure of the "spacecraft" and the place for the "spacecraft payload".

"Technology" (Notes; general, nuclear technology, all) means specific information necessary for the "development", "production" or "use" of the goods. This information is in the form of 'technical data' or 'technical assistance'.

NB 1: 'Technical assistance' can be in the form of instructions, learning skills, training, practical knowledge and advisory services and may include the transfer of 'technical data'

NB 2: 'Technical data' can be in the form of technical drawings, plans, diagrams, models, formulas, tables, technical designs and specifications, manuals and instructions in written form or on some other medium or device such as disk, tape, ROM memory.

"Pulse duration" (6) is the duration of the "laser" pulse and indicates the time between the half-intensity points of the leading and trailing edges of a single pulse.

"Persistent selectors" (5) means data or a set of data relating to an individual (eg last name, first name, email address, home address, phone number or group affiliation).

"Strip" (1) is a material made of interlaced or co-aligned "monofilaments", "cables", "rovings", "ribbons" or "yarns", etc., usually impregnated with resin.

NB: A 'cable' is a bundle of "monofilaments" (usually over 200) arranged approximately parallel.

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

"Channel control field-effect transistor" (3) means a device with one or more conducting channel semiconductor elements with a common control electrode structure surrounding and controlling the current in all conducting channel semiconductor elements.

NB This definition includes field-effect transistors with a surrounding control electrode nanolayer or nanowire channel and other semiconductor channel element "GAAFET" structures.

"Three-dimensional integrated circuit" (3) means an assembly of semiconductor dies or layers of active devices integrated together and through semiconductor interconnects that pass through an interposer, substrate, die, or layer to establish interconnections between device layers. An interposer is an interface that enables electrical connections.

"Instantaneous Bandwidth" (3 5 7) indicates the bandwidth over which the output power remains constant up to 3 dB without adjusting other operating parameters.

"Angular deviation" (2) means the largest difference between the angular position and the concrete, very precisely measured angular position, after the workpiece that is processed on the work table is moved from its initial position by turning.

"Total current density" (3) means the total number of ampere-turns in the coil (ie, the total sum of the turns multiplied by the maximum current of each coil) divided by the total cross-sectional area of the coil (including the superconducting strands, the metal matrix in which the superconducting strands are embedded, the encapsulating material , cooling channels, etc.).

"Use" (Notes; general, on nuclear technology, all) means operation, installation (including installation in the field), maintenance (checking), repair, overhaul and repair.

"Contour control" (2) means two or more "numerically controlled" movements which take place in accordance with instructions that more closely determine the next required position and the required displacement sizes for a given position. These displacement quantities are varied relative to each other to generate the desired contour (ref. ISO/DIS 2806-1980).

"Uranium enriched in isotopes 235 or 233" (0) means uranium containing the isotopes 235 or 233 or both, in such an amount that the ratio of the abundance of the sum of these isotopes in relation to the isotope 238 is greater than the ratio of the abundance of the isotope 235 to the isotope 238 that exists in nature (isotopic ratio 0.71%).

"Vaccine" (1) is a medical product intended to stimulate a protective immune response in people and animals in order to prevent disease.

"Vacuum electronic devices" (3) are electronic devices based on interaction electron beam and electromagnetic wave propagating in the vacuum circuit or interacting with the resonators of the vacuum cavity. "Vacuum electronic devices" include klystrons, traveling wave tubes and their derivatives.

"Multispectral image sensors" (6) can perform simultaneous or serial data acquisition in in the form of images from two or more discrete spectral bands. Sensors that have more than twenty discrete spectral bands are sometimes called hyperspectral image sensors.

"Fibrous or filamentary materials" (0 1 8 9) include:

a. continuous "monofilaments";

b. continuous "yarn" and "pre-yarn";

c. "strips", yarns, arbitrarily joined and twisted materials;

d. chopped fibres, raw fibers and bonded fiber felt;

e. thin fibers, whether monocrystalline or polycrystalline, of any length;

f. aromatic polyamide pulp.

"Frequency time switching" (3) means the time (ie delay) that a signal takes when moving from the initial set output frequency to reach:

a. ± 100 Hz final determined output frequency less than 1 GHz; or

b. ± 0.1 parts per million finally determined output frequency equal to or greater than 1 GHz.

"Time constant" (6) means the time for which the current increases, from the moment the light is applied excitation, reaches a value of 1 – 1/e of the final value (ie 63% of the final value).

"Required" (General Technology Note 5 6 7 9), applied to "technology", refers only to that part of the "technology" that is specifically required to achieve or extend the level of controlled performance, characteristics or functions. Such **"required"** technologies can be used by different products.

"Protection of information" (GSN GISN 5.) includes all means and functions that ensure the availability, confidentiality or integrity of information or communications, excluding means and functions that protect against failures. These include 'cryptography', 'cryptographic activation', 'cryptanalysis', protection against compromising information leakage and computer security.

Technical note:

'Cryptanalysis' the analysis of cryptographic composition or its input and output data in order to

confidential variables or sensitive data, including unsecured text, were obtained.

"Radiation sensitivity" (6) is the radiation sensitivity (mA/W) = 0.807 × (wavelength in nm) × quantum efficiency (QE).

Technical note:

QE is usually expressed as a percentage, but in this formula it is expressed as a decimal number less than one, e.g. 78% IS 0.78.

"Rotating mass gyroscope" (7) is a gyroscope that uses a constantly rotating mass to measure angular velocity to register angular displacement.

"Top trim" (9) means the stationary ring component (flat or segmented) attached to the inner surface of the turbine housing or the machining on the outer edge of the turbine blade, which primarily provides a seal between the stationary and rotating components.

CATEGORY 0
NUCLEAR MATERIALS, PLANTS AND EQUIPMENT

0A Systems, equipment and parts

0A001 "Nuclear reactors" and specially designed or prepared equipment and parts for them, as follows:

a. "Nuclear reactors";

b. Metal vessels, or significant workshop-made parts for them,

including a reactor vessel cover for a reactor pressure vessel, specially designed or prepared to place the core of a "nuclear reactor" in them;

c. Handling equipment, specially designed or prepared for insertion or removal "nuclear reactor" fuel;

d. Control rods specially designed or prepared for controlling the fission process in "nuclear reactor", support or support structures therefor, mechanisms for driving rods and tubes for guiding rods;

e. Pressure pipes specially designed or prepared to contain a fuel element i primary coolant in a "nuclear reactor";

f. Zirconium metal or zirconium alloy tubes (or tube assemblies) specially designed or prepared for use as a fuel jacket in a "nuclear reactor" and in quantities exceeding 10 kg;

NB: For zirconium tubes under pressure see 0A001.e. and for calender tubes see 0A001.h.

Mr. 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 core support columns, fuel element channels, calender tubes, heat shields, baffles, core grid plate and diffuser plates;

Technical note:

In 0A001.h. 'nuclear reactor internals' means any major structure within the reactor vessel that has one or more functions, such as supporting the core, maintaining the arrangement of the fuel elements, directing the flow of primary coolant, providing shielding from radiation from the reactor vessel and directing instrumentation within the core.

and. Heat exchangers as follows:

1. Steam generators specially designed or prepared for use in the primary or intermediate cooling circuit of a "nuclear reactor";

0A001 2. Other heat exchangers specially designed or prepared for use in the primary cooling circuit of a "nuclear reactor";

Note: 0A001.i. does not control heat exchangers for reactor auxiliaries, e.g. system for

emergency cooling or residual heat removal system.

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

k. 'External heat shields' specially designed or prepared for use in 'nuclear reactor" to reduce heat loss and to protect the containment (containment vessel).

Technical note:

In 0A001.k. 'external heat shields' means larger structures placed above the reactor vessel that reduce heat loss from the reactor and reduce the temperature inside the containment vessel.

0V Equipment for testing, verification and production

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

a. Plants specially designed for the separation of isotopes of "natural uranium", "depleted uranium" or "special fissile materials", as follows:

1. Plants for separation with gas centrifuges;

2. Plants for separation by gas diffusion;

3. Aerodynamic separation plants;

4. Plants for separation by chemical change;

5. Plants for ion exchange separation;

6. Plants for laser separation of isotopes from atomic vapor;

7. Plants for laser separation of isotopes from molecules;

8. Plants for plasma separation;

9. Installations for electromagnetic separation;

b. Gas centrifuges and assemblies and parts, specially designed or prepared for the process separation by gas centrifuges, as follows:

Technical note:

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

1. Maraging steel having a tensile strength of 1.95 GPa or greater;

2. Aluminum alloys having a tensile strength of 0.46 GPa or greater; or

0B001

3. "Fibrous or filamentary materials" with a "specific modulus" greater than 3.18 x 106 m *and a "specific tensile strength" greater than 7.62 x 104 m;*

1. Gas centrifuges;

2. Rotor assemblies;

3. Cylinders for rotor tubes with a wall thickness of 12 mm or less, diameter between 75 mm and 650 mm, made of 'high strength-to-density ratio materials';

4. Rings or couplings with a wall thickness of 3 mm or less and a diameter between 75 mm and 650 mm designed to provide local support for a rotor tube or to join multiple rotor tubes, made of 'high strength-to-density ratio materials';

5. Baffles between 75 mm and 650 mm in diameter for installation inside the rotor tube, made of 'high strength-to-density ratio materials';

6. Upper or lower rotor end caps, diameters from 75 mm to 650 mm to suit rotor tube diameter, made of 'high strength-to-density ratio materials';

7. Magnetic bearing bearings as follows:

a. Bearing assemblies composed of a ring magnet suspended in a housing made of, or protected by "materials resistant to corrosion caused by the action of UF6", containing a damping medium and having a magnet coupled to a magnetic pole or other magnet placed on the upper cover of the rotor;

b. Active magnetic bearing bearings specially designed or prepared for use with gas centrifuges;

8. Specially prepared beds that have an articulated rotating assembly with a cup, mounted on shock absorber;

9. Molecular pumps consisting of cylinders whose interior is machined or pressed spiral grooves and internally machined holes;

10. Ring-shaped motor stators for multi-phase hysteresis (or magnetic resistance, reluctance) alternating current motors for synchronous operation in vacuum at a frequency of 600 Hz or more and a power of 40 VA (volt-amperes) or more;

11. Centrifuge bed/housing containing the gas centrifuge rotor tube assembly, consisting of a rigid cylinder with a wall thickness of up to 30 mm with precisely machined ends, mutually parallel and normal to the longitudinal axis of the cylinder within 0.05° or less;

12. Blades consisting of specially designed and prepared tubes for extracting UF6 gas from the rotor tubes on the principle of a Pitot tube, which can be attached to the central gas extraction system;

0B001

13. Frequency change devices (converters or inverters) specially designed or prepared for powering the stators of gas enrichment centrifuge motors having all of the following characteristics, and specially designed parts therefor:

a. Multi-phase frequency output of 600 Hz or more; and

b. High stability (with frequency regulation better than 0.2%);

14. Shut-off valves and control valves as follows:

a. Shut-off valves specially designed or prepared for operation connected to the feed, products or residues from the UF6 gas streams of certain gas centrifuges;

b. Diaphragm shut-off and control valves, made of or protected by "materials resistant to corrosion by UF6", of an internal diameter of 10 mm to 160 mm, specially designed or prepared for use in main or auxiliary gas centrifuge systems in plants for enrichment.

c. Equipment and parts, specially designed or prepared for the gas diffusion separation process, as follows:

1. Gas diffusion barriers made of porous metal, polymer or ceramic "material resistant to corrosion caused by the action of UF6" with a pore size of 10 nm to 100 nm, a thickness of 5 mm or less, and for tubular forms with a diameter of 25 mm or less;

2. Casings for gas diffusers made of, or protected by “corrosion-resistant materials caused by the action of UF6";

3. Compressors or compressor fans with a suction capacity of UF6 volume of 1 m3/min or more, with an outlet pressure of up to 500 kPa, a pressure ratio of 10:1 or less and made of or protected by "materials resistant to corrosion caused by the action of UF6";

4. Seals for rotating shafts of compressors or fans specified in 0B001.c.3. and designed to pass damping gas at speeds lower than 1000 cm3/min;

5. Heat exchangers made of or protected by "materials resistant to corrosion caused by the action of UF6" and designed for a leakage pressure range of less than 10 Pa per hour at a pressure difference of 100 kPa;

6. Diaphragm valves, manual or automatic, for shut-off and control, made of or

protected by "materials resistant to corrosion caused by the action of UF6";

0B001 d. Equipment and parts specially designed or prepared for the procedure aerodynamic separation, as follows:

1. Separation nozzles consisting of curved channels in the form of slits, which have curvature diameter less than 1 mm, resistant to UF6 corrosion , and have sharp edges in those nozzles that divide the flow of gas flowing through them into two streams;

2. Cylindrical or conical tubes (vortex tubes), made of, or protected by "materials resistant to corrosion caused by the action of UF6" and with one or more tangential inputs;

3. Compressors or compressor fans made of, or protected by “materials resistant to corrosion caused by the action of UF6", and seals for their rotating shafts;

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

5. Enclosures of separation elements made of, or protected by “materials resistant to corrosion caused by the action of UF6", to accommodate vortex tubes or nozzles for separation;

6. Diaphragm valves, manual or automatic, for shut-off and control, made of or protected by "materials resistant to corrosion by UF6", 40 mm or more in diameter;

7. Process systems for separating UF6 from the carrier gas (hydrogen or helium) to a UF6 content of 1 ppm or lower, which include:

a. Cryogenic heat exchangers and cryoseparators for operating temperatures of 153 K (–120 °C) and below;

b. Cooling systems for operating temperatures of 153 K (–120 °C) and below;

c. Separation nozzles or vortex tubes for separating UF6 from the carrier gas;

d. Cold traps (busbars) for UF6 capable of freezing UF6;

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

1. Rapid change liquid-liquid impulse columns with a cascade retention time of 30 s or smaller, resistant to concentrated hydrochloric acid (eg made or protected by suitable plastic materials such as fluorinated hydrocarbon polymers or glass);

2. Quick-change liquid-liquid centrifugal contactors with a cascade residence time (per stage) of 30 s or less, resistant to concentrated hydrochloric acid (eg, made or protected by suitable plastic materials such as fluorinated hydrocarbon polymers or glass);

3. Electrochemical cells for reduction, resistant to concentrated hydrochloric acid, for the reduction of uranium from one valence state to another;

0B001

4. Equipment powered by electrochemical reduction cells that serves to extract U+4 from the organic stream and, for those parts in contact with the process stream, made or protected by suitable materials (eg, glass, fluorocarbon polymers, polyphenylsulfates, polyethersulfones and resins impregnated with graphite);

5. Feed preparation systems for the production of high-purity uranium chloride solutions, consisting of equipment for dissolution, selective liquid extraction and/or ion exchange for purification, and electrolytic cells for the reduction of uranium U+6 or U+4 to U+ 3;

6. Systems for the oxidation of uranium from U+3 to U+4.

f. Equipment and parts, specially designed or prepared for the ion separation process by amending as follows:

1. Ion-exchange fast-reacting resins, spherical or macroporous cross-linked resins in which the active chemical exchange groups are confined to a surface coating on an inert porous support structure, and other composite structures in any suitable form, including particles or fibers with

0.2 mm or less in diameter, resistant to concentrated hydrochloric acid and designed to have an exchange half-time of less than 10 s and capable of operating in the temperature range of 373 K (100 °C) to 473 K (200 °C);

2. Ion exchange columns (cylindrical) with a diameter greater than 1000 mm, made of or protected by materials resistant to concentrated hydrochloric acid (eg titanium or fluorocarbon polymers) and capable of operating in the temperature range of 373 K (100 °C) to 473 K (200 °C) and pressures above 0.7 MPa;

3. Ion exchange systems of return flow - reflux (chemical or electrochemical oxidation or reduction systems) for the regeneration of chemical agents for reduction or oxidation, which are used in ion exchange enrichment cascades;

Mr. Equipment and parts, specially designed or prepared for atomic vapor laser isotope separation processes as follows:

1. Uranium metal vapor generation systems designed to achieve a target power of 1 kW or larger for use in laser enrichment;

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

NB: See also 2A225.

3. Buses for collecting products and residues, for uranium metal in molten or solid form state, made of or protected by materials resistant to heat and corrosion caused by either vapor or liquid uranium, such as yttrium-coated graphite or tantalum;

0B001

4. Separator module housings (cylindrical or rectangular vessels) to house the steam source metal uranium, electron gun and collector of products and residues from the process;

5. "Lasers" or laser systems specially designed or prepared for isotope separation of uranium with spectrum frequency stabilization for longer periods of time;

NB: See also 6A005 and 6A205.

h. Equipment and parts, specially designed or prepared for molecular procedures of laser isotope separation as follows:

1. Supersonic expansion nozzles for cooling mixtures of UF6 and carrier gas up to 150 K (–123 °C) and lower, made of "materials resistant to corrosion caused by the action of UF6";

2. Components or devices for the collection of products or residues specially designed or prepared for the collection of uranium material or uranium residues after laser irradiation, made of "materials resistant to corrosion caused by the action of UF6";

3. Compressors made of, or protected by, "materials resistant to corrosion caused by the action of UF6" and seals for their rotating shafts;

4. Equipment for fluorination of UF5 (solid) into UF6 (gas);

5. Process systems for extracting UF6 from a carrier gas (eg nitrogen, argon or other gas) including:

a. Cryogenic heat exchangers and cryoseparators for operating temperatures of 153 K (–120 °C) and lower;

b. Cooling systems for operating temperatures of 153 K (–120 °C) and below;

c. Cold traps (busbars) for UF6 capable of freezing UF6;

6. "Lasers" or "laser" systems specially designed or prepared for isotope separation of uranium with spectrum frequency stabilization for longer periods of time;

NB: See also 6A005 and 6A205.

and. Equipment and parts, specially designed or prepared for the plasma separation process, as follows:

1. Microwave energy sources and antennas for producing or accelerating ions, output frequencies greater than 30 GHz, and with an average output power greater than 50 kW;

2. Radiofrequency ion excitation coils for frequencies above 100 kHz and capable of operating at medium powers greater than 40 kW;

3. Systems for generating uranium plasma;

4. Not used;

0B001

5. Buses for collecting products and residues, for uranium metal in solid state, made of or protected by materials resistant to the heat and corrosion caused by vaporized uranium, such as yttrium-coated graphite or tantalum;

6. Separation module housings (cylindrical) for housing the uranium plasma source, radio frequency excitation coil and product and residue collectors, and made of suitable non-magnetic material (eg stainless steel);

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

1. Ion sources, single or multiple, consisting of steam source, ionizer and beam accelerators made of suitable non-magnetic materials (eg graphite, stainless steel or copper), and capable of providing a total ion beam current of 50 mA or greater;

2. Ion collector plates for ion beams of enriched or depleted uranium, consisting of one or more slots and pockets, made of suitable non-magnetic materials (eg, graphite or stainless steel);

3. Vacuum housings for electromagnetic uranium separators, made of non-magnetic materials material (eg stainless steel) and designed to work at pressures of 0.1 Pa and lower;

4. Parts of magnetic poles with a diameter greater than 2 m;

5. High voltage power sources for ion sources, having all of the following characteristics:

a. They have the possibility of continuous operation;

b. Output voltage of 20000 V or higher;

c. Output currents of 1A and higher; and

d. Voltage regulation better than 0.01% in a period of 8 hours;

NB: See also 3A227.

6. Magnet power sources (high power, direct current) having all of the following characteristics:

a. The possibility of continuous operation at output currents of 500A and higher and output voltages of 100 V and higher; and

b. Current or voltage regulation better than 0.01% in a period of eight hours;

NB: See also 3A226.

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

a. Feed autoclaves, furnaces or systems used to introduce UF6 into the enrichment process;

b. Desublimators or cold separators, used to remove UF6 from the enrichment process for next transfer after warm-up;

c. Product and residue stations for transfer of UF6 to containers;

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

e. Piping and connection systems specially designed or prepared to handle UF6 in the frame cascade for gas diffusion, centrifugation or aerodynamic cascades;

f. Vacuum systems or pumps, as follows:

1. Vacuum connections, vacuum connections or vacuum pumps with a suction capacity of 5 m3/min or more;

2. Vacuum pumps specially designed for use in an atmosphere containing UF6, made of or protected by "materials resistant to corrosion caused by the action of UF6"; or

3. Vacuum systems composed of vacuum connections, vacuum connections and vacuum pumps and designed for use in an atmosphere containing UF6;

Mr. UF6 mass spectrometers/ion sources capable of continuously sampling UF6 gas streams and having all of the following:

1. Capable of measuring ions of 320 or more atomic mass units and having a resolution better than 1 in 320;

2. Ion sources made of or protected by nickel, nickel copper containing alloys 60% or more nickel by weight or nickel chromium alloy;

3. Sources for ionization based on electron bombardment; and

4. They have collector systems suitable for isotope analyses.

0V003 Uranium conversion plants and equipment specially designed or prepared for it, as follows:

a. System for conversion of uranium ore concentrate to UO3;

b. UO3 to UF6 conversion system ;

c. UO3 to UO2 conversion system ;

d. UO2 to UF4 conversion system ;

0V003 e. UF4 to UF6 conversion system ;

f. System for conversion of UF4 to metallic uranium;

Mr. UF6 to UO2 conversion system ;

h. UF6 to UF4 conversion system ;

and. UO2 to UCl4 conversion system .

0V004 Plants for the production or enrichment of heavy water, deuterium or deuterium compounds and specially designed or prepared equipment and parts therefor, as follows:

a. Plants for the production of heavy water, deuterium or deuterium compounds, as follows:

1. Water-hydrogen sulfide exchange plants;

2. Ammonia-hydrogen exchange plants;

b. Equipment and parts as follows:

1. Water-hydrogen sulfide exchange towers with a diameter equal to or greater than 1.5 m that can operate at pressures greater than or equal to 2 MPa;

2. Single-stage low-pressure (ie 0.2 MPa) centrifugal fans or compressors for the circulation of gaseous hydrogen sulphide (ie gas containing more than 70% hydrogen sulphide, H2S) of a throughput capacity equal to or greater than 56 m3/s when operating at suction pressures equal to or greater than 1.8 MPa and having seals designed for operation in a humid H2S atmosphere;

3. Ammonia-hydrogen exchange towers with a height equal to or greater than 35 m, diameter from 1.5 m to 2.5 m, suitable for working pressures equal to or greater than 15 MPa;

4. The internal equipment of the towers, consisting of cascade contactors and cascade pumps, including submersible ones, for the production of heavy water using the ammonia-hydrogen exchange process;

5. Ammonia decomposition devices with a working pressure equal to or greater than 3 MPa for the production of heavy water using the ammonia-hydrogen exchange process;

6. Infrared absorption analyzers suitable for analytical determination of the hydrogen/deuterium ratio in real time, at deuterium concentrations equal to or greater than 90% by mass;

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

8. Complete systems or their columns for improving the characteristics of heavy water, to achieve the quality of deuterium concentration required for reactors;

9. Ammonia synthesis converters or ammonia synthesis units specially designed or prepared for the production of heavy water using the ammonia-hydrogen exchange process.

0V005 Drives specially designed for the production of fuel elements for "nuclear reactors" and specially designed or constructed equipment therefor.

Technical note:

Specially designed or prepared equipment for the production of fuel elements for "nuclear "reactor" includes equipment that:

1. Ordinarily comes into direct contact with, or directly performs or controls the production flow of nuclear material;

2. It is used to seal the nuclear material inside the jacket;

3. Used to check liner or seal integrity;

4. Used to check the finish of sealed fuel, or

5. It is used for assembly of reactor elements.

0V006 Plants for the processing of irradiated "nuclear reactor" fuel elements, and in particular designed or prepared equipment and its components.

Note: 0B006 includes:

a. Facilities for the processing of irradiated "nuclear reactor" fuel elements including equipment and parts that normally come into direct contact with them and directly control the irradiated fuel processing flows and the main nuclear material and fission product processing flows;

b. Equipment for removing the lining of fuel elements and machines for splitting or chopping fuel elements, i.e. remotely operated equipment for cutting, cutting, splitting or separating irradiated assemblies, connections or fuel rods for "nuclear reactor" use;

c. Dissolution vessels or dissolvers using mechanical devices, specially designed or prepared for dissolving irradiated "nuclear reactor" fuel, capable of withstanding hot, highly corrosive liquids, and capable of being filled, operated and maintained by remote control;

d. Solvent extractors such as packed or pulsed columns, settling mixers or centrifugal contractors, resistant to the corrosive action of nitric acid and specially designed or prepared for use in plants for the processing of irradiated "natural uranium", "depleted uranium" or "special fissionable materials";

e. Holding or storage vessels specially designed to be safe in terms of criticality i resistant to the corrosive influence of nitric acid;

Technical note:

Holding or storage vessels may have the following features:

1. Walls or interior elements with boron-equivalent (calculated for all component elements as as specified in the Note to 0C004) of at least two percent;

2. Maximum diameter of 175 mm for cylindrical vessels; or

3. Maximum width of 75 mm for ring or plate vessels;

0V006 *f. Neutron measurement systems specially designed or prepared for integration i use in automated process control systems in a plant for the processing of irradiated "natural uranium", "depleted uranium" or "special fissile materials".*

0V007 Plutonium processing plants and equipment specially designed or prepared for them, as follows:

a. Systems for converting plutonium nitrate into oxide;

b. Systems for the production of plutonium metal.

0C Materials

0C001 "Natural uranium" or "depleted uranium" or thorium in the form of metals, alloys, chemical compounds or concentrates, and any other material containing one or more of the specified elements;

Note: 0C001 does not control the following:

a. Four grams or less of "natural uranium" or "depleted uranium" when contained in sensors of measuring instruments;

b. "Depleted uranium" specially produced for the following civilian, non-nuclear applications:

1. Protection against ionizing radiation;

2. Packaging;

3. Ballast weighing no more than 100 kg;

4. Counterweights that have a mass of no more than 100 kg;

c. Alloys containing less than 5% thorium;

d. Ceramic products containing thorium, which are manufactured for non-nuclear applications.

0C002 "Special fissile materials"

Note: 0C002 does not control four "effective grams" or less when contained in the sensor instrument.

0C003 Deuterium, heavy water (deuterium oxide) and other deuterium compounds, and mixtures and solutions containing deuterium in which the isotopic ratio of deuterium to hydrogen exceeds 1:5000.

0C004 Graphite of a purity greater than five parts per million 'boron equivalent' and density greater than 1.50 g/cm3 for use in a "nuclear reactor", in an amount exceeding 1 kg.

0C004 *NB: See also 1C107.*

Note 1: For export control purposes, the competent ministry of the exporting country will determine whether the export of graphite products that meet the above specifications is intended for use in a "nuclear reactor". 0C004 does not control graphite having a purity level greater than 5 ppm (parts per million) boron equivalent and a density greater than 1.50 g/ cm3, which is not for use in a "nuclear reactor".

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

BEz (ppm) = CF × element Z concentration in ppm;

where CF is the conversion factor = (ÿZ× *A)/ (ÿB× AZ),*

and ÿB *and* ÿZ *are the effective cross-sections for the capture of thermal neutrons (in barns) for natural pine and element Z, respectively;* AB *and* AZ *are the atomic masses of native boron and element Z, respectively.*

0C005 Specially prepared compounds or powders for the manufacture of gas barriers diffusion, resistant to corrosion by UF6 (ie, nickel or alloys containing 60 percent or more nickel by weight, aluminum oxide, and fully fluorinated hydrocarbon polymers), having a purity of 99.9% by weight or greater, and a size

particles smaller than 10 µm, as measured by the American Society for Testing and Materials (ADTM) standard B330, and a high degree of particle size uniformity.

0D Software

0D001 "Software" specially developed or modified for "development", "production" or "use" of goods listed in this category.

0E Technology

0E001 "Technology" in accordance with the Nuclear Technology Note for "development", "production" or "use" of goods listed in this category.

CATEGORY 1
SPECIAL MATERIALS AND RELATED EQUIPMENT

1A Systems, equipment and parts

1A001 Parts made of fluorinated materials, as follows:

a. Gaskets, sealing rings, sealing materials or fuel vanes specially designed for "aircraft" or aerospace applications, containing 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:

NB: SEE ALSO 1A202, 9A010 AND 9A110.

a. Made from some of the following:

1. Of organic chemical "matrix" and "fibrous or filamentary materials" specified in 1C010.c., 1C010.d. or

2. Preforms or preforms specified in 1C010.e.;

b. Made of metal or carbon "matrix", and some of the following materials:

1. Carbon "fibrous or filamentary materials" having all of the following properties:

a. "Specific module" exceeding 10.15 x 106 m; and

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

2. materials specified in 1C010.c.

Note 1: 1A002 does not control "composite" structures or laminates made of carbon "Fibrous or filamentary materials" impregnated with epoxy resins for the repair of "civil aviation" structures or laminates, having all of the following properties:

a. The area does not exceed 1 m2,

b. The length does not exceed 2.5 m and

c. Width exceeds 15 mm

Note 2: 1A002 does not control semi-finished products designed for exclusively civil applications, such as:

a. sports equipment;

b. car industry;

c. machine tool industry;

1A002 *d. medical application.*

Note 3: 1A002.b.1. does not control semi-finished products containing no more than two fiber dimensions in weaving and are specially designed for the following applications:

a. Furnaces for tempering metals during heat treatment;

b. Equipment for the production of silicon castings (ingots);

Note 4: 1A002 does not control finished products specially designed for specific applications.

Note 5: 1A002.b.1. does not control mechanically chopped, ground or cut carbon "Fibrous or filamentary materials" of a length of 25.0 mm or less.

1A003 Products which cannot be further cross-linked than aromatic polyimides in the form film, sheet or tape having any of the following characteristics:

a. With a thickness greater than 0.254 mm; or

b. Coated or laminated with carbon, graphite, metals or magnetic substances.

Note: 1A003 does not control products if they are coated or laminated with copper i they are designed for the production of printed circuit boards for electronics.

NB For aromatic polyimides capable of further crosslinking see 1C008.a.3.

1A004 Protection and detection equipment and parts, not specially designed for military use use as follows:

NB: SEE ALSO NKL NVO 2B351 AND 2B352.

a. Full face masks, strainers and decontamination equipment designed or modified to protect against the following or specially designed components to protect against:

Note: 1A004 includes air-purifying respirators designed or modified for defense against agents and materials specified in 1A004.a.

Technical note:

For the purposes of 1A004.a.:

1. Full face masks are also known as protective masks.

2. Strainers include filter cartridges.

1. "Biological agents",

2. 'Radioactive materials',

3. Battle poisons, or

4. Anti-riot agents including:

a. ÿ-Bromobenzeneacetonitrile, (Bromobenzyl cyanide) (CA) (CAS 5798-79-8);

1A004 b. [(2-chlorophenyl)methylene]propandinitrile, (o-Chlorobenzylidenemalononitrile) (CS) (CAS 2698-41-1);

c. 2-Chloro-1-phenylethanone, Phenylacyl chloride (ÿ-chloroacetophenone) (CN) (CAS 532-27-4);

d. Dibenz-(b,f)-1,4-oxazefin (CR) (CAS 257-07-8);

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

f. N-Nonanomorpholine, (MPA) (CAS 5299-64-9);

b. Protective suits, gloves and boots specially developed or modified to protect against any of the following:

1. "Biological agents",

2. 'Radioactive materials', or

3. Battle poisons.

c. Nuclear, biological and chemical (NBH) detection systems specially developed or modified for the detection or identification of any of the following and specially developed components for them:

1. "Biological agents",

2. 'Radioactive materials', or

3. Battle poisons.

d. Electronic equipment designed for automatic detection or identification of the presence of traces "explosives" and the use of 'trace detection' techniques (eg surface acoustic waves, ion mobility spectrometry, differential mobility spectrometry, mass spectrometry)

Technical note: For the purposes of 1A004.d. 'Trace detection' is defined as the ability to detects less than 1ppm of vapor, or 1mg of solid or liquid.

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

Note 2: 1A004.d. does not control contactless portals for transit security checks.

Note 3: 1A004 does not control:

a. Personal radiological dosimeters;

b. Safety equipment for health and safety at work, the construction or function of which is limited to protection against hazards characteristic of safety in residential areas and for civil industry, including:

1. mining;

2. quarries;

1A004 *3. agriculture;*

4. pharmacy;

5. medicine;

6. veterinary medicine;

7. environmental protection;

8. processing of waste materials;

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 or defense against radioactive materials "adapted for use in warfare", 'biological agents', chemical warfare agents, 'stimulants'. or "anti-riot agents", even if such equipment or components are used in civilian industries such as mining, quarrying, agriculture, pharmaceutical, medical, veterinary, environmental protection, waste processing or food processing.

2. 'stimulant agent' is a substance or material used as a substitute for toxic agents (chemical or biological) in training, research, testing or evaluation.

3. For the purposes of 1A004, 'biological agents' are pathogenic or toxic, selected or modified (such as by altering purity, durability, infectivity, dissemination characteristics or resistance to UV radiation) to cause human and animal death, equipment degradation or crop damage, and living environment.

1A005 Individual ballistic vests and ballistic plates, as follows:

NB: SEE ALSO NKL NGO.

a. Individual ballistic vest for body protection that is not manufactured to military standards or specifications or in accordance with equivalent norms and specially designed parts for that;

b. Ballistic plates for protective vests that provide ballistic protection equal to or less than level IIIA (NIJ 0101.06, July 2008) or in accordance with "equivalent standards".

NB: for "fibrous or filamentary materials" used in the manufacture of ballistic body protection, see 1C010.

Note 1: 1A005 does not control individual protective equipment when in personal equipment user for his personal protection.

Note 2: 1A005 does not control protective devices designed for frontal protection only against the fragmentation and impact effects of non-military explosive devices.

Note 3: 1A005 does not control protective devices designed to protect against knives only, blades, needles or blows with a blunt object.

1A006 Equipment, specially designed or modified for the neutralization or destruction of improvised explosive devices (IEDs) as follows, or specially designed components and accessories for:

NB SEE ALSO NKL NGO.

a. remotely controlled vehicles;

b. 'neutralizers'.

Technical note:

For the purposes of 1A006.b. 'neutralizers' are devices specially designed to prevent action of explosive devices by firing a liquid, solid or easily breakable rocket.

Note: 1A006 does not control equipment carried by the operator.

1A007 Equipment or devices, specially designed to initiate charges and devices which contain "energetic materials", electrically, as follows:

NB: SEE ALSO NKL NGO, 3A229 and 3A232.

a. Kits for activating explosive detonators designed for the excitation of explosives detonators specified in 1A007.b.;

b. Explosive detonators for electrical excitation, namely:

1. Explosive bridges (EB);

2. Explosive wire bridges (EBW);

3. "Slapper" detonators with transfer of detonation between two foils;

4. Deposition Film Explosive Initiators (EFI).

Technical note:

1. The word initiator or seizure was sometimes used instead of the word detonator.

2. For the purposes of 1A007.b. the detonators to which the provision refers all use a small electrical conductor (bridge, wire or foil) that explosively changes to a vapor state when exposed to the passage of a short-term current pulse of high current intensity. In non-slapper types, the exploding conductor initiates a chemical reaction in the explosive explosive it comes into contact with, such as the pentrite PETN (pentaerythritol tetranitrate). In "slapper" detonators, the explosive transition of the electrical conductor to the vapor state starts a wave ("slapper") across the gap, and the impact of the wave on the surface of the explosive starts a chemical detonation. In some constructive solutions, the wave is triggered by a magnetic force. The term foil explosive initiators can refer to either explosive bridge detonators or "slapper" detonators.

1A008 Explosive charges, devices and components as follows:

a. 'Cumulative explosive charges' having all of the above characteristics:

1. Net explosive mass (NEQ) greater than 90 g; and

2. The outer diameter of the case is equal to or greater than 75 mm;

b. Linear detonation blades with all of the above characteristics and specially designed components therefor:

1. Explosive charge content greater than 40 g/m; and

2. Width equal to or greater than 10 mm;

c. Detonating rod with explosive charge content greater than 64 g/m;

d. Blades, other than those specified in 1A008.b., and breakers with a net explosive mass (NEQ) greater than 3.5 kg.

Technical note:

For the purposes of 1A008.a. 'Cumulative explosive charges' are charges designed to concentrate the direction of action of the explosion.

1A102 Parts of resaturated pyrolyzed carbon-carbon materials designed for spacecraft specified in 9A004 or sounding rockets specified in 9A104.

1A202 Composite structures, other than those specified in 1A002, in tubular form, which meet the following characteristics:

NB: SEE ALSO 9A010 and 9A110.

a. Internal diameter between 75 mm and 400 mm; and

b. Made from any "fibrous or filamentary material" specified in 1C010.a. or b. or 1C210.a. or of carbon prepreg materials specified in 1C210.c.

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

1A226 Specialized column packings that can be used in the separation of heavy from ordinary water, which meets the following characteristics:

a. They are made of chemically treated phosphor bronze mesh to improve wetting; and

b. Designed for use in vacuum distillation columns.

1A227 High-density windows (lead glass or other) for radiation protection, which they have all the above characteristics, and specially designed frames for them:

a. 'Cold surfaces' greater than 0.09 m2;

b. Densities greater than 3 g/cm3; and

c. Thickness 100 mm or more.

1A227 *Technical note:*

In 1A227 the term 'cold surface' has the value of the window surface exposed to the lowest level radiation in the designed application.

1B Equipment for testing, verification and production

1B001 Equipment for the production of fibers, prepregs, preforms or "composites" specified in 1A002 or 1C010, as follows, and specially designed parts or accessories therefor:

NB: SEE ALSO 1B101 AND 1B201.

a. Thread winding machines with motions for positioning, twisting and winding the fibers coordinated and programmed in three or more 'primarily servo-positioning' axes, specially designed for the production of "composite" structures or laminates of "fibrous or filamentary materials";

b. 'Strip stacking machines' in which motions are used to position and lay strips or sheets coordinate and program in five or more 'primary servo-positioning' axes, specially designed for the production of 'composite' structures for 'missiles' and airframes;

Note: In 1B001.b. 'missile' means complete missile systems and unmanned aerial vehicles.

Technical note:

For the purposes of 1B001.b. 'Tape stacking machines' have the ability to lay one or more 'filament tapes' limited to a width greater than 25.4 mm and less than or equal to 304.8 mm, and to cut and restart an individual 'filament tape' during the stacking process.

c. Multidirectional, multidimensional spinning or weaving machines, including adapters and kits for modification, specially designed or modified for spinning, interweaving or plaiting fibers for "composite" structures;

Technical note:

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

d. Equipment specially designed or adapted for the production of reinforced fibers, as follows:

1. Equipment for converting polymer fibers (such as polyacrylonitrile, rayon, tar or polycarbosilane) into carbon or silicon carbide fibers, including specialized equipment for tensioning the fibers during heating;

2. Equipment for chemical deposition of elements or compounds from the gas phase on heated fibers substrates for the production of silicon carbide fibers;

3. Equipment for wet spinning of refractory ceramics (such as aluminum oxide);

4. Equipment for conversion of precursor fibers containing aluminum into aluminum oxide fibers, by heat treatment;

1B001 e. Equipment for the production of prepregs specified in 1C010.e. by the melting method;

f. Equipment for non-destructive three-dimensional inspection of defects, which uses ultrasonic or X-ray tomography and is specially designed for "composite" materials, such as:

1. X-ray tomography for three-dimensional examination of defects;

2. numerically controlled ultrasonic devices in which tracking of the transmitter and/or receiver displacement is simultaneously controlled and programmed in four or more axes to follow the contour of the tested component in three dimensions.

Mr. 'Fiber strip stacking machines' with motions for positioning and laying the strips fibers are coordinated and programmed into two or more 'primary servo-positioning' axes, specially designed for the production of 'composite' structures for 'missiles' and airframes.

Technical note:

For the purposes of 1B001.g. 'Fiber strip stackers' have the ability to lay one or multiple 'filament tapes' limited to a width greater than 25.4 mm and to cut and restart an individual 'filament tape' during the stacking process.

Technical note:

1. For the purpose specified in 1B001, 'primary servo-positioning' axes control, under 'programmed' instructions from the computer, the position of the final actuator (eg head) in space relative to the workpiece with the appropriate orientation and direction to achieved the desired process.

2. For the purpose of 1B001 'filament strip' is a single continuous piece of strip, yarn or fiber in completely or partially impregnated with resins. Fully or partially resin-impregnated 'filament tapes' include those coated with a dry powder that adheres when heated.

1B002 Equipment for the production of metal alloy powders or particles, having all of the following:

a. specially developed to prevent contamination; and

b. specially developed for use in one of the processes specified in 1C002.c.2.

NB: SEE ALSO 1B102.

1B003 Tools, dies, molds or clamps for "superplastic forming" or "diffusion bonding" of titanium or aluminum or their alloys, specially designed for the manufacture of:

a. Aircraft bodies or aircraft structures;

b. Engines for aircraft or "aircraft"; or

1B003 c. Specially designed parts for such structures or engines.

1B101 Other equipment, not specified in 1B001, for the "production" of structural composites

as follows, as well as specially designed parts and accessories for her:

NB: SEE ALSO 1B201.

Note: Parts and accessories specified in 1B101 include dies, mandrels, molds, holders and tools for pressing, cross-linking, casting, sintering or bonding of composite structures, laminates and products thereof.

a. Thread winding machines with motions for positioning, twisting and winding the fibers can be coordinated and programmed in three or more axes, specially designed for the production of composite structures or laminates from "fibrous or filamentary materials", as well as control systems for coordination and programming;

b. Tape laying machines in which the positioning and laying motions of tape or sheets can be coordinated and programmed in two or more axes, specially designed for the production of composite structures for airframes and "missiles";

c. Equipment specially designed or adapted for the "production" of "fibrous or filamentary material", as follows:

1. Equipment for the conversion of polymer fibers (such as polyacrylonitrile, rayon, tar or polycarbosilane), including specialized equipment for tensioning the fibers during heating;

2. Equipment for the deposition of elements or compounds from the gas phase on heated fibrous substrates;

3. Equipment for wet spinning of refractory ceramics (such as aluminum oxide);

d. Equipment designed or modified for special surface treatment of fibers for production prepregs and preforms specified in 9C110.

Note: 1B101.d. includes rollers, tensioners, coating equipment, cutting equipment and Dies for cutting machines.

1B102 "Production equipment" for the production of metal powders not specified in

1B002, and parts thereof as follows:

NB: SEE ALSO 1B115.b.

a. Metal powder production "production equipment" usable for the "production", in a controlled atmosphere, of spherical, spheroidal or atomized materials specified in 1C011.a, 1C011.b, 1C111.a.1, 1C111.a.2. or in NKL NGO.

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

1B102 *Note: 1B102 includes:*

a. Plasma generators (high-frequency electric arc) usable for obtaining atomized or spherical metal powders while performing the process in an argon-water environment;

b. Electric discharge equipment usable for obtaining sputtered or spherical metal of powders while performing the process in an argon-water environment;

c. Equipment usable for the "production" of spherical aluminum powders by sputtering solution in an inert medium (eg nitrogen).

1B115 Equipment, not specified in 1B002 or 1B102, for the production of propellants or propellant ingredients, as follows, and specially designed components therefor:

a. "Production equipment" for the "production", handling and acceptance control of liquid propellants or their constituents specified in 1C011.a., 1C011.b., 1C111 or in NCL NVO;

b. "Production equipment" for the "production", handling, mixing, cross-linking, casting, pressing, machining, extruding or receiving control of solid propellants specified in 1C011.a., 1C011.b., 1C111 or in NKL NVO.

Note: 1B115.b. does not control batch mixers, continuous mixers or crushers s injection. For control of batch mixers, continuous mixers or injection crushers see 1B117, 1B118 and 1B119.

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

Note 2: 1B115 does not control equipment for the "production", handling and receiving control of boron carbide.

1B116 Specially designed nozzles for pyrolytic production material formed on a mold, mandrel or other substrate from precursor gases that decompose in the temperature range of 1573 K (1300 °C) to 3173 K (2900 °C) at pressures from 130 Pa to 20 kPa.

1B117 Batch mixers having all of the following characteristics and parts specially built for them:

a. Designed or modified for mixing under vacuum in the range of zero to 13,326 kPa;

b. With the ability to control the temperature of the mixing chamber;

c. Total volume capacity of 110 liters or more;

d. At least one 'mixing/kneading shaft' mounted off-centre.

Note: In 1B117.d. the term 'mixing/ kneading shaft' does not refer to diglomerators or rotating blades.

1B118 Continuous mixing mixers having all of the following characteristics and parts specially designed for them:

a. Designed or modified for mixing under vacuum in the range of zero to 13326 kPa;

b. With the ability to control the temperature of the mixing chamber;

c. Any of the following:

1. Two or more mixing/kneading shafts; or

2. All of the above:

a. One rotating shaft that oscillates with kneading teeth/pins; and

b. kneading tooth/pins inside the mixing housing.

1B119 Injection crushers usable for crushing or grinding substances specified in 1C011.a., 1C011.b., 1C111 or in NCL NVO, and specially designed parts for them.

1B201 Thread winding machines, not specified in 1B001 or 1B101, and appropriate equipment, as follows:

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

1. They have motion for positioning, twisting and winding threads coordinated and programmable in two or more axes;

2. They are specially designed for the production of composite structures or laminates from "fibrous or filamentary materials"; and

3. They are able to wind cylindrical pipes with an internal diameter between 75 and 650 mm and a length of 300 mm and greater;

b. Equipment for coordinating and programming thread winding machines specified in 1B201.a.;

c. Precision spindles for thread winding machines specified in 1B201.a.

1B225 Cells for the electrolytic production of fluorine with a capacity greater than 250 g of fluorine per lesson.

1B226 Electromagnetic isotope separators designed or equipped with one or multiple ion sources providing a total ion jet current of 50 mA or greater.

Note: 1B226 includes separators:

a. Which can enrich stable isotopes;

b. With ion sources and collectors in a magnetic field and those configurations where they are outside the magnetic field.

1B228 Hydrogen-cooled distillation columns having the following characteristics:

a. Designed to operate at internal temperatures of 35 K (–238 °C) or less;

b. Designed to work at internal pressures from 0.5 MPa to 5 MPa;

c. Constructed from either:

1. *Society of Automotive Engineers International (SAE)* 300 series low-sulfur stainless steels with an austenitic grain size of ASTM #5 or greater (or "equivalent standard"); or

2. Equivalent materials that are compatible with low temperatures and hydrogen (H2); and

d. With an internal diameter of 30 cm or more and an 'effective length' of 4 m or more.

Technical note:

In 1.B.228 'effective length' means the active height of the packing material in the packed column or the active height of the inner divider plates in the plate column.

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

a. Gas-tight (ie hermetically sealed);

b. Capacity greater than 8.5 m3/h; and

c. They have any of the following characteristics:

1. For concentrated solutions of potassium amide (1% and more), working pressures from 1.5 MPa to 60 MPa; or

2. For diluted solutions of potassium amide (less than 1%), working pressures from 20 MPa to 60 MPa.

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

a. Plants or facilities for the production, regeneration, extraction, concentration or handling of tritium;

b. Equipment for tritium plants or facilities, as follows:

1. Hydrogen or helium cooling units capable of cooling to a temperature of 23 K (–250 °C) or lower, with a heat dissipation capacity greater than 150 W;

2. Hydrogen isotope storage or hydrogen isotope purification systems using them metal hydrides as a medium for storage or purification.

1B232 Turboexpanders or turboexpander-compressor kits having both following features:

a. They are designed to operate at an outlet temperature of 35 K (–238 °C) or lower; and

b. They are designed for hydrogen gas flow of 1,000 kg/h or more.

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

a. Plants or plants for the separation of lithium isotopes;

b. Equipment for the separation of lithium isotopes, based on lithium-mercury amalgam processes, as which follows:

1. Columns with filling for liquid-liquid exchange specially designed for lithium amalgams;

2. Pumps for mercury or lithium amalgams;

3. Cells for lithium amalgam electrolysis;

4. Evaporators for concentrated solutions of lithium hydroxide.

c. Ion exchange systems specifically designed for, and specifically for, the separation of lithium isotopes engineered components;

d. Chemical exchange systems (in which crown ethers, cryptanides or ethers with
pendant), specially designed for the separation of lithium isotopes, and specially designed components for that.

1B234 Vessels, chambers, containers and other similar devices for holding explosive explosives intended for testing high explosives or explosive devices, having all of the following characteristics:

NB: SEE ALSO NKL NGO.

a. Intended to fully withstand an explosion equivalent to an explosion of 2 kg of trinitrotoluene (TNT) or greater; and

b. They have design elements or features that allow simultaneous or delayed transmission 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 specifically designed to produce tritium through radiation, including insertion into a nuclear reactor;

b. Components specially designed for target assemblies specified in 1B235.a.

Technical note:

Components specially designed for tritium production target shells may contain lithium fragments, tritium storage components, and specially coated cladding.

1C Materials

Technical note:

Metals and alloys:

Unless otherwise specified, the terms "metals" and "alloys" in 1C001 to 1C012 include crude forms and semi-finished products, as follows:

Raw forms:

Anodes, balls, bars (including notched bars and wire rods), rolling ingots, blocks, blooms, briquettes, cakes, cathodes, crystals, cubes, tiles, grains, granules, ingots, lumps, pellets, pig iron ingots, powders, rounds, shot, slabs, slags, sponge metals, rods;

Semi-finished products (whether coated, galvanized, perforated or punched):

a. Wrought or deformed materials produced by rolling, drawing, extruding, forging, impact pressing, pressing, granulating, atomizing and grinding, that is: corners, channels, circles, discs, sawdust, flakes, foils and sheets, forgings, plates, powder, compacts and blanks, strips, rings, round bars (including unclad welding wires, wire rods and rolled wires), sections, sections, plates, strips, tubes (including circular, square and hollow tube sections), drawn or extruded wires;

b. Cast material produced by casting in sand, dies, metal, plaster, or other types of molds, including high-pressure casting, sintered shapes, and shapes obtained by powder metallurgy.

The import and export of unenumerated forms which are claimed to be finished products must not be allowed, and yes are raw forms or semi-finished products and which will thus jeopardize the purpose of control.

1C001 Materials specially prepared as absorbers of electromagnetic waves, or polymers, electrically conductive by their nature, as follows:

NB: SEE ALSO 1C101

a. Materials for absorption of frequencies higher than 2 x 1088 Hz but lower than 3 x 10121 Hz;

Note 1: 1C001.a. does not control:

a. Absorbers in the form of fur, made of natural or synthetic fibers, with non-magnetic filling to ensure absorption;

b. Absorbers without magnetic losses and whose incident surface is not plate-shaped, including

pyramids, cones, wedges and curved surfaces;

c. Plate absorbers having all of the following characteristics:

1. are made of any of the following materials:

a. plastic materials (flexible or rigid), filled with carbon, or organic materials, including binders, whose echo is greater than 5% compared to metal in a frequency range greater than ± 15% of the center frequency of the incident radiation, and which are unable to withstand temperatures in excess of 450 K (177 °C); or

1C001

b. Ceramic materials whose echo is greater than 20% compared to metal in the frequency range that is greater than ±15% of the center frequency of the incident radiation, and which are unable to withstand temperatures higher than 800 K (527 °C);

Technical note:

For the purposes of 1C001.a. Notes 1.c.1. samples for examination of absorption characteristics should be square of at least five wavelengths of the center frequency and placed far in the field of the radiating element.

2. Tensile strength less than 7 x 106 N/m2; and

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

d. Plate absorbers made of sintered ferrite, which have:

1. Specific gravity greater than 4.4; and

2. Maximum operating temperature of 548K (275 °C) or less.

e. Plate absorbers with no magnetic losses and manufactured from 'open cell foam' plastic material with a density of 0.15 g/cm3 or less.

Technical note:

For the purposes of 1C001.a. Notes 1.e., 'Open cell foams' are flexible and porous materials with an internal structure open to the atmosphere. 'Open cell foams' are also known as insoluble foams.

Note 2: Nothing in Note 1 to 1C001.a. does not interfere with the absorption of magnetic materials when are in color.

b. Materials that are not transparent to visible light and specially designed to absorb radiation in the near-infrared region of the spectrum, with a wavelength greater than 810 nm but less than 2000 nm (that is, a frequency greater than 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.

c. Polymeric electrically conductive materials with a 'bulk electrical conductivity' exceeding 10000 S/m (Siemens per meter) or a 'surface conductivity' of less than 100 ÿ per square, based on one of the following polymers:

1C001 1. Polyaniline;

2. Polypyrrole;

3. Polythiophene;

4. Polyphenylene-vinylene; or

5. Polythienyl-vinylene.

Note: 1C001.c. does not control liquid materials.

Technical note:

For the purposes of 1C001.c., 'Volume electrical conductivity' and 'Surface conductivity' defines according to ASTM D-257 or equivalent national standard.

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

NB: SEE ALSO 1C202.

Note: 1C002 does not control metal alloys, metal alloy powders and alloying materials which are specially designed for applying coatings.

Technical note:

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

a. Aluminides, as follows:

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

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

b. Metal alloys, as follows, made from powders or particles of materials specified in 1C002.c.:

1. Nickel alloys:

a. Fracture strength greater than or equal to 10,000 hours at 923 K (650 °C) at a load of 676 MPa; or

b. Low-cycle fatigue resistance greater than or equal to 10000 cycles at 823 K (550 °C) at a maximum load of 1095 MPa;

2. Niobium alloys:

a. Fracture strengths greater than or equal to 10,000 hours at 1073 K (800 °C) at a load of 400 MPa; or

b. Low-cycle fatigue resistance greater than or equal to 10,000 cycles at 973 K (700 °C) at a maximum load of 700 MPa;

3. Titanium alloys:

1C002 a. Fracture strength greater than or equal to 10,000 hours at 723 K (450 °C) under a load of 200 MPa; or

b. Low-cycle fatigue resistance greater than or equal to 10,000 cycles at 723 K (450 °C) at a maximum load of 400 MPa;

4. Aluminum alloys with a tensile strength of:

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

b. 415 MPa or greater at 298 K (25 °C);

5. Magnesium alloys:

a. Tensile strength of 345 MPa or greater; and

b. Corrosion resistance of not less than 1 mm/year in 3% aqueous sodium chloride solution, measured in accordance with ASTM Standard G-31 or its equivalent national standard;

Technical note:

For the purposes of 1C002.b.:

1. Fracture resistance is determined by ASTM E-139 or an equivalent national standard.

2. Low-cycle fatigue resistance is determined by ASTM Standard E-606 'Recommended Practice for low-cycle constant-amplitude fatigue testing' or according to the corresponding national

equivalent. The test is performed in the axial direction and with an average load ratio equal to 1 and a load concentration factor (KT) equal to 1. The average load ratio is defined as the difference between the maximum and minimum loads divided by the maximum load.

c. **Metal alloy powders or fines for material, having all of the following properties:**

1. They are made of any of the following compositions:

Technical note:

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

a. Nickel alloy (Ni-Al-X, Ni-X-Al) suitable for turbo engine parts or their parts, ie. with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100 µm per 109 alloy particles;

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

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

d. Aluminum 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);

1C002 2. Manufactured in a controlled atmosphere by one of the following processes:

a. 'Vacuum atomization';

b. 'Gas atomization';

c. 'Rotational atomization';

d. 'Spray hardening';

e. By 'melt spinning' and 'grinding';

f. By 'melt extraction' and 'grinding';

Mr. 'Mechanical alloying'; or

h. 'Plasma atomization'; and

3. From which materials specified in 1C002.a. can be obtained. or 1C002.b.

d. **Alloy materials possessing all of the following characteristics:**

1. Constructed from any of the complex systems specified in 1C002.c.1.;

2. They are in the form of unground flakes, strips or thin round bars;

3. They are produced in a controlled atmosphere by any of the following processes:

a. 'Spray hardening';

b. 'Spinning the melt'; or

c. 'Melt extraction';

Technical notes:

For the purposes of 1C002:

1. 'vacuum atomization' is a process by which a stream of liquid metal is reduced to droplets of diameter 500 µm or less by rapid evolution of dissolved gas due to exposure to vacuum.

2. 'gas atomization' is a process by which a stream of molten metal alloy is broken down into droplets diameter of 500 µm or less with a high pressure gas stream.

3. 'Rotational atomization' is a process that uses centrifugal force to break up the molten stream or base of metal into droplets with a diameter of up to 500 µm or less.

4. 'Sputtering quenching' is the process of rapid solidification of the molten stream by striking a cooled block, forming a flaky product.

5. 'Melt spinning' is a process that rapidly 'quick-hardens' a stream of molten metal impinging on by a rotating cooled block, forming a hair, strip or rod.

6. 'Comminution' is the process of reducing a material to particles by crushing or grinding.

7. 'Melt extraction' is a process by which a product of a similar alloy is rapidly 'spun' and extracted ribbons by inserting short segments of a rotating cooled block into a bath of thin metal alloy.

8. 'Mechanical alloying' is an alloying process resulting from bonding, breaking and re-alloying binding of the element and dust of the master alloy by mechanical influence.

1C002 *Non-metallic particles may be incorporated into the alloy by the addition of suitable powders.*

9. 'Plasma atomization' is a process for reducing a molten stream or solid metal into droplets diameter of 500 µm or less, using a plasma torch in an inert gas environment.

10. For the purposes of Technical Notes 1C002, 'rapid solidification' is a process involving solidification of the molten material when the cooling rate exceeds 1,000 K/ sec.

1C003 Magnetic materials, of all types and in any form, having any of the following:

a. An initial relative permeability of 120,000 or greater and a thickness of 0.05 mm or less;

Technical note:

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

b. Magnetostrictive alloys, having any of the following properties:

1. Magnetostriction at saturation greater than 5 x 10-4; or

2. Magnetomechanical coupling factor (k) greater than 0.8; or

c. Amorphous or 'nanocrystalline' tape shavings, possessing all of the following characteristics:

1. A composition containing a minimum of 75 percent by weight of iron, cobalt, or nickel;

2. Magnetic induction at saturation (BS) of 1.6 T or greater; and

3. Any of the following:

a. Tape thickness of 0.02 mm or less; or

b. A specific resistance of 2 x 10-4 ÿ cm or greater.

Technical note:

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

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

a. Density exceeding 17.5 g/cm;

b. Elastic limit higher than 880 MPa;

c. Tensile strength exceeding 1270 MPa; and

d. Elongation exceeding 8%

1C005 "Superconducting" "composite" conductors of a length exceeding 100 m or a mass exceeding 100 g, as follows:

a. "Superconducting" "composite" conductors containing one or more niobium-titanium fibers having all of the following characteristics:

1. Embedded in a non-copper "matrix" or copper-based mixed "matrix"; and

2. a cross-sectional area smaller than 0.28 x 10 mm (diameter 6 µm for fibers with a circular cross-section);

b. "Superconducting" "composite" conductors consisting of one or more "superconducting" fibers other than niobium-titanium, having all of the following:

1. "Critical temperature" at zero magnetic induction exceeding 9.85K (–263.31 °C); and

2. Retention of the "superconducting" state at a temperature of 4.2 K (–268.96 °C) when exposed to a magnetic field oriented in any direction normal to the longitudinal axis of the conductor and a corresponding magnetic induction of 12 T with a critical current density greater than 1750 A/mm2 throughout the cross section cross section of the conductor.

c. "Superconducting" "composite" conductors consisting of one or more "superconducting" fibers that retain "superconductivity" above 115 K (-158.16°).

Technical note:

For the purposes of 1S005, the fibers must be in the form of wire, cylinder, film or strip.

1C006 Fluids and lubricants, as follows:

a. Not used.

b. Lubricating materials containing, as basic ingredients, phenylene or alkylphenylene ethers or thioethers, or their mixtures containing more than two ether or thioether functional groups or their mixtures;

c. Damper and flotation fluids having all of the following characteristics:

1. Purity above 99.8%,

2. Contain less than 25 particles of size 200 µm or larger in 100 ml,

3. Consisting of at least 85% of any of the following compounds or materials:

a. Dibromotetrafluoroethane (CAS 25497-30-7, 124-73-2, 27336-23-8);

b. Polychlorotrifluoroethylene (oil and wax type modifications only); or

c. Polybromotrifluoroethylene;

d. Fluorocarbon fluids made for electronic cooling, having all of the following features:

1C006 1. Containing by weight 85% or more of any of the following, or mixtures thereof:

a. Monomeric forms of perfluoropolyalkyl ether-triazine or perfluoro aliphatic ethers;

b. Perfluoroalkylamines;

c. Perfluorocycloalkanes; or

d. Perfluoroalkanes;

2. Densities at 298 K (25 °C) 1.5 g/ml or greater;

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

4. They contain 60% by weight or more of fluorine.

Note: 1C006.d. does not control materials listed and packaged as medicinal products.

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

NB: SEE ALSO 1C107.

a. Ceramic powders based on simple or complex titanium diboride (TiB2) (CAS 12045-63-5) containing less than 5000 ppm of metallic impurities, not counting intentionally added, average particle size equal to or less than 5 µm and with no more than 10% of particles larger than 10 µm;

b. Not used;

c. Ceramic - "matrix" "composite" materials, as follows:

1. Ceramics - ceramic "composite" materials with a glass or oxide "matrix" and reinforced with fibers, made of any of the following materials:

a. Continuous fibers made from any of the following materials:

1. Al2O3 (CAS 1344-28-1); or

2. Si-CN; or

Note: 1C007.c.1.a. does not control “composites” containing fibers with a tensile strength of less than 700 MPa at 1273K (1000 °C) or creep resistance greater than 1% strain under a load of 100 MPa at 1273K (1000 °C) for 100 hours.

b. Fibers that satisfy all of the following:

1. Made of any of the following materials:

a. Son;

b. Si-C;

c. Si-Al-ON; or

d. Si-O-N; and

1C007 2. Having a "specific tensile strength greater than" 12.7 x 103 m;

2. Ceramic "matrix" "composite" materials where the "matrix" consists of carbides or nitrides silicon, zirconium or boron;

d. Not used;

e. Precursor materials (special purpose polymeric or organometallic materials) specially designed for the "production" of materials specified in 1C007.c., as follows:

1. Polydiorganosilanes;

2. Polysilazane;

3. Polycarbosilazanes;

f. Not used;

Technical note:

For the purpose of 1C007, 'precursor materials' are polymeric or metallurgical organic materials intended for the "production" of silicon carbide, silicon nitride or ceramics with silicon, carbon and nitrogen.

1C008 Non-fluorinated polymeric materials, as follows:

a. Imidy, as follows:

1. Bisamides of maleic acid;

2. Aromatic polyamides-imides (PAI) whose glass transition temperature is above 563K (290 °C);

3. Aromatic polyimides whose glass transition temperature is above 505K (232 °C);

4. Aromatic polyether-imides whose 'glass transition temperature (Tg)' is above 563K (290 °C);

Note 1: 1C008.a. controls liquid and solid forms including fibers, powders, balls, films, tiles, tapes or strips.

NB For articles of aromatic polyimides which cannot be further cross-linked in film, sheet or strip form, see 1A003.

b. Not used;

c. Not used;

d. Polyarylene ketones;

e. Polyarylene sulfides, where the arylene group is biphenylene, triphenylene or a combination thereof;

f. Polybiphenylethersulfone with a transition temperature (Tg) above 563K (290 °C)

Technical note:

1. For the purposes of 1C008.a.2. 'glass transition temperature (Tg)' *for thermoplastic materials in 1C008.a.4. and materials in 1C008.f. is determined using the method described in ISO 11357-2 (1999) or an equivalent national standard.*

1C008 2. *For the purposes of 1C008.a.2. 'glass transition temperature* (Tg)' *for thermoactive materials and materials in 1C008.a.3. determined by the point load test method described in ASTM D 7028-07 or an equivalent national standard. The test must be performed on a dry test sample with a degree of hardening of at least 90% as defined by ASTM E 2160-04 or an equivalent national standard, which has been dried using a combination of standard and post-drying procedures that achieve the highest* Tg.

1C009 Untreated fluorinated compounds, as follows:

a. Not used;

b. Fluorinated polyimides containing 10% by weight or more of bound fluorine;

c. Fluorinated phosphazene elastomers containing 30% by weight, or more, of bound fluorine.

1C010 "Fibrous or filamentary materials" as follows:

NB: SEE ALSO 1C210 AND 9S110.

Technical notes:

1. For the purposes of calculating the "specific tensile strength", "specific modulus" or specific gravity of "fibrous and filamentary materials" in 1C010.a., 1C010.b., 1C010.c. or 1C010.e.1.b., fiber and module strength shall be determined by Method A described in ISO 10618 (2004) or an equivalent national standard.

2. For the purposes of evaluating "specific tensile strength", "specific modulus" or specific the weight of "fibrous and filamentary materials" (eg fabrics, random fiber materials or braided materials) in 1C010 must be based on the mechanical properties of the constituent unidirectional monofilaments (eg monofilaments, threads, yarns or tows) prior to processing into non-unidirectional "fibrous or filament materials".

a. Organic "fibrous or filamentary materials", having both of the following characteristics:

1. "Specific module" larger than 12.7 x 10 m; and

2. "Specific tensile strength" greater than 23.5 x 10 m;

Note: 1C1010.a. not controlled by polyethylene.

b. Carbon "fibrous or filamentary materials", having both of the following characteristics:

1. "Specific module" exceeding 14.65 x 10 m; and

2. "Specific tensile strength" exceeding 26.82 x 10 m;

Note: 1C010.b. does not control:

a. Fabrics made of "fibrous or filamentary materials" for the repair of civil structures aircraft or laminates, which have all the above characteristics:

1. An area of no more than 1 m2;

1C010 *2. A length not exceeding 2.5 m, i*

3. Width greater than 15 mm.

b. Mechanically shredded, ground or cut carbon fiber or filament materials length less than or equal to 25 mm.

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

1. Have any of the following:

a. Consists of 50% or more silica and has a "specific modulus" exceeding 2.54 x 106 m; or

b. Not specified in 1S010.s.1.a. and which have a "specific modulus" greater than 5.6 x 106 m; and

2. Melting, softening, decomposition or sublimation point above 1922 K (1649 °C) in an inert atmosphere;

Note: 1C010.c. does not control:

a. Discontinuous, multiphase, polycrystalline aluminum oxide fibers in chopped fiber or randomly entangled form, containing 3 weight percent or more of silicon, with a specific modulus of less than 10 x 106 m;

b. Molybdenum fibers and molybdenum alloys;

c. Boron fibers;

d. Discontinuous ceramic fibers with a melting, softening, decomposition or sublimation point lower than 2043 K (1770 °C) in an inert atmosphere.

d. "Fibrous or filamentary materials":

1. Consisting of any of the following:

a. Polyetheramides specified in 1C008.a.; or

b. Materials specified in 1C008.d. to 1C008.f.; or

2. Made of materials specified in 1C010.d.1.a. or 1C010.d.1.b. and 'mixed' with other fibers specified in 1C010.a., 1C010.b. or 1C010.c.;

Technical note:

For the purposes of 1C010.d.2., 'mixed' means a mixture of filaments of thermoplastic fibers and fibers for reinforcement to produce a fiber reinforcement "armature" in the overall fiber form.

e. Fibers completely or partially impregnated with resins (preprezi), coated with metal or carbon (preforms) or 'carbon fiber preforms', as follows:

1. With any of the above characteristics:

a. Made of inorganic "fibrous or filamentary materials" specified in 1C010.c.; or

1C010 b. Made of organic or carbonaceous "fibrous or filamentary materials" which have all the above characteristics:

1. "Specific module" larger than 10.15 x 106 m; and

2. "Specific tensile strength" greater than 17.7 x 10 m;

2. With any of the above characteristics:

a. Resin or tar specified in 1C008 or 1C009.b.;

b. 'Dynamic mechanical test glass transition temperature (DMA Tg)' equal to or greater than 453 K (180 ºC) and contains phenolic resin; or

c. A 'dynamic mechanical test glass transition temperature (DMA Tg)' equal to or greater than 505 K (232 ºC) and containing a resin or tar not specified in 1C008 or 1C009.b., other than a phenolic resin;

Note 1: Fibrous or filamentary materials coated with metal or carbon (preforms) or 'carbon fiber preforms', not impregnated with resin or tar are specified as "fibrous or filamentary materials" in 1C010.a., 1C010.b. or 1C010.c.

Note 2: 1C010.e. does not control:

a. Matrices based on epoxy resins impregnated with carbon fiber or filament

materials (preparations) for the repair of civil aircraft structures or laminates, which have all the above characteristics:

1. An area of no more than 1 m2,

2. A length of no more than 2.5 m and

3. Width greater than 15 mm.

b. Carbon fiber or filament materials fully or partially impregnated with resins or tars, mechanically comminuted, ground or cut to a length of 25 mm or less, when resins or tars other than those specified in 1C008 or 1C009.b are used.

Technical note:

1. For the purposes of 1C010.e. and Notes 1, 'carbon fiber preforms' means an arranged arrangement uncoated or coated fibers intended to assemble the framework of parts before being "matrixed" to form a "composite".

2. For the purposes of 1C010.e.2. of materials, 'dynamic mechanical test glass transition temperature (DMA Tg)' for materials specified in 1C010.e. is determined using the method described in ASTM D 7028-07, or an equivalent national standard, on a dry sample. In the case of thermostable materials, the degree of crosslinking must be a minimum of 90% as defined in ASTM E 2160-04 or an equivalent national standard.

1C011 Metals and compounds, as follows:

NB: SEE ALSO NKL NGO and 1C111.

a. Metals with a particle size of less than 60 µm, whether spherical, atomized, spheroidal, flaky or ground, obtained from material containing 99% or more of zirconium, magnesium or their alloys;

Technical note:

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

Note: Metals or alloys specified in 1C011.a. they are controlled whether they are or not encapsulated in aluminium, magnesium, zirconium or beryllium.

b. Boron or boron alloys with a particle size of 60 µm or less and that:

1. Boron with a purity of 85% (by weight) or greater;

2. Boron alloys with boron content equal to or greater than 85% (by weight);

Note: Metals or alloys specified in 1C011.b. they are controlled whether they are or not encapsulated in aluminium, magnesium, zirconium or beryllium.

c. Guanidine nitrate (CAS 506-93-4);

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

NB See also NKL NGO for metal powder mixed with other substances to form a mixture formulated for military purposes

1C012 Materials as follows:

Technical note:

For the purposes of 1C012 these materials are normally used as nuclear heat sources.

a. Plutonium in any form with a plutonium-238 isotope content above 50% by weight.

Note: 1C012.a. does not control:

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

b. Deliveries of 3 "effective grams" or less when contained in the sensing portion of the instrument.

b. "Pre-split" neptunium-237 in any form.

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

1C101 Conspicuity reduction materials and equipment such as radar reflectivity, ultraviolet/infrared characteristic reflections, acoustic reflections, other than those specified in 1C001, usable for "missiles", missile subsystems or unmanned aerial vehicles specified in 9A012 or 9A112.a.

1C101 *Note 1: 1C101 includes:*

a. Construction materials and coatings specially developed to reduce radar reflection;

b. Coatings, including paints, specially developed to reduce or adjust reflectivity or silhouette emissivity in the microwave, infrared or ultra-violet region of the electromagnetic spectrum.

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

Technical note: In 1S101, a missile is considered a complete missile system and an unmanned aerial vehicle with a range of over 300 km.

1C102 Resaturated pyrolyzed 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-grained graphite, bulk density 1.72 g/cm or greater, measured at 288K (15 °C), particle size 100 mm or less, usable for rocket nozzles and tips (nose caps) of serviceable re-entry vehicles for the production of any of the mentioned products;

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

2. Pipes having an internal diameter of 65 mm or more, a wall thickness of 25 mm or more and a length of 50 mm or more;

3. Blocks of size 120 mm x 120 mm x 50 mm or larger;

NB: SEE ALSO 0C004.

b. Pyrolytic or fiber-reinforced graphite usable for rocket nozzles and tips (nose caps) re-entry vehicle; 9A004 or sounding missiles specified in 9A104.

NB: SEE ALSO 0C004.

c. Ceramic composite materials (dielectric constants less than 6 at frequencies of 100 MHz to 100 GHz) usable for "rockets", space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.;

d. Silicon carbide-reinforced bulk machinable unfired ceramics usable for "missile" nose tips and space launch vehicles specified in 9A004 or sounding rockets specified in 9A104;

e. Ceramic composites reinforced with silicon carbide, usable for nose caps, aircraft s atmospheric re-entry and wing nozzles used in "rockets", spacecraft specified in 9A004 or sounding rockets specified in 9A104.;

f. Ceramic composite materials of massive material consisting of a matrix of 'Ultra High Temperature Ceramic (UHTC)' with a melting point equal to or greater than 3000 °C, reinforced with fibers or filaments, which can be used for rocket components (such as being nose tips, re-entry vehicles, leading edges, nozzles, control surfaces or rocket motor throat inserts) in "missiles", spacecraft specified in 9A004, sounding rockets specified in 9A104 or "missiles".

1C107 *Note: 1C107.f. does not control the materials of 'ultra heat-resistant ceramics' (Ultra High Temperature Ceramic-UHTC)' in an incomplete form.*

Technical Note 1:

In 1C107.f. "missile" means complete missile systems and unmanned aerial vehicles capable of a range greater than 300 km.

Technical Note 2:

'Ultra High Temperature Ceramic-UHTC' includes:

1. titanium diboride (TiB2);

2. zirconium diboride (ZpB2);

3. Niobium diboride (NbB2);

4. Hafnium diboride (HfB2);

5. Tantalum diboride (TaB2);

6. Titanium carbide (TiC);

7. Zirconium carbide (ZrC);

8. Niobium carbide (HbC);

9. Hafnium carbide (HfC);

10. Tantalum carbide (TaC).

1C111 Propellants and chemical compositions therefor, not specified in 1C011, as follows:

a. Propellants:

1. Spherical or spheroidal aluminum powder, which is not listed in NKL NVO, particle weight
less than 200 µm and with an aluminum content of 97% by weight or greater, if at least 10% of the total weight consists of particles smaller than 63 µm, according to ISO 2591-1:1988 or its national equivalents;

Technical note:

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

2. Metal powders that are not listed in NKL NVO, as follows:

a. Metal powders of zirconium, beryllium or magnesium, or alloys of these metals if at least 90% by volume or weight of the total amount of particles consists of particles smaller than 60 µm (as determined by measuring techniques such as sieve, laser diffraction or optical scanning techniques), regardless of whether they are spherical, atomized, spheroidal, flaky or ground, with a mass fraction of 97% of any of the following metals:

1C111 1. Zirconium;

2. Beryllium; or

3. Magnesium.

Technical note:

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

b. Metal powders of boron or boron alloys with a mass fraction of boron of 85% or more, if at least 90% by volume or weight of the total amount of particles consists of particles smaller than 60 µm (as determined by measurement techniques such as sieve, laser diffraction or optical scanning techniques), regardless of whether they are spherical, atomized, spheroidal, flaky or ground;

Note: 1C111.a.2.a. and 1C111.a.2.b. control the powder mixture with multimodal distribution particle (eg mixtures of different grain sizes) if one or more ways are controlled.

3. Oxidizing agents in liquid fuels as follows:

a. Diazot-trioxide;

b. Nitrogen dioxide/dianitrogen tetroxide;

c. Diazot-pentoxide;

d. Mixed oxides of nitrogen (MON);

Technical note:

Mixed oxides of nitrogen (MON) are solutions of nitrogen oxides (NO) in nitrogen tetraoxide/ nitrogen dioxide (N204/ N02) that can be used in rocket systems. There are a number of compositions that can be designated as MONi or MONij, where i and j are integers representing the percentage of nitrous oxide in the mixture (eg MON3 contains 3% nitrous oxide, MON25 25% nitrous oxide. The upper limit is MON40 , 40% by weight).

e. See NKL NGO for Inhibited Red Fuming Nitric Acid (IRFNA);

f. See NKL NVO and 1C238 for compounds composed of fluorine and one or more other halogens,
oxygen or nitrogen.

4. The following hydrazine derivatives

NB: See also NKL NGO

a. Trimethylhydrazine (CAS 1741-01-1);

b. Tetramethylhydrazine (CAS 6415-12-9);

c. N,N diallylhydrazine (CAS 5164-11-4);

1C111 d. Allylhydrazine (CAS 7422-78-8);

e. Ethylene dihydrazine (CAS 6068-98-0);

f. Monomethyl hydrazine dinitrate;

Mr. unsymmetrical dimethylhydrazine nitrate;

h. Hydrazinium azide (CAS 14546-44-2);

and. 1,1-dimethyl hydrazinium azide (CAS 227955-52-4)/1,2-dimethyl hydrazinium azide (CAS 299177-50-7);

j. Hydrazinium dinitrate (CAS 13464-98-7);

k. Diimidoxalic acid dihydrazime (CAS 3457-37-2);

l. 2-hydroxyethylhydrazine nitrate (HEHN);

m. See NKL NGO for hydrazinium perchlorate;

n. Hydrazinium dichlorate (CAS 13812-39-0);

about. 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);

5. Materials of high energy density, which are not specified in NKL NVO, which can be
for use in guided missiles and unmanned aerial vehicles specified in 9A012 or 9A112.a.:

a. Fuel mixtures that include both liquid and solid fuels, such as boron compound based paste,
with an energy density per unit mass of 40 x 106 J/kg or greater;

b. Other high energy density fuels and fuel additives (eg, cubane, ionic solutions, JP-10)
which have an energy density per unit volume of 37.5 x 109 J/m3 or greater, measured at 20 oC and atmospheric pressure (101,325 kPa);

Note: 1C111.a.5.b. does not control refined fossil fuels and vegetable biofuels, including fuels certified for use in civil aviation, unless specially designed for 'guided missile' or unmanned aerial vehicles specified in 9A012 or 9A112.a.

Technical note:

In 1C111.a.5. a rocket means a rocket system or an unmanned aerial vehicle with a range exceeding 300 km.

6. Hydrazine substitute fuels, as follows:

2-dimethylaminoethylazide (DMAZ) (CAS 86147-04-8);

1C111 b. Polymer materials:

1. Polybutadiene with carboxy-terminal groups (including polybutadiene with carboxyl-terminal groups) (CTPB);

2. Polybutadiene with hydroxy-terminal groups (including polybutadiene with hydroxyl-terminal groups) (HTPB) (CAS 69102-90-5), which is not listed in NKL NVO;

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. Polyglycidyl nitrate (PGN or poly-GLYN) (CAS 27814-48-8).

c. Other fuel additives and agents:

1. **See NKL NGO for carboranes, decarboranes, pentaboranes and derivatives;**

2. Triethylene glycol dinitrate (TEGDN) (CAS 111-22-8);

3. 2-nitrodiphenylamine (SAS 119-75-5);

4. Trimethylolethane trinitrate (TMETN) (SAS 3032-55-1);

5. Diethylene glycol dinitrate (DEGDN) (CAS 693-21-0);

6. The following ferrocene derivatives:

a. See NKL NGO for catocena;

b. See NKL NGO for ethyl ferrocene;

c. See NKL NGO for propyl ferrocene;

d. See NKL NGO for n-butyl ferrocene;

e. See NKL NGO for pentyl ferrocene;

f. See NKL NGO for dicyclopentyl ferrocene;

Mr. See NKL NGO for dicyclohexyl ferrocene;

h. See NKL NGO for diethyl ferrocene;

and. See NKL NGO for dipropyl ferrocene

j. See NKL NGO for dibutyl ferrocene;

k. See NKL NGO for dihexyl ferrocene;

l. See NKL NGO for acetyl ferrocene/1,1'-c diacetyl ferrocene;

m. See NKL NGO for ferrocenecarboxylic acid;

n. See NKL NGO for butacene;

1C111 o. Other ferrocene derivatives suitable for fuel burn rate modifiers and not listed in NKL NVO.

Note: 1C111.c.6.o. does not control ferrocene derivatives containing six aromatics carbon functional groups added to the ferrocene molecule.

7. 4,5 diazidomethyl-2-methyl-1,2,3-triazole (iso-DAMTR), except for the one listed in NKL NVO.

d. 'Dense fuels', other than those listed in the NKL NGO, specifically intended for use in, 'missiles'.

Technical note:

1. In 1C111.d. A 'thick fuel' is a fuel or oxidant formulation in which an agent for gelation, e.g. silicates, kaolin (clay), carbon or any polymeric gelling agent.

2. In 1C111.d. 'Missile' means a complete missile system and an unmanned aerial vehicle system with a range greater than 300 km.

Note: For propellants and chemicals contained therein not specified in 1C111, see NKL NVO.

1C116 Maraging (martensitic aged) steels, of a kind used for 'missiles', which possess all of the following:

NB: SEE ALSO 1C216.

a. Having a tensile strength measured at 293 K (20 °C) equal to or greater than:

1. 0.9 GPa in the hardened solution state; or;

2. 1.5 GPa in the state of precipitation hardening; and

b. Any of the following forms:

1. Sheet, plate or tube shape with wall or plate thickness equal to or less than 5 mm;

2. Pipe shape with a wall thickness equal to or less than 50 mm and with an internal diameter equal to or greater than 270 mm.

Technical Note 1:

Maraging (martensitic aged) steels are iron alloys:

1. Which are generally characterized by high nickel content, very low carbon content and utilization additional elements or deposits in order to harden and harden the alloy by ageing; and

2. Which are subjected to heat treatment cycles to facilitate the process of martensitic transformation (solution hardening state) and then hardened by ageing.

Technical Note 2:

In 1C116 the term 'missile' means components of missile systems and unmanned aerial vehicles with a range greater than 300 km.

1C117 Materials for the manufacture of 'missile' 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 µm) or less;

b. Molybdenum and alloys in particulate form with a molybdenum content of 97% by weight or more i particle size 50 × 10-6 m (50 µm) or less;

c. Tungsten materials in solid form having all of the following:

1. Each of the following materials:

a. Tungsten and alloys containing 97% by weight or more of tungsten;

b. Copper-infiltrated tungsten containing 80% or more tungsten by weight; or

c. Silver infiltration tungsten containing 80% by weight or more tungsten; and

2. It can be processed into any of the following products:

a. Cylinders with a diameter of 120 mm or more and a length of 50 mm or more;

b. Pipes having an internal diameter of 65 mm or more and a wall thickness of 25 mm or more and a length of 50 mm or more; or

c. Blocks measuring 120 mm by 120 mm by 50 mm or more.

Technical note:

In 1C117 'missile' means complete missile systems and unmanned aerial vehicle systems with with the possibility of exceeding 300 km.

1C118 Titanium stabilized double alloy stainless steels (Ti-DSS) which possess all of the following:

a. Which possess all of the following characteristics:

1. Contain 17.0 to 23.0 percent by weight of chromium and 4.5 to 7.0 percent by weight of nickel;

2. Have a titanium content greater than 0.10 percent by weight; and

3. The ferritic-austenitic microstructure (which is also defined as a two-phase microstructure) of which is at least 10% austenite by volume (per ASTM E-1181-87 or appropriate equivalent national standard); and

b. They take any of the following forms:

1. Ingots or bars measuring 100 mm or more in each dimension;

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

3. Pipes with an outer diameter of 600 mm or more and a wall thickness of 3 mm or less.

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

a. Aluminum alloys having both of the following properties:

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

1C202 2. In the form of tubes or logs (including forgings) with an external diameter greater than 75 mm;

b. Titanium alloys having both of the following properties:

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

2. They are in the form of pipes or logs (including forgings) with an outer diameter greater than 75 mm;

Technical note:

The term 'possessing' refers to alloys before or after heat treatment.

1C210 'Fibrous or filamentary materials' or prepregs, not specified in 1C010.a., b. or e., as follows:

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

1. "Specific module" of 12.7 x 10 m or larger; or

2. "Specific tensile strength" of 23.5 x 10 m or greater;

Note: 1C210.a. does not control aramid 'fibrous or filamentary materials' contained therein ester-based surface modifiers 0.25% by weight or more.

b. Glass 'fibrous or filamentary materials' having both of the following characteristics:

1. "Specific module" of 3.18 x 10 m or larger; and

2. "Specific tensile strength" of 7.62 x 10 m or greater;

c. Thermosetting resin-impregnated "yarn", "pre-yarn", "fiber strips" or "strips" of width 15 mm or less (prepregs), made of 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' are restricted to continuous "monofilaments", "yarn", "pre-yarn", "fiber strips" or "strips".

1C216 Martensitic steels, not specified in 1C116, 'having' tensile strength of 1950 MPa or greater, at 293 K (20 °C);

Note: 1C216 does not control shapes where all linear dimensions are 75 mm or less.

Technical note:

The expression that maraging steel 'has' a property implies maraging steel before or after heat treatment.

1C225 Boron enriched in the isotope boron-10 (10B), in an amount greater than the natural contribution, as follows: elemental boron, compounds, mixtures containing boron, products thereof, waste and sawdust from the previous one.

Note: In 1C225 boron-containing mixtures include boron-filled materials.

Technical note:

The natural isotopic fraction of boron-10 is approximately 18.5 weight percent (20 atomic percent).

1C226 Tungsten, tungsten carbide and alloys containing more than 90% tungsten by weight, other than those specified in 1C117, having both of the following characteristics:

a. In forms with the symmetry of hollow cylinders (including cylinder segments) that have internal diameter between 100 mm and 300 mm; and

b. Masses greater than 20 kg.

Note: 1C226 does not control products specifically designed as weights or gamma collimators radiation.

1C227 Calcium having both of the following properties:

a. Contains less than 1000 parts per million (ppm) by weight of metallic impurities other than magnesium; and

1C227 b. Contains less than 10 parts per million (ppm) by weight.

1C228 Magnesium having both of the following properties:

a. Contains less than 200 parts per million (ppm) by weight of metallic impurities other than calcium; and

b. Contains less than 10 parts per million (ppm) by weight.

1C229 Bismuth having both of the following characteristics:

a. Purity of 99.99% by weight or greater; and

b. It contains less than 10 parts per million (ppm) by weight of silver.

1C230 Beryllium metal, alloys containing more than 50% by weight of beryllium, beryllium compounds, articles thereof, waste and shavings of any of the foregoing, other than those specified in NKL NVO.

NB: SEE ALSO NKL NGO.

Note: 1C230 does not control the following:

a. Metal windows for X-ray machines, or for hole inspection equipment;

b. Oxide forms in finished products or products in parts for electronics or substrates for electronic circuits;

1C230 *c. Beryl (a silicate of beryllium and aluminum) in the form of emerald and aquamarine.*

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

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

Note: 1C232 does not control products or devices containing less than 1 g of helium-3.

1C233 Lithium enriched in the isotope lithium-6 (6Li) to an amount greater than the natural fraction, and products or devices containing enriched lithium, as follows: elemental lithium,

alloys, compounds, mixtures containing lithium, products thereof, scrap or shavings of any of the foregoing.

Note: 1C233 does not control thermoluminescent dosimeters.

Technical note:

The natural proportion of lithium-6 is approximately 6.5 weight percent (7.5 atomic percent).

1C234 Zirconium with a hafnium content of less than 1 part by weight of hafnium in 500 parts of zirconium, as follows: metal, alloys containing more than 59% by weight of zirconium, compounds, products thereof, waste or shavings of any of the foregoing, other than those specified in 0A001.f.

Note: 1C234 does not control zirconium in the form of foils 0.10 mm thick and thinner.

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

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

1C236 'Radionuclides' suitable for generating neutron sources by alpha-n reaction, other than those specified in 0C001 or 1C012.a. in the following forms:

a. Elementary;

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 above.

Note: 1C236 does not control products or devices containing less than 3.7 GBq *(100 millicuries) of activity.*

1C236 *Technical note:*

In 1C236 'radionuclide' is any of the following:

– Actinium-225 (Ac-225)

– Actinium-227 (Ac-227)

– Californium-253 (Cf-253)

– Curium-240 (Cm-240)

– Curium-241 (Cm-241)

– Curium-242 (Cm-242)

– Curium-243 (Cm-243)

– Curium-244 (Cm-244)

– Einsteinium-253 (Es-253)

– Einsteinium-254 (Es-254)

– Gadolinium-148 (Gd-148)

- Plutonium-236 (Pu-236)

- Plutonium-238 (Pu-238)

– Polonium-208 (Po-208)

– Polonium-209 (Po-209)

– Polonium-210 (Po-210)

– Radium-223 (Ra-223)

– Thorium-227 (Th-227)

– Thorium-228 (Th-228)

– Uranium-230 (U-230)

– Uranium-232 (U-232)

1C237 Radium-226 (226Ra), radium-226 alloys, radium-226 compounds, mixtures which containing radium-226, and products and devices containing any of the foregoing.

Note: 1C237 does not control the following:

a. Medical devices;

b. Products or devices containing less than 0.37 GBq *(10 millicuries) of radium-226.*

1C238 Chlorine trifluoride (ClF3).

1C239 Explosives not specified in NCL NVO, or substances or mixtures which they contain more than 2% by weight, crystal density greater than 1.8 g/cm³ and detonation speed greater than 8000 m/s.

1C240 Nickel powder and porous metallic nickel, not specified in 0S005, as follows:

a. Nickel powder having both of the following properties:

1. Nickel with a purity of 99.0% by weight or greater; and

2. Average particle size less than 10 μm measured according to ASTM B-330 standard;

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

Note: 1C240 does not control the following:

a. Fibrous nickel powders;

b. Individual sheets of porous nickel with an area of 1000 cm2 per sheet or less.

Technical note:

1C240.b. refers to porous metal obtained by pressing and sintering material from 1C240.a. in order to obtain fine pores interconnected by the entire volume of the structure.

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

a. In shapes with hollow cylindrical symmetry (including cylinder segments) of internal diameter between 100 mm and 300 mm; and

b. Masses greater than 20 kg.

1C350 Chemicals which can be used as precursors for toxic chemical agents, as follows, and "chemical mixtures" containing one or more of the following:

NB: SEE ALSO NKL NVO I 1C450

1. Thiodiglycol (CAS111-48-8);

2. Phosphorus oxychloride (CAS10025-87-3);

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

4. SEE NQL NGO for methyl phosphonyl difluoride (CAS676-99-3);

5. Methylphosphonyl dichloride (CAS676-97-1);

6. Dimethyl phosphite (DMP) (CAS868-85-9);

7. Phosphorus trichloride (CAS7719-12-2);

8. Trimethyl phosphite (TMP) (CAS121-45-9);

9. Thionyl chloride (CAS7719-09-7);

10. 3-hydroxy-1-methylpiperidine (CAS3554-74-3);

11. N, N-diisopropyl-(beta)-aminoethyl chloride (CAS96-79-7);

12. N, N-diisopropyl-(beta)-aminoethane thiol (CAS5842-07-9);

1C350 13. 3-quinuclidinol (CAS1619-34-7);

14. Potassium fluoride (CAS7789-23-3);

15. 2-chloroethanol (CAS107-07-3);

16. Dimethylamine (CAS124-40-3);

17. Diethyl ethylphosphonate (CAS78-38-6);

18. Diethyl-N, N-dimethylphosphoramidate (CAS2404-03-7);

19. Diethyl phosphite (CAS762-04-9);

20. Dimethylamine hydrochloride (CAS506-59-2);

21. Ethyl phosphinyl dichloride (CAS1498-40-4);

22. Ethyl phosphonyl dichloride (CAS1066-50-8);

23. SEE NQL NGO for ethyl phosphonyl difluoride (CAS753-98-0);

24. Hydrogen fluoride (CAS7664-39-3);

25. Methyl benzilate (CAS76-89-1);

26. Methyl phosphinyl dichloride (CAS676-83-5);

27. N, N-diisopropyl-(beta)-amino ethanol (CAS96-80-0);

28. Pinacolyl alcohol (CAS464-07-3);

29. SEE NQL NGO FOR O-ethyl-O-2-diisopropylaminoethyl methylphosphonite (QL) (CAS57856-11-8);

30. Triethyl phosphite (CAS122-52-1);

31. Arsenic trichloride (CAS7784-34-1);

32. Benzylic acid (CAS76-93-7);

33. Diethyl methylphosphonite (CAS15715-41-0);

34. Dimethyl ethylphosphonate (CAS6163-75-3);

35. Ethyl phosphinyl difluoride (CAS430-78-4);

36. Methyl phosphinyl difluoride (CAS753-59-3);

37. 3-quinuclidinone (CAS3731-38-2);

38. Phosphorus pentachloride (CAS10026-13-8);

39. Pinacolon (CAS75-97-8);

40. Potassium cyanide (CAS151-50-8);

41. Potassium bifluoride (CAS7789-29-9);

42. Ammonium hydrogen fluoride or ammonium bifluoride (CAS1341-49-7);

43. Sodium fluoride (CAS7681-49-4);

44. Sodium bifluoride (CAS1333-83-1);

45. Sodium cyanide (CAS143-33-9);

46. Triethanolamine (CAS102-71-6);

1C350 47. Phosphorus pentasulphide (CAS1314-80-3);

48. Di-isopropylamine (CAS108-18-9);

49. Diethylaminoethanol (CAS100-37-8);

50. Sodium sulfide (CAS1313-82-2);

51. Sulfur monochloride (CAS10025-67-9);

52. Sulfur dichloride (CAS10545-99-0);

53. Triethanolamine hydrochloride (CAS637-39-8);

54. N, N-diisopropyl-(beta)-aminoethyl chloride hydrochloride (CAS4261-68-1);

55. Methylphosphonic acid (CAS993-13-5);

56. Diethyl methylphosphonate (CAS683-08-9);

57. N,N-dimethylaminophosphoryl dichloride (CAS677-43-0);

58. Triisopropylphosphite (CAS116-17-6);

59. Ethyldiethanolamine (CAS139-87-7);

60. O,O-diethylphosphorothioate (CAS2465-65-8);

61. O,O-diethylphosphorodithioate (CAS298-06-6);

62. Sodium hexafluorosilicate (CAS16893-85-9);

63. Methylphosphonium dichloride (CAS676-98-2);

64. Diethylamine (CAS109-89-7);

65. N,N-diisopropylaminoethanol 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);

1C350 82. N,N-Dipropylpropanamidine (CAS 1341496-89-6);

83. N,N-dimethylbutanamidine (CAS 1340437-35-5);

84. N,N-diethylbutanamide (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-diethylisobutanamide (CAS 1342789-47-2);

89. N,N-Dipropylisobutanamide (CAS 1342700-45-1).

Note 1: For import and export from/to "states not party to the Chemical Weapons Convention", 1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in 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 the share of individual listed ingredients does not exceed 10% by weight of the mixture.

Note 2: For import and export from/to "Chemical Weapons Convention States", 1C350 does not control "chemical mixtures" containing one or more of the chemicals specified in 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 the share of individual listed ingredients does not exceed 30% by weight of the mixture.

Note 3: 1C350 does not control "chemical mixtures" containing one or more chemicals specified in 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 and .89 in which the proportion of individual listed ingredients does not exceed 30% of the weight of the mixture.

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

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

a. **Viruses, whether natural, enhanced or modified, in any form "isolated live cultures" or as agents comprising living organisms intentionally inoculated or contaminated with cultures such as:**

1. African horse sickness virus;

2. African swine fever virus;

3. Andes virus;

4. Bird flu viruses (avian influenza), which are:

1C351 a. uncharacterized; or

b. defined in Annex I (2) of the European Council Directive 2005/94/EC (OJ L10, 14.01.2006.p.16) as highly pathogenic, such as:

1. Type A viruses with intravenous pathogenicity index (IVPI) greater than 1.2 in 6-year-old chickens Sunday; or

2. Viruses of type A, subtypes *H5* and *H7,* in which there are genomic sequences responsible for coding multiple basic amino acids at the cleavage site of the hemagglutinin molecule, similar to those observed in other *NRAI* viruses (highly pathogenic avian influenza viruses), indicating that cleavage of the molecule hemoglutinin can be induced by host proteases;

5. Bluetongue virus;

6. Chapare virus;

7. Chikungunya virus;

8. Choclo virus;

9. Congo-Crimean hemorrhagic fever virus; Crimean-Congo hemorrhagic fever virus;

10. Not used;

11. Dobrava–Belgrade hemorrhagic fever virus;

12. Eastern equine encephalitis virus;

13. Ebola virus: all members of the Ebola virus;
14. Foot and mouth virus;
15. Goatpox virus;
16. Guanarito virus;
17. Hantaan virus;
18. Hendra virus (Horse pox virus);
19. Porcine herpesvirus 1 (Pseudorabies virus (Aujeszky's disease);
20. Hog cholera virus;
21. Japanese encephalitis virus;
22. June virus;
23. Kyasanur Forest disease virus;
24. Laguna Negra virus;
25. Lassa virus;
26. Looping ill virus;
27. Lujo virus;

1C351 28. Lumpy skin virus;

29. Lymphocytic choriomeningitis virus (inflammation of the meninges);
30. Machupo virus;
31. Marburg virus; all members of the Marburg virus genus;
32. Monkeypox virus (monkey pox virus);
33. Murray Valley encephalitis virus;
34. Newcastle virus;
35. Nipah virus;
36. Ohm hemorrhagic fever virus;
37. Oropouche virus;
38. Peste-des-petits ruminants virus (plague virus of small ruminants);
39. Pig vesicular disease virus (pig enterovirus type 9);
40. Powassan virus;
41. Rabies virus and all others from the genus Lyssa virus;
42. Rift Valley hemorrhagic fever virus;
43. Rinderpest virus;
44. Rocio virus;
45. Sabia virus;
46. Seoul virus;
47. Sheeppox virus;
48. Sin nombre virus of hemorrhagic fever;
49. St Louis encephalitis virus;
50. Teschen swine virus;

51. Tick-borne encephalitis virus (far eastern subspecies);

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;

1C351 c. Bacteria whether natural, enhanced or modified, whether in form
"isolated live cultures" or as agents comprising living organisms intentionally inoculated or contaminated with 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 (previously known as Chlamydophila psittaci);

8. Clostridium argentinense (formerly known as Clostridium botulinum Type G), strains that produce botulism neurotoxins;

9. Clostridium baratii, strains that produce botulism neurotoxins;

10. Clostridium botulinum;

11. Clostridium butyricum, strains that produce botulism neurotoxins;

12. Clostridium perfringens types that produce epsilon toxin;

13. Coxiella burnetii;

14. Francisella tularensis;

15. Mycoplasma capricolum subspecies capripneumoniae (coj 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) serogroups O26, O45, O103, O104, O111, O121, O145, O157 and other Shiga toxin-producing serogroups;

Note: Shiga toxin-producing Escherichia coli (STEC) includes, among others, enterohemorrhagic E. coli (EHEC), verocytotoxin-producing E. coli (VTEC), or verocytotoxin-producing E. coli (VTEC).

20. Shigella dysenteriae;

21. Vibrio cholerae;

22. Yersinia pestis;

d. "Toxins", followed by their "subunits":

1. Botulism toxins;

2. Clostridium perfringens alpha, beta 1, beta 2, epsilon and iota toxins;

3. Conotoxin;

1C351 4. Ricin;

5. Saxitoxin;

6. Shiga toxin (Shiga-toxins, verotoxins and verocytotoxins);

7. Staphylococcus aureus enterotoxins, hemolysin alpha toxin and syndrome-causing toxin
toxic shock (previously 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.

Note: 1C351.d. does not control botulism toxins or conotoxins in a product form that meets all of the following criteria:

1. that these are pharmaceutical formulas intended for prescribing to people in the treatment of medically indicated conditions;

2. that they are prepackaged for distribution as medical products;

3. that they are allowed to be sold as medical products by a government body.

e. Fungi, whether natural, enhanced or modified, whether in the form of "isolated live cultures" or as agents comprising living organisms intentionally inoculated or contaminated with cultures as follows:

1. *Soccidioides and mmitis;*

2. *Soccidioides posadasii.*

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

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

a. A 'genetically modified organism' containing or 'genetic elements' encoding any of the following elements:

1. any gene or genes specific for any virus specified in 1C351.a. or 1C354.a.

2. any gene specific for bacteria specified in 1C351.c. or 1C354.b. or fungi listed in

1C351.e. or 1C354.c., and having any of the following:

a. in itself or by means of its copied or transferred products presents a significant danger to human, animal or plant health, or

b. may 'facilitate or enhance pathogenicity', or

3. any toxin specified in 1C351.d. or "toxin subunits".

b. Not used.

Technical note:

1. 'Genetically modified organisms' include organisms in which the genetic material (sequences nucleic acids) modified in a manner that does not involve natural copulation and/or natural recombination, and includes those produced artificially in whole or in part.

2. "Genetic elements" include, among other things, chromosomes, genomes, plasmids, transposons, vectors, and inactive organisms that contain parts of nucleic acid that can be recovered regardless of whether they are genetically altered or partially or fully chemically modified. For the purposes of controlling genetic elements, nucleic acids from an inactive organism, virus or sample are considered recoverable if the inactivation and preparation of the material is intended to facilitate the isolation, purification, amplification, detection or identification of the nucleic acids.

3. 'Enable or enhance pathogenicity' is defined as the likelihood that the insertion or integration of a nucleic acid sequence or sequences enables or increases the ability of the organizer to be used to intentionally cause disease or death. To be able to include altered, among others: virulence, transmissibility, stability, route of infection, host range, reproducibility, ability to evade host immunity, resistance to medical countermeasures or detectability.

Note 1: 1 S353 does not refer to the nucleic acid sequences of Shiga toxin produced by Escherichia coli, serogroups O26, O45, O103, O104, O111, O121, O145, O157 and other Shiga toxin-producing strains, except those responsible for encoding Shiga toxin or its subunits.

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

1C354 Plant pathogens, as follows:

a. Viruses, whether natural, enhanced or modified, in any form "isolated live cultures" or as agents comprising living organisms intentionally inoculated or contaminated with cultures such as:

1. Andean potato latent virus (Andean potato latent thymovirus);

2. Potato spindle tuber virus;

b. Bacteria, whether natural, enhanced or modified, whether in the form of "isolated live cultures" or as agents comprising living organisms deliberately inoculated or contaminated with cultures such as:

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 species 3, biovar 2;

c. Fungi, whether natural, enhanced or modified, whether in the form of "isolated live cultures" or as agents comprising living organisms deliberately inoculated or contaminated with cultures such as:

1. *Colletotrichum* kahawae (Colletotrichum *coffeanum var. Virulans)*

2. Bipolaris oryzae *(Cochliobolus miyabeanus, Helminthosporium oryzae);*

3. Pseudocercospora ulei *(Microcyclus ulei, syn. 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 endobioticium;

10. Tilletia indica;

11. Thecaphora solani.

1C450 Toxic chemicals and toxic chemical precursors, as follows, and "chemical mixtures" containing one or more of them:

NB: SEE ALSO 1S350, 1S351.d. And NKL NGO

a. **Toxic chemicals, such as:**

1. Amiton: O,O-diethyl S-[2-(diethylamino)ethyl] thiophosphate (78-53-5) and derived alkylated or protonated salts;

2. PFIB: 1, 1, 3, 3, 3-pentafluoro-2-(trifluoromethyl)-1-propene (382-21-8);

3. SEE NKL NGO FOR BZ: 3-
quinuclidinyl benzilate (6581-06-2);

4. Phosgene: carbonyl dichloride (75-44-5);

5. Chlorotian (506-77-4);

6. Hydrogen cyanide (74-90-8);

7. Chloropicrin: Trichloronitromethane (76-06-2);

Note 1: For import and export from/ to "states not party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.a.1. and .a.2. in which the share of individual listed ingredients does not exceed 1% by weight of the mixture.

Note 2: For import and export from/ to "States Parties to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.a.1. and .a.2. in which the share of individual listed ingredients does not exceed 30% by weight of the mixture.

Note 3: 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.a.4., .a.5., .a.6. and .a.7. in which the share of individual listed ingredients does not exceed 30% by weight of the mixture.

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

b. **Precursors of toxic chemicals, as follows:**

1. Chemicals that are not listed in NKL NVO or in 1C350, and contain a phosphorus atom to which it is attached one methyl, ethyl or propyl (normal or iso) group but no other carbon atoms;

Note: 1C450.b.1. not controlled by phonophos: O-ethyl S-phenyl ethyldithiophosphonate (944-22-9);

2. N,N -dialkyl [methyl, ethyl or propyl (normal or iso)]-phosphamide dihalides, various
from N,N-dimethylaminophosphoryl dichloride;

NB See 1S350.57 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 defined in 1S350;

1C450 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 hydrochlorides specified in 1S350;

5. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethan-2-ols and corresponding protonated salts other than N,N-diiso-propyl-(beta)-aminoethanol (96-80-0) and N,N diethylaminoethanol (100-37-8) which are defined in 1C350;

Note: 1S450.b.5 does not control the following:

a. N,N-dimethylaminoethanol (108-01-0) and corresponding protonated salts;

b. Protonated salts of N,N diethylaminoethanol (100-37-8);

6. N,N-dialkyl [methyl, ethyl or propyl (normal or iso)] aminoethane-2-thiols and corresponding protonated salts other than N,N-diiso-propyl-(beta)-aminoethanethiol (5842-07-9) and N,N-diisopropylaminoethanethiol hydrochloride (41 480-75-5) which is defined in 1C350;

7. **SEE 1S350 for ethyldiethanolamine (139-87-7);**

8. Methyldiethanolamine (105-59-9).

Note 1: For import and export from/ to "states not party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.b.1., .b.2., . b.3., .b.4., .b.5. and .b.6. in which the share of individual listed ingredients does not exceed 10% by weight
smile.

Note 2: For import and export from/ to a "State Party to the Chemical Weapons Convention", 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.b.1., .b.2., .b .3., .b.4., .b.5. and .b.6. in which the share of individual listed ingredients does not exceed 30% by weight of the mixture.

Note 3: 1C450 does not control "chemical mixtures" containing one or more of the chemicals specified in 1C450.b.8. in which the share of individual listed ingredients does not exceed 30% by weight
smile.

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

1D Software

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

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

1D003 "Software" specially developed or modified to operate equipment specified in 1A004.c. or 1A004.d.

1D101 "Software" specially developed or modified for the management or maintenance of goods specified in 1B101, 1B102, 1B115, 1B117, 1B118 or 1B119.

1D103 "Software" specially developed for the analysis of observability reductions, such as radar reflection, ultraviolet/infrared characteristic reflections and acoustic reflections.

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

1E Technology

1E001 "Technology" in accordance with the General Technology Note for "development" or "Production" of equipment or materials specified in 1A002 through 1A005, 1A006.b., 1A007, 1B or 1C.

1E002 Other "technology", as follows:

a. "Technology" for the "development" or "production" of polybenzothiazole or polybenzoxazole;

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 of "non-composite" ceramic materials:

1. Ceramic powders that possess all of the above properties:

a. Any of the following compositions:

1. Simple or complex oxides of zirconium and complex oxides of silicon or aluminum;

2. Simple boron nitrides (cubic crystal structural form);

3. Simple or complex carbides of silicon or boron; or

4. Simple or complex nitrides of silicon;

b. Any of the following total metallic impurity contents, excluding intentional additions, which are less than:

1. 1000 ppm for simple oxides or carbides; or

2. 5000 ppm for complex compounds or simple nitrides; and

c. If they are any of the following:

1. Zirconium (CAS 1314-23-4) with an average particle size equal to or less than 1 µm, and with no more than 10% of particles larger than 5 µm; or

1E002 2. Other ceramic powders with an average particle size of 5 µm or less, and with no more than 10% of particles larger than 10 µm; or

2. Non-composite ceramic materials consisting of materials specified in 1E002.c.1.;

Note: 1E002.c.2. does not control the "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 and 1C007.c.

Note: 1E002.f. does not control "technology" for repairing "civilian aircraft" structural parts using carbon "fibrous or filamentary materials" and epoxy resins, which are contained in "aircraft" manufacturers' manuals.

Mr. "Libraries" that are specially designed or modified to enable the equipment to perform functions specified in 1A004.c. or 1A004.d.

1E101 "Technology" in accordance with the General Technological Note for the "use" of the goods listed 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 regulating temperature, pressure or atmosphere in autoclaves or hydroclaves, when used for the "production" of "composites" or semi-manufactured "composites".

1E104 "Technology" related to the "production" of pyrolytically processed materials formed in molds, spindles or other substrates from precursor gases decomposed at temperatures of 1,573 K (1,300 °C) to 3,173 K (2,900 °C) and pressures of 130 Pa to 20 kPa.

Note: 1E104 includes "technology" for precursor gas composition flow rate and parameters i schedules for process control.

1E201 "Technology" in accordance with 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 1A 007, 1A202 or 1A225 to 1A227.

1E203 "Technology" in accordance with the General Technology Note for the "development" of "software" specified in 1D201.

CATEGORY 2

PROCESSING OF MATERIALS

2A Systems, equipment and components

NB: *For noiseless movable bearings, see NKL NVO.*

2A001 Antifriction bearings and bearing systems and parts, as follows:

NB: *SEE ALSO 2A101.*

a. Ball bearings and solid roller bearings having tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 or 2 (or equivalent national standard) or better and having both 'rings' and 'ball elements' (ISO5593) of monel metal (alloys of nickel, copper, iron and manganese) or beryllium;

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

Technical note:

For the purposes of 2A001.a.:

1. 'Ring' – the circular part of a radial roller bearing containing one or more channels (ISO 5593:1997)

2. 'Rollo element' – a ball or roller that rotates between channels (ISO 5593:1997).

b. Not used.

c. Active magnetic bearing systems using any of the following and specifically for them designed components:

1. Materials with a (magnetic) flux density of 2.0 T or greater and tensile strength greater than 414 MPa;

2. All electromagnetic 3D homopolar polarized constructions for actuators; or

3. High temperature position sensors (450 K (177 °C) and more)).

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

a. An inner ring with an opening between 12 mm and 50 mm in diameter;

b. Outer diameter of the outer ring between 25 mm and 100 mm; and

c. Width between 10 mm and 20 mm.

2A225 Refractory vessels made of materials resistant to liquid metal actinides, as follows:

a. Refractory vessels having both of the following characteristics:

2A225 1. Volume between 150 cm3 and 8000 cm3; and

2. Made or covered with a layer of one of the above materials, or a combination of the following materials, which have a total impurity level of 2% by mass or less:

a. Calcium fluoride (CaF2);

b. Calcium zirconate (metazirconate) (CaZrO3);

c. Cerium sulfide (Ce2S3);

d. Erbium oxide (erbium) (Er2O3);

e. Hafnium oxide (hafnia) (HfO2);

f. Magnesium oxide (MgO);

Mr. Nitrided niobium-titanium-tungsten alloy (about 50% Nb, 30% Ti, 20% W);

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

and. Zirconium oxide (zirconia) (ZrO2);

b. **Refractory vessels having both of the following characteristics:**

1. Volume between 50 cm3 and 2000 cm3; and

2. They are made or coated with tantalum, with a purity of 99.9 mass % or higher;

c. **Refractory vessels having all the above characteristics:**

1. Volume between 50 cm3 and 2000 cm3;

2. They are made or coated with tantalum, with a purity of 98 mass % or higher; and

3. They are coated with a layer of tantalum carbide, nitride, boride or some of their combinations.

2A226 Valves having all of the following characteristics:

a. A 'nominal size' of 5 mm or greater;

b. They have a bellows seal; and

c. They are completely made or coated with aluminum, aluminum alloy, nickel or alloy nickel containing more than 60 mass % of nickel.

Technical note:

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

2B Equipment for testing, verification and production

Technical notes:

1. For purposes of 2B secondary parallel contour axis (such as w-axis on horizontal milling machines or a secondary axis of rotation with a center line parallel to the main axis of rotation) are not included in the total number of contour (controlled) axes. The rotary axes should not rotate more than 360°. The rotary axis can be driven using a linear accessory (screw or gear and rack).

2. For the purposes of 2B, the number of axes that can be simultaneously coordinated for "contour control by processing" is the number of axes along which or around which simultaneous and relative movements of the tool in relation to the workpiece are performed during processing. This does not include additional axes that affect other relative movements within the machine. Such axes include:

a. Spindle dressing system for grinders;

b. Parallel rotary axes designed for mounting separate preparations;

c. Collinear rotary axes designed to manipulate the same workpiece clamped at different ends.

3. For the purposes of 2B, the marking of the axes must be in accordance with the international standard ISO 841:2001, Industrial automation system and integration - Numerical control of machines - Coordinate system and motion nomenclature

4. For the purposes of 2B001 to 2B009, "tilting spindles" are considered as rotary axes.

5. For the purposes of 2B 'declared "one-way positioning repeatability"' may be used for each individual machine tool model instead of individual machine tests and is determined as follows:

a. Choose five machines of the model to be tested;

b. Measure the repeatability of the linear axes (Rÿ, Rÿ) according to ISO230-2:2014 and evaluate the “one-way positioning repeatability” for each axis of all five machines;

c. Determine the arithmetic mean of the "one-way positioning repeatability" for each axis of all five machines together. Those arithmetic mean values of "one-way positioning repeatability" (

$\overline{UPR}$) *become the declared value for each model axis(* $\overline{UPR}_x$, $\overline{UPR}_y$ *...);*

d. Since the Category 2 list applies to each linear axis, it will

be as many declared "one-way positioning repeatability" values as there are linear axes;

e. If any axis of the machine model not controlled by 2B001.a. to 2B001.c. has "declared" "one-way positioning repeatability" equal to or less than the controlled "one-way positioning repeatability" of each machine tool model increased by 0.7 µm, the manufacturer should confirm the level of accuracy every eighteen months.

6. For the purposes of 2B001.a. to 2B001.c., measurement uncertainty for "unidirectional positioning repeatability" of machine tools, as defined by the international standard ISO 230-2:2014 or an equivalent national standard, will not be considered.

2B *7. For the purposes of 2B001.a. to 2B001.c. axis measurement is performed in accordance with the testing procedures from chapter 5.3.2. standard ISO 230-2:2014. Tests for axles longer than 2 meters will be carried out on sections of 2 m length. Axles longer than 4 meters require multiple tests (e.g. two tests for axles 4 m to 8 m long, three tests for axles 8 m to 12 m long), each on a section of 2 m length and spaced at equal intervals the length of the entire axis. The parts on which the tests are carried out are evenly distributed along the length of the entire axis, and any excess length is evenly distributed at the beginning, middle and end of the part on which the tests are carried out. The lowest value of "one-way positioning repeatability" of all parts under test shall be reported.*

2B001 Machine tools, as follows, and any combination thereof, for separation (or cutting) of metals, ceramics or "composites", which in accordance with the technical specification of the manufacturer can be equipped with electronic devices for "numerical control":

NB: SEE ALSO 2B201.

Note 1: 2B001 does not control special purpose machine tools limited to production 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 cutting tools;

c. Extrusion screws;

d. Engraved or polished parts of jewelry or

e. Dental prostheses.

Note 3: A machine tool having at least two of the following three functions: turning, milling or grinding (eg a rotary machine which can also perform a milling function), must be evaluated against each of the applicable items in 2B001.a., b. or c.

Note 4: A machine tool that, in addition to the attachment for turning, milling or grinding, also has an additional attachment production must be assessed against each applicable entry in 2V001.a., .b. or .c.

NB: For machine tools for optical processing see 2B002.

a. Turning machine tools that have two or more axes that can be aligned simultaneously for "contour control" and have any of the following characteristics:

1. "Unidirectional positioning repeatability" equal to or less (better) than 0.9 µm along one or more linear axes with a path length of less than 0.1 m; or

2. "Unidirectional positioning repeatability" equal to or less than 1.1 µm along one or more linear axes with a path length of 1.0 m or more;

2B001 *Note 1: 2B001.a. does not control rotating machines specially designed for production contact lenses, which have all of the above characteristics:.*

a. Machine controller limited to use of software with partial input programming data for the production of ophthalmic lenses; and

b. Without vacuum suction.

Note 2: 2B001.a. does not apply to turning machines (Swissturn), limited exclusively to machining with a bar device, if the largest diameter of the bar is 42 mm or less and if there is no possibility to install a chuck. Machines can have drilling and milling capabilities for processing parts with a diameter of less than 42 mm.

b. Milling machine tools, having any of the following characteristics:

1. Three linear axes and one rotary axis that can be simultaneously adjusted for "steering contouring", which have any of the following characteristics:

a. "Unidirectional positioning repeatability" equal to or less (better) than 1.1 µm along one or more linear axes with a path length of less than 1.0 m; or

b. "Unidirectional positioning repeatability" equal to or less than 1.1 µm along one or more linear axes with a path length of 1.0 m or more;

2. Five or more axes that can be simultaneously coordinated for "contour control" i have any of the following:

a. "Unidirectional positioning repeatability" equal to or less (better) than 0.9 µm along one or more linear axes, with a path length of less than 1.0 m;

b. "Unidirectional positioning repeatability" equal to or less (better) than 1.4 µm along one or multiple linear axes, with a travel length equal to or greater than 1 m and less than 4 m;

c. "Unidirectional positioning repeatability" equal to or less (better) than 6.0 µm along one or multiple linear axes with a travel length equal to or greater than 4 m;

d. Not used.

3. "One-way positioning repeatability" for pattern drilling machines, equal to or less (better) than 1.1 µm along any linear axis; or

4. Machines with flying (rotating) knife(s) that have all the above characteristics:

a. Spindle "runout" and "eccentricity" less (better) than 0.0004 mm TIR; and

2B001 b. Angular deviations (pitch, yaw, roll) less (better) than 2 arcseconds, TIR over 300 mm range of movement of transverse sliders;

c. Grinding machine tools, having any of the following characteristics:

1. Possess all of the following:

a. "Unidirectional positioning repeatability" equal to or less (better) than 1.1 µm along one or more linear axes; and

b. Three or more axes that can be used simultaneously for "contour control"; or

2. Five or more axes that can be simultaneously coordinated for "contour control" which have any of the following;

a. "Unidirectional positioning repeatability" equal to or less (better) than 1.1 µm along one or several linear axes, with a travel length of less than 1 m;

b. "Unidirectional positioning repeatability" equal to or less (better) than 1.4 µm along one or multiple linear axes, with a travel length equal to or greater than 1 m and less than 4 m;

c. "Unidirectional positioning repeatability" equal to or less (better) than 6.0 µm along one or multiple linear axes with a travel length equal to or greater than 4 m;

Note: 2B001.c does not control the following grinding machines:

a. Cylindrical external, internal and external-internal grinding machines with all of the following characteristics:

1. Limited to cylindrical grinding; and

2. Limited to a maximum outer diameter or length of the working part of 150 mm.

b. Machines specially designed as pattern grinding machines that do not have a z- or w-axis, a

have a "unidirectional positioning repeatability" equal to or less (better) than 1.1 µm.

c. Surface grinders.

d. Electric discharge machines (EDM) of the cordless type with two or more rotary axes that can be simultaneously used for "contour processing management";

e. Machine tools for the removal of metals, ceramics or "composites" having all of the following characteristics:

1. Removing material with any of the following:

a. Water or other liquid jets, including those with abrasive additives;

b. Electron beam; or

c. With a "laser" beam; and

2B001 2. At least two rotary axes having all of the following:

a. They can be simultaneously used for "contour management"; and

b. Have a positioning "accuracy" of less (better) than 0.003º;

f. Deep drilling machines and rotary machines modified for deep drilling, with max with an achievable opening depth of more than 5 m.

2B002 Numerically controlled machine tools equipped to produce non-spherical optical surfaces and having all of the above characteristics:

a. Surface finish less (better) than 1.0 µm;

b. Finishing with a roughness less (better) than 100 nm rms;

c. Three or more axes that can be simultaneously coordinated for "contour control"; and

d. Use any of the following processes:

1. magnetorheological finishing ('MRF');

2. electrorheological finishing ('ERF');

3. 'finishing with a jet of energetic particles';

4. 'processing by inflating the tool membrane'; or

5. 'liquid-jet processing'.

Technical note:

For the purposes of 2B002:

1. 'MRF' is a material removal process using an abrasive magnetic fluid viscosity controlled by magnetic field;

2. 'ERF' is a material removal process using an abrasive fluid whose viscosity is controlled by an electric field.

3. 'Energy Particle Jet Finishing' uses RAP (Reactive Atom Plasmas) or jets ions for selective material removal.

4. 'Membrane inflation machining' is a process that uses a pressurized membrane, which deforms in such a way that only a small part of the membrane is in contact with the object being processed;

5. 'Liquid-jet processing' uses a flow (jet) of liquid for material removal.

2B003 "Numerically controlled" machine tools, specially designed for turning, finishing, grinding or honing hardened (Rc = 40 or more) having all of the following characteristics:

a. Slope diameter greater than 1 250 mm;

b. Working contact width equal to or greater than 15% of the split diameter; and

c. Finish 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:

NB: SEE ALSO 2B104 AND 2B204.

a. A controlled thermal environment in a closed cavity and chamber cavity with an internal diameter of 406 mm or greater; and

b. Any of the following:

1. Maximum working pressure greater than 207 MPa;

2. Controlled thermal environment with a temperature higher than 1773 K (1500 ºC); or

3. Device for hydrocarbon impregnation and removal of the resulting gaseous decomposition products.

Technical note:

For the purposes of 2B004, the internal dimension of the chamber is the dimension of the chamber in which the working and the achieved are achieved temperature and working pressure, without fasteners. This dimension will be smaller than either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of these chambers is located inside the other.

NB: In relation to specially designed cutting tools, dies and placement devices tools see 1B003, 9B009 and NKL NVO.

2B005 Equipment specially designed for the application, treatment and control during processing of inorganic topcoats, coatings and surface modifications, as specified for in column 2 of the Deposition Techniques Table, according to the procedures shown in column 1 of the Deposition Techniques Table following 2E003.f ., as well as specially designed components for automatic handling, positioning, manipulation and control:

a. Chemical vapor deposition (CVD) manufacturing equipment having all of the following:

NB: SEE ALSO 2B105.

1. By a process modified for one of the following:

a. Pulsed chemical vapor deposition (CVD);

b. Controlled thermal nucleation deposition (CNTD); or

c. Plasma-enhanced or plasma-assisted chemical vapor deposition (CVD); and

2. Has any of the following:

a. Rotary seals for high vacuum (equal to or less than 0.01 Pa); or

b. Control of the thickness of the upper layer in situ;

b. Production equipment used for ion implantation with a beam current of 5 mA or greater;

2B005 c. Electron beam physical vapor deposition (EB-PVD) production equipment, together with propulsion systems exceeding 80 kW, with any of the following:

1. Laser system for controlling the liquid level in the tank, which precisely regulates the speed movements of ingots (casting); or

2. Computer control device that works on the principle of photoluminescence of ionized atoms in the evaporator current, for controlling the rate of deposition of the upper layer containing two or more elements;

d. Production equipment used for plasma injection, having any of the following characteristics:

1. Work in a controlled atmosphere at reduced pressure (equal to or less than 10 kPa, measured above and at a distance of up to 300 mm from the exit of the nozzle of the gun), in a vacuum chamber with the possibility of reaching a pressure of up to 0.01 Pa before the injection process; or

2. Control of the thickness of the upper layer in situ;

e. Production equipment used for sputter deposition, with current densities of 0.1 mA/mm2

or greater, with a deposition rate of 15 µm/h or greater;

f. Production equipment used for deposition using a cathode arc, with an electromagnetic grid for managing the position of the arc on the cathode;

Mr. Production equipment used for ion galvanization, which is able to perform in situ measurements of any of the following:

1. The thickness of the upper layer deposited on the lower layer and for speed control; or

2. Optical characteristics.

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

2B006 Dimensional control systems and equipment or measuring systems and equipment, units for position feedback and "electronic circuits", as follows:

a. Computer-controlled, "numerically controlled" coordinate measuring machines (CMMs) with a three-dimensional (volumetric) length measurement error (E0, MPE) at any point within the working range of the machine (ie, within the axis length) equal to or less (better) than (1.7 + L/1000)µm (L is the measured length in mm), tested in accordance with ISO10360-2:2009;

Technical note:

For the purposes of 2B006.a., E0, MPE, *the most accurate machine configuration specified by the manufacturer (eg the best of the following: probe, measuring arm length, motion parameters, environment)*

NB: SEE ALSO 2B206.

2B006 b. Linear displacement measuring instruments or systems, feedback units with linear position and "electronic assemblies", as follows:

Note: Interferometric and optical measuring systems incorporating a "laser" are specified only in 2B006.b.3. and 2B206.c.

1. "Non-contact measuring systems" with a 'resolution' equal to or less (better) than 0.2 µm within a measuring range of up to 0.2 mm;

Technical note:

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

1. "non-contact measuring systems" are designed to measure the distance between the probe and the measured of the object along one 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" of less (better) than (800 + (600 × L/1 000)) nm (L equals the effective length in mm);

3. Measuring systems with all the following elements:

a. They contain a "laser";

b. *Full range 'resolution' of 0.200 nm or less (better); and*

c. The ability to achieve a "measurement uncertainty" equal to or less (better) than (1.6 + L/2000) nm (L is the measured length in mm) at any point of the measuring range, when the value is compensated against the refractive index of air and measured in a period of 30 seconds at a temperature of 20 ± 0.01 °C; or

4. "Electronic assemblies" specially designed to provide feedback in the systems specified in 2B006.b.3.;

Technical note:

For the purposes of 2B006.b., 'resolution' is the smallest displacement of the measuring device; on digital instruments, the least significant part.

c. Rotary position feedback units specially designed for tooling

angular displacement measuring machines or instruments, having an angular position "accuracy" equal to or less (better) than 0.9 seconds of arc;

Note: 2B006.c. *it does not control the optical instruments, such as autocollimators, that they use collimator light (eg "laser" light) to detect the angular displacement of the mirror.*

2B006 d. Equipment for measuring surface roughness (including surface defects), by measurement optical scattering, 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 devices if they meet or exceed the criteria specified for the functions of measuring devices.

2B007 "Robots" having any of the following, and specially designed controllers and "end effectors" therefor:

NB: SEE ALSO 2B207.

a. Not used;

b. Specially designed in accordance with applicable national safety standards to the environment of explosive ammunition;

Note: 2V007.b. does not control "robots" specifically intended for use in paint shops.

c. Specially designed or rated as radiation-hardened to withstand the total amount radiation greater than 5 × 103 Gy (silicon) without reducing operational capabilities; or

Technical note:

The term Gy (silicon) refers to the energy in joules per kilogram absorbed by the unprotected sample of silicon when exposed to ionizing radiation.

d. Specially designed to work at altitudes higher than 30,000 m.

2B008 'Compound rotary tables' and 'tilting spindles' specially designed for tool machines, as follows:

a. Not used;

b. Not used;

c. 'Compound rotary tables' or 'tilting spindles', having all of the following:

1. Designed for turning, milling or grinding machine tools; and

2. Two rotary axes designed to be simultaneously coordinated for "contour control";

Technical note:

For the purposes of 2B008.c., a 'compound rotary table' is a table that allows the workpiece to be rotated and tilted about two non-parallel axes

d. "Tilt spindles" having all of the following characteristics:

1. Designed for machine tools for turning, milling or grinding; and

2. Designed to be simultaneously used for "contour control".

2B009 Rotary rolling forming machines with or without changing the thickness of the work pieces which, in accordance with the manufacturer's technical specifications, may be equipped with "numerical control" or computer control units and which have all of the following characteristics:

NB: SEE ALSO 2B109 AND 2B209.

a. Three or more axes that can be used simultaneously for "contour control"; and

b. Force on the rolls greater than 60 kN.

Technical note:

Machines with combined functions of rotary rolling with thickness change (flowforming) or without changing the thickness of the workpiece (spinforming) are for the purposes of 2B009 considered as machines for

forming by rotary rolling.

2B104 "Isostatic presses", other than those specified in 2B004, having all of the following characteristics:

NB: SEE ALSO 2B204.

a. With a maximum working pressure of 69 MPa or more;

b. Designed to reach and maintain a controlled thermal environment of 873K (600 ºC) or higher; and

c. They have a chamber cavity with an internal diameter of 254 mm or more.

2B105 Chemical vapor deposition (CVD) furnaces, other than those specified in 2B005.a., designed or modified for densification of carbon-carbon composites.

2B109 Rotomolding machines, other than those specified in 2B009, usable in the "production" of propulsion components and equipment (eg engine housings and intermediate spaces) for "missiles" and specially designed components, as follows:

NB: SEE ALSO 2B209.

a. Rotary roll forming machines having all of the following characteristics:

1. Equipped with or in accordance with the technical specifications of the manufacturer can be equipped by "numerical control" or computer control units, even if they were not equipped with said units; and

2. More than two axes that can be simultaneously used for "contour control".

b. Specially designed components for roll forming machines specified in 2B009 or 2B109.a.

Technical note:

Machines with the combined functions of spinforming and flowforming are considered as spinforming machines for the purposes of 2B109.

2B116 Vibration testing systems, equipment and components therefor, as follows:

a. Vibration testing systems using feedback or closed-loop techniques, and with a digital controller, capable of oscillating the system at 10g rms or more over the entire frequency range of 20 Hz to 2000 Hz, with applied forces of 50 kN or more, measured 'bare' to the table';

b. Digital controllers, in combination with specially developed vibration testing software, with a 'real-time bandwidth' exceeding 5 kHz, designed for use with vibration testing systems specified in 2B116.a.;

Technical note:

In 2V116.b. 'real-time bandwidth' represents the maximum speed at which the controller is capable to perform a complete cycle of sampling, data processing and transmission of control signals.

c. Vibration exciters, with or without amplifiers, with the possibility of applying forces of 50 kN or larger, measured on a 'bare table', and usable in vibration testing systems specified in 2B116.a.;

d. Test part holders and electronic units designed to combine multiple vibration exciters in a system capable of providing an effective combined force of 50 kN or greater, measured 'bare table', usable in vibration systems specified in 2B116.a.

Technical note:

In 2B116 'bare table' refers to a flat table or surface, without fastening or tightening devices.

2B117 Equipment and process controls other than those specified in 2B004, 2B005.a., 2B104 or 2B105, which are designed and modified for densification and pyrolysis of rocket nozzles and nose tips of ballistic missiles made of structural composites.

2B119 Balancing machines and related equipment, as follows:

NB: SEE ALSO 2B219.

a. Balancing machines having all of the following characteristics:

1. They cannot balance rotors/assemblies weighing more than 3 kg;

2. They can balance rotors/assemblies at speeds higher than 12500 rpm;

3. They can correct imbalances in two planes or more; and

4. They can perform balancing up to a residual specific unbalance of 0.2 g mm per kg of rotor mass;

Note: 2B119.a. does not apply to balancing machines designed or modified for dental or other medical equipment.

b. Indicators designed or modified for use with machinery specified in 2B119.a.

2B119 *Technical note:*

Indicators are sometimes known as balancing instrumentation.

2B120 Motion simulators or speed tables, having all of the following:

a. Two or more axes;

b. Slip rings for transmission of electrical power and/or signal information; and

c. With any of the following characteristics:

1. Any single axis has all of the following characteristics:

a. A speed of 400º/s or more, or 30º/s or less; and

b. Speed resolution equal to or less than 6º/s, and accuracy equal to or less than 0.6º/s;

2. Worst-case speed stability equal to or better (less) than an average of ±0.05% at 10º or more; or

3. Positioning accuracy equal to or better than 5 arcseconds.

Note 1: 2B120 does not control rotary tables designed or modified for machine tools or for medical equipment. For control of machine tool rotary tables, see 2B008.

Note 2: *Motion simulators or speed tables specified in 2V120 remain subject export controls regardless of whether they are fitted with slip rings or integrated contactless devices.*

2B121 Positioning tables (equipment for precise positioning when rotating approx any axle) not specified in 2B120, having all of the following characteristics:

a. Two or more axes; and

b. Positioning accuracy equal to or better than 5 arcseconds.

Note: 2B121 does not control rotary tables designed or modified for machine tools or for medical equipment. For control of machine tool rotary tables, see 2B008.

2B122 Centrifuges for acceleration above 100 g, designed or modified with slip rings or with integrated non-contact devices for the transmission of electrical power, information or both.

Note: Centrifuges listed in 2V122 remain subject to export control regardless of whether slip rings or integrated non-contact devices are fitted to them.

2B201 Machine tools, other than those specified in 2B001, as follows, for removing or cutting metals, ceramics or "composites" which, in accordance with the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes ;

Technical note:

Declared levels of positioning accuracy determined on the basis of the following procedures with measurements carried out in accordance with ISO 230-2:19882 or an equivalent national standard may be used for each machine tool model, if submitted to national competent authorities instead of carrying out individual machine testing and if these authorities authorities accept. Determination of declared positioning accuracy:

a. Choose five machines of the model to be tested;

b. Measure the accuracy of linear axes in accordance with ISO 230-2:19882;

c. Determine the accuracy-related values (A-value) for each axis of each machine. Method A-value calculation is described in ISO standard 230-2:19882;

d. Determine the average A-value of each axis. That average value becomes the declared 'positioning accuracy' of each axis for each model (Âx Ây...);

e. Since the subject of 2B201 applies to each linear axis, there will be as many declared 'positioning accuracies' as there are linear axes;

f. If any axis of the machine model, not controlled by 2B201.a., 2B201.b. or 2B201.c. has a declared positioning accuracy of 6 µm or better (less) for grinding machine, and 8 µm or better (less) for milling machines and turning machines, both according to ISO 230-2:19882 *the manufacturer should confirm the level of accuracy every eighteen months.* ,

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

1. 'Positioning accuracy' with 'all available compensations' equal to or less (better) than 6 µm in accordance with ISO 230-2:(1988)2 or equivalent national standard along any linear axis;

2. Two or more rotary axes for profiling; or

3. Five or more axes that can be adjusted simultaneously for "contour control";

Note: 2B201.a. does not apply to milling machines with the following characteristics:

a. Path along the x-axis greater than 2 m; and

b. Overall x-axis 'positioning accuracy' greater (better) than 30 µm.

2B201 b. Grinding machine tools, having any of the following characteristics:

1. Positioning accuracy with "all compensation available" equal to or less (better) than 4 µm, in accordance with ISO 230-2:(1988)2 or equivalent national standard, along any linear
wasps;

2. Two or more rotary axes for profiling; or

3. Five or more axes that can be adjusted simultaneously for "contour control";

Note: 2B201.b. does not apply to grinders with the following characteristics:

a. Cylindrical external, internal and external-internal grinding machines with all of the following characteristics:

1. Limited to a maximum outer diameter or length of the working part of 150 mm; and

2. Limitation on x, z and c axes;

b. Pattern grinders that do not have a z-axis or w-axis with overall 'positioning accuracy' less (better) than 4 µm in accordance with ISO 230-2:(1988)2 or an equivalent national standard.

c. Turning machine tools having a 'positioning accuracy' with 'all available compensation' of less (better) than 6 µm in accordance with ISO 230-2:(1988)2 along any linear axis (overall accuracy) for machines having the possibility of processing diameters greater than 35 mm;

Note: 2B201.c. does not control bar turning machines (Swissturn) limited exclusively to processing with a rod device, if the largest diameter of the rod is 42 mm or less and if there is a possibility for

installation of the clamping base. Machines may have drilling and/or milling capabilities for processing parts smaller than 42 mm in diameter.

Note 1: 2B201 does not control special purpose machine tools limited to making either which of the following parts:

a. Gears;

b. Crankshaft or camshaft;

c. Tools or blades;

d. Screw extruders.

Note 2: Machine tools having at least two of the three functions: turning, milling or grinding (eg a rotary machine with a milling function), must be evaluated against all items specified in 2B201.a., b. or c.

Note 3: Items 2B201.a.3. and 2B201.b.3. include machines based on parallel linear kinetic designs (eg hexapods) that have 5 or more axes, none of which are rotary.

2B204 "Isostatic presses" other than those specified in 2B004 and 2B104 and suitable equipment, as follows:

a. "Isostatic presses" having both of the following characteristics:

1. They can reach a maximum working pressure of 69 MPa or more; and

2. The chamber cavity has an internal diameter greater than 152 mm;

b. Dies, molds and controls, specially designed for "isostatic presses", specified in 2B204.a.

Technical note:

In 2B204, the internal dimension of the chamber is the dimension of the chamber in which the operating temperature is reached and working pressure, without fasteners. This dimension will be smaller than either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of these chambers is located inside the other.

2B206 Dimensional control machines, instruments or systems, not specified in 2B006, as follows:

a. Computer-controlled or numerically controlled dimensional control machines (CMMs) having any of the following:

1. Have only two axes and have a maximum allowable length measurement error one-dimensionally identified as any combination of E0x,MPE, E0y,MPE, or E0z,MPE that is equal to or less (better) than (1.25 + L/1000) µm (L is the measured length in mm) at any point within the measuring range (ie, within the length of the axis), according to ISO 10360-2 (2009) or

2. Three or more axes and have a three-dimensional (volumetric) maximum permissible length measurement error (E0,MPE) equal to or less (better) than (1.7 + L/800) m (where L is the measured length in mm), on to any point of the measuring range of the machine (ie, within the length of the axis), in accordance with ISO 10360-2 (2009);

Technical note:

E0,MPE *of the most accurate CMM configuration specified in accordance with ISO 10360-2 (2009) by manufacturer (eg, best of the following: probes, needle lengths, motion parameters, environment) and with all compensations available are compared to a threshold of 1.7 + L/ 800 µm*

b. Systems for simultaneous linear-angular control of half-capsules, with both of the following characteristics:

1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3.5 µm per 5 mm; and

2. "Angular position deviation" equal to or less than 0.02º.

c. 'Linear error' measurement systems having all of the following characteristics:

2B206 *Technical note:*

For the purposes of 2B206.c. 'linear error' means the change in distance between the measuring probe and the object

measurements.

1. contain "laser" and

2. Can be maintained, for at least 12 hours, at a temperature of ± 1 K (± 1 °C) or in conditions standard temperature and standard pressure, and all of the following:

a. a 'resolution', across their full range, equal to or better than 0.1 µm; and

Technical note:

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

b. "measurement uncertainty" equal to or better (less) than (0.2 + L/2 000) µm (L is measured in lengths in mm).

Note: 2B206.c. it does not apply to the measuring set of interferometers, without a feedback connection with a closed one or open loop, containing a laser for measuring error in the sliding motion of machine tools, dimensional inspection machines, or similar equipment.

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

Technical note:

For the purpose of 2B206.d. 'linear displacement' means the change in 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 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 a working range greater than 5 mm; and

2. Drift equal to or better (less) than 0.1% per day at standard test ambient temperature ± 1 K (± 1° C)

Note 1: Machine tools that can be used as measuring machines are covered if meet or exceed the criteria specified for machine tool functions or measuring machine functions.

Note 2: Machines described in 2B206 are covered if they exceed the control threshold over the entire operating range.

Technical note:

All parameters of measured values in 2B206 are plus/minus values, ie. they do not include the whole range.

2B207 "Robots", "end effectors" and control units, not specified in 2B007, as follows:

a. "Robots" or "end effectors" specially designed in accordance with national safety standards applicable to the handling of high explosives (for example, meeting the nominal power of the electrical code for high explosives);

b. Control units specially designed for any of the "robots" or "end effectors" specified in 2B207.a.

2B209 Rotary rolling forming machines with or without workpiece thickness change capable of rotary rolling forming, other than those specified in 2B009 and 2B109, and mandrels, as follows:

a. Machines having both of the following characteristics:

1. Three or more rollers (active or leading); and

2. Which, in accordance with the manufacturer's technical specifications, can be equipped with units for "numerical control" or computer control;

b. Mandrels for forming rotors designed for forming internal cylindrical rotors
diameter between 75 mm and 650 mm.

Note: 2B209.a. includes machines having only one rolling cylinder designed for metal deformation and two auxiliary rolling cylinders that represent the support of the mandrel, but do not participate directly in the deformation process.

2B219 Centrifugal multi-plane balancing machines, fixed or portable, horizontal or vertical, as follows:

a. Centrifugal balancing machines designed for balancing flexible rotors
600 mm or more in length and having all of the following characteristics:

1. Processing diameter or sleeve diameter greater than 75 mm;

2. The possibility of balancing masses from 0.9 to 23 kg; and

3. The possibility of rotation speeds for balancing greater than 5000 rpm;

b. Centrifugal balancing machines designed for balancing hollow cylindrical rotor components having all of the following characteristics:

1. Sleeve diameter greater than 75 mm;

2. The possibility of balancing masses from 0.9 to 23 kg;

3. The possibility of balancing to a residual imbalance equal to or less than 10 g × mm/kg per plane; and

4. Belt drive.

2B225 Remote manipulators usable for remote actions in radiochemical separation operations or in hot chambers, having any of the following characteristics:

a. Possibility of penetration through the wall of the hot chamber of 0.6 m or more (operation through the wall); or

b. The possibility of bridging the top of the wall of the hot chamber with a thickness of 0.6 m or more (operation over the wall).

Technical note:

Remote control devices (remote manipulators) enable the transfer of human activity (human operator) to the activities of a remote mechanical arm and end device. They can be of the main/ sub type or controlled by a joystick or keyboard.

2B226 Induction furnaces with controlled atmosphere (vacuum or inert gas) except those specified in 9B001 and 3B001 and the electrical power supply therefor:

NB: SEE ALSO 3B001 and 9V001.

a. Stoves having all of the following characteristics:

1. Ability to work at temperatures above 1,123 K (850 °C);

2. Induction coils with a diameter of 600 mm or less; and

3. Designed for an input power of 5 kW or more;

Note: 2B226.a. does not control furnaces made for the processing of semiconductor wafers.

b. Electrical supplies, with a specified power output of 5 kW or greater, specially designed for furnaces specified in 2B226.a.

2B227 Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and suitable equipment, as follows:

a. Arc melting and casting furnaces having both of the following characteristics:

1. Consumable electrodes with a capacity between 1,000 cm3 and 20,000 cm3, and

2. Ability to work at melting temperatures above 1,973 K (1,700 °C);

b. Electron jet melting furnaces and plasma atomization and melting furnaces having both of the following characteristics:

1. Power 50 kW or more; and

2. Ability to work at melting temperatures above 1,473 K (1,200 °C).

c. Computer control and management systems specially designed for any furnace specified in 2B227.a. or 2B227.b.

d. Plasma torches specially designed for furnaces specified in 2V227.b. which have both of the following feature:

1. Operation with power greater than 50 kW; and

2. Ability to work above 1 473 K (1 200 oC);

2B227 e. Electron jet guns specially designed for furnaces listed in

2V227.b. which operate with a power greater than 50 kW.

2B228 Rotor or assembly manufacturing equipment, rotor straightening equipment, mandrels for forming bellows and dies:

a. Rotor assembly equipment for mounting parts of gas centrifuge rotor tubes, partitions and end caps;

Note: 2B228.a. includes precision mandrels, clamps and hot drawing machines.

b. Straightening equipment for centering parts of gas centrifuge rotor tubes towards the main axis;

Technical note:

In 2B228.b. this type of equipment usually consists of precision measuring probes that are connected to by a computer that later controls e.g. the role of pneumatic pistons used to center parts of the rotor tube.

c. Mandrels for forming bellows and dies for the production of single-spiral bellows.

Technical note:

In 2B228.c. Bellows have the following characteristics:

1. The inner diameter is between 75 mm and 650 mm;

2. Length equal to or greater than 12.7 mm;

3. The depth of one spiral is greater than 2 mm; and

4. They are made of high-strength aluminum alloys, maraging steel or other "fibrous or filament materials" of high strength.

2B230 All types of 'pressure transducers' that can measure absolute pressures and have it all listed features:

a. Pressure-sensitive elements made of or protected by aluminum, aluminum alloy, aluminum oxide (alumina or sapphire), nickel, nickel alloy with more than 60% nickel by weight, or fully fluorinated hydrocarbon polymers;

b. Seals, if any, essential for closing the pressure of the measuring element, and in direct contact with process media, which are made or protected by aluminum, aluminum alloy, aluminum oxide (alumina or sapphire), nickel, nickel alloy with more than 60% nickel by mass or fully fluorinated with hydrocarbon polymers; and

c. They have any of the following characteristics:

1. Full scale range less than 13 kPa and 'accuracy' greater than 1% of full scale range; or

2. Full scale of 13 kPa or greater and 'accuracy' greater than 130 Pa, when measured at 13 kPa.

2B230 *Technical notes:*

1. In the 2B230 the 'pressure transducer' is the means that converts the pressure measurement into a signal.

2. In 2B230 'accuracy' includes non-linearity, hysteresis and repeatability at ambient temperature.

2B231 Vacuum pumps having all of the following characteristics:

a. Entrance opening size equal to or greater than 380 mm;

b. Pumping speed equal to or greater than 15 m3/s; and

c. The possibility of producing a pressure vacuum greater than 13 mMPa.

Technical notes:

1. The pumping speed is determined at the measuring point with nitrogen or air.

2. Pressure vacuum is determined at the pump inlet when the pump inlet is blocked.

2B232 High velocity gun systems (propellant, gas, rail, electromagnetic and electrothermal and other advanced systems) capable of accelerating missiles up to 1.5 km/s or more.

NB: SEE NKL NGO.

2B233 Bellows scroll compressors and bellows scroll vacuum pumps all of the following characteristics:

NB: See also 2B350.i.

a. Ability to achieve an inlet volumetric flow rate of 50 m3/h or greater;

b. Ability to achieve a pressure ratio of 2:1 or greater; and

c. All their surfaces that come into contact with the process gas are made of one of the following materials:

1. aluminum or aluminum alloy;

2. aluminum oxide;

3. stainless steel;

4. nickel or nickel alloys;

5. phosphor bronzes; or

6. fluoropolymers.

2B350 Chemical production plants, equipment and components:

a. Reaction vessels or reactors, with or without agitator, total internal (geometric) volumes greater than 0.1 m3 (100 litres) and less than 20 m3 (20,000 litres), where all surfaces that come into direct contact with the chemicals being processed or present are made of any of the following materials:

N.V. For repair kits, see 2V350.k.

1. Alloy with more than 25 mass % nickel and 20 mass % chromium;

2B350 2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Nickel or an alloy with more than 40% nickel by mass;

5. Tantalum or tantalum alloy;

6. Titanium or titanium alloy; or

7. Zirconium or zirconium alloy;

8. Niobium (columbium) or niobium alloy.

b. Agitators intended for use in reaction vessels or reactors specified in 2B350.a., and rotating parts, vanes or shafts designed for such agitators, where all surfaces of the agitator that come into direct contact with the chemicals being processed or are present,

made from any of the following materials:

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Nickel or alloy with more than 40 mass % of nickel;

5. Tantalum or tantalum alloy;

6. Titanium or titanium alloy;

7. Zirconium or zirconium alloy; or

8. Niobium (columbium) or niobium alloy.

c. Storage tanks, containers or tanks with a total internal (geometric) volume greater than 0.1 m3 (100 litres), where all surfaces that come into direct contact with the chemicals being processed or present are made of any of the following materials:

N.V. For repair kits, see 2V350.k.

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Nickel or alloy with more than 40 mass % of nickel;

5. Tantalum or tantalum alloy;

6. Titanium or titanium alloy;

7. Zirconium or zirconium alloy; or

8. Niobium (columbium) or niobium alloy.

2B350 d. Heat exchangers or condensers that have a heat exchange surface greater than 0.15 m2, and less than 20 m2 as well as pipes, plates, coils or blocks (cores) designed for such heat exchangers or condensers, where all surfaces that come into direct contact with the chemicals being processed or present, are made of some of the following materials:

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Graphite or 'carbon-graphite';

5. Nickel or alloy with more than 40 mass % of nickel;

6. Tantalum or tantalum alloy;

7. Titanium or titanium alloy;

8. Zirconium or zirconium alloy;

9. Silicon carbide;

10. Titanium carbide; or

11. Niobium (columbium) or niobium alloy.

e. Distillation or absorption columns with an internal diameter greater than 0.1 m; as well as liquid manifolds, vapor manifolds or liquid manifolds designed for such distillation or absorption columns, where all surfaces that come into direct contact with the chemicals being processed or present are made of any of the following materials:

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Graphite or 'carbon-graphite';

5. Nickel or alloy with more than 40 mass % of nickel;

6. Tantalum or tantalum alloy;

7. Titanium or titanium alloy;

8. Zirconium or zirconium alloy; or

9. Niobium (columbium) or niobium alloy.

f. Remotely controlled charging equipment whose all surfaces come into direct contact with processed chemicals made from any of the following materials:

1. Alloy with more than 25 mass % nickel and 20 mass % chromium; or

2. Nickel or an alloy with more than 40% nickel by mass;

2B350 g. Valves and components as follows:

1. Valves with both of the above characteristics:

a. 'Nominal sizes' greater than DN 10 mm or NPS 3/8; and

b. That all their surfaces that come into direct contact with the chemical or chemicals that are manufactured, processed or stored made of 'corrosion resistant materials';

2. Valves, other than those specified in 2B350.g.1., having all of the following characteristics:

a. 'nominal sizes' equal to or greater than DN 25 or NPS 1 and equal to or less than DN 100 or NPS 4;

b. Casings (valve bodies) or reshaped casing liners;

c. The closing element is designed to be replaceable; and

d. all casing surfaces (valve bodies) or reshaped casing liners that come in direct contact with a chemical or chemicals that are manufactured, processed or stored are made of 'corrosion resistant materials';

3. components made for valves not specified in 2B350.g.1. or 2B350.g.2., in which all surfaces which come into direct contact with the chemical or chemicals being produced, processed or stored are made of 'corrosion-resistant materials as follows':

a. Casings (valve bodies);

b. Reshaped case linings;

Technical note:

1. For the purposes of 2B350.g., 'corrosion resistant materials' refers to any of the following materials:

a. Nickel or alloys with more than 40% nickel by mass

b. Alloys with more than 25 mass % nickel and 20 mass % chromium;

c. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

d. Glass or glass lining (including glazed or glazed coatings);

e. Tantalum or tantalum alloys;

f. Titanium or titanium alloys;

Mr. Zirconium or zirconium alloys;

h. Niobium (columbium) or niobium alloys, or

and. Ceramic materials as follows:

1. Silicon carbide with a purity of 80% by mass or greater;

2. Aluminum oxide (alumina, alumina) purity 99.9% by mass or higher;

3. Zirconium oxide (zirconia).

2B350 *2. 'Nominal size' is defined as the smaller of the inlet and outlet diameters.*

3. 'Nominal sizes' (DN) of valves are in accordance with ISO 6708:1995. 'Nominal size' pipe (NPS) *are in accordance with ASME B36.10 or B36.19 or national equivalents.*

h. A multi-wall piping system having a leak detection connection where all surfaces that come into direct contact with the chemicals being processed or are present are made of any of the following materials:

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

3. Glass (including glazed or glazed coatings or glass lining);

4. Graphite or 'carbon-graphite';

5. Nickel or alloy with more than 40 mass % of nickel;

6. Tantalum or tantalum alloy;

7. Titanium or titanium alloy;

8. Zirconium or zirconium alloy; or

9. Niobium (columbium) or niobium alloy.

and. Pumps with multiple seals, diaphragm or bellows pumps without auxiliary drive or magnetically driven, with a manufacturer's specified maximum flow rate of more than 0.6 m3/h or vacuum pumps with a manufacturer's specified maximum flow rate of more than 5 m3/h (at standard temperature of (273K (0 °C)) and at standard pressure (101,3 kPa), other than those of 2B233, as well as casings (pump bodies), pressed casing liners, pump rotating parts, impeller nozzles or jet pumps, designed for such pumps where all surfaces that come into direct contact with the chemicals being processed are made of some of the following materials:

1. Alloy with more than 25% by mass of nickel and 20% by mass of chromium;

2. Ceramics;

3. Ferrosilicon (iron alloys with a high silicon content);

4. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by mass);

5. Glass (including glazed or glazed coatings or glass cladding);

6. Graphite or 'carbon-graphite';

7. Nickel or alloy with more than 40 mass % of nickel;

8. Tantalum or tantalum alloy;

9. Titanium or titanium alloy;

10. Zirconium or zirconium alloy; or

2B350 11. Niobium (columbium) or niobium alloy.

Technical notes:

In 2B350.i. the term "sealants" refers only to those sealants that come into direct contact with with the chemical or chemicals being processed (or intended to be) and perform a sealing function when the reciprocating or rotary drive shaft passes through the pump body.

j. Annealing devices designed for the destruction of chemicals specified in 1C350, having specially designed waste systems, special handling equipment and average chamber temperature

for combustion greater than 1273 K (1000 °C), where all surfaces in the waste system that come into direct contact with waste materials are made of or coated with any of the following materials:

1. "Alloys" with more than 25% by mass of nickel and 20% by mass of chromium;

2. Ceramics; or

3. Nickel or "alloys" with more than 40% nickel by mass;

k. Repair assemblies with metal surfaces in direct contact with the chemical being processed, made of tantalum or tantalum alloys as follows, and specially designed components therefor:

1. Intended for mechanical attachment to glass-lined reaction vessels or reactors from item 2B350.a.; or

2. Intended for mechanical attachment to glass tanks, containers or receptacles specified in 2B350.c.

Note: For the purposes of 2V350, materials used for gaskets, packing, sealing, screws, washers or other materials performing a sealing function do not determine control status, provided such components are designed to be replaceable.

Technical note:

1. "Carbon graphite" is a composition consisting of amorphous carbon and graphite, in which graphite content 8 percent or more by weight.

2. For the materials specified in the items above, the term 'alloy' when not followed by a specific elemental concentration is understood as the identification of those alloys in which the identified metal is present in a higher percentage by weight than any other element.

2B351 Devices for controlling toxic gases and related control systems detection components, other than those specified in 1A004, as follows; and detectors; sensor devices; and replaceable sensor cartridges for them:

a. Designed for continuous operation and usable for detection of chemical management agents rata or chemicals specified in 1C350, at concentrations less than 0.3 mg/m3; or

b. Designed to detect inhibition of cholinesterase activity.

2B352 Biological production and handling equipment, as follows:

a. Contents of the facility and accompanying equipment, as follows:

1. Complete containment equipment, meeting the containment criteria P3 or P4 (BL3, BL4, L3, L4) as specified in the WHO Manual on Laboratory Biological Safety (3rd edition Geneva, 2004);

2. Equipment intended for fixed installation in containment facilities controlled by 2B352.a., as follows:

a. Autoclaves for decontamination with double pass-through doors;

b. Showers for decontamination of breathing suits;

c. Mechanically sealed pass-through doors or pass-through doors with inflatable seals;

b. Fermentation vessels and components as follows:

1. Fermentation vessels suitable for the cultivation of "micro-organisms", or living cells for the production of viruses or toxins, without developing aerosols, having an internal volume of 20 liters or more;

2. Components designed for fermentation vessels specified in 2B352.b.1. as follows:

a. Breeding chambers designed to be sterilized or disinfected on site;

b. Holders for breeding chambers;

c. Process monitoring units that can simultaneously monitor and control two or more indicators of fermentation composition (eg temperature, pH value, nutrients, mixing, dissolved oxygen, air flow, foam control);

Technical note:

1. For the purposes of 2B352.b. fermentation vessels and include bioreactors, disposable bioreactors (for disposable), hemostats and continuous flow systems.

2. For the purposes of 2B352.b. culture chamber holding devices include disposable culture chambers with rigid walls.

c. Centrifugal separators, suitable for continuous separation without developing aerosols, which have all the above characteristics:

1. The flow rate exceeds 100 liters per hour;

2. Components are made of polished stainless steel or titanium;

3. One or more sealing joints in the vapor containing area; and

4. The possibility of independent steam sterilization in a given closed system;

2B352 *Technical note:*

Centrifugal separators also include decanters.

d. Transverse (tangential) filtration equipment and components, as follows:

1. Transverse (tangential) filtration equipment, suitable for separating "microorganisms", viruses, toxins or cell cultures, which has both of the following characteristics:

a. Complete filtration surface equal to or greater than 1 m2; and

b. Which has any of the following characteristics:

1. Can perform sterilization or disinfection in-situ; or

2. Uses disposable filtration components.

Technical note:

In 2B352.d.1.b. Sterilization refers to the elimination of all viable microbes from equipment via physical (eg steam) or chemical agents. Disinfection refers to the destruction of potential microbial infections in equipment through chemical agents with a germicidal effect. Disinfection and sterilization are distinct from sanitization, which refers to a cleaning procedure designed to reduce the microbial content of equipment without guaranteeing that all microbial infections will be eliminated or their viability will be achieved.

Note: 2B352.d. does not control reverse osmosis and hemodialysis equipment, as stated by the manufacturer.

2. Components of transverse (tangential) filtration equipment (eg modules, elements, cassettes, cartridges, units or plates) with a filtration area equal to or greater than 0.2 m2 for each component and designed for use in transverse (tangential) equipment for filtration specified in 2B352.d.;

e. Equipment for cold sterilization by dry freezing which can sterilize with steam or gas and which has a condenser capacity that is greater than 10 kg of ice per 24 hours and less than 1000 kg of ice per 24 hours;

f. Protective and covering equipment, namely:

1. Suits with full or partial protection, as well as capes with limited air supply from external environments, which function under positive pressure.

Note: 2B352.f.1. does not control clothing intended to be worn with separate breathing apparatus.

2. Biological containment chambers, isolators or biological safe booths having all of the following characteristics for normal operation:

a. A completely closed work space in which the worker is separated from the work by a physical partition;

b. Can work at negative pressure;

2B352 c. Means for safe management of tools in the work area;

d. Air supply and air outlet from the work area filtered with a HEPA filter;

Note 1: 2B352.f.2. refers to Category III biologically safe cabins, as described in the latest edition of the WHO biological activity manual, or constructed in accordance with national standards, regulations and guidelines.

Note 2: 2B352.f.2. refers to any insulator that fulfills all the mentioned characteristics, regardless of its purpose and its designation.

Note 3: 2B352.f.2. it does not apply to isolators that are specifically intended for health care or the transport of infected patients.

Mr. Aerosol inhalation equipment intended for testing resistance to aerosols with "microorganisms", "viruses" or "toxins" as follows:

1. full-body exposure chambers that have a capacity of 1 m3 or more;

2. directional aerosol chambers in which only the nose is exposed and which have a capacity for exposure:

a. 12 rodents or more; or

b. two or more non-rodent animals;

3. Closed tubes to prevent the movement of animals, intended for use with chambers with directed flow of aerosols, in which only the nose of the animal is exposed;

h. Spray drying equipment that can dry toxins or pathogenic microorganisms, which has all of the following characteristics:

1. Water evaporation capacity ÿ 0.4 kg/h and ÿ 400 kg/h;

2. The ability to achieve a typical mean particle size of ÿ 10 µm with the existing installation or with minimal modifications to the spray dryer with atomizing sprays that enable the required particle size to be achieved, and

3. It can be sterilized or disinfected on the spot.

and. Nucleic acid assemblers and synthesizers that are partially or fully automated and designed to generate continuous nucleic acids longer than 1.5 kilobases with an error rate of less than 5% in a single run.

2C Materials

Does not have

2D Software

2D001 "Software", not specified in 2D002, as follows:

a. "Software" specially designed or adapted for the "development" or "production" of said equipment in 2A001 or 2B001 to 2V009

b. "Software" specially designed or modified for the "use" of equipment specified in 2A001.c, 2B001 or 2B003 to 2B009.

Note: 2D001 does not control partial "software" that generates codes for "numerical control" for processing various parts.

2D002 "Software" for electronic devices, whether as part of a device or system, enabling such device or system to function as a "numerical control" unit, capable of coordinating more than four axes simultaneously for "contouring control"

Note 1: 2D002 does not control "software" specially designed or modified for operation items that are not listed in Category 2.

Note 2: 2D002 does not control "software" for items specified in 2B002. See 2D001 and 2D003 for

"Software" control for items specified in 2B002.

Note 3: *2D002 does not control "software" that is exported with a good not specified in Category 2 and that is minimally required for the operation of that good.*

2D003 "Software" designed or modified for the operation of equipment specified in 2B002, that converts visual design functions, workpiece measurements and material processing procedures into "numerical control" commands to achieve a desired object shape.

2D101 "Software", specially designed or modified for the "use" of the equipment specified in 2B104, 2B105, 2B109, 2B116, 2B117 or 2B119 to 2B122.

NB: SEE ALSO 9D004.

2D201 "Software" specially designed for the "use" of equipment in 2B204, 2B206, 2B207, 2B209, 2B219 or 2B227.

2D202 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 2B201.

Note: 2D202 does not control partial "software" that generates command codes for "numerical control", but the direct use of equipment for processing various parts is not allowed.

2D351 "Software", other than that specified in 1D003, specially designed for the "use" of equipment specified in 2B351.

2D352 "Software" specially designed for nucleic acid assemblers and synthesizers specified in 2B352.i., capable of designing and constructing functional genetic elements from digital sequence data.

2E Technology

2E001 "Technology" in accordance with the General Technology Note for the "development" of equipment or "software" referred to in 2A, 2B or 2D.

Note: 2E001 includes "technology" for incorporating probe systems into coordinate measuring devices specified in 2B006.a.

2E002 "Technology" in accordance with the General Technology Note for the "production" of equipment specified in 2A or 2B.

2E003 Other "technology", as follows:

a. Not used;

b. "Technology" for metalworking processes, as follows:

1. "Technology" for designing tools, dies or clamping devices designed for any of the following processes:

a. "Superplastic molding";

b. "Diffusion binding"; or

c. 'Hydraulic pressing with direct action';

Technical note:

For the purposes of 2E003.b.1.c., "direct acting hydraulic pressing" is a deformation process in which, in direct contact with the object being processed, uses a flexible container filled with liquid.

2. It is not used;

NB: For "technology" for metalworking processes for manufacturing processes for gas turbine engines and components, see 9E003 and NKL NVO.

2E003 c. "Technology" for the "development" or "production" of hydraulic forming machines stretching and the necessary molds for the production of aircraft fuselage structures.

d. Not used;

e. "Technology" for the "development" of integration "software" for the installation of expert systems for a higher level

support for basic operations of the work unit in "numerical control" units;

f. "Technology" for the application of inorganic coatings for surfacing or inorganic coatings for surface modification (specified in column 3 of the following table) on non-electronic substrates (specified in column 2 of the following table) by the process specified in column 1 of the following table and defined in the technical note.

Note: The table and technical note appear after the introduction of 2E301.

2E003 *NB: This table specifies the "technology" of a particular coating process and only when the resulting coating is in column 3 in the paragraph directly opposite the corresponding substrate in column 2. For example, process technical data for Chemical Vapor Deposition (CVD) are included for silicide deposition on carbon–carbon, ceramic, and metal "matrix" "composite" substrates, but are not included for silicide deposition on cemented tungsten carbide (16) and silicon carbide (18) substrates. In another case, the resulting coating is not listed in the paragraph in column 3 directly opposite the paragraph in column 2 that lists cemented tungsten carbide (16) and silicon carbide (18).*

2E101 "Technology" in accordance with the General Technology Note for the "use" of equipment or "software" specified in 2B004, 2B009, 2B104, 2B109, 2B116, 2B119 to 2B122 or 2D101.

2E201 "Technology" in accordance with the General Technology Note for the "use" of equipment or "software" specified in 2A225, 2A226, 2B001, 2B006, 2B007.b., 2B008, 2B009, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B233, 2D201 or 2D202.

2E301 "Technology" in accordance with the General Technology Note for the "use" of goods specified in 2B350 to 2B352.

Table of
Deposition Techniques (Coating)

	1. Swipe process(1)*	2. Substrate	3. Resultant coating
A. Chemical Vapor Deposition (CVD)		"Superalloys"	Aluminides for internal passages
		Ceramics (19) and low expansion glass (14)	Silicides
			Carbides
			Dielectric layers (15)
			Diamond
			Diamond Carbon (17)
		Carbon-carbon, ceramics and "composites" with metal "matrix"	Silicides
			Carbides
			Refractory metals
			Their mixtures (4)
			Dielectric layers (15)
			Aluminides
			Alloyed aluminides (2)
			Boron nitride
			Carbides

		Cemented Tungsten Carbide (16), Silicon Carbide (18)	Tungsten
			Their mixtures (4)
			Dielectric layers (15)
		Molybdenum and molybdenum alloys	Dielectric layers (15)
		Beryllium and beryllium alloys	Dielectric layers (15)
			Diamond
			Diamond Carbon (17)
		Sensor pane materials (9)	Dielectric layers (15)
			Diamond
			Diamond Carbon (17)
B.	Thermal Vapor Physical Deposition (TE-PVD)		
B.1.	Physical Gas Deposition (PVD): Electron Beam Physical Gas Deposition (EB-PVD)	"Superalloys"	Alloyed silicides
			Alloyed aluminides (2)
			MCrAlX (5)
			Modified Zirconium (12)
			Silicides
			Aluminides
			Their mixtures (4)
		Ceramics (19) and low expansion glasses (14)	Dielectric layers (15)
		Corrosion Resistant Steel (7)	MCrAlX (5)
			Modified Zirconium (12)
			Their mixtures (4)
		carbon, ceramics and "composites" with a metal "matrix"	Silicides
			Carbides
			Refractory metals Carbon-
			Their mixtures (4)
			Dielectric layers (15)
			Boron nitride

		Cemented Tungsten Carbide (16), Silicon Carbide (18)	Carbides
			Tungsten
			Their mixtures (4)
			Dielectric layers (15)
		Molybdenum and molybdenum alloys	Dielectric layers (15)
		Beryllium and beryllium alloys	Dielectric layers (15)
			Fight
			Beryllium
		Sensor pane materials (9)	Dielectric layers (15)
		Titanium alloys (13) Borides	
			Nitrides
	Physical vapor deposition (PVD) with B.2. by ion-assisted resistance heating (ion metallization)	Ceramics (19) and low expansion glasses (14)	Dielectric layers (15)
			Diamond Carbon (17)
		Carbon-Carbon Ceramics Dielectric layers "matrix"	and "composites" with metal (15)
		Cemented tungsten carbide (16), silicon carbide	Dielectric layers (15)
		Molybdenum and molybdenum alloys	Dielectric layers (15)
		Beryllium and beryllium alloys	Dielectric layers (15)
		Sensor pane materials (9)	Dielectric layers (15)
			Diamond Carbon (17)
		Ceramics (19) and low expansion glasses (14)	Silicides
			Dielectric layers (15)
			Diamond Carbon (17)
		Carbon-Carbon Ceramics Dielectric layers "matrix"	and "composites" with metal (15)
B.3.	Physical vapor deposition (PVD): "laser" evaporation	Cemented tungsten carbide (16), silicon- Dielectric layers	

		carbide	(15)
		Molybdenum and molybdenum alloys	Dielectric layers (15)
		Beryllium and beryllium alloys	Dielectric layers (15)
		Sensor pane materials (9)	Dielectric layers (15)
			Diamond Carbon (17)
B.4.	Physical vapor deposition (PVD): discharging the cathode through an electric arc	"Superalloys"	Alloyed silicides
			Alloyed aluminides (2)
			MCrAlX (5)
		Polymers (11) and "composites" with an organic matrix	Fight
			Carbides
			Nitrides
			Diamond Carbon (17)
C.	Cement packing (see A above for cement sealing) (10)	Carbon-carbon, ceramics and "composites" with a metal "matrix"	Silicides
			Carbides
			Their mixtures (4)
		Titanium alloys (13)	Silicides
			Aluminides
			Alloyed aluminides (2)
		Refractory metals and alloys (8)	Silicides
			Oxides
		"Superalloys"	MCrAlX (5)
			Modified Zirconium (12)
			Their mixtures (4)
			Grindable nickel-graphite
			Grindable materials containing Ni-Cr-Al
			Sandable Al-Si-Polyester
			Alloyed aluminides (2)
		Aluminum alloys (6)	MCrAlX (5)

D. Plasma spraying			Modified Zirconium (12)
			Silicides
			Their mixtures (4)
		Refractory metals and alloys (8)	Aluminides
			Silicides
			Carbides
		Corrosion Resistant Steel (7)	MCrAlX (5)
			Modified Zirconium (12)
			Their mixtures (4)
		Titanium alloys (13)	Carbides
			Aluminides
			Silicides
			Alloyed aluminides (2)
			Grindable nickel-graphite
			Grindable materials containing Ni-Cr-Al
			Sandable Al-Si-Polyester
E. Slurry deposition		Refractory metals and alloys (8)	Fused silicides
			Fused aluminides except for heat-resistant elements
		Carbon-carbon, ceramics and "composites" with a metal "matrix"	Silicides
			Carbides
			Their mixtures (4)
		"Superalloys"	Alloyed silicides
			Alloyed aluminides (2)
			Aluminides modified with precious metals (3)
			MCrAlX (5)
			Modified Zirconium (12)
			Platinum
			Their mixtures (4)

F. Spray deposition		Ceramics and low expansion glass (14)	Silicides
			Platinum
			Their mixtures (4)
			Dielectric layers ((15)
			Diamond Carbon (17)
		Titanium alloys (13)	Fight
			Nitrides
			Oxides
			Silicides
			Aluminides
			Alloyed aluminides (2)
			Carbides
		carbon, ceramics and "composites" with a metal "matrix"	Silicides
			Carbides
			Refractory metals Carbon-
			Their mixtures (4)
			Dielectric layers ((15)
			Boron nitride
		Cemented Tungsten Carbide (16), Silicon Carbide (18)	Carbides
			Tungsten
			Their mixtures (4)
			Dielectric layers (15)
			Boron nitride
		Molybdenum and molybdenum alloys	Dielectric layers (15)
		Beryllium and beryllium alloys	Fight
			Dielectric layers (15)
			Beryllium
		Sensor pane materials (9)	Dielectric layers (15)
			Diamond Carbon (17)

		Refractory metals and alloys (8)	Aluminides
			Silicides
			Oxides
			Carbides
G. Ion implantation		Steel that can withstand high temperatures	Addition of chromium, tantalum or niobium (columbium)
		Titanium alloys (13)	Fight
			Nitrides
		Beryllium and beryllium alloys	Fight
		Cemented Tungsten Carbide (16)	Carbides
			Nitrides

* The numbers in parentheses correspond to the numbers in the notes that follow the table.

NOTES to the
DEPOSITATION TECHNIQUES table

1. The term 'coating process' includes the repair and re-polishing of the coating as well as the original coating.

2. The term 'alloy aluminide coating' includes one or more coating steps in which they are one or more elements deposited before or during the application of the aluminide coating, even if those elements are deposited by another coating process. However, it does not include the multiple application of a single step cementation process with a mixture of powders to achieve an alloyed aluminide.

3. The term 'noble metal modified aluminide' coating includes a multi-stage coating in which the noble metal or metals have been deposited by some other coating process prior to the application of the aluminide layer.

4. The term 'mixtures thereof' includes fused materials, graded compositions, co-precipitates and multilayered precipitates obtained by one or more of the coating processes listed in the table.

5. 'MCrAlX' refers to a coating-alloy where M is cobalt, iron, nickel or a combination thereof, and X- hafnium, yttrium, silicon, tantalum, in any amount, or other intentional addition above 0.01 mass % in various proportions and combinations, except:

a. CoCrAlY coating containing less than 22 mass % chromium, less than 7 mass % aluminum and less than 2% by mass of yttrium;

b. CoCrAlY coating containing 22 to 24 wt% chromium, 10 to 12 wt% aluminum and 0.5 to 0.7 wt% yttrium; or

c. NiCrAlY coating containing 21 to 23 wt% chromium, 10 to 12 wt% aluminum and 0.9 up to 1.1% by weight of yttrium.

6. The term 'aluminium alloy' refers to an alloy having a critical tensile strength of 190 MPa or more, measured at 293 K (20 °C).

7. The term 'corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series steels or equivalent national standard steels.

8. 'Refractory metals and alloys' include the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. 'Materials for sensor panes': aluminum oxide, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide, diamond, gallium phosphide, sapphire and the following metal halides: materials for

sensor shafts with a diameter greater than 40 mm for zirconium-fluoride and hafnium-fluoride.

10. "Technology" for single-stage cementation with a mixture of powders of solid profiles (wings) is not

controlled by Category 2.

11. 'Polymers': polyimides, polyesters, polysulphides, polycarbonates and polyurethanes.

12. 'Modified zirconium dioxide' refers to the addition of other metal oxides (ie calcium, magnesium, yttrium, hafnium, rare earth oxides) zirconium dioxide in order to stabilize certain crystallographic phases and phase compositions.

13. 'Titanium alloys' refer only to aerospace alloys having critical strength

to a tensile strength of 900 MPa or more measured at 293 K (20 °C).

14. 'Low-expansion glass' refers to glass with a coefficient of thermal expansion of 1

x 10-7 K-1 or less measured at 293 K (20 °C).

15 'Dielectric layers' are coatings made of multiple layers of insulating material in which the interference characteristics of materials of different refraction are used to reflect, transmit or absorb different wavelengths. Dielectric layers refer to more than four dielectric layers or "composite" dielectric/metal layers.

16. 'Cemented tungsten carbide' does not include cutting and shaping tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium or chromium carbide/ nickel.

17. "Technology" specifically prescribed for the application of diamond carbon to any of the following is not subject to control: magnetic disk and head drives, disposable goods manufacturing equipment, faucet valves, acoustic diaphragms for speakers, automotive engine parts, tools for cutting, cutting-pressing dies, office automation equipment, microphones or medical equipment or molds for casting or molding in plastics, made from alloys containing less than 5% beryllium.

18. 'Silicon carbide' does not include cutting and shaping tool materials.

19. Ceramic substrate, as used in this entry, does not include ceramic materials

which contain 5% by weight or more of clay or cement in their composition, either as special ones constituents either in combination.

TECHNICAL NOTE with the DEPOSITATION TECHNIQUES table

The PROCESSES specified in column 1 of the Table are defined as follows:

a. **Chemical vapor deposition** (CVD) is a deposition or surface modification coating process in which a metal, alloy, "composite", dielectric or ceramic is deposited onto a heated substrate. Gaseous reactants are decomposed or combined near the substrate resulting in the deposition of the desired element, alloy or compound onto the substrate. The energy for this decomposition or chemical reaction process can be provided by heating the substrate, a glowing plasma discharge, or "laser" radiation.

NB1 CVD includes the following processes: directional gas flow out of package-powder mixture deposition, pulsed CVD, controlled thermal nucleation deposition (CNTD), plasma enhanced or assisted CVD processes.

NB2 Packaging indicates that the substrate is immersed in a powder mixture.

NB3 Gaseous reactants used outside the packing process are obtained using the same basic reactions and parameters as in the cement packing process, except that the substrate to be coated is not in contact with the powder mixture.

b. **Physical Gas Phase Thermal Vapor Deposition** (TE-PVD) is a coating process performed in a vacuum at a pressure of less than 0.1 Pa in which a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of vaporized particles on a suitably positioned substrate.

Adding gases to the vacuum chamber during the coating process to synthesize the complex coatings, a process modification is common.

Using ion or electron beams, or plasma, to activate or assist deposition coating is also a common modification in this technique. The use of a monitor to measure the optical characteristics and thickness of the coating during the process itself can be a feature of these processes.

The specific TE-PVD processes are as follows:

1. Electron beam physical vapor deposition (PVD) uses an electron beam to vaporize the coating material.

2. Physical vapor deposition (PVD) with ion-assisted resistive heating uses an electroresistive heat source in combination with an ion beam that impinges (etches) the surface to create a controlled and uniform flow of vaporized particles for the coating;

3. "Laser" vaporization uses either pulsed or continuous waves of laser beams to evaporates the coating-forming material.

4. Cathodic arc deposition uses a disposable cathode of the material that forms the coating and has a discharge via an electric arc that is established with the surface by instantaneous contact by tripping the ground. The controlled movement of the arc erodes the surface of the cathode creating a highly ionized plasma. The anode can be either a cone attached to the cathode via insulators or chambers. A biased substrate is used for off-line deposition;

NB This definition does not include accidental cathodic arc deposition with substrates without bias voltage.

5. Ion metallization is a special modification of the general TE-PVD process in which the plasma source or ions are used to ionize the particles to be deposited, and a negative bias voltage is applied to the substrate in order to facilitate the extraction of particles from the plasma. The introduction of reactive particles, the evaporation of solid particles in the process chamber, as well as the use of monitors to ensure the measurement of optical characteristics and coating thickness during the process, are common process modifications.

c. **Cement packing** is a surface modification process or surface coating process in which the substrate is immersed in a powder mixture (packing), and consists of:

1. Metal powders that are deposited (usually aluminum, chromium, silicon or their combination);

2. Activators (usually halides); and

3. Inert powder, most often aluminum oxide.

The substrate and powder mixture are inside a retort heated between 1030 K (757 °C) and 1375 K (1102 °C) in sufficient time for the coating to settle.

d. **Plasma spraying** is a coating process in which a torch that creates and controls the plasma, accepts powder or wire coating materials, melts them and directs them towards the substrate on which an integrally bonded coating is formed. Plasma spraying can be either low pressure plasma spraying or high velocity plasma spraying.

NB1 Low pressure means a pressure lower than the ambient atmospheric pressure.

NB2 High velocity corresponds to a gas exit velocity from the nozzle over 750 m/s, calculated at 293K (20° C) at 0.1 MPa.

e. **Slurry deposition** is a surface modification process or coating process in which it is applied metal or ceramic powder with an organic binder suspended in a liquid and applied to a substrate by spraying, dipping or coating, followed by air or oven drying and heat treatment to produce the desired coating.

f. **Sputtering** is a coating application process based on the force pulse transfer phenomenon, in which positive ions are accelerated by an electric field towards the surface of the anticathode (coating material). The kinetic energy of the impinging ions is sufficient to cause atoms from the surface of the anticathode to break free and deposit on a suitably positioned substrate.

NB1 The table applies only to triode, magnetron or sputter deposition used to increased coating adhesion and deposition rate as well as radio frequency-enhanced sputter deposition used to allow vaporization of non-metallic materials used for coatings.

NB2 Low energy ion beams (less than 5 keV) can be used to activate deposition.

Mr. **Implantation** is a process of surface modification with a coating in which the element to be alloyed is ionized, accelerated over a potential gradient and implanted in the area of the substrate surface. This includes processes in which ion implantation is performed simultaneously with physical deposition from the gas phase by electron beam or sputter deposition.

CATEGORY 3
ELECTRONICS

3A Systems, equipment and components

Note 1: The control status of equipment and components described in 3A001 or 3A002, other than those described in 3A001.a.3. to 3A001.a.10., or 3A001.a.12 to 3A001.a.14. or 3A001.b.12. which are specially designed for other equipment or have the same functional characteristics as other equipment, is determined by the control status of that other equipment.

3A *Note 2: Control status of integrated circuits specified by 3A001.a.3. to 3A001.a.9., or in 3A001.a.12. to 3A001.a.14., which are not programmable or designed for a specific function performed by other equipment, is determined by the control status of that other equipment.*

NB: When the manufacturer or user cannot determine the control status of that other equipment, control the status of integrated circuits is specified by 3A001.a.3. to 3A001.a.9. and 3A001.a.12 to 3A001.a.14.

Note 3: The control status of semiconductor wafers (finished or unfinished) whose function is defined will be monitored by the parameters of 3A001.a., 3A001.b., 3A001.d., 3A001.e.4., 3A001.g., 3A001. h. or 3A001.i.

3A001 Electronic components, as follows:

a. General Purpose Integrated Circuits:

Note: Integrated circuits can be of the following types:

- "Monolithic integrated circuits";

- "Hybrid integrated circuits";

- "Integrated circuits with multiple chips";

- "Film type integrated circuits", including silicon-on-sapphire type integrated circuits;

- "Optical integrated circuits";

- "Three-dimensional integrated circuits";

- "Monolithic Microwave Integrated Circuits" ("MMIS's")

1. Integrated circuits, designed or classified as resistant to radiation, which can withstand one of the following radiation doses:

a. A total radiation dose of 5 x 103 Gy (silicon) or greater;

b. A radiation dose rate of 5 x 106 Gy (silicon)/s or greater; or

c. A flux density (integral flux) of neutrons (equivalent to 1 MeV) of 5 x 1013 n/cm2 or greater at silicon, or its equivalent for other materials;

Note: 3A001.a.1.c. does not apply to metal-insulated semiconductors (MIS).

2. "Microprocessor electronic circuits", "microcomputer electronic circuits", microcontroller electronic circuits, compound semiconductor memory integrated circuits, analog-to-digital converters, digital-to-analog converters, electro-optical or "optical integrated circuits" designed for "signal processing", programmable logic devices, integrated circuits for neural networks, conventional integrated circuits where either the function or the control status of the device with which such a circuit will be used is unknown, fast Fourier transform (FFT) processors, static random access memories (SRAMs) or ' non-volatile memory', which have any of the following characteristics:

3A001 a. Operating mode in ambient temperature above 398 K (125 0C);

b. Operating mode in ambient temperature below 218 K (–55 ºC); or

c. Operating mode within the temperature range from 218 K (–55 ºC) to 398 K (125 ºC);

Note: 3A001.a.2. does not apply to integrated circuits intended for use in civil applications automotive industry or railways.

Technical note:

For the purposes of 3A001.a.2., 'non-volatile memory' is memory with retention of data over a period of time period after the power supply has stopped.

3. "Electronic circuits of microprocessors", "electronic circuits of microcomputers" and electronic circuits of microcontrollers, made of complex semiconductors and operating at a frequency above 40 MHz;

Note: 3A001.a.3. includes digital signal processors, digital matrix processors, and digital coprocessors.

4. Not used;

5. Analog-to-digital (ADC) and digital-to-analog converters (DAC) of integrated circuits:

a. Analog-to-digital converters (ADCs) having any of the following characteristics:

NB: SEE ALSO 3A101

1. A resolution of 8 bits or greater, but less than 10 bits, with a "sampling rate" greater than 1.3 gigabytes samples per second (GSPS);

2. A resolution of 10 bits or greater, but less than 12 bits, with a "sampling rate" greater than 600 megabytes samples per second (MSPS);

3. A resolution of 12 bits or greater, but less than 14 bits, with a "sampling rate" greater than 400 megabytes samples per second (MSPS);

4. A resolution of 14 bits or greater, but less than 16 bits, with

with a "sampling rate" greater than 250 mega samples per second (MSPS); or

5. A resolution greater than 16 bits or greater, with a "sampling rate" greater than 65 mega samples per second (MSPS);

NB For integrated circuits containing analog-to-digital converters, storage or processing digitized data, see 3A001.a.14.

3A001 *Technical notes:*

For the purposes of 3A001.a.5.a.:

1. A resolution of n bits corresponds to a quantization of 2n *levels.*

2. The number of bits of the output word is equal to the resolution of the analog-to-digital converter (ADC).

3. For "multi-channel analog-to-digital converters" (ADCs), "sampling rates" do not add up and "sample rate" is the maximum rate of any single channel.

4. For "interleaved analog-to-digital converters" (ADCs) or for "multi-channel analog-to-digital converters" (ADCs) that are specified to have an interlaced "sample rate" mode of operation are summed and the output rate is the maximum combined total rate of all outputs.

b. Digital-to-analog converters (DACs) having any of the following:

1. A resolution of 10 bits or greater but less than 12 bits with a "set refresh rate" greater than 3500 MSPS; or

2. A resolution of 12 bit or higher and have any of the following characteristics:

a) "adjustable refresh rate" greater than 1250 MSPS, not exceeding 3500 MSPS and having any of the following:

1. The time required to reach a deviation of or within 0.024% of the full output value is less than 9 ns; or

2. 'Fundamental Signal Power to Strongest Signal to Noise or Output Harmonic Distortion Component Ratio' (SFDR) greater than 68 dBc (carrier) when synthesizing a full-band analog signal of 100 MHz or a full-band analog signal of the highest frequency below 100 MHz; or

b. "Adjustable refresh rate" is greater than 3500 MSPS;

Technical notes:

For the purposes of 3A001.a.5.b.:

1. The ratio of the strength of the basic signal to the strongest noise signal or harmonic distortion component at output' (SFDR) is defined as the ratio of the RMS value of the carrier frequency at the input to the DAC to the RMS value of the next largest noise or harmonic distortion component at the output.

3A001 *2. SFDR is determined directly from the specification table or SFDR characteristic diagrams by frequency.*

3. A signal is defined to be full range when the amplitude is greater than – 3 dBfs (full range).

4. 'Set refresh rate' for DAC:

a. For conventional DACs (without interpolation) the "set refresh rate" is the ratio at which it is the digital signal is converted to analog and the output analog value is modified when converting to DAC. For DACs where the interpolation mode can be bypassed (interpolation factor one), the DAC should be considered a conventional DAC (no interpolation).

b. For interpolation DACs (oversampling DACs), the 'set refresh rate' is defined as the DAC refresh rate divided by the smallest interpolation factor. For interpolating DACs, "set refresh rate" can refer to a variety of conditions including:

– speed of input data;

– speed of input words;

– speed of input samples;

– maximum total speed of the input bus;

– maximum clock speed at the clock input to the DAC.

6. Electro-optical and "optical integrated circuits", designed for "signal processing", having all of the following:

a. One or more internal "laser" diodes;

b. One or more internal light sensing elements; and

c. Optical lines;

7. Programmable logic devices, having any of the following characteristics:

a. The highest number of DC digital input/output data equal to or greater than 700 or;

b. an 'overall one-way maximum transceiver serial data rate' of 500 Gb/s or greater;

Note: 3A001.a.7. includes:

ÿ Complex Programmable Logic Devices (CPLD),

ÿ Field programmable gates (FPGA),

ÿ Field programmable logic arrays (FPLA),

3A001 *ÿ Field Programmable Interconnects (FPICs).*

NB For integrated circuits with programmable logic devices that are combined with analog-digital converter, see 3A001.a.14.

Technical notes:

For the purposes of 3A001.a.7.:

1. The maximum number of digital input/ output data from

3A001.a.7.a. is also known as the maximum number of data that the user enters or receives or the maximum number of input/ output data available, regardless of whether the integrated set is in the case or without it;

2. 'Total One-way Maximum Transceiver Serial Data Rate' is the product the maximum serial one-way data transfer rates of the transceivers and the number of field transceivers (FPGAs).

8. Not used;

9. Integrated circuits for neural networks;

10. Common integrated circuits, where either the function or control status of the device is unknown with which such a circuit will be used, which have some of the following characteristics:

a. More than 1500 extracts;

b. Typical "base gate propagation delay time" less than 0.02 ns; or

c. Operating frequency exceeds 3 GHz;

11. Digital integrated circuits, other than those described in 3A001.a.3. to 3A001.a.10. and in 3A001.a.12., based on any compound semiconductor, having any of the following characteristics:

a. The equivalent gate contains more than 3,000 gates (with 2 inputs); or

b. The clock frequency exceeds 1.2 GHz;

12. Fast Fourier Transform (FFT) processors have an execution time of one complex Fourier transforms of N points, less than (N log2 N)/20,480 ms, where N is the number of points;

Technical note:

For the purposes of 3A001.a.12., when N equals 1,024 points, the formula in 3A001.a.12. gives an execution time of 500 µs.

13. Integrated circuits for direct digital synthesis *(Direct Digital Synthesizer - DDS)* that have any of the following characteristics:

a. *Digital-to-Analogue* Converter (DAC) clock frequency of 3.5 GHz or greater and DAC resolution of 10 bits or greater, but also less than 12 bits; or

3A001 b. A DAC clock frequency of 1.25 GHz or greater and a DAC resolution of 12 bits or greater;

Technical note:

For the purposes of 3A001.a.13., the clock frequency of the digital-to-analog converter can be precisely specified as the main clock frequency or the input clock frequency.

14. Integrated circuits that perform or can be programmed to perform all of the following:

a. Analog-to-digital conversions that fulfill any of the following:

1. A resolution of 8 bits or more, but less than 10 bits, with a "sampling rate" in excess of 1.3 gigs per second (GSPS);

2. A resolution of 10 bits or more but less than 12 bits, with a "sampling rate" of over 1.0 giga samples per second (GSPS);

3. A resolution of 12 bits or more, but less than 14 bits, with a "sampling rate" of over 1.0 gigabytes samples per second (GSPS);

4. A resolution of 14 bits or more, but less than 16 bits, with a "sampling rate" greater than 400 mega samples per second (MSPS); or

5. A resolution of 16 bits or higher with a "sampling rate" greater than 180 mega samples per second (MSPS); and

b. Any of the following:

1. storage of digitized data; or

2. processing of digitized data;

NB1. For analog-to-digital converter integrated circuits see 3A001.a.5.a.

NB2. For programmable logic device fields see 3A001.a.7.

Technical note:

For the purposes of 3A001.a.14.:

1. The resolution of n bits corresponds to the quantization of 2 n levels.

2. ADC resolution is the number of bits of the ADC digital output that represent the measured analog input. The effective number of bits (ENOB) is not used to determine the ADC resolution.

3. For integrated circuits with non-interleaved "multi-channel ADC", the "sampling rate" is not aggregated and "sample rate" is the maximum rate of any single channel.

4. For "embedded ADC" or "multi-channel ADC" ICs specified to have a combined mode of operation, the "sampling rate" is aggregated and the "sampling rate" is the maximum combined total rate of all embedded channels.

3A001 b. Microwave and millimeter wave items as follows:

Technical note:

For the purposes of 3A001.b. in the technical data about the product, it is possible to refer to the parameter saturated maximum output power as output power, saturated output power, maximum output power, peak output power and envelope output power.

1. "Vacuum electronic devices" and cathodes:

Note 1: 3A001.b.1. does not control "vacuum electronic devices" designed or designed to operate in any frequency range and have all of the following characteristics:

a. The frequency does not exceed 31.8 GHz; and

b. The frequency is "ITU distributed" for radio communication use.

Note 2: 3A001.b.1. does not control “vacuum electronic devices” that are not “suitable for use in space" and meet all the following characteristics:

a. Average output power is equal to or less than 50 W; and

b. Designed to operate in any frequency range where all of the following are met features:

1. Frequency higher than 31.8 GHz and lower than 43.5 GHz; and

2. The frequency is "ITU-allocated" for radiocommunication use, but not for radiodetermination.

a. Progressive wave, pulsed or continuous wave "vacuum electronic devices" which:

1. They work at frequencies higher than 31.8 GHz;

2. Devices that have a cathode heater with a nominal RF power on time of less than 3 s;

3. Devices or their derivatives with a "broken bandwidth" greater than 7%, or with with a peak power exceeding 2.5 kW;

4. Devices based on spirals, folding waveguide or serpentine waveguide circuit or theirs derivatives, with any of the following characteristics:

a. "Instantaneous bandwidth", which is greater than one octave, and the average power product (expressed in kW) and frequency (expressed in GHz) greater than 0.5;

3A001 b. "Instantaneous bandwidth" of one octave or less, and the product of mean power (expressed in kW) and frequency (expressed in GHz) greater than 1; or

c. "Suitable for use in outer space"; or

d. has a network electronic cannon;

5. Devices with "instantaneous bandwidth" greater than or equal to 10%, with any of the following feature:

a. Ring electron beam;

b. Non-axisymmetric electron beam; or

c. Multiple electron beams;

b. "Vacuum electronic devices" with crossed fields having a gain exceeding 17 dB;

c. Impregnated cathodes, designed for "vacuum electronic devices", with constant density currents that exceed 10 A/cm2 in operating mode;

d. "Vacuum electronic devices" with the ability to operate in 'dual mode'.

Technical note:

For the purposes of 3A001.b.1.d., 'dual mode' means that the beam current of the "vacuum electronic device" can be intentionally switched between continuous wave and pulsed modes of operation using a network that provides a maximum output power greater than the continuous wave output power.

2. "Monolithic Microwave Integrated Circuit" ("MMIC") amplifiers having any of the following:

NB For "MMIC" *amplifiers having an integrated phase shifter, see 3A001.b.12.*

a. Are rated for operation at frequencies greater than 2.7 GHz up to (inclusive) 6.8 GHz, with a "broken bandwidth" greater than 15% and have any of the following characteristics:

1. A saturated maximum output power exceeding 75 W (48.75 dBm) at any frequency greater than 2.7 GHz up to and including 2.9 GHz;

2. A saturated maximum output power greater than 55 W (47.4 dBm) at any frequency greater than 2.9 GHz up to and including 3.2 GHz;

3. A saturated maximum output power greater than 40 W (46 dBm) at any frequency greater than 3.2 GHz up to and including 3.7 GHz or

3A001 4. A saturated maximum output power exceeding 20 W (43 dBm) at any frequency greater than 3.7 GHz up to and including 6.8 GHz;

b. Being rated for operation at frequencies greater than 6.8 GHz up to and including 16 GHz, with a "fractional bandwidth" greater than 10%; and having any of the following:

1. A saturated maximum output power greater than 10 W (40 dBm) at any frequency greater than 6.8 GHz up to and including 8.5 GHz or

2. A saturated maximum output power greater than 5 W (37 dBm) at any frequency greater than 8.5 GHz up to and including 16 GHz;

c. That they are rated for operation with a saturated maximum output power greater than 3 W (34.77 dBm) and at at any frequency above 16 GHz up to and including 31.8 GHz where the "fractional bandwidth" is greater than 10%;

d. Are rated for operation at a saturated maximum output power greater than 0.1 nW (–70 dBm) and at any frequency greater than 31.8 GHz up to and including 37 GHz;

e. Are rated for operation at a maximum saturated output power greater than 1 W (30 dBm) and at any frequency greater than 37 GHz up to and including 43.5 GHz, where the "fractional bandwidth" is greater than 10% ;

f. That they are rated for operation with a saturated maximum output power greater than 31.62 mW (15 dBm) and at any frequency above 43.5 GHz up to and including 75 GHz where the "fractional bandwidth" is greater than 10%;

Mr. That they are rated for operation with a saturated maximum output power greater than 10 mW (10 dBm) and at any frequency greater than 75 GHz up to and including 90 GHz where the "fractional bandwidth" is greater than 5% or

h. That they are rated for operation with a saturated maximum output power greater than 0.1 nW (–70 dBm) and at any frequency greater than 90 GHz;

Note 1: Not used

Note 2: Control status MMIC whose range

frequency spans more than one frequency range as specified in 3A001.b.2.a. to 3A001.b.2.h. is determined by the lowest controlled threshold of saturated maximum output power.

3A001 *Note 3: Notes 1 and 2 in the Category 3A introduction mean that*

3A001.b.2. not controlled by MMIC if they are specifically designated for use for other purposes, e.g. telecommunications, radars, cars.

3. Microwave transistors having any of the following characteristics:

a. Being rated for operation at frequencies greater than 2.7 GHz up to (including) 6.8 GHz, and having any of the following characteristics:

1. A saturated maximum output power exceeding 400 W (56 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

2. A saturated maximum output power exceeding 205 W (53.12 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

3. A saturated maximum output power exceeding 115 W (50.61 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz, or

4. A saturated maximum output power exceeding 60 W (47.78 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b. Being rated for operation at frequencies greater than 6.8 GHz up to (inclusive) 31.8 GHz and having any of the following characteristics:

1. A saturated maximum output power exceeding 50 W (47 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

2. A saturated maximum output power exceeding 15 W (41.76 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

3. A saturated maximum output power exceeding 40 W (46 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz or

4. A saturated maximum output power exceeding 7 W (38.45 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

c. That they are rated for operation with a saturated maximum output power greater than 0.5 W (27 dBm) and at any frequency greater than 31.8 GHz up to and including 37 GHz;

3A001 d. That they are rated for a saturated maximum output power greater than 1 W (30 dBm) and on any frequency greater than 37 GHz up to and including 43.5 GHz;

e. That they are rated for operation with a saturated maximum output power greater than 0.1 nW (–70 dBm) and on any frequency greater than 43.5 GHz; or

f. Except those specified in 3A001.b.3.a. to 3A001.b.3.e and are designed to operate at a maximum saturated power greater than 5 W (37.0 dBm) at all frequencies exceeding 8.5 GHz up to and including 31.8 GHz;

Note 1: Transistor control status in 3A001.b.3.a. to 3A001.b.3.e. whose frequency range covering more than one frequency area, as specified by 3A001.b.3.a. to 3A001.b.3.e. is determined by the lowest threshold of saturated maximum output power.

Note 2: 3A001.b.3.includes non-insulated board, board mounted on supports or board placed in the housing. Some discrete transistors may also be referred to as power amplifiers, and the status of such transistors is specified in 3A001.b.3.

4. Solid state microwave semiconductor amplifiers and microwave modules containing microwave amplifiers and are any of the following:

a. That they are intended to operate at frequencies higher than 2.7 GHz up to and including 6.8 GHz, where "fractional bandwidth" greater than 15% and having any of the following characteristics:

1. A saturated maximum output power exceeding 500 W (57 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

2. A saturated maximum output power exceeding 270 W (54.3 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

3. A saturated maximum output power exceeding 200 W (53 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz, or

4. A saturated maximum output power exceeding 90 W (49.54 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz.

3A001 b. That they are intended for operation at frequencies above 6.8 GHz up to and including 31.8 GHz, with a "fractional bandwidth" greater than 10% and that they have any of the following characteristics:

1. A saturated maximum output power exceeding 70 W (48.45 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

2. A saturated maximum output power exceeding 50 W (47 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

3. A saturated maximum output power exceeding 30 W (44.77 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz; or

4. A saturated maximum output power exceeding 20 W (43 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

c. That they are intended for operation with a saturated maximum output power greater than 0.5 W (27 dBm) and at any any frequency greater than 31.8 GHz up to and including 37 GHz;

d. That they are intended for operation with a saturated maximum output power greater than 2 W (33 dBm) and at any frequency greater than 37 GHz up to and including 43.5 GHz and where the "fractional bandwidth" is greater than 10%

e. That they are intended to operate at frequencies greater than 43.5 GHz and that they have any of the following feature:

1. saturated maximum output power greater than 0.2 W (23 dBm) and at any frequency greater than 43.5 GHz up to and including 75 GHz, where the "fractional bandwidth" is greater than 10%;

2. A saturated maximum output power exceeding 20 mW (13 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, where the "fractional bandwidth" is greater than 5% or

3. A saturated maximum output power exceeding 0.1 nW (–70 dBm) at any frequency exceeding 90 GHz; or

f. Not used;

NB1: The "MMIC" of the power amplifier should be rated according to the criteria in 3A001.b.2.

NB2: For 'transmit/ receive' modules and 'transmit modules' see 3A001.b.12.

3A001 *NB3: For converters and mixers, designed to extend the operating or frequency range of signal analysers, signal generators, network analyzers or microwave test receivers, see 3A001.b.7.*

Note 1: Not used

Note 2: Control status of products whose frequency range spans more than one frequency area, as specified in 3A001.b.4.a. to 3A001.b.4.e., is determined by the lowest saturated threshold
maximum output power.

5. Filters with the possibility of electronic or magnetic adjustment of the passband or stopband, which have more than 5 tuning resonators with the ability to adjust over a 1.5:1 frequency range (fmax/fmin) in less than 10 µs, and possess any of the following characteristics:

a. The bandwidth is greater than 0.5% of the center frequency; or

b. The bandwidth is less than 0.5% of the central frequency;

6. Not used;

7. Mixers and converters, which are any of the following:

a. Designed to extend the "signal analyzer" frequency range above 90 GHz;

b. Designed to extend the operating range of signal generators as follows:

1. Above 90 GHz;

2. Output powers exceeding 100 mW (20 dBm) anywhere in the frequency range above 43.5 GHz but not exceeding 90 GHz;

c. Designed to extend the operating range of network analyzers as follows:

1. Above 110 GHz;

2. Output powers exceeding 31.62 mW (15 dBm) anywhere in the frequency range above 43.5 GHz, but not over 90 GHz;

3. Output powers over 1 mW (0 dBm) anywhere in the frequency range above 90 GHz, but not over 110 GHz; or

d. Designed to extend the frequency range of microwave test receivers above 110 GHz;

3A001 8. Microwave power amplifiers incorporating "vacuum electronic devices" controlled with 3A001.b.1. and have all of the following characteristics:

a. Operating frequencies above 3 GHz;

b. The ratio of average output power to mass exceeds 80 W/kg; and

c. The volume is less than 400 cm3;

Note: 3A001.b.8. it does not control devices designed, or operating mode, on any band frequency that is "ITU-allocated" for radiocommunication use, but not for radiodetermination.

9. Microwave Power Modules (MPMs) consisting minimally of wave "vacuum electronic device", "microwave monolithic integrated circuit" ("MMIC") and integrated power regulator and having any of the following:

a. 'Power-on time', reaching full functionality, from off position in less than 10 seconds;

b. Smaller volume than the maximum power expressed in W multiplied by 10 cm3/W; and

c. A "current band" greater than 1 octave (fmax. › 2 fmin) and any of the following:

1. For frequencies less than or equal to 18 GHz, the RF output power is greater than 100 W; or

2. Frequencies above 18 GHz.

Technical notes:

For the purposes of 3A001.b.9.:

1. For the calculation of the control volume in 3A001.b.9.b., the following example is given: for a maximum power of 20 W, the volume is: 20 W x 10 cm3/W = *200* cm3.

2. 'Power-on time' in 3A001.b.9.a. refers to the time from fully off to fully on function; i.e. includes the heating time of the MPM.

10. Oscillators and oscillator assemblies, designed to operate with a single-sided (SSB) phase noise in dBc/Hz of less (better) than –(126 + 20log10F-20log10f)) anywhere in the range 10 Hz *ÿ* F *ÿ* 10 kHz ;

Technical note:

For the purposes of 3A001.b.10., F is the deviation from the operating frequency in Hz and f is the operating frequency in MHz.

11. "Electronic circuits" for "frequency synthesizers" having "time switching

frequency" as specified by any of the following values:

3A001 a. Less than 143 ps;

b. Less than 100 µs for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

c. Not used;

d. Less than 500 µs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 31.8 GHz but not exceeding 37 GHz;

e. Less than 100 µs for any frequency change greater than 2.2 GHz within the synthesized frequency range exceeding 37 GHz but not exceeding 75 GHz;

f. Less than 100 µs for any frequency change greater than 5.0 GHz within the synthesized range frequency exceeding 75 GHz but not exceeding 90 GHz; or

Mr. Less than 1 ms within a synthesized frequency range exceeding 90 GHz;

Technical note:

For the purposes of 3A001.b.11., 'frequency synthesizer' is any type of frequency source, regardless of the actual applied technique, which provides a plurality of simultaneous or alternative output frequencies, from one or more outputs, controlled, derived or disciplined by a smaller number of standards (or frequencies).

NB: For signal analyzers, signal generators, network analyzers and general purpose microwave test receivers see the appropriate items 3A002.c., 3A002.d., 3A002.e. and 3A002.f. respectively.

12. 'Transmitter/receiver modules', 'transmitter/receiver MMICs', 'transmitter module' and 'transmitter MMIC's', designed to operate at frequencies above 2.7 GHz and having all of the following:

a. Maximum saturated power output (in watts), Psat, greater than 505.62 divided by maximum operating frequency (in GHz) squared (Psat > 505.62 W*GHz2/fGHz 2) for any channel;

b. "Instantaneous Bandwidth" of 5% or greater for each channel;

c. Any flat surface of length d (in cm) equal to or less than 15 divided by the smallest work frequency in GHz (d ÿ 15cm * GHz * N/fGHz) where N is the number of channels for sending or transmission/reception; and

d. Electronically variable phase shift per channel.

Technical notes:

For the purposes of 3A001.b.12.:

1. 'Transmit/ Receive Module': it is multifunctional

"electronic circuit" that provides bidirectional amplitude and phase control for transmit and receive signal.

3A001 *2. "Transmitter module": "electronic assembly" that provides amplitude and phase control for signal transmission.*

3. 'Transmit/ Receive MMIC': a multi-functional "MMIC" that provides bi-directional amplitudes and phase controls for transmitting and receiving signals.

4. 'Transmit MMIC': is an "MMIC" that provides amplitude control and phase control of transmission signal.

5. 2.7 GHz should be used as the minimum operating frequency (fGHz) *in the formula in 3A001.b.12.c. for transmission/ reception or transmission of modules whose operating range range extends to 2.7 GHz and below (d ÿ 15cm * GHz * N/ 2.7 GHz).*

6. 3A001.b.12. refers to 'transmitter/ receiver modules' or 'transmitter modules' with or without heatsinks. The value of d in 3A001.b.12.c. does not include any part of the 'transmitter/ receiver module' or 'transmitter module' that functions as a heat sink.

7. 'Transmit/ receive modules' or 'transmit modules' or 'transmit/ receive MMICs' or 'transmit

MMICs may or may not have N integrated beam antennas, where N is the number of transmit or transmit/ receive channels.

c. Devices for processing acoustic waves and specially designed components for this purpose:

1. Devices for processing surface acoustic waves and shallow surface acoustic waves (shallow bulk) (i.e. "signal processing" devices that exploit elastic waves in materials), and have any of the following characteristics:

a. Carrier frequency exceeds 6 GHz;

b. Carrier frequency exceeding 1 GHz but not exceeding 6 GHz, with any of the following:

1. 'Band Side Suppression' is greater than 65 dB;

2. The product of the maximum delay time (expressed in µs) and the bandwidth (expressed in MHz) is greater than 100;

3. The bandwidth is above 250 MHz; or

4. The dispersion delay is greater than 10 µs; or

c. Having a carrier frequency of 1 GHz or less, and having any of the following characteristics:

1. The product of maximum delay time and bandwidth (time is in µs and bandwidth in MHz) is greater than 100;

2. The dispersion delay is greater than 10 µs; or

3. Sideband suppression' is greater than 65 dB and bandwidth is greater than 100 MHz;

3A001 *Technical Note:*

For the purposes of 3A001.c.1., 'range side suppression' is the maximum value suppression specified in the technical data.

2. Mass (bulk) devices for processing acoustic waves (ie devices for "signal processing" using elastic waves), which allow direct processing of signals at frequencies exceeding 6 GHz;

3. Acoustic-optical "signal processing" devices that use the interaction between acoustic waves (volume or surface) and light waves to allow direct signal or image processing, including spectral analysis, correlation or convolution;

Note: 3A001.c. it does not control acoustic devices that are limited to single-band, low-pass, high-pass filtering, or frequency filtering or resonance function.

d. Electronic devices and integrated circuits, incorporating components manufactured from "superconducting" material, specially designed for operation at temperatures below the "critical temperature" and with at least one "superconducting" component, having any of the following:

1. A current switch for digital circuits using "superconducting" gates, and where the product of the gate delay time (expressed in seconds) and the power dissipation per gate (expressed in W) is less than 10-14 J; or

2. Frequency selection in all areas, using resonant circuits with a Q-value exceeding 10,000;

e. High energy devices:

1. Electrochemical 'cells':

a. 'Primary cells' which at 20 0C have any of the following:

1. an 'energy density' exceeding 550 Wh/kg and a 'sustained power density' exceeding 50 W/kg; or

2. an 'energy density' exceeding 50 Wh/kg and a 'sustained power density' exceeding 350 W/kg

b. 'Secondary cells' have an 'energy density' exceeding 350 Wh/kg at 20 0C;

3A001 *Technical Note:*

1. For the purposes of 3A001.e.1., 'energy density' is obtained from the product of the mean power in W with the rated capacity in Ah divided by the total mass in kilograms. If the nominal capacity is not specified, the energy density is calculated from the product of the square root of the nominal voltage and the discharge duration in hours divided by the discharge resistance in ohms and the mass in kilograms.

2. For the purposes of 3A001.e.1., a 'cell' is defined as an electrochemical device, having a positive and negative electrode, an electrolyte and a source of electrical energy. It is the basic constituent element of the battery.

3. For the purposes of 3A001.e.1.a., a 'primary cell' is a 'cell' that is not designed to be charged with any what kind of source.

4. For the purposes of 3A001.e.1.b., a 'secondary cell' is a 'cell' designed to be charged using an external energy source.

5. For the purposes of 3A001.e.1.a., 'Continuous power density' (W/ kg) is calculated from the rated voltage multiplied by the specified maximum continuous discharge current in amperes (A) divided by the mass in kilograms. 'Permanent power density' is also called specific power.

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

2. High-energy capacitors, as follows:

NB: SEE ALSO 3A201.a. and NKL NGO

a. Capacitors with a charge repetition rate of less than 10 Hz having all of the following features:

1. The operating voltage is equal to or greater than 5 kV;

2. The energy density is equal to or greater than 250 J/kg; and

3. The total energy is equal to or greater than 25 kJ;

b. Capacitors with a charge repetition frequency of 10 Hz or higher (frequency capacitors). charge repetitions), having all of the following characteristics:

1. The operating voltage is equal to or greater than 5 kV;

2. The energy density is equal to or greater than 50 J/kg;

3. The total energy is equal to or greater than 100 J; and

4. The total number of charge/discharge cycles is equal to or greater than 10,000;

3. "Superconducting" electromagnets and solenoids specially designed to be completely charged or discharged in less than 1 s and having all of the following characteristics:

3A001 NB: SEE ALSO 3A201.b.

Note: 3A001.e.3. it does not control "superconducting" electromagnets or solenoids specifically designed for magnetic resonance imaging (MRI) in medical devices.

a. The energy released during discharge exceeds 10 kJ in the first second;

b. The inner diameter of the supporting coils is greater than 250 mm; and

c. The operating mode is with a magnetic induction greater than 8 T or with a "total current density" of u windings greater than 300 A/mm2;

4. Solar cells, cell components (CIC), solar panels and solar grids, which are "suitable for space use", whose minimum mean efficiency is above 20% at an operating temperature of 301 K (28 0C) under simulated "AMO" illumination with a radiation of 1,367 W/m2.

Technical note:

For the purposes of 3A001.e.4., "AMO" or "Air Mass Zero", refers to the spectral radiation of sunlight in the earth's outer atmosphere where the distance between the earth and the sun is one astronomical unit (AU).

f. Encoders of the absolute position of the input rotary shaft, which have an "accuracy" equal to or less (better) than 1.0 seconds of arc and specially designed encoder rings, discs or scales therefor;

Mr. Solid state pulsed power thyristor switching devices and thyristor modules using either electrical, optical or electron radiation control switching methods and having some of the following characteristics:

1. Maximum switching speed (di/dt) above 30,000 A/µs and power supply above 1,100V; or

2. Maximum switching speed (di/dt) above 2,000 A/µs and all the following characteristics:

a. Peak voltage greater than or equal to 3,000 V; and

b. Peak current greater than or equal to 3,000 A.

Note 1: *3A001.g. includes:*

– silicon controlled rectifiers (SCR)

– thyristors with electrical triggering (ETT)

- light triggered thyristors (LTT)

– integrated gate thyristors (IGCT)

– thyristors with revolving gate (GTO)

– MOS controlled thyristors (MCT)

- Solidtron

Note 2: 3A001.g. it does not control thyristor devices and 'thyristor modules' built into equipment intended for civil railways or "civil aircraft".

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

3A001 h. Electronic solid state switches, diodes, or "modules", having all of the following features:

1. Declared for a maximum working (junction) temperature greater than 488 K (215 °C);

2. Maximum permissible periodic blocking voltage over 300 V; and

3. Continuous current greater than 1 A.

Note 1: The maximum allowable periodic voltage in 3A001.h. includes the voltage between the drain and source, as well as the voltage from the collector to the emitter, the maximum periodic inverse voltage and the maximum permissible periodic blocking voltage.

Note 2: 3A001.h. includes:

– Junction Field Effect Transistor (JFET)

– Vertical junction field effect transistor (VJFET)

– Metal-oxide semiconductor field-effect transistor (MOSFET)

– Double Diffused Metal Oxide Semiconductor Field Effect Transistor (DMOSFET)

– Insulated Gate Bipolar Transistor (IGBT)

– High Electron Mobility Transistor (HEMT)

– Bipolar Junction Transistor (BJT)

– Thyristors with Silicon Controlled Rectifiers (SCR)

– GTO thyristor (GTO)

– ETO thyristor (ETO)

– PIN diodes

– Sotky diodes

Note 3: 3A001.h. does not control switches, diodes, or "modules" incorporated in equipment designed for civil automobile, civil railway, or civil aviation applications.

Technical note:

For the purposes of 3A001.h., "modules" contain one or more electronic semiconductor switches or diodes.

and. Electro-optical modulators of intensity, amplitude or phase, designed for analog signals and have any of the following characteristics:

1. Maximum operating frequency greater than 10 GHz but less than 20 GHz, optical insertion loss equal to or less than 3 dB and having any of the following characteristics:

a. A 'half-wave voltage' ('Vÿ') of less than 2.7 V when measured at a frequency of 1 GHz or below; or

b. 'Vÿ' less than 4 V when measured at a frequency greater than 1 GHz; or

2. Maximum operating frequency equal to or greater than 20 GHz, optical insertion loss equal to or less than 3 dB and having any of the following:

3A001 a. 'Vÿ' less than 3.3 V when measured at a frequency of 1 GHz or lower; or

b. 'Vÿ' less than 5 V when measured at a frequency greater than 1 GHz.

Note: 3A001.i. includes electro-optical modulators with optical input and output connectors (eg fiber optic cables).

Technical note:

For the purposes of 3A001.i., 'Half-wave voltage' ('Vÿ') is the applied voltage required to change the phase of 180 degrees in the wavelength of the light propagating through the optical modulator.

3A002 "Electronic equipment" general purpose modules and equipment as follows:

a. Recording equipment and oscilloscopes as follows:

1. It is not used;

2. It is not used;

3. It is not used;

4. Not used;

5. Not used;

6. Systems of digital measuring devices for recording data having all the following characteristics;

a. 'Continuous bandwidth' greater than 6.4 Gbit/s on a disk or hard storage drive; and

b. "Signal processing" of radio frequency signal data during recording;

Technical note:

For the purposes of 3A002.a.6.:

1. For recording devices with parallel bus architecture, the rate of 'continuous bandwidth power' means the maximum word speed multiplied by the number of bits in the word.

2. 'Continuous Throughput' is the highest bit rate that the instrument can record on disk or hard drive without losing information, while maintaining the input digital data transfer rate or digitizer conversion rate.

7. Real-time oscilloscopes having a vertical root mean square (rms) noise voltage of less than 2% of full value at a set vertical axis scale that provides the lowest noise for any input bandwidth of 3 dB and 60 GHz or greater per channel ;

Note: 3A002.a.7. does not apply to equivalent time sampling oscilloscopes.

b. Not used

3A002 c. "Signal Analyzers" as follows:

1. "Signal analyzers" with a resolution bandwidth (RBW) of 3 dB above 40 MHz anywhere in frequency range exceeding 31.8 GHz but not exceeding 37 GHz,

2. "Signal analyzers" with a displayed average noise level (DANL) of less (better) than - 150 dBm/Hz anywhere in the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

3. "Signal analyzers" with a frequency exceeding 90 GHz;

4. "Signal analyzers" having all of the following characteristics:

a. 'Real-time bandwidth' greater than 170 MHz; and

b. It has any of the following characteristics:

1. 100 percent detection probability with less than 3 dB reduction from full amplitude due to lag or influence signal window function of 15 µs or less; or

2. 'Frequency Mask Trigger' feature with 100% trigger (record) probability for signals lasting 15 µs or less;

Technical notes:

1. For the purposes of 3A002.c.4.a., 'real-time bandwidth' is the widest frequency range for which the analyzer can continuously transform time-domain data entirely into frequency-domain results, using a Fourier or other discrete-time transform that processes each input time point, without reducing the measurement amplitude more than 3 dB below the actual signal amplitude caused by gaps or window effects, while transmitting or displaying the transformed data.

2. For the purposes of 3A002.c.4.b.1., the detection probability of 3A002.c.4.b.1. also called interception probability or capture probability.

3. For the purposes of 3A002.c.4.b.1. the duration of 100 percent detection probability is equivalent minimum signal duration required for a certain degree of measurement uncertainty.

4. For the purposes of 3A002.c.4.b.2., a 'frequency masking driver' is a mechanism in which the function trigger being able to select a frequency band to trigger as a subset of the acquisition bandwidth, while ignoring other signals that may be present in the same acquisition bandwidth. A 'frequency masking trigger' may contain more than one independent set of constraints.

3A002 *Note: 3A002.c.4. it does not control those "signal analyzers" that only use filters with constant percentage bandwidth (also known as octave filters or partial octave filters).*

5. Not used.

d. Signal generators having any of the following characteristics:

1. Specified to generate pulse modulated signals anywhere in the frequency range above 31.8 GHz but not exceeding 37 GHz:

a. 'Pulse duration' less than 25 ns and

b. On/off ratio equal to or greater than 65 dB;

2. Output powers exceeding 100 mW (20 dBm) anywhere in the frequency range above 43.5 GHz but not exceeding 90 GHz;

3. "Frequency change time" as determined by any of the following:

a. Not used;

b. Less than 100 µs for any frequency change above 2.2 GHz within the frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

c. Not used;

d. Less than 500 µs for any frequency change above 550 MHz within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz; or

e. Less than 100 µs for any frequency change above 2.2 GHz within the frequency range exceeding 37 GHz but not exceeding 75 GHz;

f. Not used:

Mr. Less than 100 µs for any frequency change greater than 5.0 GHz within a frequency range exceeding 75 GHz but not exceeding 90 GHz;

4. *Single sideband* (SSB) noise in dBc/Hz, having any of the following:

a. That it is less (better) than – (126 + 20log10F-20log10f) anywhere in the range of 10 Hz < F < 10 kHz anywhere within the frequency range above 3.2 GHz but not above 90 GHz; or

b. That it is less (better) than – (206 – 20log10f) anywhere in the range of 10 kHz < F ÿ 100 kHz anywhere within frequency range above 3.2 GHz, but not above 90 GHz; or

3A002 *Technical Note:*

For the purposes of 3A002.d.4., F is the deviation from the operating frequency expressed in Hz and f is the operating frequency expressed in MHz.

5. An 'RF modulation bandwidth' of digital base signals having any of the following:

a. Exceeds 2.2 GHz in a frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

b. Exceeds 550 MHz in a frequency range exceeding 31.8 GHz but not exceeding 37 GHz; or

c. Exceeds 2.2 GHz in a frequency range exceeding 37 GHz but not exceeding 75 GHz; or

d. Exceeds 5.0 GHz in a frequency range exceeding 75 GHz but not exceeding 90 GHz; or

Technical note:

For the purposes of 3A002.d.5., 'RF modulation bandwidth' is the radio frequency (RF) range occupied by a digitally coded base signal modulated to an RF signal. It is also called information bandwidth or vector modulation bandwidth. I/Q digital modulation is a technical method for producing a vector modulated RF output signal, and that output signal is usually specified as having an 'RF modulation bandwidth'.

6. Maximum frequency over 90 GHz;

Note 1: For the purposes of 3A002.d., the term signal generators includes the basic waveform and function of the generator.

Note 2: 3A002.d. does not control a device in which the output frequency is obtained by addition or subtraction of frequencies originating from two or more crystal oscillators, or by a single addition or subtraction followed by multiplication of the result.

Technical notes:

1. For the purposes of 3A002.d., the maximum frequency of an arbitrary waveform or function generator is calculated by dividing the sampling rate in samples/second by a factor of 2.5.

2. For the purposes of 3A002.d.1.a. "pulse duration" is defined as the time period between the point of the leading edge of the pulse which is 50% of the pulse amplitude and the trailing edge of the pulse which is 50% of the pulse amplitude.

e. Network analyzers with any of the following:

1. Output power greater than 31.62 mW (15 dBm) anywhere within the 43.5 GHz operating frequency range but not above 90 GHz;

2. Output power greater than 1 mW (0 dBm) anywhere within the 90 GHz operating frequency range, but not above 110 GHz;

3A002 3. 'Non-linear vector measurement functionality' at frequencies exceeding 50 GHz but not exceeding 110 GHz; or

Technical note:

For the purposes of 3A002.e.3., 'non-linear vector measurement functionality' is the capability of the instrument to

analysis of test results of devices operated in the area of large signals or non-linear distortion area.

4. Maximum operating frequency higher than 110 GHz;

f. Microwave test receivers having all of the following characteristics:

1. The maximum operating frequency exceeds 110 GHz; and

2. Possibility of simultaneous measurement of amplitude and phase;

Mr. Atomic frequency standards having any of the following characteristics:

1. "Suitable for use in space";

2. Non-rubidium frequency standards and have long-term stability (aging) less (better) than 1 h 10-11/month; or

3. Are not "space-qualified" and have all of the following:

a. Rubidium frequency standards;

b. Long-term stability (aging) less (better) than 1 h 10-11/month; and

c. Total energy consumption less than 1W.

h. "electronic assemblies" modules and equipment intended for:

1. analog-to-digital conversions having any of the following characteristics:

a. a resolution of 8 bits or greater but less than 10 bits, with a "sample rate" of greater than 1
300 Giga samples per second (GSPS);

b. a resolution of 10 bits or greater but less than 12 bits with a "sample rate" bit rate greater than 1.0 (GSPS);

c. a resolution of 12 bits or greater, but less than 14 bits, with a "sample rate" of greater than 1.0 (GSPS);

d. a resolution of 14 bits or greater but less than 16 bits, with a "sample rate" of greater than 400 Mega Samples Per Second (MSPS); or

e. a resolution of 16 bits or greater, with an input sample rate greater than 180 (MSPS), and

2. which have any of the following characteristics:

a. digital data output;

b. storage of digital data; or

c. digital data processing;

3A002 NB: *Digital data recorders, oscilloscopes, "signal analysers", signal generators, network analyzers and microwave test receivers specified in 3A002.a.6., 3A002.a.7., 3A002.c., 3A002.d. , 3A002.e. ie 3A002.f.*

Technical note:

For the purposes of 3A002.h.:

1. The resolution of n bits corresponds to the quantization of 2 n levels.

*2. ADC resolution is the number of bits of the ADC digital output that represent the measured analog input.
The effective number of bits (ENOB) is not used to determine the ADC resolution.*

*3. For unembedded multi-channel "electronic assemblies", modules or equipment, the "sampling rate"
is not aggregated, and the "sample rate" is the maximum rate of any single channel.*

4. For interleaved channels on multi-channel "electronic assemblies", modules or equipment, the "sampling rate" is aggregated and is the maximum combined total rate of all interleaved channels.

Note: 3A002.h. including ADC cards, waveform digitizers, cards for

data acquisition, signal acquisition tiles and transient recording.

3A003 A spray thermal cooling system using multiple fluid use equipment within a closed system, wherein the dielectric fluid is sprayed onto specially designed electronic components using specially designed spray nozzles designed to keep the electronic components active within their temperature defined working environment.

3A101 Electronic equipment, devices and parts, not specified in 3A001, as follows:

a. Analog-to-digital converters, usable in "missiles", designed to meet military requirements
standards for equipment intended for use in adverse conditions;

b. Accelerators capable of generating electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and systems containing such accelerators.

Note: 3A101.b. does not specify equipment specially designed for medical purposes.

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

Technical notes:

1. According to 3A102 "thermal batteries" are simple-to-use batteries containing solid inorganic salt as electrolyte. The battery has a built-in pyrolytic material. Its ignition melts the electrolyte and thus activates the battery.

2. In 3A102, "missile" means a complete missile system which, with the help of a vehicle, is capable of operating in an area wider than 300 km.

3A201 Electronic components, not specified in 3A001, as follows:

a. Capacitors having any of the following characteristics:

1. a. Operating voltage higher than 1.4 kV;

b. Accumulation of energy greater than 10 J;

c. Capacitance greater than 0.5 µF; and

d. Operating inductance less than 50 nH; or

2. a. Operating voltage higher than 750 V;

b. Capacitance greater than 0.25 µF; and

c. Operating inductance less than 10 nH;

b. Superconducting solenoid electromagnets having the following characteristics:

1. Capable of creating magnetic fields greater than 2 T;

2. Ratio of length to internal diameter greater than 2;

3. Internal diameter greater than 300 mm; and

4. Uniform magnetic field up to more than 1% over the central 50% of the inner diameter;

Note: 3A201.b. does not control magnets specially designed for medical nuclear magnetic resonance (NMR) and exported 'as parts' of the same. The term 'as part' does not necessarily mean a physical part in the same load; shipments from different sources are permitted, provided the appropriate export documents clearly state that the shipments are sent 'as part' of the MRI system.

c. X-ray generators or pulsed electron accelerators having any of the following
feature:

1. a. Maximum accelerator electron energy of 500 keV or greater but less than 25 MeV; and

b. With a 'goodness factor' (K) of 0.25 or greater; or

2. a. Maximum accelerator electron energy of 25 MeV or greater; and

b. 'Maximum power' greater than 50 MW.

Note: 3A201.c. it does not control accelerators that are integral parts of devices that are not designed for electron beam irradiation or X-radiation (for example electron microscopy) nor those designed for medical purposes.

Technical notes:

1. The 'goodness factor' K is defined as:

K = 1.7 x 103 V2.65Q

where V is the peak electron energy in million electron volts.

If the duration of the pulsed accelerator jet is less than or equal to 1 µs, then Q is accelerated in total charge in coulombs. If the duration of the accelerator pulse is longer than 1 µs, then Q is the maximum accelerated charge in 1 µs.

3A201 *Q is equal to the integral with respect to t, for less than 1 µs or the duration of the pulse jet (Q = ÿ idt), where i is the jet current in amperes and t is the time in seconds.*

2. 'Peak Power' = (Peak Voltage in Volts) x (Peak Current in Amps).

3. In machines based on microwave resonators for acceleration, duration pulse jet is shorter than 1µs or the duration of a directed jet packet resulting from one microwave modulator pulse.

4. In machines based on microwave resonators for acceleration, the peak jet current is the mean current over the duration of the directed jet packet.

3A225 Frequency converters or generators, other than those specified in 0B001.b.13., capable of being used as a variable or fixed frequency motor drive and having all of the following characteristics:

NB 1: 3D225 specifies "software" specially designed to enhance or remove limitations operating characteristics of the frequency converter or generator to meet the characteristics of 3A225.

NB 2: 3E225 specifies "technology" in the form of codes and buttons for enhancement or removal operating characteristic limitations of the converter or frequency generator to satisfy the characteristics of 3A225.

a. a multi-phase output that delivers 40 VA or more;

b. operates at a frequency of 600 Hz or higher; and

c. frequency control better (less) than 0.2%.

Note: 3A225 does not apply to frequency converters or generators if they have limitations in in respect of hardware, "software" or "technology" which sets a performance limit lower than the above, provided that they satisfy any of the following characteristics:

1. that they need to be returned to the original manufacturer for improvement or removal of limitations;

2. that they require "software", as specified in 3D225, for improvement or removal operating characteristic limitations which satisfy the characteristics of 3A225 or

3. requiring "technology" in the form of codes and keys, as specified in 3E225, to improve or remove limitations of operating characteristics thereby meeting the characteristics of 3A225.

3A225 *Technical Notes:*

1. The frequency converters of the 3A225 are known as converters or inverters;

2. Frequency converters from 3A225 can be marketed as generators, electronic test equipment, AC sources, variable speed motor drives, variable speed drives, variable frequency drives, adjustable frequency drives or adjustable speed drives.

3A226 High power direct current sources, not specified in 0B001.j.6., having both of the following characteristics:

3A226 a. Capable of continuously producing, for a period of 8 hours, 100 V or more with an output current of 500 A or more; and

b. Current or voltage stability greater than 0.1% over a time period of 8 hours.

3A227 High voltage direct current sources, not specified in 0B001.j.5., having both of the following characteristics:

a. The ability to continuously produce, during a time period of 8 hours, 20 kV or more with output current of 1 A or more; and

b. Current or voltage stability greater than 0.1% over a time period of 8 hours.

3A228 Switching devices:

a. Cold cathode tubes, whether gas-filled or not, function similarly to an arrester, and have the following characteristics:

1. They contain three or more electrodes;

2. Peak anode voltage 2.5 kV or higher;

3. Anode peak current 100 A or greater; and

4. Anode response time of 10 µs or less;

Note: 3A228.a. includes gas tubes with arc discharge and vacuum sprytron tubes.

b. Trigger arresters having both of the following characteristics:

1. Anode response time of 15 µs or less; and

2. Peak current mode of 500 A or greater;

c. Modules or assemblies with a quick disconnect function, other than those specified in 3A001.g. or 3A001.h., having all of the following characteristics:

1. Anode peak voltage greater than 2 kV;

2. Anode peak current 500 A or greater; and

3. Turn-on time of 1 µs or less.

3A229 High current pulse generators as follows:

NB: SEE ALSO NKL NGO.

a. Detonator activation equipment (starting systems, ignition systems) including equipment electronically, explosively or optically actuated actuation, other than those specified in 1A007.a., designed to actuate multiple controlled detonators specified in 1A007.b.;

b. Modular electric pulse generators (pulse devices) having the following features:

1. Designed to be portable, mobile or for use in adverse conditions;

2. Can deliver energy in less than 15 µs with loads less than 40 ohms;

3. They have an output greater than 100 A;

4. None of their dimensions is greater than 30 cm;

5. Weighs less than 30 kg; and

6. Are intended for use over an extended temperature range of 223 K (–50 ºC) to 373 K (100 ºC) or listed as suitable for aerospace applications.

Note: 3A229.b. includes drivers (drivers) of xenon flashing lamps.

c. Plugs having all of the following characteristics:

1. none of their dimensions is greater than 35 mm;

2. their nominal voltage is equal to or greater than 1 kV and

3. Capacitance equal to or greater than 100 nF.

3A230 Fast pulse generators with associated 'pulse heads' having both following features:

a. Output voltage greater than 6 V with active load less than 55 ÿ, i

b. 'Pulse transition time' less than 500 ps.

Technical notes:

1. In 3A230 'pulse transition time' is defined as the time interval between 10% and 90% of the voltage amplitude.

2. 'Impulse heads' are networks that form impulses intended to accept the voltage jump of its shaping into various impulse shapes which can be rectangular, triangular, jump, impulse, exponential or monocyclic. 'Pulse heads' can be an integral part of a pulse generator, they can be plug-in components for a device or an external power supply device.

3A231 Neutron generator systems, including tubes, having both of the following characteristics:

a. Designed to work without an external vacuum system; and

b. They apply any of the following:

1. Electrostatic acceleration to induce a tritium-deuterium nuclear reaction or

2. Electrostatic acceleration to induce a deuterium-deuterium nuclear reaction with which it can produce 3 × 109 or more neutrons per second.

3A232 Detonators and multipurpose initiation systems other than those specified in 1A007:

NB: SEE ALSO NKL NGO.

NB: SEE 1A007.b. for detonators.

a. Not used

b. Deployments using single or multiple detonators designed to be nearly simultaneous initiate an explosive surface over more than 5,000 mm² from a single ignition signal with an initial surface propagation time of less than 2.5 µs.

Note: 3A232 does not control detonators using only primary explosives, such as azide lead.

3A233 Mass spectrometers, other than those specified in 0B002.g., capable of measuring ions of 230 in or greater and having a resolution greater than 2/230, and their ion sources, as follows:

a. Inductively Coupled Plasma Mass Spectrometers (ICP/MS);

b. Luminescence Discharge Mass Spectrometers (GD/MS)

c. Thermal ionization mass spectrometers (TI/MS);

d. Electron bombardment mass spectrometers having both of the following characteristics:

1. molecular beam input system that introduces a collimated beam of analyte molecules into the ion source region where the molecule is ionized by the electron beam, and

2. one or more 'cooling traps' capable of cooling to a temperature of 193 K (– 80 °C);

e. Not used

f. Mass spectrometers equipped with an ion microfluorination source, designed for actinides or actinide fluorides.

Technical notes:

1. Electron bombardment mass spectrometers specified in 3A233.d. they are also known as maseni electron impact spectrometers or electron ionization mass spectrometers.

2. In 3A233.d.2. A 'refrigeration trap' is a device that traps gas molecules by condensing or freezing the molecules on cold surfaces. For the purposes of 3A233.d.2. closed loop gas helium-cryogenic vacuum pump is not a 'cooling trap'.

3A234 Microstrip lines providing a low-inductance connection to detonators, having the following characteristics:

a. nominal voltage higher than 2 kV i

b. inductance less than 20 nH.

3B Equipment for testing, verification and production

3B001 Equipment for the manufacture of semiconductor devices or materials and, in connection therewith, specially designed components and accessories:

NB SEE ALSO 2B226

a. Epitaxial growth equipment as follows:

1. Equipment, designed or modified, capable of producing any layer of material, except silicon, whose thickness homogeneity is less than ±2.5% along a distance of 75 mm or more;

Note: 3B001.a.1. includes everything related to atomic layer epitaxy.

2. Metal organic vapor deposition reactors, designed for epitaxial growth of compound semiconductor materials, having two or more of the following elements: aluminum, gallium, indium, arsenic, phosphorus, antimony, and nitrogen;

3. Equipment for epitaxial growth from molecules using gas or solid sources;

b. Equipment designed for ion implantation, having some of the following features:

1. Not used

2. Designed and optimized to operate at a beam energy of 20 keV or greater and a beam current of 10 mA or greater for implantation of hydrogen, deuterium or helium;

3. Possibility of direct enrollment;

4. The possibility of implanting high-energy oxygen into heated semiconductor material "substrates" with a beam energy of 65 keV or greater and a beam current of 45 mA or greater; or

5. It is designed and optimized to operate at a beam energy of 20 keV or greater and a beam current of 10 mA or greater for implanting silicon into a semiconductor "substrate" material that has been heated to 600 °C or higher;

c. Not used.

d. Not used.

3B001 e. Processing systems with automatic loading of a multi-chamber center plate, having both of the following characteristics:

1. The board's input and output are designed to interface with more than two functionally different 'semiconductor processing tools' specified in 3B001.a.1., 3B001.a.2, 3B001.a.3. or 3B001.b.; and

2. Designed according to the form of an integrated system in a vacuum environment for sequential semiconductor wafer processing in multiple operations;

Note: 3B001.e. does not control automatic robotic wafer processing systems, which are specially designed for parallel processing of tiles.

Technical notes:

1. For the purposes of 3B001.e.1., 'semiconductor processing tools' refers to modular tools that enable physical processes to produce semiconductors that are functionally distinct, such as deposition, implantation or heat treatment.

2. For the purposes of 3B001.e.2., 'sequential processing of a semiconductor wafer

in multiple operations' means the ability to process each wafer in different semiconductor processing tools, such as when transferring a wafer from one tool to another and third using central automatic multi-chamber loaders as interoperation manipulation systems.

f. Lithography equipment with the following characteristics:

1. Equipment for alignment, exposure stage and repeat (direct stage on semiconductor wafer), or step and scan, using the photo-optical or X-ray method, having any of the following characteristics:

a. The light source has a wavelength less than 193 nm; or

b. Ability to produce 'minimum resolution element' (MRF) patterns of 45 nm or less;

Technical note:

For the purposes of 3B001.f.1.b., the 'minimum resolving element' (MRF) is obtained from the following formula:

MRF = (wavelength of exposure light source in nm) x (K factor) numerical aperture

where K factor = 0.35

2. Lithographic printing equipment capable of producing details of 45 nm or less;

Note: 3B001.f.2. includes:

– microcontact printing tools

– hot tools

– lithography tools with nano precision

– tools for making incremental and flash lithographic prints (S-FIL).

3B001 3. Equipment specially designed for making a mask having all of the following characteristics:

a. It uses a deflected beam of focused electrons, an ion beam or a "laser" beam; and

b. It has any of the following characteristics:

1. Spot size FWHM (full width at half height) is less than 65 nm and positioning images less than 17 nm (mean +3 ÿ); or

2. not used;

3. The precision of making the upper layer is better than 23 nm (mean value + 3 ÿ) on the mask;

4. Equipment intended for the processing of devices using the direct recording method, which has the following features:

a. deviation of the focused electron beam, i

b. has any of the following characteristics:

1. smallest beam size of 15 nm or less; or

2. overlap error less than 27 nm (mean value + 3 ÿ);

Mr. Masks and networks designed for integrated circuits specified in 3A001;

h. Multilayer masks with phase shift interface, other than those specified in 3B001.g. and intended use with lithographic equipment whose wavelength of the light source is less than 245 nm;

Note: 3B001.h. does not control multilayer phase moving layer masks intended for the manufacture of memory devices not controlled by 3A001.

NB: For masks and nets, specially designed for optical sensors, see 6V002.

and. Lithographic patterns are designed to control the integrated circuits controlled in 3A001.

j. Masks for "substrates" with a multi-layer reflector structure consisting of molybdenum and silicon, and having all of the following:

1. Specially designed for 'extreme ultraviolet' ('EUV') lithography; and

2. Conforms to SEMI standard P37.

Technical note:

For the purposes of 3B001.j., "extreme ultraviolet" ("EUV") refers to wavelengths electromagnetic spectrum greater than 5 nm and less than 124 nm.

3B002 Test equipment specially designed for testing finished or unfinished semiconductor components and specially designed components and accessories therefor, as follows:

a. For testing the S-parameters of goods specified in 3A001.b.;

b. Not used;

c. For testing goods specified in 3A001.b.2.

3C Materials

3C001 Heteroepitaxial materials consisting of any of the following "substrates" for multilayer epitaxial growth:

a. Silicon;

b. Germanium;

c. Silicon carbide; or

d. III/V compounds of gallium or indium;

e. Gallium oxide (Ga2O3); or

f. Diamond.

Note: 3C001.d. does not apply to "substrates" having one or more epitaxial layers P-type from GaN, InGaN, AlGaN, InAlN, InAlGaN, GaP, GaAs, InP, InGaP, AlInP or InGaAlP, depending on the order of the elements, unless the P-type epitaxial layer is between the N-type layers.

3C002 Resistive materials and "substrates" coated with the following protective coatings:

a. Protective coatings for semiconductor lithography as follows:

1. positive protective coatings specially adjusted (optimized) for use in waves lengths less than 193 nm, but greater than or equal to 15 nm;

2. protective coatings specially adjusted (optimized) for use at wavelengths less than 15 nm, but greater than 1 nm;

b. All resistors designed to use electron or ion beams, with a sensitivity of 0.01 µcoulomb/mm2, or better;

c. Not used;

d. All resistors optimized for surface recording technologies;

e. All resistors designed or optimized for use with lithography equipment for printing from 3V001.f.2 using either a thermal or photo-renewable process.

3C003 Organic-inorganic compounds:

a. Organic compounds of aluminum, gallium or indium metals, having a purity (metallic basis) of better than 99.999%;

3C003 b. Organic compounds of arsenic, antimony or phosphorus, having a purity (inorganic element in the base) of better than 99.999%.

Note: 3C003 controls only compounds of which it is metallic, partially metallic or non-metallic element directly attached to carbon in the molecule.

3C004 Phosphorus, arsenic or antimony hydrides, having a purity greater than 99.999%, even when diluted in inert gases or hydrogen.

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

3C005 High resistance materials:

a. Semiconductor "substrates" of silicon carbide (SiC), gallium nitride (GaN), aluminum nitride (AlN) or aluminum gallium nitride (AlGaN), gallium oxide (Ga2O3) or diamond semiconductor "substrates", or ingots, parts or other semi-finished products of these materials with a resistance greater than 10,000 ÿ/cm at 20 °C;

b. Polycrystalline "substrates" or semicrystalline ceramic "substrates", having a resistivity greater than 10,000 ohm-cm at 20 °C and having at least one non-epitaxial layer of silicon (Si), silicon carbide (SiC), gallium nitride (GaN), aluminum nitride (AlN), or aluminum gallium nitride (AlGaN), gallium oxide (Ga2O3) or diamond on the "substrate" surface.

3C006 "Substrates" other than those specified in 3C001, consisting of "substrates" specified in 3C005 with at least one epitaxial layer of silicon carbide (SiC), gallium nitride (GaN), aluminum nitride (AlN), aluminum gallium nitride (AlGaN), gallium oxide (Ga2O3) or diamond.

3D Software

3D001 "Software" specially designed for the "development" or "production" of the specified equipment of 3A001.b. to 3A002.h. or 3B.

3D002 "Software" specially designed for the "use" of equipment specified in 3B001.a. to f., 3B002 or 3A225.

3D003 'Computer lithography' "software" specially designed for the "development" of patterns on EUV-lithographic masks or grids.

Technical note:

For the purposes of 3D003, 'computational lithography' is the use of computer modeling to predict, correction, optimization and verification of image performance of the lithographic process through a series of patterns, processes and system conditions.

3D004 "Software" specially designed for the "development" of equipment specified in 3A003.

3D005 "Software" specially designed to restore normal operation of microcomputers, "microprocessor microcircuits" or "microcomputer microcircuits" within 1 ms after being disturbed by electromagnetic pulse (EMP) or electrostatic discharge (ESD), without interruption.

3D006 "Software" for 'Electronic Computer Aided Design' ('ECAD') specially designed for the "development" of integrated circuits having any "channel control field effect transistor" ("GAAFET") structure and any of the following:

a. specially designed to apply 'physically achievable levels' (Register Transfer Level - 'RTL') to the standard 'Geometrical Database Standard II' ('GDSII') or an equivalent standard; or

b. specifically designed to optimize power or time rules.

Technical notes:

For the purposes of 3D006:

1. 'Electronic Computer Aided Design' ('ECAD') is a category of 'software' tools used to design, analyze, optimize and validate the functioning of an integrated circuit or printed circuit board.

2. The 'Physically Realizable Level' (Register Transfer Level - 'RTL') is an abstract design by which synchronous digital circuitry in terms of the flow of digital signals between hardware registers, and the logical operations performed on those signals.

3. 'Geometrical Database Standard II' (,GDSII') is an interchange database file format integrated circuit data or integrated circuit plan.

3D101 "Software" specially designed or modified for use with equipment specified in 3A101.b.

3D225 "Software" specially designed to improve or remove limitations on the operating characteristics of frequency converters or generators to meet the characteristics of 3A225.

3E Technology

3E001 "Technology" according to the General Technology Note for "development" or "production" equipment or materials listed in 3A, 3B or 3C.

Note 1: 3E001 does not control "technology" for equipment or components controlled by 3A003.

Note 2: 3E001 does not control "technology" for integrated circuits specified in 3A001.a.3. to 3A001.a.12., having all of the following characteristics:

1. They use "technology" at the level of 0.130 µm or above, i

2. Have embedded multilayer structures with up to three or fewer metal layers.

Note 3: 3E001 does not control 'process design kits' ('PDK') unless they include libraries implementing functions or technologies for items specified in 3A001.

Technical note:

For the purposes of 3E001 Note 3, a 'process design kit' ('PDK') is a software tool that provided by the semiconductor manufacturer to ensure that the required design practices and rules are taken into account in order to successfully produce a specific integrated circuit design in a specific semiconductor process, within technological and manufacturing constraints (each semiconductor manufacturing process has its own specific 'PDK') .

3E002 "Technology" according to the General Technology Note, as opposed to that which is specified in 3E001 also refers to the "development" or "production" of "microprocessor electronic circuits", "microcomputer electronic circuits" and microcontroller electronic circuits and having a single arithmetic logic unit accessed with words of 32 bits or more and having any of the following feature:

a. A 'Vector Processing Unit' designed to perform more than two computations simultaneously with 'floating point' vectors (one-dimensional 32-bit arrays or larger numbers);

Technical note:

For the purpose of 3E002.a., a 'vector processing unit' is a processing element with embedded instructions that simultaneously perform multiple calculations on 'floating point' vectors (one-dimensional 32-bit arrays or larger numbers), having at least one vector arithmetic logic unit of at least 32 elements.

b. Designed to perform more than four 64-bit or larger 'floating point' operations per cycle; or

c. Designed to perform more than four 16-bit 'fixed-point' multiple-accumulate operations per cycle (eg digital manipulation of analogue information that has previously been converted to digital form, known as digital 'signal processing').

Technical note:

1. For the purposes of 3E002.a. and 3E002.b., 'floating point' is defined in IEEE-754.

2. For the purpose of 3E002.c., 'fixed point' refers to a real number of fixed width with integer and partial component, which does not include integer formats.

Note 1: 3E002. does not control the "technology" for multimedia extensions.

Note 2: 3E002 does not control the "technology" of microprocessor cores having all of the following characteristics:

a. They use "technology" of 0.130 µm or more; and

b. They include multilayer structures with five or fewer metal layers.

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

3E003 Other "technology" for the "development" or "production" of:

a. Vacuum microelectronic components;

b. Electronic devices (components) with semiconductor heterostructures, such as high electron mobility transistors (HEMT), heterobipolar transistors (HBT), quantum well and superlattice components;

Note: 3E003.b. does not control the technology of high electron mobility transistors (HEMT) operating at frequencies below 31.8 GHz and heterobipolar transistors (HBT) operating at frequencies below 31.8 GHz.

3E003 c. "Superconducting" electronic components;

d. Diamond substrates for electronic components;

e. Silicon-on-insulator (SOI) substrate, for integrated circuits in which the insulator is silicon-dioxide;

f. Silicon carbide substrate for electronic components;

Mr. "Vacuum electronic devices" operating at frequencies of 31.8 GHz or greater;

h. Gallium oxide substrate for electronic components.

3E004 "Technology" "required" for cutting, grinding and polishing silicon wafers 300 mm in diameter to achieve a 'front least squares area' ('SFQR') of less than or equal to 20 nm at all 26 mm × 8 mm locations on the face of the wafer, with no edges 2 mm or less in width.

Technical note:

For the purpose of 3E004 'SFQR' is the range of maximum and minimum deviation from the front reference plane, calculated by the method of least squares with all front surface data, including surface boundaries at a specific location.

3E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 3A001.a.1. or 2., 3A101, 3A102 or 3D101.

3E102 "Technology" according to the General Technology Note for the "development" of "software" specified in 3D101.

3E201 "Technology" according to the General Technology Note for the "use" of the specified equipment in 3A001.e.2., 3A001.e.3., 3A001.g., 3A201, 3A225 to 3A234.

3E225 "Technology" in the form of codes or keys to enhance or remove restrictions operating characteristics of the frequency converter or generator to meet the characteristics of 3A225.

CATEGORY 4
COMPUTERS

Note 1: Computers, their equipment and "software" performing telecommunications or "local area networking" functions must also be evaluated against the performance characteristics of Category 5, Part 1 (Telecommunications).

Note 2: Control units that connect directly to buses or ducts central processing unit, 'main memory' or disk controllers are not considered to be telecommunications equipment described in Category 5, Part 1 (Telecommunications).

NB: for state control of "software" specially designed for packet switching, see 5D001.

Technical note:

For the purposes of Note 2, 'main memory' is the primary memory for data or instructions for rapid access to the central processing unit. It consists of the internal memory of the "digital computer" and any hierarchical extensions, such as cache memory or non-sequentially accessible extended memory.

4A Systems, equipment and components

4A001 Electronic computers and related equipment having all of the above characteristics, and "electronic assemblies" and specially designed components for them, which are:

NB: SEE ALSO 4A101.

a. Specially designed to have some of the following characteristics:

1. intended for operation at an ambient temperature below 228 K (–45 °C) or above 358 K (85 °C); or

Note: 4A001.a.1. does not apply to computers specially designed for use in civilian automobiles, trains or "civil aircraft".

2. Reinforced for operation in a radiation field that exceeds the limits specified in the following specification:

a. total radiation dose 5 x 103 Gy (silicon);

b. alarming ionizing radiation dose rate of 5 x 106 Gy (silicon)/s; or

c. single/single disturbance 1 x 10-8 errors/bit/day;

Note: 4A001.a.2. does not apply to computers specially designed for use in "civil aircraft".

b. Not used.

4A003 "Digital computers", "electronic circuits", related devices and specially therefor engineered components such as:

Note 1: 4A003 includes the following:

– Vector processors;

– Matrix processors;

– Digital signal processors;

– Logical processors;

- Equipment designed for "image enhancement".

Note 2: Condition control of "digital computers" and related equipment described in 4A003 is specified in relation to the state control of other devices or available systems:

a. "Digital computers" or related equipment are basic elements necessary for the operation of other devices or system;

b. "Digital computers" or related equipment are not "core elements" of other devices or systems; and

4A003 *NB1: The condition control of "signal processing" or "image amplification" equipment specially designed for other devices, with functions limited to satisfy other devices is determined by the condition control of other devices and equipment, even if they exceed the criteria of a "core element" .*

NB2: For monitoring the condition of "digital computers" or related devices for telecommunications equipment, see Category 5, Part 1. (Telecommunications).

c. "Technology" for "digital computers" and related devices is determined by 4E.

a. Not used;

b. "Digital Computers" with "Adjusted Peak Performance" ("APP - Adjusted Peak Performance") which exceeds 70 weighted teraflops (WT - Weighted TeraFLOPS);

c. "Electronic assemblies" specially designed or modified to improve performance by coupling processors so that the "APP" assembly exceeds the limit of 4A003.b.;

Note 1: 4A003.c. applies only to those "electronic assemblies" and programmable interconnects not exceeding the limits given in 4A003.b. when supplied as non-integrated "electronic assemblies".

Note 2: 4A003.c. does not control "electronic assemblies" specially designed for the product or a group of products whose maximum configuration does not exceed the limits of 4A003.b.

d. Not used;

e. Not used;

f. Not used;

Mr. Devices specially designed to support the operation of "digital computers" by providing external connectivity enabling communications at data rates exceeding 2.0 Gbyte/s

by connection.

Note: 4A003.g. does not control internal interconnect parts (eg backplanes, buses), passive interconnect devices, "network access controllers" or "communication channel controllers".

4A004 Computers, and specially designed related equipment therefor, "electronic assemblies" and their components, such as:

a. 'Systolic matrix computers';

b. 'Neural computers';

c. 'Optical computers'.

4A004 *Technical Note:*

1. For the purposes of 4A004.a., 'systolic matrix computers' are computers where flow and modification of data can be dynamically controlled at the logical door level by the user.

2. For the purposes of 4A004.b., 'neural computers' are computing devices designed or modified so that they mimic the behavior of neurons or collections of neurons, that is. computing devices that differ in their hardware ability to modulate the weight and number of interconnections of multiple computing components based on prior data.

3. For the purposes of 4A004.c., 'optical computers' are computers designed or modified to use light for data presentation and whose computational logic elements are based on directly connected optical devices.

4A005 Systems, equipment and components therefor specially designed or modified for the production, command and control or delivery of "tamper detection software".

4A101 Analog computers, "digital computers" or digital differential analyzers, other than those specified in 4A001.a.1., that are enhanced and designed or modified for use on spacecraft launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

4A102 Hybrid computers specially designed for modelling, simulation or design integration of launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

Note: This control applies only when devices have "software" specified in 7D103 or 9D103.

4B Equipment for testing, verification and production

Does not have.

4C Materials

Does not have.

4D Software

Note: "Software" status control for devices described in other categories is performed in within the corresponding Category.

4D001 "Software" as follows:

a. "Software" specially designed or modified for the "development" or "production" of devices or "Software" specified in 4A001 to 4A004, or 4D.

b. "Software", not specified in 4D001.a., specially designed or modified for the "development" or "production" of equipment as follows:

4D001 1. "Digital computers" with an APP ("Adjusted Peak Performance") value exceeding 24 weighted teraflops (WT - Weighted TeraFLOPS); or

2. "Electronic assemblies" specially designed or modified to improve performance connecting the processor so that the "APP" set exceeds the limit of 4D001.b.1.;

4D002 Not used.

4D003 Not used.

4D004 "Software" specially designed or modified for the production, command and control or delivery of "tamper detection software".

Note: 4D004 does not control "software" specially designed and limited to provide "software" updates or upgrades that meet the following:

4D004 *a. An update or upgrade only works with the approval of the system owner or administrator; and*

b. After an update or upgrade, the updated or upgraded "Software" is none of the following:

1. "Software" specified in 4D004; or

2. "Software" for unauthorized entry.

4E Technology

4E001 "Technology" as follows:

a. "Technology" in accordance with the General Technology Note, for "development", "production" or "using" devices or "software" specified in 4A or 4D.

b. "Technology", according to the General Technology Note other than that specified in 4E001.a., for the "development" or "production" of the following:

1. "Digital computers" with an APP ("Adjusted Peak Performance") value exceeding 24 wt teraflops (WT – Weighted TeraFLOPS); or

2. "Electronic assemblies" specially designed or modified to improve performance by connecting processors so that the "APP" set exceeds the limit of 4E001.b.1.

c. "Technology" for the "development" of "tamper detection software".

Note 1: 4E001.a. and 4E001.c. they do not control "vulnerability detection" or "cyber incident response".

Note 2: Note 1 does not reduce the rights of the competent authority of the country where the exporter has its headquarters to determine compliance with 4E001.a. and 4E001.c.

TECHNICAL NOTE O
"CORRECTED MAXIMUM ABILITY" ("APP")

"APP" is the corrected maximum capability, with which "digital computers" perform 64-bit or greater floating point addition or multiplication.

"APP" is expressed in weighted teraflops (WT), in units of 1012 corrected operations s floating point per second.

Abbreviations used in this Technical Note are as follows:

n:	number of processors in a "digital computer"
and:	number of processors (i,...n)
you:	processor cycle time **(ti** = **1/Fi)**
Fee:	processor frequency
Ri:	the fastest floating point calculation speed
WiFi:	computer architecture correction factor

Presentation of the "APP" calculation method:

1. For each processor i, determine the largest number of 64-bit or larger floating-point operations, **FPOi ,** that are performed in each processor cycle in the "digital computer".

Note: When specifying **FPOi,** *include only 64-bit or larger floating-point additions or multiplications. All floating-point operations should be expressed in operations per processor cycle; operations that require a larger number of cycles can be expressed with decimal numbers per cycle. For processors, which cannot calculate in floating-point operands of size 64-bit or larger, the effective calculation speed R is equal to zero.*

2. Calculate the floating point rate R for each processor:

Ri **=** FPOi/ti .

3. Calculate **"APP"** as

"APP" = W1 **x** R1 **+** W2 **x** R2 **+ ... +** Wn **x** Rn.

4. For vector processors, Wi **= 0.9.**

For non "vector processors", Wi **= 0.3.**

Note 1: If processors perform complex operations, e.g. addition and multiplication with moving parts comma, each operation is counted separately.

Note 2: With processors connected in series, the effective calculation speed R is higher than the speed in series, when the array is filled, or from non-linear velocity.

Note 3: The computational speed R of each processor is calculated at the theoretically maximum possible values, before the "APP" value for the combination was derived. It is assumed that there are simultaneous operations, when the manufacturer mentions their parallel or simultaneous operation in the manual or instructions for the computer.

Note 4: When calculating "APP", do not include processors, which are limited to input only output or peripheral functions (eg for diskette drive, communications or video display).

Note 5: "APP" values do not count for combinations of processors, connected in "local area networks", wide area networks, shared input/ output devices, input/ output controllers, and for any "software" controlled communication link.

Note 6: "APP" values should be calculated for combinations of processors, containing processors, specially designed to increase the ability by connection-aggregation, which act simultaneously and with the use of memory;

Technical note:

1. Assemble all processors and accelerators that work simultaneously and are located on the same board.

2. Combinations of processors share memory when any processor is able to access any memory location in the system by hardware transfer of cache lines or memory words without the use of a software mechanism, which can be achieved using "electronic circuits" specified in 4A003.c.

Note 7: A "vector processor" is defined as a processor with built-in instructions that simultaneously perform multiple floating-point vector calculations (one-dimensional arrays of 64-bit or larger numbers), have at least two vector functional units, and at least eight vector registers with at least 64 elements .

CATEGORY 5
TELECOMMUNICATIONS AND "INFORMATION PROTECTION"

PART
1 TELECOMMUNICATIONS

Note 1: Category 5, Part 1 specifies the control status of components, test and "production" equipment, and "software" specially designed for telecommunications equipment or systems.

NB: For "lasers" specially designed for telecommunications equipment or systems, see 6A005.

Note 2: "Digital computers", related equipment or "software" are considered specially designed components if they are necessary to operate and support the telecommunications equipment described in this category, and provided they are standard models supplied by the manufacturer. This includes

computer systems for operation, administration, maintenance, engineering or billing.

5A1 Systems, equipment and components

5A001 Telecommunications systems, equipment, components and accessories as follows:

a. Any type of telecommunications equipment that has any of the following characteristics, functions or trait:

1. Specially designed to withstand transistor electronic effects or electromagnetic pulse effects that occur in a nuclear explosion;

5A001 2. Specially hardened to withstand gamma, neutron or ion radiation;

3. Specially designed to work at a temperature below 218 K (–55 °C); or

4. Specially designed to operate at temperatures above 397 K (124 °C)

Note: 5A001.a.3. and 5A001.a.4. applies only to electronic equipment.

Note: 5A001.a.2. and 5A001.a.3. and 5A001.a.4. do not control equipment designed or modified for use on satellites.

b. Telecommunications equipment and systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

1. Underwater communication systems that have any of the following characteristics:

a. Acoustic carrier frequency outside the range of 20 kHz to 60 kHz;

b. They use an electromagnetic carrier frequency below 30 kHz;

c. They use control techniques based on an electron beam; or

d. They use a "laser" or light-emitting diodes (LEDs) with a wavelength greater than 400 nm and smaller than 700 nm, in the local network;

2. Radio equipment operating in the band 1.5 MHz to 87.5 MHz and having any of the following feature:

a. Automatic prediction and selection of frequencies as well as the "speed of the total digital transfer" per channel in order to optimize the transmission; and

b. Built-in linear power amplifier in a configuration that can support multiple signals simultaneously, at an output power of 1 kW or more, in the frequency range of 1.5 MHz to 30 MHz, or 250W or more in the frequency range of 30 MHz or more, but less than 87.5 MHz, over the "current bandwidth" within an octave or more and with output harmonics and distortion better than –80 dB.

3. Radio equipment using "spread spectrum" techniques, including "frequency hopping" techniques, other than that specified in 5A001.b.4. and having any of the following:

a. user-programmable spectrum extension codes; or

b. a total transmit signal bandwidth that is 100 or more times the width of any information channel and exceeds 50 kHz;

Note: 5A001.b.3.b. does not apply to radio equipment specially designed for use with any of the following:

5A001 *a. Systems of civil radio communication stations; or*

b. Fixed or mobile satellite earth stations for commercial civil telecommunications.

Note: 5A001.b.3. does not apply to radio equipment designed to operate with an output power of 1W or less.

4. Radio equipment using an ultra-wideband modulation technique, having user-programmable channelization codes, scrambling codes or network identification, and having any of the following:

a. bandwidth greater than 500 MHz; or

b. a "relative bandwidth" of 20% or more.

5. Digitally controlled radio receivers meeting all of the following:

a. they have more than 1,000 channels;

b. "time to change the channel." " less than 1 ms;

c. Automatic search or scanning of part of the electromagnetic spectrum; and

d. Identification of the receiving signal or transmitter type; or

Note: 5A001.b.5. does not apply to radio equipment specially designed for use in civil radio communication station systems.

Technical note:

For the purposes of 5A001.b.5.b., "channel change time" means the time (ie delay) to change from one reception frequency to another, to achieve ± 0.05% or close to that percentage of the final specified reception frequency. Items with a specified frequency range of less than ± 0.05% around their center frequency are defined as incapable of changing the channel frequency.

6. Uses a digital "signal processing" function to provide "speech encoding" at rates below 700 bit/s.

Technical note:

1. For variable speech coding rates, 5A001.b.6. is applied to the audio coding output of continuous speech.

2. For the purposes of 5A001.b.6. "speech coding" is defined as a sampling technique of the human voice and then convert it into a digital signal, taking into account the specific characteristics of the human voice.

5A001 c. Optical fibers longer than 500 m, which are specified by the manufacturer to be able to withstand a 'trial test' to a tensile strength of 2x109 N/m2 or more;

NB: For underwater connecting cables see 8A002.a.3.

Technical note:

For the purposes of 5A001.c., 'trial testing': On-line and off-line testing during the manufacturing process by dynamic application of the prescribed stretching stress to fibers 0.5 to 3 m long, at a passing speed of 2 to 5 m/s between rollers with an approximate diameter of 150 mm. The ambient temperature is nominally 293K (20 °C) and the relative humidity is 40%. Equivalent national standards may be used to perform the test.

d. 'Electronically steerable phased antenna arrays' as follows:

1. Intended for operation above 31.8 GHz but not exceeding 57 GHz, having an effective radiated power (ERP) equal to or greater than + 20 dBm (22.15 dBm effective iserotropic radiated power (EIRP));

2. Intended for operation above 57 GHz, but not exceeding 66 GHz, having an ERP equal to or greater than + 24 dBm (26.15 dBm EIRP);

3. Intended for operation above 66 GHz, but not more than 90 GHz, having an ERP equal to or greater than +20 dBm (22.15 dBm EIRP);

4. They are intended for operation up to 90 GHz;

Note 1: 5A001.d. does not apply to 'electronically steerable phased antenna arrays' for landing instruments meeting ICAO microwave landing gear standards (Microwave Landing Systems - MLS)

Note 2: 5A001.d. does not control antennas specially designed for:

a. Civil cellular or WLAN radio communication systems;

b. IEEE 802.15 or Wireless HDMI; or

c. Fixed or mobile satellite earth stations for commercial civil telecommunications.

Technical note:

For the purposes of 5A001.d. An 'electronically steerable phased array antenna' is a beam forming antenna by phase coupling, (ie the beam direction is controlled by complex excitation coefficients of the radiation elements) and the direction of that beam can be varied (both transmission and reception) in azimuth or elevation, or both, by applying an electrical signal.

e. Equipment for detecting the direction of radio transmission (radio-goniometer) at frequencies above 30 MHz that has both features, and specially designed components for it, as follows:

1. "Current Passive Bandwidth" of 10 MHz or greater; and

2. The ability to search for a Line of Bearing (LOB) with an uncooperative radio transmitters whose signal duration is less than 1 ms.

5A001 f. Mobile telecommunications equipment for interception or jamming and their equipment how follows, and specially designed components for it:

1. Interception equipment designed to extract voice or data transmitted by radio contact;

2. Interception equipment, not specified in 5A001.f.1., designed to extract identifiers device or subscriber (eg IMSI, TIMSI or IMEI), signaling or other metadata transmitted by radio face-to-face;

3. Jamming equipment specially designed or modified to intentionally or selectively interfere with, reject, retain, weaken or deter mobile telecommunications services, which does any of the following:

a. It simulates the functions of equipment for accessing the radio network (Radio Access Network - RAN); or

b. It detects and uses the specific characteristics of the applied mobile telecommunications protocols (eg GSM); or

c. It uses the specific characteristics of a given mobile telecommunication protocol (eg, GSM).

4. Radio frequency (RF) monitoring equipment designed or modified to detect the operation of items specified in 5A001.f.1., 5A001.f.2. or 5A001.f.3.;

Note: 5A001.f.1. and 5A001.f.2. they do not control any of the following:

a. Equipment specially designed for interception of analog private mobile radio network (Private Mobile Radio - PMR), IEEE 802.11 WLAN;

b. Equipment designed for operators of mobile telecommunication networks; or

c. Equipment designed for the "development" or "production" of mobile telecommunications equipment or system.

NB1: See also NKL NGO.

NB2: For radio receivers see 5A001.b.5.

Mr. Passive coherent locator (RSL) systems or equipment specially designed for the detection and tracking of moving objects by measuring the reflections of radio frequency emissions of the environment, equipped with non-radar transmitters.

Technical note:

For the purposes of 5A001.g., non-radar transmitters may include commercial radio, television or telecommunication base stations.

Note: 5A001.g. does not control any of the following:

1. Radio-astronomical equipment;

5A001 *2. Systems or equipment requiring any radio transmission from the target.*

h. Equipment against improvised explosive devices (Improvised Explosive Devices - IED) i associated equipment as follows:

1. Radio frequency (RF) transmission equipment other than that specified in 5A001.f. projected or

modified to prematurely activate or prevent the initiation of improvised explosive devices (IEDs) controlled by radio communication;

2. Equipment in which techniques intended to enable radio communication on channels are applied the same frequencies on which the co-located equipment specified in 5A001.h.1 emits.

NB: See also NKL NGO.

and. Not used;

j. Systems or equipment for monitoring Internet Protocol (IP) networks and specially designed components for them that have all of the following:

1. Perform all of the following on a carrier-class IP network (eg backbone IP network of national category):

a. Analysis at the application layer (eg, the 7th layer of the Open Systems Interconnection Model (Open Systems Interconnection - OSI) (ISO/IEC 7498-1));

b. Extraction of selected metadata and application content (eg voice, video, message, attachment); and

c. Indexing of extracted data, i

2. They are specially designed to perform all of the following:

a. Performing searches based on "permanent selectors"; and

b. Mapping the relational network of individuals or groups of people.

Note: 5A001.j. does not control systems or equipment specially designed for any of the following:

a. Marketing purposes;

b. Quality of service in the network (Quality of Service - QoS) or

c. Quality of Experience (QoE).

5A101 Remote sensing (telemetry) and remote control (telecontrol) equipment, including the ground part of the equipment, designed or modified for "missiles".

Technical note:

In 5A101 "missiles" *means complete missile systems or unmanned aerial vehicles, capable of a range greater than 300 km.*

Note: 5A101 does not control:

a. Equipment designed or adapted for manned aircraft or satellites;

5A101 *b. Ground equipment designed or adapted for use on land or sea*

c. Equipment designed for commercial, civil or security GNSS services - "Life insurance" (eg data integrity, flight safety);

5B1 Equipment for testing, verification and production

5B001 Telecommunications equipment, components and accessories for verification, testing and production, as follows:

a. Equipment and specially designed components or accessories therefor, specially designed for "Development" or "production" of equipment, functions or features specified in 5A001.

Note: 5B001.a. does not control optical fiber characterization equipment.

b. Equipment and specially designed components or accessories therefor, specially designed for "development" of any telecommunications equipment, transmission or switching, as follows:

1. Not used.

2. Equipment using a "laser" and having any of the following characteristics:

a. A transmission wavelength greater than 1750 nm;

b. Not used;

c. Not used;

d. It uses analog techniques and has a range above 2.5 GHz;

Note: 5B001.b.2.d. does not apply to equipment specially designed for the "development" of commercial TV systems.

3. It is not used;

4. Radio equipment using the Quadrature Amplitude Modulation (QAM) technique above the 1 024 level;

5. Not used.

5C1 Materials

Does not have.

5D1 Software

5D001 "Software" as follows:

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment, functions or features specified in 5A001.

b. Not used.

5D001 c. Specific "software" specially designed or modified to enable features, functions or features of equipment specified in 5A001 or 5B001;

d. "Software" specially designed or modified for the "development" of any of the following telecommunication equipment, transmission or switching:

1. Not used.

2. Equipment using a "laser" and having any of the following:

a. Transmission wavelength greater than 1750 nm; or

b. It uses analog techniques and has a bandwidth greater than 2.5 GHz; or

Note: 5D001.d.2.b. does not control "software" specially designed or modified for "development" commercial TV systems.

3. Not used.

4. Radio equipment using the Quadrature Amplitude Modulation (QAM) technique above the 1 024 level.

e. "Software", other than that specified in 5D001.a. or 5D001.c., specially designed or modified for monitoring or analysis by law enforcement authorities, providing all of the following:

1. Searching based on "permanent selectors" of communication content or metadata received from the provider of communication services using the "handover interface"; and

2. Mapping the relational network or tracking the movements of targeted individuals based on the results of communications content or metadata searches or searches as described in 5D001.e.1.

Technical notes:

1. For the purposes of 5D001.e., a "handover interface" is a physical and logical interface, designed to use by an authorized law enforcement authority, through which targeted interception measures are requested from the communications service provider and the results of the interception are delivered from the communications service provider to the requesting authority. "Handover interface" applies to systems or equipment (eg, mediation devices) that receive and confirm an interception request and deliver to the requesting authority only interception results that meet the confirmed request.

2. "Handover interface" may be defined by international standards (including but not limited to ETSI TS 101 331, ETSI TS 101 671, 3GPP TS 33.108) or national standards.

Note: 5D001.e. does not control "software" specially designed or modified for any of the following:

a. Purposes of accounting;

b. Network Quality of Service (QoS));

c. Quality of Experience (QoE);

5D001 *d. Mediation devices; or*

e. Mobile payment or banking.

5D101 "Software" specially designed or modified for the "use" of equipment specified in 5A101.

5E1 Technology

5E001 "Technology" as follows:

a. "Technology" according to the General Technology Note for the "development", "production" or "use" (excluding operational) of equipment, functions or features specified in 5A001 or "software" specified in 5D001.a. or 5D001.e.

b. Specific "technologies", as follows:

1. "Technology" "required" for the "development" or "production" of telecommunications equipment specifically designed for use on a satellite;

2. "Technology" for the "development" or "use" of laser communication techniques capable of automatically finding and tracking signals and maintaining communications through nonatmospheric or subsurface (water) environments.

3. "Technology" for the "development" of equipment for receiving digital base radio stations, the reception characteristics of which are such that they enable multi-band, multi-channel, multi-mode and multi-code algorithm or multi-protocol operation, and can be modified by changes in "software";

4. "Technology" for the "development" of "extended spectrum" techniques, including "one-sided frequency reflection" techniques.

Note: 5E001.b.4. does not control the "technology" for the "development" of any of the following:

1. Civil radio communication systems; or

2. Fixed or mobile earth stations for commercial civil telecommunications.

c. "Technology" according to the General Technology Note for the "development" or "production" of any of the following:

1. It is not used;

2. Equipment using a "laser" and having any of the following characteristics:

a. A transmission wavelength greater than 1750 nm;

b. Not used;

c. Not used;

d. It uses wavelength division multiplexing techniques for optical carriers at less than 100 GHz per window; or

5E001 e. It uses analog techniques and has a range above 2.5 GHz;

Note: 5E001.c.2.e. does not control the "technology" of commercial TV systems.

NB: For "technology" for the "development" or "production" of non-telecommunications equipment using a "laser", see 6E.

3. Equipment that uses "optical termination"; and has an interrupt time of less than 1 ms;

4. Radio equipment having any of the following characteristics:

a. uses the Quadrature Amplitude Modulation (QAM) technique above the 1 024 level;

b. Operates at input or output frequencies above 31.8 GHz; or

Note: 5E001.c.4.b. does not control "technology" for equipment designed or modified for operation in any frequency range "allocated by the ITU" for radiocommunication services but not for radiodetermination.

c. It operates in the frequency range from 1.5 MHz to 87.5 MHz and includes adaptation techniques ensuring more than 15 dB attenuation of the interference signal; or

5. Not used.

6. Mobile equipment that has all of the following:

a. It operates at an optical wavelength greater than or equal to 200 nm, and less than or equal to 400 nm, and

b. It works as a "local area network".

d. "Technology" according to the General Technology Note for the "development" or "production" of Microwave A Microwave Monolithic Integrated Circuit ("MMIC") power amplifier, specially designed for telecommunications and having any of the following characteristics:

Technical note:

For the purposes of 5E001.d. in the technical data of the product, it is possible to refer to the saturated maximum/ pulse output power parameter as output power, saturated output power, maximum output power, peak output power or envelope output power.

1. Intended for operation at frequencies greater than 2.7 GHz up to and including 6.8 GHz with "relative bandwidth" greater than 15% and having any of the following;

a. A saturated peak output power greater than 75 W (48.75 dBm) at any frequency greater than 2.7 GHz up to and including 2.9 GHz;

5E001 b. A saturated peak output power exceeding 55 W (47.4 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

c. A saturated peak output power exceeding 40 W (46 dBm) at any frequency above 3.2 GHz up to and including 3.7 GHz; or

d. A saturated peak output power greater than 20 W (43 dBm) at any frequency greater than 3.7 GHz up to and including 6.8 GHz;

2. Intended for operation at frequencies greater than 6.8 GHz up to and including 16 GHz, whereby A "relative bandwidth" greater than 10% and having any of the following:

a. A saturated peak output power exceeding 10 W (40 dBm) at any frequency above 6.8 GHz up to and including 8.5 GHz; or

b. A saturated peak output power greater than 5 W (37 dBm) at any frequency above 8.5 GHz up to and including 16 GHz;

3. Designed to operate at a saturated peak output power greater than 3 W (34.77 dBm) and at any frequency greater than 16 GHz up to and including 31.8 GHz, with a "relative bandwidth" greater than 10%;

4. Intended for operation with saturated peak output power greater than 0.1 nW (–70 dBm) and at any frequency higher than 31.8 GHz up to and including 37 GHz;

5. Designed to operate at a saturated peak output power greater than 1 W (30 dBm) and at any frequency greater than 37 GHz up to and including 43.5 GHz, with a "relative bandwidth" greater than 10%;

6. Designed to operate at a saturated peak output power greater than 31.62 mW (15 dBm) and at any frequency greater than 43.5 GHz up to and including 75 GHz, with a "relative bandwidth" greater than 10%;

7. Intended to operate at a saturated peak output power greater than 10 mW (10 dBm) and at any frequency greater than 75 GHz up to and including 90 GHz, with a "relative bandwidth" greater than 5%, or

8. Intended to operate at a saturated peak output power greater than 0.1 nW (–70 dBm), at any frequency higher than 90 GHz;

e. "Technology" according to the General Technology Note for the "development" or "production" of electronic

devices and circuits, specially designed for telecommunications and with components made of "superconducting" materials, specially designed to operate at temperatures below the "critical temperature" of at least one of the "superconducting" parts, and having any of the following characteristics:

1. A circuit breaker for digital circuits uses "superconducting" outputs, where the product of the delay time per output (in seconds) and the power dissipation per output (in watts) is less than 10-14 J; or

5E001 2. Frequency selection using a resonant circuit with Q-values is at all frequencies higher than 10,000.

5E101 "Technology" according to the General Technology Note for "development", "production" or "use" of equipment specified in 5A101.

SECTION 2 "PROTECTION OF INFORMATION"

Note 1: Not used;

Note 2: Category 5 - Part 2 does not control products when users use them for personal use.

Note 3: Cryptographic Note 5A002, 5D002.a.1., 5D002.b. and 5D002.c.1. do not control the following products:

a. Products that meet the following:

1. Fully available to the public by sale, without restriction, from warehouse stocks of retail stores, in the following ways:

a. Direct retail sales;

b. By ordering through the mail;

c. Electronic transactions; or

d. Ordering by phone;

2. The user cannot easily change the cryptographic properties;

3. Installation is performed by the user without the need for significant support from the supplier; and

4. When there is a need for it, detailed information about the product will be available and will be provided, upon request, to the competent authorities of the member country where the exporter is based, to confirm that the goods meet the conditions described above in paragraphs 1 to 3;

b. Hardware components or 'executable software' of existing products described in paragraph a. these notes, which are designed for existing products and meet all of the following:

1. "Information Protection" is not a primary function or set of functions of a component or 'executable software';

2. The component or 'executable software' does not alter existing cryptographic functionality products nor does it add new cryptographic functionality to existing products;

3. The feature set of the component or 'executable software' is permanent and has not been engineered or modified according to the customer's specifications; and

4. If the competent authorities of the Member State in which the exporter has its headquarters have so determined, details on the component or 'executable software' and details of the relevant end products are available and will be provided to the competent authority on request for compliance with the conditions described above.

Technical note:

For the purposes of the Cryptographic Note, 'executable software' means 'software' in executable form, from existing hardware components excluded from 5A002 in the Cryptographic Note.

Note: 'Executable software' does not include the entire binary images of the "software" that runs on the end product.

Note with Cryptographic Note:

1. In order to fulfill the requirements of paragraph a. Notes 3, all of the following apply:

a. The product is potentially interesting to a wide number of individuals and business entities; and

b. The price and information about the basic functionality of the product are available before purchase, without the need for consultation with the seller or supplier. A price request is not considered a consultation

2. When determining the admissibility of paragraph a. from Note 3. Competent authorities may take into account relevant factors such as quantity, price, technical skills required, existing sales channels, usual customers, usual use or exclusivity practices of suppliers.

5A2 Systems, equipment and components

5A002 "Information protection" systems, equipment and components, as follows:

NB To control the receiver equipment of satellite navigation systems, containing or using decryption, see 7A005, and for associated decryption "software" and "technology", see 7D005 and 7E001.

a. Designed or modified to use 'data confidentiality cryptography' having a 'described security algorithm', where that cryptographic capability is usable, activated, or capable of being activated by any means other than secure "cryptographic activation", as follows:

1. Items that have "information protection" as a primary function;

2. Digital communication or networking systems, equipment or components, not specified in 5A002.a.1.;

3. Computers and other items storing information or processing as a primary function and components therefor, not specified in 5A002.a.1. or 5A002.a.2.;

NB For operating systems see 5D002.a.1. and 5D002.c.1.

4. Items not specified in 5A002.a.1. to 5A002.a.3., where 'data confidentiality cryptography' having a 'described security algorithm' and having all of the following:

a. They support a non-primary function; and

5A002 b. It is performed with built-in equipment or "software" that, as a stand-alone item, would be specified in Category 5 - Part 2.

Technical note:

1. For the purposes of 5A002.a., ``cryptography for data confidentiality'' means ``cryptography'' that uses digital techniques and performs any cryptographic function other than any of the following:

a. "Authentication";

b. Digital signature;

c. Data integrity;

d. Non-rejection;

e. Digital rights management, including enforcement of copy-protected "software";

f. Encryption or decryption to support celebrations, mass commercial transmissions or disposal of medical documents; or

Mr. Key management in support of any function described in subparagraph a. to f.

2. For the purposes of 5A002.a., 'described security algorithm' means any of the following:

a. A "symmetric algorithm" that uses a code length greater than 56 bits, not including bits parity; or

b. "Asymmetric algorithm" where the security of the algorithm is based on any of the following:

1. Factorization of integer values with more than 512 bits (eg RSA);

2. Calculation of discrete logarithms in multiplicative groups of a finite field of larger size of 512 bits (eg Diffie-Hellman over Z/pZ); or

3. Discrete logarithms in other groups not mentioned in 5A002.a.1.b.2., exceeding 112 bits (eg Diffie-Hellman over elliptic curve);

c. "Asymmetric algorithm" where the security of the algorithm is based on any of the following:

1. Shortest vector or nearest vector problems related to lattices (eg NewHope, Frodo, NTRUEncrypt, Kyber, Titanium);

2. Finding isogenies between supersingular elliptic curves (eg supersingular isogenic key encapsulation); or

3. Decoding random codes (eg McEliece, Niederreiter).

5A002 *Technical Note*

The algorithm described in Technical Note 2.c. it can be called post-quantum, quantum-safe or quantum-resistant.

Note 1: If necessary, as determined by the competent authority in the exporter's country, the details of the item must be available and given to the authority on request, in order to establish any of the following:

a. whether the item meets the criteria of 5A002.a.1. to 5A002.a.4.; or

b. Is the cryptographic capability for data secrecy specified in 5A002.a. usable without "cryptographic activation".

Note 2: 5A002.a. does not control any of the following:

a. Smart cards and smart card 'printers' as follows:

1. A smart card or electronically readable personal document (eg token, passport) that fulfills any of the following:

a. Cryptographic capabilities do all of the following:

1. Prohibited for use in any of the following:

a. Equipment or system exempted from the control in 5A002.a.1. to 5A002.a.4.;

b. Equipment or systems that do not use cryptography for confidential data have a 'described security algorithm'; or

c. Equipment or system exempted in 5A002.a. items b. to f. these notes; and

2. May not be reprogrammed for any other use; or

b. It has all of the above:

1. It is specially made and limited to allow the protection of the 'personal data' it contains;

2. Is personalized or can be personalized only for public or commercial transactions or personal identification; and

3. When cryptographic capabilities are not available to the user;

5A002 *Technical Note:*

For the purposes of 5A002.a.. Note a.1.b.1., 'personal data' includes any data specific to a particular person or entity, such as the amount of money invested and data required for "authentication".

2. 'Printers' specially designed or modified but limited for use with cards specified in a.1. these notes.

Technical note:

For the purposes of 5A002.a. Note a.1.b.2., 'printers' includes equipment that via a network communicates with smart cards or electronically readable documents.

b. Encryption equipment specially made and restricted for banking or 'money' use transactions';

Technical note:

For the purposes of 5A002.a. Note b., 'monetary transactions' in 5A002.a. Note b. include jobs collections and settlements or credit affairs (liquidation or credit services).

c. Portable or mobile telephones for civil use (eg for use in commercial civilian mobile radio communication systems) which cannot directly transmit encrypted data to other telephones or equipment (other than Radio Access Network (RAN) equipment), nor transmit encrypted data through RAN equipment (eg Radio Network Controller (RNC) or Base Station Controller (BSC));

d. Cordless phone equipment that cannot perform end-to-end encryption where maximum the effective range of wireless operation without amplification (ie single transmission between the terminal and the home base station) less than 400 meters according to the manufacturer's specification;

e. Portable or mobile telephones and similar consumer wireless devices for civilian use, which apply only published or commercial cryptographic standards (except for anti-piracy, which may be unpublished) and also comply with paragraphs a.2. to a.45. Notes on Cryptography (Note 3 in Category 5 - Part 2), which are adapted for specific applications in civil industry with features that do not affect the cryptographic functionality of those originally unadapted devices.

f. Equipment whose "information protection" function is limited functionality of wireless "personal networks" applying only published or commercial cryptographic standards;

5A002 *g. Mobile radio network telecommunication equipment (RAN) designed for civil use, which meets the provisions of paragraph a.2. to a.4. cryptographic notes (Note 3 in Category 5 - Part 2) and whose RF output power is limited to 0.1 W (20 dBm) or less and supports 16 or fewer parallel users.*

h. Routers, switches, gateways or relays where "information protection" functionality is limited to "Operation, Management or Maintenance" ("OAM") tasks applying only published or commercial cryptographic standards; or

and. General purpose computer equipment or servers, if the "information protection" functionality meets all of the following characteristics:

1. Uses exclusively published or commercial cryptographic standards; and

2. Any of the following:

a. It is integrated into a CPU that meets the provisions of Note 3 in Part Two of Category 5;

b. It is integrated into an operating system other than that specified in 5D002.; or

c. It is limited to "OAM" equipment.

j. Items specifically intended for "civil industry related application" and fulfill:

1. Any of the following:

a. An endpoint device that supports the network and fulfills any of the following:

1. The "information protection" function is limited to the provision of "unwanted data" or "Operation, Management or Maintenance" ("OAM") tasks; or

2. The device is limited to a specific 'related civil industry application'; or

b. Network equipment that does all of the following:

1. That it is specially designed for communication with the devices listed in paragraph j.1.a. these notes; and

2. The "information protection" function is limited to the support of the "civil industry related application" of the devices specified in paragraph j.1.a. these notes, or "OAM" tasks of this network equipment or other items listed in paragraph j. these notes; and

5A002 *2. Where the "information protection" functionality implements only published or commercial cryptographic standards, and the cryptographic functionality cannot be easily changed by the user.*

Technical notes:

1. For the purposes of 5A002.a. Note j., "connected civil industry application" means a network for consumer or civil industry other than "information protection", digital communication,

general purpose networking or computing.

2. For the purposes of 5A002.a. Note j.1.a.1., "inadvertent data" means sensor or measurement data that are directly related to the stability, performance or physical measurements of the system (eg temperature, pressure, flow, mass, volume, voltage, physical location, etc.), which cannot be changed by the user of the device.

b. 'Cryptographic activation token';

Technical note:

For the purposes of 5A002.b., a 'cryptographic activation token' is an item designed or modified for any of the following:

1. The conversion, by "cryptographic activation", of an item not specified in Category 5 - Part 2 in 5A002.a. or 5D002.c.1., and is not contained in the Note on Cryptography (Note 3 in Category 5 – Part 2); or

2. Enables, by means of "cryptographic activation", additional functionality of the products listed in 5A002.a. for a product already listed in Category 5 - Part 2.

c. Designed or modified to use or perform "quantum cryptography".

Technical note:

For the purposes of 5A002.c., "quantum cryptography" is also known as quantum code distribution (QKD – Quantum Key Distribution)

d. Designed or modified to use cryptographic techniques to generate codes for channeling, jamming or network identification, for systems using ultra-wideband time modulation, having any of the following:

a. bandwidth greater than 500 MHz; or

b. a "relative bandwidth" of 20% or more.

5A002 e. Designed or modified to use cryptographic techniques to generate code for the extension of "spread spectrum" systems, other than those specified in 5A002.d., including sequence hopping for "frequency hopping" systems;

5A003 Non-cryptographic information systems, equipment and components for the "protection information", as follows:

a. Communication cable systems designed or modified for the use of mechanical, electrical or electronic means for detecting covert intrusion;

Note: 5A003.a. only controls physical layer security. According to 5A003.a. physical layer includes Layer 1 of the Open Systems Interconnection (OSI) reference model (ISO/ IEC 7498-1).

b. Specially designed or engineered to reduce signal interference between the signal information carrier and what is necessary for health, safety or electromagnetic interference standards;

5A004 Penetration, weakening or circumvention systems, equipment and components "information protection", as follows:

a. Designed or modified to perform 'cryptanalytic functions';

Note: 5A004.a. includes systems or equipment designed or modified for performing 'cryptoanalytic functions' using reverse engineering.

Technical note:

For the purposes of 5A004.a., 'cryptanalytic functions' are functions designed to break cryptographic mechanisms to obtain confidential variables or sensitive data, including clear text, passwords or cryptographic keys.

b. Items, not specified in 4A005 or 5A004.a., designed to do all of the following:

1. 'Extracting raw data' from a computer or communication device; and

2. Bypassing "authentication" or device authorization controls to perform a function

described in 5A004.b.1.

Technical note:

For the purposes of 5A004.b.1., ``extracting raw data'' from a computing or communications device means retrieving binary data from a storage medium (eg RAM, flash memory or hard disk) without interpretation by an operating system or file system.

Note 1: 5A004.b. does not control systems or equipment specially designed for the "development" or "production" of computing or communications equipment.

Note 2: 5A004.b. does not include:

a. Debugging programs, hypervisors;

b. Products intended exclusively for extracting logical data;

5A004 *c. Chip-off or JTAG data extraction products; or*

d. Products specially designed and intended exclusively for unauthorized unlocking (jailbreaking or rooting).

5B2 Equipment for testing, verification and production

5B002 Equipment for the test, verification and "production" of "information protection" equipment, as follows:

a. Equipment specially designed for the "development" or "production" of equipment specified in 5A002, 5A003, 5A004 or 5B002.b.;

b. Measuring equipment specially designed for the calculation and verification of the "information protection" functions of equipment specified in 5A002, 5A003 or 5A004 or "software" specified in 5D002.a. or 5D002.c.

5C2 Materials

Does not have

5D2 Software

5D002 "Software" as follows:

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment, any of the following:

1. equipment specified in 5A002 or "software" specified in 5D002.c.1.;

2. Equipment specified in 5A003 or "software" specified in 5D002.c.2.; or

3. the following equipment or "software".

a. equipment specified in 5A004.a. or "software" specified in 5D002.c.3.a.;

b. equipment specified in 5A004.b. or "software" specified in 5D002.c.3.b.

b. "Software" having the characteristics of a 'cryptographic activation token' specified in 5A002.b.;

c. "Software" that features, or performs or simulates the functions of, any of the following:

1. Equipment specified in 5A002.a, 5A002.c., 5A002.d. or 5A002.e.;

Note: 5D002.c.1. does not control "software" limited to the "OAM" tasks to which they are applied exclusively published or commercial cryptographic standards.

2. Equipment specified in 5A003; or

3. The following equipment:

a. equipment specified in 5A004.a.;

b. equipment specified in 5A004.b.

Note: 5D002.c.3.b. does not refer to "hacking software".

5D002 d. Not used;

5E2 Technology

5E002 "Technology", as follows:

a. "Technology" according to the General Technology Note for the "development", "production" or "use" of equipment specified in 5A002, 5A003 or 5A004, 5B002 or "software" specified in 5D002.a. or 5D002.c.

Note: 5E002.a. does not control "technology" for products specified in 5A004.b., 5D002.a.3.b. or 5D002.c.3.b.

b. "Technology" having the characteristics of a 'cryptographic activation token' specified in 5A002.b.

Note: 5A002 includes "information protection" technical data based on procedures that are carried out for the purpose of evaluation or determination of methods of evaluation of functions, features or techniques specified in Category 5 - Second part.

CATEGORY 6
SENSORS AND LASERS

6A Systems, equipment and components

6A001 Acoustic systems, equipment and components, as follows:

a. Marine acoustic systems, equipment and components specially designed for them, such as:

1. Active (transmitting or receiving) systems, equipment and components specially designed for them, such as:

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

a. Depth sounders that operate vertically below the device, which do not include an overhead scanning function ±20o and which are limited to water depth measurement, distance measurement to submerged or buried objects or for fish location;

b. Acoustic floats such as:

1. Safety acoustic floats;

2. Pingers specially designed for relocation or positioning under water.

a. Acoustic seabed observation equipment, as follows:

1. Observation equipment for surface vessels designed for topographic mapping of the seabed, having all of the following characteristics:

a. Designed for measurements at an angle greater than 20o in relation to the vertical;

b. Designed for measuring the topography of the seabed at depths greater than 600 m;

6A001 c. A 'depth measurement resolution' of less than 2; and

d. 'Increasing the "accuracy" of depth determination' by compensating for the influence of all the following factors:

1. Movements of the acoustic sensor;

2. Propagation of the sound wave through the water from the sensor to the bottom and back; and

3. Speed of sound on the sensor;

Technical notes:

1. For the purposes of 6A001.a.1.a.1.c., 'depth measurement resolution' is the furrow width in degrees divided by with a maximum number of measurements per furrow.

2. For the purposes of 6A001.a.1.a., 'increasing the "accuracy" of depth determination' includes the ability compensation with external means.

2. Underwater equipment for seabed research, designed for the production of topographic maps

seabed, having any of the following characteristics:

Technical notes:

For the purposes of 6A001.a.1.a.2., the estimated pressure of the acoustic sensor determines the depth of the equipment.

a. They have all of the following:

1. Designed or modified for operation at depths greater than 300 m; and

2. The 'probing rate' is greater than 3,800 m/s; or

Technical notes:

For the purposes of 6A001.a.1.a.2.a.2., the 'sounding rate' is the product of the highest velocity (m/s) at which the sensor for the sake of the maximum number of soundings in the band assuming 100% coverage. For systems that produce bi-directional sounding (3D sonars), the highest 'sounding rate' in both directions should be used.

b. Research equipment not specified in 6A001.a.1.a.2.a. and which has all of the following features:

1. Designed or modified for operation at depths greater than 100 m;

2. It is designed for taking measurements at an angle greater than 20° in relation to the vertical;

3. Have any of the following characteristics:

a. Operating frequency below 350 kHz; or

b. It is designed for measuring the topography of the seabed at a depth greater than 200 m from the acoustic sensor; and

6A001

4. "Improving" depth measurement "accuracy" by compensation for all of the following feature:

a. Acoustic sensor displacement;

b. Transmits sound in water from the sensor to the seabed and back; and

c. Speeds of sound on the sensor;

3. Side Scan Sonar (SSS) or Synthetic Aperture Sonar (SAS), designed for seabed imaging, having all of the following and specially designed to transmit and receive acoustic fields therefor:

a. Designed or modified to operate at depths greater than 500 m;

b. The 'degree of area coverage' is greater than 570 m2/s with operation at the highest possible range, while the 'longitudinal resolution' is less than 15 cm; and

c. 'Transverse resolution' is less than 15 cm;

Technical notes:

For the purposes of 6A001.a.1.a.3.:

1. 'Area coverage rate' (m2/s) is the double product of the maximum range of the radar (m) and the maximum speed (m/s) at which the sensor can work.

2. 'Longitudinal resolution' (cm), with SSS only, is the product of azimuth (horizontal), bandwidth (in degrees), maximum sonar range (m) and a factor of 0.873.

3. 'Transverse resolution' (cm) is 75 divided by the bandwidth of the signal (kHz).

b. Transceiver systems or arrays, designed to detect or locate objects having the following characteristics:

1. Transmission frequency less than 10 kHz;

2. Sound pressure level exceeding 224 dB (reference is 1 µPa at 1 m) for equipment whose working frequency in the range between 10 kHz and 24 kHz;

3. Sound pressure level exceeding 235 dB (reference is 1 µPa at 1 m) for equipment whose working frequency in the range between 24 kHz and 30 kHz;

4. Formation of beams narrower than 1o along any axis whose operating frequency is less than 100 kHz;

5. Designed to work with an indicator that clearly shows a distance greater than 5120 m; or

6. Designed to withstand pressure in normal operation at depths greater than 1000 m and which have converters with the following characteristics:

6A001 a. With dynamic pressure compensation; or

b. Which do not have lead-zirconate titanate as a converter element;

c. Acoustic projectors, including transducers, with built-in piezoelectric, magnetic restrictive, electrodynamic or hydraulic elements operating separately or in combination, and having any of the following:

Note 1: State of control of acoustic projectors, including transducers, specially designed for other equipment not specified in 6A001 is determined by the control status of the other equipment.

Note 2: 6A001.a.1.c. does not control electronic sources that direct sound only vertically, or mechanical (eg air or pneumatic gun) or chemical sources (eg explosives).

Note 3: Piezoelectric elements specified in 6A001.a.1.c. include those made from single crystals of lead-magnesium-niobate/ lead-titanate Pb(Mg1/3Nb2/3)O3-PbTiO3, *or PMN-PT) grown from solid solution or single crystals, lead-indium-niobate/ lead-magnesium- niobate/ lead-titanate (Pb(In1/2Nb1/2)O3–Pb(Mg1/2Nb1/2)O3–PbTiO3, or PIN-PMN-PT) grown from solid solution.*

1. Operating at frequencies below 10 kHz and having any of the following:

a. They are not designed for continuous operation at 100% duty cycle with 'free field source level (SLrms)' radiation greater than (10log(f) + 169.77) dB (reference value 1 µPa at 1 m) where f is the frequency in Hertz the highest voltage response of the transmitter (TVR) of less than 10 kHz; or

b. Designed for continuous operation at 100% duty cycle with 'free field source level (SLrms)' radiation at 100% duty cycle greater than (10log(f) + 159.77) dB (reference value 1 µPa at 1 m) where f frequency in hertz of the highest voltage response of the transmitter (TVR) of less than 10 kHz; or

Technical note:

For the purposes of 6A001.a.1.c.1., 'free field source level (SLrms)' *is defined along the axis of greatest response of the sound signal in the far field of the acoustic projector. It can be obtained from the transmitter voltage response using the following equation:* SLrms = *(TVR + 20log* Vrms) *dB (reference value 1 µPa at 1 m), where* SLrms is *the source level, TVR is the transmitter voltage response, and* Vrms *is the projector excitation voltage.*

6A001 2. Not used;

3. Suppression of side lobes greater than 22 dB;

d. Acoustic systems, equipment and specially designed components used to determine the position of surface vessels and underwater vehicles and having all of the above, as well as specially designed components therefor:

1. Coverage distance exceeding 1000 m; and

2. Determined positioning error of less than 10 m rms (root mean square value) when measured at a distance of 1000 m;

Note: 6A001.a.1.d. includes:

a. Equipment that uses coherent "signal processing" between two or more floats and a hydrophone unit carried by a surface or underwater vessel;

b. Equipment that can automatically correct propagation speed error when calculating a point sound.

e. Active individual sonars, specially designed or modified to detect, locate and automatically classify swimmers or divers who have all of the following characteristics, and specifically for them

projected transmitting and receiving acoustic fields:

1. Detection distance exceeding 530 m;

2. Determined positioning error of less than 15 m rms (root mean square value) when measured at a distance of 530 m; and

3. The bandwidth of the transmitted signal that is greater than 3 kHz;

NB: For diver detection systems specially designed or modified for military use see NKL NGO.

Note: For 6A001.a.1.e., when different detection distances are specified for different conditions environment, the largest detection distance is used.

2. Passive systems, equipment and specially designed components for them, such as:

Note: 6A001.a.2 also controls receiving equipment, whether or not in normal applications connected to other active equipment, as well as specially designed components for it.

a. Hydrophones having any of the following:

Note: The control status of hydrophones specially designed for other equipment is determined by the control status of that equipment.

6A001 *Technical Note:*

For the purposes of 6A001.a.2.a.:

1. Hydrophones consist of one or more sensory elements that create one acoustic output channel. Those containing multiple elements can be called a group of hydrophones.

2. Underwater acoustic transducers designed to operate as passive receivers are hydrophones.

1. They contain continuous flexible sensor elements;

2. Containing continuous flexible transducers or assemblies of discrete transducer elements whose diameter or length is less than 20 mm and with a mutual distance between elements less than 20 mm;

3. They have some of the following sensor elements:

a. Optical fibers;

b. "piezoelectric polymer layers" other than polyvinylidene fluoride (PVDF) and its copolymers P(VDF-TrFE) and P(VDF-TFE);

c. Flexible piezoelectric composite materials;

d. Piezoelectric single crystals of lead-magnesium-niobate/lead-titanate (i.e. Pb(Mg1/3Nb2/3)O3–PbTiO3, or PMN-PT) grown from solid solution; or

e. Piezoelectric single crystals of lead-indium-niobate/lead-magnesium-niobate/lead-titanate (Pb(In1/2Nb1/2)O3–Pb(Mg1/2Nb1/2)O3–PbTiO3, or PIN-PMN-PT) grown from solid solution;

4. Have a 'hydrophone sensitivity' of better than –180 dB at any depth without acceleration compensation;

5. Designed to work at depths greater than 35 m with acceleration compensation; or

6. Designed to operate at depths greater than 1000 m and with a 'hydrophone sensitivity' greater than 230 dB below 4 kHz;

Technical notes:

1. For the purposes of 6A001.a.2.a.3.b., 'piezoelectric polymer layer' sensing elements consist of a polarized polymer layer stretched over the elements and attached to a support frame or mandrel.

2. For the purposes of 6A001.a.2.a.3.c., Sensor elements of

'flexible piezoelectric composite materials' consist of piezoelectric ceramic particles or fibers, combined with conductive and acoustically transparent rubber, polymer

or an epoxy mixture, whereby the mixture is an integral part of the sensor element.

3. For the purposes of 6A001.a.2.a., 'hydrophone sensitivity' is defined as 20 logarithms to the base 10 of the rms output voltage ratio at a reference of 1V rms, when the hydrophone transducer, without a preamplifier, is placed in a plane wave acoustic field with a pressure of 1µPa rms. For example, a -160 dB hydrophone (the reference is 1 V per µPa) gives an output voltage of 10-8 *V in that field, while a -180 dB one gives an output voltage of only* 10-9 *V. So -160 dB is better than –180 dB.*

6A001 b. A towed array of acoustic hydrophones that meet the following:

Technical note:

For the purposes of 6A001.a.2.b., hydrophone arrays consist of a number of hydrophones generating multiple acoustic output channels.

1. Spacing of hydrophone groups less than 12.5 m or 'may be modified' so that the spacing of hydrophones the group is smaller than 12.5 m;

2. Are designed or 'can be modified' to operate at depths greater than 35 m;

Technical note:

For the purposes of 6A001.a.2.b.2., 'may be modified' in 6A001.a.2.b.1. and 2. means that there is a backup possibility of changing the wiring or interconnections to change the distances in the hydrophone group or the limiting working depth. Backup options include: backup wiring longer than 10% of cores, hydrophone group spacing adjustment blocks, or internally adjustable depth limiters or devices that control multiple hydrophone groups.

3. Heading sensors defined in 6A001.a.2.d.;

4. Longitudinally reinforced intestines;

5. Collapsible field with a diameter of less than 40 mm;

6. Not used

7. Hydrophone whose characteristics are defined in 6A001.a.2.a; or

8. Accelerometer-based hydroacoustic sensors specified in 6A001.a.2.g.;

c. Processing equipment, specially designed for towed acoustic hydrophone arrays, having "user-accessible programmability" and processing and correlation in the time or frequency domain, including spectrum analyses, digital filtering or beamforming using fast Fourier or other transforms or processes;

d. Heading sensors with all of the following characteristics:

1. "Accuracy" better than 0.5°; and

2. Designed to operate at depths greater than 35 m or have adjustable or removable sensing devices that enable operation at depths greater than 35 m;

6A001 *NB For systems with inertial heading sensors, see 7A003.c.*

e. Cable or hydrophone arrays for bottom or underwater use, having any of the following feature:

1. Containing hydrophones defined in 6A001.a.2.a.;

2. Containing hydrophone groups with multiplexed signals having all of the following characteristics:

a. Designed to operate at depths greater than 35 m or having adjustable or removable sensing devices enabling operation at depths greater than 35 m; and

b. In operation, they can be replaced by modules of towed arrays of acoustic hydrophones; or

3. Having accelerometer-based hydroacoustic sensors specified in 6A001.a.2.g.;

f. Processing equipment, specially designed for cable systems on the bottom or underwater that they own "user-accessible programmability" and processing and correlation in the time or frequency domain, including spectrum analyses, digital filtering or beamforming using fast Fourier or other transforms or processes;

Mr. Accelerometer-based hydroacoustic sensors having all of the following:

1. They consist of three accelerometers that are arranged along three separate axes;

2. Have an overall 'acceleration sensitivity' better than 48 dB (reference value 1 000 mV rms at 1 g);

3. Designed to work at depths greater than 35 meters; and

4. The operating frequency is below 20 kHz.

Note: 6A001.a.2.g. it does not control particle velocity sensors or geophones.

Technical note:

1. For the purposes of 6A001.a.2.g., accelerometer-based hydraulic sensors are also known as called vector sensors.

2. For the purposes of 6A001.a.2.g.2., 'acceleration sensitivity' is defined as twenty times the decade the logarithm of the quotient (ratio) of the output voltage and the 1 V rms reference, where the hydroacoustic sensor, without a preamplifier, is placed in a plane wave acoustic field with an rms acceleration of 1 g (ie 9.81 m/s2).

6A001 b. **Correlation velocity or Doppler velocity sonar equipment designed to measure the horizontal velocity of an equipment carrier relative to the seabed such as follows:**

1. Correlation velocity sonar equipment having any of the following:

a. Designed to work at a distance between the carrier and the seabed greater than 500 m; or

b. "Accuracy" of speed determination better than 1% of speed;

2. Doppler speed sonar equipment having a speed "accuracy" of better than 1% of speed.

Note 1: 6A001.b. does not control depth sounders with restrictions on any of the following:

a. For measuring water depth;

b. For measuring the distance from submerged or buried objects; or

c. Finding fish.

Note 2: 6A001.b. does not control equipment specifically designed for surface installation vessels.

c. Not used.

6A002 Optical sensors or equipment and components as follows:

NB: SEE ALSO 6A102.

a. Optical detectors, such as:

1. "Space-grade" solid state semiconductor detectors, such as:

Note: For the purposes of 6A002.a.1., solid state semiconductor detectors include "matrix detectors".

a. "Space-grade" solid state semiconductor detectors having all of the following:

1. Peak response in the range of wavelengths greater than 10 nm, but not over 300 nm; and

2. Response less than 0.1% in relation to the peak response at wavelengths greater than 400 nm;

b. "Space-grade" solid state semiconductor detectors having all of the following:

1. Peak response in the range of wavelengths greater than 900 nm, but not over 1200 nm; and

2. Response "time constant" of 95 ns or less;

c. "Space-grade" solid-state semiconductor detectors whose peak response is in the range of wavelengths over 1200 nm but not over 30000 nm;

d. " Space-grade" " *matrix detectors"* having more than 2048 elements per array and a peak response in the wavelength range above 300 nm but not exceeding 900 nm.

6A002 2. Electronic image intensifier tubes and specially designed components therefor, such as are:

Note: 6A002.a.2. does not control photomultiplier tubes having a vacuum electron detection device limited to one of the following:

a. One metal anode; or

b. Metal anodes whose central distances are greater than 500 µm.

Technical note:

For the purposes of 6A002.a.2., 'charge multiplication' is a method of electronic image amplification and is defined as the generation of charge carriers resulting from the increase in ionization due to impact. 'Charge multiplication' sensors can be in the form of image intensifier tubes, solid state sensors or 'matrix detectors'.

a. Electronic image intensifier tubes having all of the following characteristics:

1. Peak response in the range of wavelengths greater than 400 nm, but not over 1050 nm;

2. Electronic image (light) amplification using any of the following:

a. Microchannel image intensifier plates having a hole pitch (measured center to hole center) of 12 µm or less; or

b. An electronic sensor device with a physical (non-binned) pixel size of 500 µm or less, specially designed to achieve 'charge multiplication' differently than with a microchannel plate; and

3. Any of the following photocathodes:

a. Multialkaline photocathodes (eg S-20, S-25) or multialkaline photocathodes with light sensitivity higher than 350 µA/lm;

b. GaAs or GaInAs photocathodes; or

c. Other group III-V compound semiconductor photocathodes having a maximum "light sensitivity" exceeding 10 mA/W;

b. Electronic image intensifier tubes having all of the following:

1. Peak response in the range of wavelengths greater than 1050 nm but not greater than 1800 nm;

2. Electronic image intensification using any of the following:

a. Microchannel plate pitches holes 12 µm or smaller (measured center to center); or

b. Electron detection device with a physical (non-binned) pixel size of 500 µm or less, specially designed or modified to achieve 'charge multiplication' other than by means of a microchannel plate; and

3. Semiconductor photocathodes of III-V group compounds (eg GaAs or GaInAs) and TE (transferred electron) photocathodes, which have a maximum "light sensitivity" above 15 mA/W;

6A002 c. Specially designed components such as:

1. Microchannel plate with hole spacing of 12 µm or less (measured center to center); or

2. An electron detection device with a physical (non-binned) pixel size of 500 µm or less specially designed or modified to achieve 'charge multiplication' other than by means of a microchannel plate; and;

3. Semiconductor photocathodes of group III-V compounds (eg GaAs or GaInAs) and TE (transferred electron) photocathodes;

Note: 6A002.a.2.c.3. does not control photocathodes from semiconductor compounds designed to achieve a "light sensitivity" of any of the following levels:

a. 10 mA/W or less peak response in the wavelength range above 400 nm but not exceeding 1050

nm; or

b. 15 mA/W or less peak response in the wavelength range above 1050 nm but not exceeding 1800 n.m.

3. "Matrix detectors" that are not "suitable for use in space", such as:

NB: 'microbolometers' for 'matrix detectors' not 'suitable for use in space", are specified only in 6A002.a.3.f.

Technical Note: For the purposes of 6A002.a.3., linear or two-dimensional detector arrays with multiple elements are "matrix detectors";

Note 1: 6A002.a.3. includes photoconductive and photovoltaic detectors.

Note 2: 6A002.a.3. does not control:

a. Multi-element photoconductive encapsulated cells (maximum 16 elements) based on lead sulfide or lead selenide;

b. Pyroelectric detectors of the following types:

1. Triglycine sulfate and variants;

2. Lead-lanthanum-zirconium titanate and variants;

3. Lithium tantalate;

4. Polyvinyl fluoride and variants; or

5. Strontium-barium niobate and variants.

6A002 *c. "Matrix detectors" specially designed or*

modified to achieve 'charge multiplication' and limited by design to have a maximum 'light sensitivity' of 10 mA/W or less for wavelengths above 760 nm, and having all of the following:

1. have a response limitation mechanism designed so that it cannot be removed or modified; and

2. Any of the following:

a. The response limiting mechanism is integrated into or combined with the detector element; or

b. The "matrix detector" can only work when the response limiting mechanism is on place.

Technical Note: For the purposes of 6A002.a.3. Notes 2.c.2.a., the response limitation mechanism integrated u element of the detector is designed so that it cannot be removed or modified so that the detector does not become unusable.

d. Thermoelectric arrays having less than 5 130 elements.

Technical Note: 'Charge Multiplication' is a form of electronic image enhancement and is defined as the creation of charge carriers resulting from impact ionization increments. 'Charge multiplication' sensors can be in the form of image intensifier tubes, solid state sensors or 'matrix detectors'.

a. "Matrix detectors" not "suitable for use in space", having all of the following characteristics:

1. Individual elements of peak response in the range of wavelengths over 900 nm but not over 1050 nm; and

2. Any of the following:

a. "Time constant" of response less than 0.5 ns; or

b. Specially designed or modified to achieve 'charge multiplication' and with a maximum 'light sensitivity' in excess of 10 mA/W.

b. "Matrix detectors" not "suitable for use in space", with all of the following

characteristics:

1. Individual elements of peak response in the range of wavelengths over 1050 nm but not over 1200 nm; and

6A002 2. Any of the following:

a. "Time constant" response up to 95 ns; or

b. Specially designed or modified to achieve 'charge multiplication' and with a maximum 'light sensitivity' in excess of 10 mA/W.

c. Non-linear (two-dimensional) "matrix detectors" not "suitable for space use", with individual peak response elements in the wavelength range exceeding 1200 nm but not exceeding 30000 nm;

NB: Silicon-based 'microbolometers' and other materials for "array detectors" not "suitable for space use" are specified only in 6A002.a.3.f.

d. Linear (one-dimensional) "matrix detectors" that are not "suitable for use in space",
with all of the following characteristics:

1. Individual elements of peak response in the range of wavelengths over 1200 nm but not over 3000 nm; and

2. Any of the following:

a. The ratio of the dimension of the 'scanning direction' of the detecting element to the dimension of the 'transverse scanning direction' of the detecting element is less than 3.8 or

b. Signal processing in detector elements;

Note: 6A002.a.3.d. does not control "matrix detectors" (with not more than 32 elements) having a detector element made exclusively of germanium-based material.

Technical Note: For the purposes of 6A002.a.3.d., the 'transverse scan direction' is defined as the axis parallel to the linear array of detector elements and the 'scan direction' is defined as the axis normal to the linear array of detector elements.

e. Linear (one-dimensional) non-“space-grade” “matrix detectors” with individual peak response elements in the wavelength range exceeding 3000 nm but not exceeding 30000 nm.

f. Non-"space-grade" non-linear (two-dimensional) infrared "matrix detectors" based on "microbolometers" of element materials individually
having an unfiltered response in the wavelength range equal to or greater than 8000 nm but not greater than 14000 nm .

6A002 *Technical Note: For the purposes of 6A002.a.3.f. A 'microbolometer' is defined as a thermal imaging detector which is used to generate any usable signal due to the temperature change in the detector resulting from the absorption of infrared radiation.*

Mr. "Matrix detectors" not "suitable for use in space", having all of the following characteristics:

1. With individual elements of peak response in the wavelength range over 400 nm, but not over 900 nm;

2. Specially designed or modified to achieve 'charge multiplication' and with
with a maximum "light sensitivity" of over 10 mA/W for wavelengths over 760 nm; and

3. With more than 32 elements.

b. "Monospectral image sensors" and "multispectral image sensors" intended for observation of
distance, with all of the following characteristics:

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

2. Designed to operate in the wavelength range greater than 400 nm but not exceeding 30000 nm and having all of the following characteristics:

a. They provide an image in digital format; and

b. They are labeled as:

1. "Suitable for use in space"; or

2. Designed for aviation use, not using silicon detectors and having an 'IFOV' of less than 2.5 mrad (milliradians).

Note: 6A002.b.1. it does not control "monospectral image sensors" with peak response in the range of wavelengths exceeding 300 nm but not exceeding 900 nm and only if it contains any of the detectors that are not "suitable for use in space" or "array detectors" that are not "suitable for use in space":

1. Devices based on CCD technologies that are not designed or modified to achieve 'charge multiplication'; or

2. Semiconductors based on CMOS technologies that are not designed or modified to achieve "charge multiplication".

c. Imaging equipment that provides 'direct view' in the visible or infrared spectrum, including any of the following:

1. Image intensifier tubes defined in 6A002.a.2.a.; or 6A002.a.b.;

2. "Matrix detectors" defined in 6A002.a.3.; or

3. Solid state semiconductor detectors specified in 6A002.a.1.;

6A002 *Technical Note: For the purposes of 6A002.c., 'direct display' means forming equipment an image that works in the visible or infrared spectrum and that shows the operator an image without converting it into an electronic television signal, i.e. which cannot record or store the image photographically, electronically or by any other means.*

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

a. Industrial alarms or alarms for securing civil facilities, control systems industrial or traffic movements or counting systems;

b. Medical equipment;

c. Industrial equipment used to inspect, sort or analyze material properties;

d. Flame detectors for industrial furnaces;

e. Equipment designed for laboratory work.

d. Special components for optical sensors, such as:

1. Cryo-coolers "suitable for use in space";

2. Cryo-coolers that are not "suitable for use in space" and whose cooling source temperature is below 218 K (-55o C):

a. With a closed cycle with a defined mean time to failure (MTTF) or mean time between failures (MTBF) greater than 2500 hours;

b. Joule-Thompson (JT) self-regulating mini-coolers with an opening (outer) diameter of less than 8 mm;

3. Optically sensitive fibers specially made by composition or structure or modified coating so that they are sensitive to acoustic, thermal, inertial, electromagnetic or nuclear radiation.

Note: 6A002.d.3. does not control encapsulated optical sensitive fibers specifically designed for use in boreholes.

e. Not used.

f. 'Readout integrated circuits' ('ROIC') specially designed for "matrix detectors" specified in 6A002.a.3.

Note: 6A002.f. not controlled by 'integrated readout circuits' specially designed for civilian automotive applications.

6A002 *Technical Note:*

For the purposes of 6A002.f., a 'readout integrated circuit' ('ROIC') is an integrated circuit designed to be underlying or interfaced with a "detector array" ("FPA") and used for readout (ie extracting and registering) of the produced signals by means of the detector elements. At a minimum the 'ROIC' reads the charge of the detector elements by extracting the charge and applying a multiplexing function in a manner that preserves the relative spatial position and orientation information of the detector elements for processing within or outside the 'ROIC'.

6A003 Cameras, systems or equipment, and related components, as follows:

NB: SEE ALSO 6A203.

a. Instrumentation cameras and specially designed components for them such as:

Note: Instrumentation cameras of modular structure, defined in 6A003.a.3. to 6A003.a.5., should be judged according to their maximum capabilities that can be achieved by using accessories added to them according to the camera manufacturer's specifications.

1. It is not used;

2. It is not used;

3. Electronic cameras that have a time resolution better than 50 ns;

4. Electronic framing cameras with speeds greater than 1,000,000 frames/s;

5. Electronic cameras having all of the following characteristics:

a. Electronic shutter speed (possibility of closing) less than 1 µs for the entire frame; and

b. A readout time that enables a frame rate greater than 125 full frames per second.

6. Camera accessories with all of the following features:

a. Specially designed for instrumentation cameras of modular structure defined in 6A003.a.; and

b. Which enable those cameras to meet the characteristics defined in 6A003.a.3., 6A003.a.4. or 6A003.a.5. according to the camera manufacturer's specifications.

b. Imaging cameras such as:

Note: 6A003.b. does not control television or video cameras specially designed for broadcast of a television program.

1. Video cameras with a semiconductor sensor and a maximum response amplitude in the wave range from 10 nm to 30000 nm, and having all of the following:

a. They have any of the following:

6A003 1. More than 4 x 106 "active pixels" per semiconductor array for monochrome (black-white) cameras;

2. More than 4 x 106 "active pixels" per semiconductor array for color cameras containing three semiconductor array; or

3. More than 12 x 106 "active pixels" per semiconductor array for color cameras containing a single semiconductor array; and

b. They have any of the following:

1. optical mirrors controlled in 6A004.a.;

2. control optical equipment specified in 6A004.d.; or

3. the ability to keep an internal record of camera tracking data.

Technical notes:

1. For the purposes of 6A003.b.1., digital video cameras shall be evaluated against the maximum "active pixels" used to capture moving images.

2. For the purposes of 6A003.b.1.b.3., the camera tracking data record is the information necessary to determine the linear orientation of the camera's field of view relative to the ground. This includes: 1) the horizontal angle of the camera's field of view in relation to the direction of the earth's magnetic field; 2) the vertical angle of the camera's field of view relative to the horizon.

2. Scanning cameras or scanning systems having all of the following:

a. Peak response in the wavelength range over 10 nm but not over 30000 nm;

b. Linear detector array with more than 8 192 elements in array; and

c. Mechanical scanning in one direction;

Note: 6A003.b.2. does not control scanning cameras or scanning systems specially designed for any of the following:

a. Photocopiers for industrial or civil use;

b. Scanners specially designed for civilian, stationary use in a close environment (eg reproduction of images or printed material from documents, works of art or photographs); or

c. Medical equipment.

3. Imaging cameras incorporating image intensifier tubes defined in 6A002.a.2.a. or 6A002.a.2.b.;

4. "Matrix detector" imaging cameras having any of the following:

a. having "matrix detectors" specified in 6A002.a.3.a. to 6A002.a.3.e.;

6A003 b. having "matrix detectors" specified in 6A002.a.3.f. or

c. having "matrix detectors" specified in 6A002.a.3.g.;

Note 1: Imaging cameras described in 6A003.b.4. including "matrix detectors" which are connected to the built-in circuits for data reading by satisfactory signal-processing electronics, which allows to obtain a minimum analog or digital signal at the output after the power supply is applied.

Note 2: 6A003.b.4.a. does not control cameras containing linear "matrix detectors" with 12 or fewer elements, nor containing a time-delay and integrating element therein, intended for the following:

a. Industrial or civil security alarms, industrial or traffic control systems and counting systems;

b. Industrial equipment used to inspect or monitor heating in buildings, equipment or industrial processes;

c. Industrial equipment used to inspect, sort or analyze material properties;

d. Equipment designed for laboratory work; or

e. Medical equipment.

Note 3: 6A003.b.4.b. does not control cameras that have any of the following characteristics:

a. Maximum image recording rate ÿ 9 Hz;

b. It has all of the following:

1. minimum horizontal or vertical 'instantaneous field of view' (IFOV - Instantaneous-Field-Of-View)' of at least 2 mrad (milliradians);.

2. a lens with an invariable focal length, which is mounted so that it is impossible to remove it;

3. They do not include "direct display", i

4. Have any of the following:

a. They do not have the ability to obtain an image of the detected field of view, or

b. The camera is designed for special applications and does not allow user modifications; or

c. The camera is purpose built for installation in a civilian passenger vehicle and has all of the following features:

1. The position and configuration of the camera in the vehicle is only to help the driver to use the vehicle safely;

6A003 *2. Operates only when fitted to any of the following:*

a. Civilian passenger vehicle for which it is intended and whose mass is less than 4500 kg (gross vehicle mass); or

b. A specially designed and authorized maintenance test tool; and

3. Includes an active mechanism that prevents the camera from operating in cases of its removal from the vehicle for which it was intended.

Technical notes:

1. 'Instantaneous-Field-Of-View (IFOV)' specified in 6A003.b.4. Note 3.b. is a smaller value than the horizontal or vertical IFOV.

Horizontal 'IFOV' = horizontal field of view (FOV)/ number of horizontal detector elements.

Vertical 'IFOV' = vertical field of view (FOV)/ number of vertical detector elements.

2. Direct view specified in 6A003.b.4. Note 3.b. refers to an imaging camera that operates in the infrared spectrum and displays visual images to the viewer using small screens near the eye, incorporating any light safety mechanism.

Note 4: 6A003.b.4.c. does not control imaging cameras that have any of the following:

a. They have all of the following:

1. The camera is specially designed to be installed as an integral part of the indoor surveillance system or equipment, which is activated by a wall switch, as follows:

a. Supervision of industrial processes, quality control or analysis of material properties;

b. Laboratory equipment specially designed for scientific research;

c. Medical equipment;

d. Financial fraud detection equipment; and

2. It is operational only if it is installed in the following cases:

a. System(s) or equipment for which it is intended; or

6A003 *b. Specially designed, authorized maintenance facility; and*

3. Contains active mechanisms that render the camera inoperable when removed from the system or equipment for which it is intended;

b. The imaging camera is specially designed for installation in a civilian passenger vehicle or passenger-vehicle vessel and has all of the following:

1. The location and configuration of the camera in the vehicle or vessel are only intended to assist the driver or operator in the safe use of the vehicle;

2. It is operational only if it is installed in the following cases:

a. Civilian passenger vehicle for which it is intended and whose mass is less than 4500 kg (gross vehicle mass);

b. A vessel for the carriage of passengers and vehicles for which it is intended and which has a length overall (LOA) of 65 m or more; or

c. Designed and authorized maintenance testing tool; and

3. Includes an active mechanism that prevents the camera from working in cases of its removal from the vehicle for which it was intended;

c. The construction of the camera limits the maximum "light sensitivity" to 10 mA/ W or less

for wavelengths of light greater than 760 nm, and having all of the following:

1. Contains a response limitation mechanism that cannot be removed or modified;

2. Contains an active mechanism that renders the camera inoperative when the response limiting mechanism is removed; and

3. Not specially designed or modified for underwater use; or

d. It has all of the following:

1. It does not have the possibility of "direct view" or electronic image display;

2. There is no equipment for visual display of the image of the detected field of view;

3. "Matrix detector" is operational only if it is installed in the camera for which it is intended; and

4. The "matrix detector" contains an active mechanism that renders it permanently inoperative when removed from the camera for which it is intended;

6A003 5. Imaging cameras incorporating solid state semiconductor detectors specified in 6A002.a.1.

6A004 Optical equipment and components, as follows:

a. Optical mirrors (reflectors) such as:

Technical note:

For the purposes of 6A004.a. threshold of sensitivity of optical components to damage caused by operation laser (Laser Induced Damage Threshold - LIDT) is measured in accordance with the ISO 21254-1:2011 standard.

NB For optical mirrors specially designed for lithography equipment, see 3B001.

1. 'Deformable mirrors' having an active optical opening (aperture) greater than 10 mm and any of the following characteristics, and specially designed components therefor;

a. They have all the following characteristics:

1. A mechanical resonant frequency of 750 Hz or more; and

2. More than 200 actuators; or

b. The laser damage threshold (LIDT) of optical components has any of the following characteristics:

1. It is greater than 1 kW/cm2 when using a "CW laser"; or

2. It is greater than 2 J/cm2 when using "laser" pulses of 20 ns with a repetition frequency of 20 Hz;

Technical note:

'Deformable mirrors' are mirrors having any of the following:

1. a. A single continuous optical reflecting surface that dynamically deforms by applying individual torques or forces to compensate for distortions in the optical waveform appearing on the mirror; or

b. Multiple optical reflective elements that can be individually and dynamically repositioned by the application of moments or forces to compensate for distortions in the optical waveform appearing on the mirror.

2. 'Deformable mirrors' are also known as adaptive optical glasses.

2. Light monolithic mirrors whose mean "equivalent density" is less than 30 kg/m2 and total mass greater than 10 kg;

Note: 6A004.a.2. does not apply to mirrors that are specially shaped for directing of direct sunlight on terrestrial heliostatic installations.

6A004 3. Mirrors of light "composite" or foam structure having a medium "equivalent density" less than 30 kg/m2 and total mass greater than 2 kg;

Note: 6A004.a.3. does not apply to mirrors specially shaped for directional purposes of direct sunlight to heliostatic installations on land.

4. Mirrors specially designed for beam directing mirror parts specified in 6A004.d.2.a. with a uniformity of ÿ/10 or better (lambda is 633 nm), and having any of the following characteristics:

a. Diameter or length of main axis greater than or equal to 100 mm; or

b. They have all the following characteristics:

1. Diameter or length of main axis greater than 50 mm, but less than 100 mm; and

2. The laser damage threshold (LIDT) of optical components has any of the following characteristics:

a. It is greater than 10 kW/cm2 when using a "CW laser"; or

b. It is greater than 20 J/cm2 when using "laser" pulses of 20 ns with a repetition frequency of 20 Hz;

b. Zinc selenide (ZnSe) or zinc sulphide (ZnS) optical components having a transmission (transmittance) in the wavelength range exceeding 3000 nm but not exceeding 25000 nm and having any of the following:

1. Volume greater than 100 cm3; or

2. Diameter or length of the main axis over 80 mm and thickness (depth) 20 mm.

c. Components of the optical system "suitable for use in space", such as:

1. Components lighter than 20% "equivalent density" compared to massive ones of the same aperture and thickness;

2. Raw substrates, processed substrates with layers (single-layer, multi-layer, metal or dielectric, conducting, semiconducting or insulating) or with a protective film;

3. Segments or assemblies of mirrors intended for mounting in space in an optical system with a collective an aperture that is equivalent or greater in relation to a single optic with a diameter of 1m;

4. Components manufactured from "composite" materials whose coefficient of linear thermal expansion is equal to or less than 5 x 10-6/K in any coordinate direction.

6A004 d. Optical management equipment such as:

1. Equipment specially designed to maintain surface shape or component orientation "suitable for use in space" according to 6A004.c.1. or 6A004.c.3.;

2. Equipment for guiding, tracking, stabilizing or adjusting as follows;

a. Beam directing mirror parts intended for carrying mirrors with a diameter or major axis length exceeding 50 mm having all of the following characteristics, and specially designed electronic control equipment therefor:

1. The largest angular stroke of ± 26 mrad or greater;

2. Mechanical resonance frequency of 500 Hz or higher; and

3. Angular accuracy of 10 µrad (microradians) or less (better);

b. Resonator tuning equipment with a bandwidth of 100 Hz or more and an accuracy of 10 µrad or less (better);

3. Cardan suspensions with the following characteristics:

a. Maximum rotation greater than 5o;

b. Bandwidth 100Hz or greater;

c. Angular pointing errors of 200 µrad or less; and

d. With any of the following characteristics:

1. The diameter or length of the main axis is greater than 0.15 m, but not greater than 1 m and can withstand angular acceleration

greater than 2 rad/s2; or

2. The diameter or length of the main axis is greater than 1m and can withstand angular acceleration greater than 0.5 rad/s2;

4. Not used;

e. 'Aspherical optical elements' having all of the following characteristics:

1. The largest dimension of the optical aperture for the passage of light is greater than 400 mm;

2. Surface roughness less than 1nm (rms) for sampling lengths equal to 1mm or greater; and

3. The absolute value of the linear thermal expansion coefficient is less than 3 x 10-6/K at 25 oC.

Technical notes:

1. For the purposes of 6A004.e., an 'aspherical optical element' is any element of an optical system which an image surface or surfaces projected to deviate from the shape of an ideal ball.

6A004 *2. For the purposes of 6A004.e.2., manufacturers are not required to measure surface roughness unless the component is designed or manufactured to meet or exceed the controlled parameter.*

Note: 6A004.e. does not control aspherical optical elements with any of the following feature:

a. The largest dimension of the optical opening for the passage of light is less than 1m and the ratio of the focal length to the aperture for the passage of light is equal to or greater than 4.5:1;

b. The largest dimension of the optical aperture for the passage of light is equal to or greater than 1m and the ratio of the focal length to the opening for the passage of light is equal to or greater than 7:1;

c. Designed as Fresnel, multi-prismatic (flyeye), strip, prismatic or diffractive optical elements;

d. Made of borosilicate glass with a coefficient of linear thermal expansion greater than 2.5 x 10-6/K *at 25 oC; or*

e. An X-ray optical element with internal mirror properties (eg tube-type mirrors).

NB: For 'aspherical optical elements' used in lithographic equipment see 3B001.

f. Dynamic wavefront (phase) measurement equipment that has all of the following feature:

a. "Frame rate" equal to and greater than 1 kHz; and

b. Wavefront accuracy equal to or less (better) than ÿ/20 at the design wavelength.

Technical note:

For the purposes of 6A004.f., "Frame rate" is the frequency at which all "active pixels" in the "matrix in focal plane" included for capturing images projected by sensor optics.

6A005 "Lasers" other than those defined in 0B001.g.5. or 0B001.h.6., components i optical elements such as:

NB: See also 6A205.

Note 1: Pulsed “lasers” include those operating in continuous wave (CW) mode with superimposed impulses.

Note 2: Excimer, semiconductor, chemical, CO, CO2 and non-repetitive pulsed Nd: "lasers" are specified only in 6A005.d.

6A005 *Technical Note:*

For the purposes of 6A005 Note 2, 'non-repetitive pulsed ' "lasers" refer to "lasers" which either generate a single output pulse or have a time interval between pulses longer than one minute.

Note 3: 6A005 includes fiber-based "lasers".

Note 4: Control state of the "laser" which contains frequency conversion or change

wavelengths, not counting those where the "laser" excites another "laser", is determined by applying control parameters for both the output of the original "laser" and the frequency-shifted optical output.

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

a. Rubinsky with an output energy of less than 20 J;

b. Nitrogenous;

c. Kryptonian.

Note 6: For the purposes of 6A005.a. and 6A005.b., 'single (mono) transverse mode' refers to "lasers", with a beam profile having a factor M2 *of less than 1.3, and 'multiple transverse mode' refers to "lasers" having a beam profile having a factor* M2 *1.3 or higher.*

Technical note:

For the purposes of 6A005 "Wall-plug" performance is defined as the ratio of the output power of the "laser" (or "mean output power") according to the total input electrical power required for the operation of the "laser", including the stabilization of the power source and the operation of the thermoregulator, i.e. the heat exchanger.

a. Non-tunable CW "lasers" (Continuous Wave), (non-tunable lasers) that have either which of the following:

1. Output wavelength less than 150 nm and output power greater than 1 W;

2. Output wavelength greater than or equal to 150 nm but not exceeding 510 nm, and with output power greater than 30 W;

Note: 6A005.a.2. does not control argon "lasers" with output power less than or equal to 50W.

3. Output wavelength exceeding 510 nm but not exceeding 540 nm and with any of the following feature:

a. 'Single transverse mode' with an output power greater than 50 W; or

b. 'Multiple transverse mode' with an output power greater than 150 W;

4. Output wavelength greater than 540 nm but not exceeding 800 nm and with output power greater than 30 W;

5. Output wavelength greater than 800 nm but not exceeding 975 nm and with any of the following feature:

a. 'Single transverse and mode' having an output power greater than 50 W; or

6A005 b. 'Multiple Transverse Mode' whose output power is greater than 80 W;

6. Output wavelength greater than 975 nm but not exceeding 1150 nm and with any of the following feature:

a. 'Single transverse mode' and has any of the following:

1. output power greater than 1000 W; or

2. Has any of the following:

a. output power greater than 500W; and

b. Spectral range less than 40 GHz; or

b. A 'multiple transverse mode' having any of the following:

1. "Wall plug" performance greater than 18% and output power greater than 1000 W; or

2. Output power greater than 2 kW;

Note 1: 6A005.a.6.b. does not control industrial "lasers" with a 'multiple transverse mode' output power exceeding 2 kW but not exceeding 6 kW and a total mass exceeding 1200 kg. For the purposes of this note, the total mass includes all components required to operate the "laser", eg. "laser", power source, heat exchanger, but does not include external optics for beamforming and/or emission.

Note 2: 6A005.a.6.b. does not control 'multiple transverse mode' industrial "lasers" having any of the following characteristics:

a. Not used;

b. Output power greater than 1 kW, but not above 1.6 kW and BPP greater than 1.25 mm•mrad;

c. Output power greater than 1.6 kW, but not above 2.5 kW and BPP greater than 1.7 mm•mrad;

d. Output power greater than 2.5 kW, but not above 3.3 kW and BPP greater than 2.5 mm•mrad;

e. Output power greater than 3.3 kW, but not above 6 kW and BPP greater than 3.5 mm•mrad;

f. Not used;

Mr. Not used;

h. Output power greater than 6 kW, but not above 8 kW and BPP greater than 12 mm•mrad; or

and. Output power greater than 8 kW, but not above 10 kW and BPP greater than 24 mm•mrad.

7. Output wavelength greater than 1150 nm but not exceeding 1555 nm and with any of the following characteristics:

a. 'Single transverse mode' with an output power greater than 50 W; or

b. 'Multiple transverse mode' with an output power greater than 80 W; or

6A005 8. Output wavelength exceeding 1555 nm but not exceeding 1850 nm and output power greater than 1 W.

9. An output wavelength exceeding 1850 nm but not exceeding 2100 nm and any of the following:

a. 'Single transfer mode' and output power greater than 1W; or

b. 'Multiple transverse mode' and output power greater than 120 W; or

10. Output wavelength greater than 2100 nm and output power greater than 1W;

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

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

a. Output energy greater than 50 mJ per pulse and "maximum (peak) pulse power" greater than 1 W; or

b. "Average output power" greater than 1 W;

2. An output wavelength of 150 nm or greater but not exceeding 510 nm with any of the following feature:

a. Output energy greater than 1.5 J per pulse and "peak power" pulse greater than 30 W; or

b. "Average output power" exceeding 30 W;

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

3. Output wavelength exceeding 510 nm but not exceeding 540 nm and with any of the following feature:

a. A 'single transverse mode' having any of the following:

1. Output energy greater than 1.5 J per pulse and "maximum power" of the pulse greater than 50W; or

2. "Average output power" greater than 80 W;

b. A 'multiple transverse mode' having any of the following:

1. Output energy greater than 1.5 J per pulse and "maximum power" pulse greater than 150W; or

2. "Average output power" greater than 150 W;

4. Output wavelength greater than 540 nm but not exceeding 800 nm and with any of the following feature:

a. "Pulse duration" of less than 1 ps and any of the following:

1. Output energy greater than 0.005 J per pulse and "peak power" pulse greater than 5 GW; or

2. "Average output power" greater than 20 W; or

b. "Pulse duration" equal to or greater than 1 ps and any of the following:

1. Output energy greater than 1.5 J per pulse and "peak power" greater than 30 W; or

2. "Average output power" greater than 30 W;

6A005 5. Output wavelength greater than or equal to 800 nm but not exceeding 975 nm and with either which of the following characteristics:

a. A "pulse duration" of less than 1 ps and any of the following:

1. Output energy greater than 0.005 J per pulse and "peak power" pulse greater than 5 GW; or

2. 'Single transverse mode' having an average output power greater than 20 W;

b. "Pulse duration" equal to or greater than 1 ps and not greater than 1 ms and having any of the following:

1. Output energy greater than 0.5 J per pulse and "maximum power" pulse greater than 50 W;

2. 'Single transverse mode' having an average output power greater than 20 W; or

3. 'Multiple transverse mode' having an average output power greater than 50 W; or

c. "Pulse duration" greater than 1 ms and having any of the following:

1. Output energy greater than 2 J per pulse and "maximum power" of the pulse greater than 50W;

2. 'Single transverse mode' having an average output power greater than 50 W; or

3. 'Multiple transverse mode' having an average output power greater than 80 W;

6. Output wavelength greater than 975 nm but not exceeding 1150 nm and with any of the following feature:

a. A "pulse duration" of less than 1 ps and any of the following:

1. Output "pulse power" greater than 2 GW per pulse;

2. "Average output power" greater than 30 W; or

3. Output energy greater than 0.002 J per pulse;

b. "Pulse duration" equal to or greater than 1 ps and not greater than 1 ns and having any of the following:

1. Output "peak" power greater than 5 GW per pulse;

2. "Average output power" greater than 50 W; or

3. Output energy greater than 0.1 J per pulse;

c. "Pulse duration" equal to or greater than 1 ns but not greater than 1 ms and having any of the following:

1. A 'single transverse mode' having any of the following:

a. "Peak" power greater than 100 MW;

b. "Average output power" greater than 20 W design-limited to maximum frequency pulse repetitions less than or equal to 1 kHz;

c. "Wall-plug" efficiency greater than 12% and "average output power" greater than 100 W and capable of operating at pulse repetition frequency higher than 1 kHz;

6A005 d. "Average output power" exceeding 150 W and operating at a pulse repetition frequency exceeding 1 kHz; or

e. Output energy greater than 2 J per pulse; or

2. A 'multiple transverse mode' having any of the following:

a. "Peak" power greater than 400 MW;

b. "Wall-plug" performance greater than 18% and "average output power" greater than 500 W;

c. "Average power output" greater than 2 kW; or

d. Output energy greater than 4 J per pulse; or

d. "Pulse duration" greater than 1 ms and having any of the following:

1. A 'single transverse mode' having any of the following:

a. "maximum (Peak)" power greater than 500 MW;

b. "Wall-plug" performance greater than 12% and "average output power" greater than 100 W; or

c. "Average output power" exceeding 150 W; or

2. A 'multiple transverse mode' having any of the following:

a. "Peak" power greater than 1 MW;

b. "Wall-plug" performance greater than 18% and "average output power" greater than 500 W; or

c. "Average power output" greater than 2 kW;

7. Output wavelength greater than 1150 nm but not exceeding 1555 nm and with any of the following feature:

a. A "pulse duration" of less than 1 ms and having any of the following:

1. Output energy greater than 0.5 J per pulse and "peak power" greater than 50 W;

2. 'Single transverse mode' with an "average output power" greater than 20W; or

3. 'Multiple transverse mode' with an "average output power" greater than 50W;

b. "Pulse duration" greater than 1 ms and having any of the following:

1. Output energy greater than 2 J per pulse and "peak power" greater than 50 W; or

2. 'Single transverse mode' with an "average output power" exceeding 50 W; or

3. 'Multiple transverse mode' with an "average output power" exceeding 80 W; or

8. Output wavelength greater than 1555 nm but not exceeding 1850 nm with any of the following feature:

6A005 a. Output energy greater than 100 mJ per pulse and "peak power" greater than 1 W; or

b. "Average output power" exceeding 1 W;

9. An output wavelength exceeding 1 850 nm but not exceeding 2 100 nm with any of the following:

a. 'Single transverse mode' and any of the following:

1. Output energy greater than 100 mJ per pulse and "maximum (peak) power" greater than 1 W; or

2. "Average output power" greater than 1 W; or

b. 'Multiple transverse mode' and any of the following:

1. Output energy greater than 100 mJ per pulse and "maximum power" greater than 10 kW; or

2. "Average output power" greater than 120 W; or

10. An output wavelength exceeding 2 100 nm with any of the following:

a. Output energy greater than 100 mJ per pulse and "peak power" greater than 1 W; or

b. "Average output power" greater than 1 W;

c. "Tunable" wavelength "Lasers" having any of the following:

1. An output wavelength of less than 600 nm with any of the following:

a. Output energy greater than 50 mJ per pulse and "maximum power" pulse greater than 1W; or

b. Medium output power or CW output power greater than 1 W;

Note: 6A005.c.1. does not control "lasers" based on dyes or other fluids they have multimode output and a wavelength of 150 nm or greater but not exceeding 600 nm and all of the following:

1. Output energy less than 1.5 J per pulse or "maximum power" pulse less than 20 W; and

2. Medium or CW output power less than 20 W.

2. An output wavelength of 600 nm or greater but not exceeding 1400 nm with any of the following feature:

a. Output energy greater than 1 J per pulse and "peak power" pulse greater than 20 W; or

b. Medium or CW output power greater than 20 W; or

3. Output wavelength greater than 1400 nm with any of the following characteristics:

a. Output energy greater than 50 mJ per pulse and "peak power" pulse greater than 1 W; or

b. Medium or CW output power greater than 1 W;

d. Other "lasers" not controlled in 6A005.a., 6A005.b. or 6A005.c., as follows:

1. Semiconductor "lasers" such as:

6A005 *Note 1: 6A005.d.1. includes semiconductor "lasers" that have optical outputs connectors (eg fiber optic connectors).*

Note 2: The control status of semiconductor "lasers" specially designed for other equipment is determined by the control status of that other equipment.

a. Individual single transverse mode semiconductor "lasers" having any of the following:

1. Wavelength equal to or less than 1570 nm or with medium or CW output power greater than 2.0 W; or

2. Wavelength greater than 1570 nm, average output power or CW greater than 500 mW;

b. Individual multi-transverse mode semiconductor "lasers" having all of the following:

1. Wavelength less than 1400 nm, medium or CW output power greater than 25 W;

2. Wavelength greater than or equal to 1400 nm and less than 1900 nm, average output power or CW greater than 2.5 W; or

3. Wavelength greater than or equal to 1900 nm, medium or CW output power greater than 1 W.

c. "Rods" with individual semiconductor "lasers" having all of the following characteristics:

1. Wavelength less than 1400 nm and medium or CW output power greater than 100 W;

2. Wavelength equal to or greater than 1400 nm and less than 1900 nm and medium or CW output power greater than 25 W; or

3. Wavelength greater than or equal to 1900 nm and medium or CW output power greater than 10 W;

d. Semiconductor "laser" 'stacked arrays' (two-dimensional arrays) having any of the following:

1. Having a wavelength of less than 1400 nm and having any of the following:

a. An average or CW total output power of less than 3 kW and has an average or CW output 'power density' greater than 500 W/cm2;

b. An average or CW total power output equal to or greater than 3 kW but less than or equal to 5 kW, and has

an average or CW output 'power density' greater than 350 W/cm2;

6A005 c. Medium or CW total output power greater than 5 kW;

d. A peak pulse 'power density' greater than 2500 W/cm2; or

Note: 6A005.d.1.d.1.d. does not apply to epitaxially fabricated monolithic devices.

e. A spatially coherent mean or CW total output power greater than 150 W;

2. A wavelength equal to or greater than 1400 nm but less than 1900 nm, and having any of the following:

a. A medium or CW total output power of less than 250 W and has a medium or CW output 'density power' greater than 150 W/cm2;

b. Medium or CW total output power equal to or greater than 250 W but less than or equal to 500 W and has an average output power or CW output 'power density' greater than 50 W/cm2;

c. Medium or CW total output power greater than 500 W;

d. A peak pulse 'power density' greater than 500 W/cm2; or

Note: 6A005.d.1.d.2.d. does not apply to epitaxially fabricated monolithic devices.

e. Spatially coherent mean or CW total output power greater than 15 W;

3. Having a wavelength equal to or greater than 1900 nm and having any of the following:

a. An average or CW output 'power density' greater than 50 W/cm2;

b. Medium or CW output power greater than 10 W; or

c. A spatially coherent mean or CW total output power greater than 1.5 W; or

4. At least one "laser" 'bar' specified in 6A005.d.1.c.;

Technical note:

For the purposes of 6A005.d.1.d., 'power density' means the total output power of the "laser" divided by emitting surface of the 'stacked array'.

e. Semiconductor "laser" 'stacked arrays', other than those specified in 6A005.d.1.d., having all of the following:

1. Specially designed or modified to be combined with other 'stacked arrays' to form a larger 'stacked array'; and

6A005 2. Integrated connections, common to both electronics and cooling;

Note 1: 'Stacked arrays', formed by combining semiconductor "laser" 'stacked arrays' specified in 6A005.d.1.e., not designed to be further combined are specified in 6A005.d.1.d.

Note 2: 'Stacked arrays', formed by combining semiconductor "laser" 'stacked arrays' specified in 6A005.d.1.e., which are designed to be further combined or modified are specified in 6A005.d.1.e.

Note 3: 6A005.d.1.e. does not control modular assemblies of individual 'bars' designed to be made in end-to-end linear arrays.

Technical note:

For the purposes of 6A005.d.1.e.:

1. Semiconductor "lasers" are usually called "laser" diodes.

2. A 'rod' (also called a semiconductor 'laser' 'rod', a 'laser' diode 'rod' or a diode 'rod') consists of multiple semiconductor 'lasers' in a one-dimensional array.

3. "Stacked arrays" consist of multiple 'rods' that form a two-dimensional array of semiconductor "lasers".

2. Carbon monoxide (CO) "lasers" having any of the following:

a. Output energy greater than 2 J per pulse and "maximum power" pulse greater than 5 kW; or

b. Medium or CW output power greater than 5 kW;

3. Carbon dioxide (CO2) "lasers" having any of the following:

a. Continuous (CW) output power greater than 15 kW;

b. A "pulse duration" pulse output that is longer than 10 µs and with any of the following feature:

1. Average output power greater than 10 kW; or

2. "Maximum power" of the pulse greater than 100 kW; or

c. A "pulse duration" pulse output equal to or less than 10 µs with any of the following feature:

1. Pulse energy greater than 5 J per pulse; or

2. Average output power greater than 2.5 kW;

4. Excimer "lasers" with the following characteristics:

a. An output wavelength not exceeding 150 nm with any of the following characteristics:

1. Output energy greater than 50 mJ per pulse; or

2. "Average output power" greater than 1W;

6A005 b. An output wavelength exceeding 150 nm but not exceeding 190 nm, and with any of the following feature:

1. Output energy greater than 1.5 J per pulse; or

2. "Average output power" greater than 120 W;

c. Output wavelength exceeding 190 nm but not exceeding 360 nm and with any of the following feature:

1. Output energy greater than 10 J per pulse; or

2. "Average output power" greater than 500 W; or

d. An output wavelength greater than 360 nm with any of the following:

1. Output energy greater than 1.5 J per pulse; or

2. "Average output power" greater than 30 W;

NB: For an excimer "laser" intended for lithographic equipment, see 3B001.

5. "Chemical lasers" having the following characteristics:

a. Hydrogen fluoride (HF) "lasers";

b. Deuterium fluoride (DF) "lasers";

c. 'transmission lasers' such as:

1. Oxygen-iodine (O2I) "lasers";

2. Deuterium fluoride-carbon-dioxide (DF-CO2) "lasers";

Technical note:

For the purposes of 6A005.d.5.c., 'transmission lasers' are 'lasers' in which the laser medium is activated by energy transfer by the collision of atoms or molecules not in the process of lasing with species of atoms or molecules that are in the process of lasing.

6. Non-repetitive pulsed Nd glass "lasers" having any of the following:

a. A "pulse duration" of less than 1 ms and an output energy greater than 50 J per pulse or

b. "Pulse duration" greater than 1 ms and output energy greater than 100 J per pulse.

Note: Non-repetitive pulsed "lasers" refer to "lasers" that generate either a single output pulse or that have a time interval between pulses longer than one minute.

e. Components such as:

1. Mirrors cooled by 'active cooling' or cooling tubes;

Technical note:

For the purposes of 6A005.e.1., 'active cooling' is a cooling technique for optical components that uses subsurface fluid flow (typically at a depth of less than 1mm below the optical surface of the component) to dissipate heat.

2. Optical mirrors or transmissive (transmissive) or partially transmissive (transmissive) optical or electro-optical components, other than mixers of multiple optical signals from optolines physically connected to the input of the mixer and multilayer dielectric gratings (MLDs), specially designed for use with certain "lasers";

6A005

Note: Optical fiber mixers and multilayer dielectric gratings are specified in 6A005.e.3.

3. Fiber-based "laser" components or fiber-optic "laser" components as follows:

a. Multimode-multimode mixers of multiple optical signals from optolines physically connected to the input mixers having all of the following characteristics:

1. Insertion loss equal to or better (less) than 0.3 dB maintained at a rated total average or CW output power (excluding output power transmitted through the single-mode core, if any) greater than 1,000 W; and

2. Three or more input fibers;

b. Single-mode-multimode mixers of multiple optical signals from optical lines physically connected to the input mixers that have all the sitting characteristics:

1. Insertion loss better (less) than 0.5dB maintained at rated overall average or CW output power greater than 4,600 W;

2. Three or more input fibers; and

3. Have any of the following characteristics:

a. The beam parameter product (BPP) measured at the output does not exceed 1.5 mm mrad for 5 or fewer input fibers; or

b. The beam parameter product (BPP) measured at the output does not exceed 2.5 mm mrad for more than 5 input fibers;

c. Multilayer Dielectric Lattices (MLDs) that have all-seated characteristics:

1. They are intended for the combination of spectral or coherent beams from 5 or more fiber-based "lasers"; and

2. Threshold of sensitivity of optical components to damage caused by "laser" action (LIDT) of continuous wave mode radiation is 10 kW/cm2 or more.

f. Optical components such as:

NB: For common aperture optical elements that work in "super-power lasers" ("Super-High Power Laser" ("SPHL")) see NKL NGO.

1. It is not used;

2. "Laser" diagnostic equipment that can measure angular errors of beam direction "SHPL" system and has an angular "accuracy" of 10 µrad (microradian) or less (better);

6A005 3. Optical equipment and components specially designed for "SHPL" phased array systems for

combining a coherent beam and having any of the following characteristics:

1. "Accuracy" of 0.1 µm or less for wavelengths greater than 1 µm; or; or

2. "Accuracy" of ÿ/10 or less (better) at a defined wavelength, for wavelengths equal to or less than 1 µm;

4. Projection telescopes intended for "SHPL" systems.

Mr. 'Laser-acoustic detection equipment' having all of the following:

1. Output CW power of the "laser" equal to or greater than 20 mW;

2. "Laser" frequency stability equal to or better (less than) 10 MHz;

3. "Laser" wavelengths equal to or greater than 1,000 nm, but not greater than 2,000 nm;

4. Optical resolution of the system better (less than) 1 nm; and

5. Optical signal to noise ratio equal to or greater than 103.

Technical note:

For the purposes of 6A005.g., 'Laser-acoustic detection equipment' is also referred to as a "laser" microphone or a microphone for particle flow detection.

6A006 "Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers", underwater electric field sensors, "compensation systems" and components therefor, as follows:

NB: SEE ALSO 7A103.d.

Note: 6A006 does not control instruments intended for use in fisheries and medical biomagnetic measurements.

a. "Magnetometers" and subsystems as follows:

1. "Magnetometers" using "superconducting" (SQUID) "technology" and having any of the following:

a. SQUID systems designed for stationary operation, without specially designed moving noise reduction subsystems, and having a "noise level" (sensitivity) equal to or lower (better) than 50 fT (rms) per square root of Hz at a frequency of 1 Hz; or

b. SQUID systems having a "noise level" (sensitivity) lower (better) than 20 pT (rms) per square root of Hz at a frequency of 1 Hz, and which are specially designed to reduce sound during operation;

2. "Magnetometers" using optically pumped or nuclear precession (proton/Overhauser) "technology" or "technology" and having a "noise level" (sensitivity) lower (better) than 20 pT (rms) per square root of Hz at frequency of 1 Hz;

6A006 3. "Magnetometers" using triaxial flow "technology" and having a "noise level" (sensitivity) lower (better) than 10 pT (rms) per square root of Hz at a frequency of 1 Hz;

4. "Magnetometers" with an induction coil having a "noise level" (sensitivity) lower (better) than:

a. 0.05 nT (rms) per square root of Hz for frequencies less than 1 Hz;

b. 1x10-3 nT (rms) per square root of Hz for frequencies of 1 Hz or more but not exceeding 10 Hz; or

c. 1x10-4 nT (rms) per square root of Hz for frequencies above 10 Hz;

5. Fiber optic "magnetometers" with a "noise level" (sensitivity) lower (better) than 1 nT (rms) per square root of Hz;

b. Underwater electric field sensors having a "noise level" (sensitivity) lower (better) than 8 nV per meter per square root of Hz when measured at 1Hz;

c. "Magnetic gradiometers" as follows:

1. "Magnetic gradiometers" using multiple "magnetometers" defined in 6A006.a.;

2. A fiber optic "intrinsic magnetic gradiometer" having a gradient "noise level" (sensitivity) magnetic field less (better) than 0.3 nT/m (rms) per square root in Hz;

3. "Intrinsic magnetic gradiometers" using "technology" other than fiber optics, which have a magnetic field gradient "noise level" (sensitivity) of less (better) than 0.015 nT/m (rms) per square root of Hz;

d. "Compensation systems" for magnetic sensors or underwater electric field sensors of which capabilities equal to or better than the control parameters specified in 6A006.a., 6A006.b., 6A006.c.;

e. Underwater electromagnetic receivers incorporating magnetic field sensors specified in 6A006.a. or underwater electric field sensors specified in 6A006.b.

Technical note:

For the purposes of 6A006., "noise level" (sensitivity) is the root-mean-square noise threshold limited by the device characteristics, which is the smallest signal that can be measured.

6A007 Gravity meters (gravimeters) and gravity gradiometers, as follows:

NB: SEE ALSO 6A107.

a. Gravity meters designed or modified for terrestrial use and having a static "accuracy" less (better) than 10 µGal,

Note: 6A007.a. does not control terrestrial gravity meters with a quartz element (Worden).

6A007 b. Gravity meters intended for mobile platforms, with all of the following features:

1. Static "accuracy" less (better) than 0.7 mGal; and

2. Operating "accuracy" less (better) than 0.7 mGal with "registration of time to steady state" shorter of 2 minutes in all combinations of auxiliary corrective compensation and motion influence;

c. Gravity gradiometers.

6A008 Radar systems, equipment and assemblies having any of the following characteristics i specially designed components for them:

NB: SEE ALSO 6A108.

Note: 6A008 does not control:

– Secondary surveillance radars (SSR);

– Radars intended for use in traffic for the prevention of car collisions;

– Displays and monitors used in air traffic control (ATC);

– Meteorological radars (for weather forecasting).

– Precision Approach Radar (PAR) equipment that meets ICAO standards and uses electronically controlled linear (1-dimensional) arrays or mechanically positioned passive antennas.

a. Operating frequencies from 40 GHz to 230 GHz and having any of the following:

1. Average output power greater than 100 mW; or

2. Locating "accuracy" of 1m or less (better) per distance, and 0.2 degrees or less (better) per direction.

b. Adjustable bandwidth wider than ± 6.25% of the 'central operating frequency';

Technical note:

For the purposes of 6A008.b., 'central operating frequency' is equal to half the sum of the highest and lowest defined working frequency.

c. Capable of simultaneously working on more than two carrier frequencies;

d. Capable of operating in Synthetic Aperture Radar (SAR), Inverse Synthetic Aperture Radar (ISAR) and Side-Side Aircraft Radar (SLAR) modes;

e. They contain electronically scanned antennas;

Technical note:

For the purposes of 6A008.e., electronically scanned antennas are also known as electronically steerable antenna arrays.

f. They can determine the height of non-cooperative goals;

Mr. Specially designed for aircraft (for mounting on balloons or airships) with Doppler "signal processing" for the detection of moving targets;

6A008 h. They process radar signals using any of the following:

1. "radar extended spectrum" techniques; or

2. "radar frequency agility" techniques;

and. They operate from the ground with a maximum 'instrument range' of more than 185 km;

Note: 6A008.i. does not control:

a. Surveillance ground radars for fishing;

b. Ground-based flight control radar equipment if:

1. Maximum 'instrument range' 500 km or less;

2. Configured so that radar target data is transmitted in one direction only, from the radar to one or more civilian ATC centers;

3. It does not support remote control of the radar scanning speed from the ATC center; and

4. It is permanently installed;

c. Weather balloon tracking radars.

Technical note:

For the purposes of 6A008.i. 'instrument range' is the designated unambiguous range of the radar display.

j. If the "laser" radar or light guidance and ranging (LIDAR) equipment is the following feature:

1. "Suitable for use in space"

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

3. Designed to perform aerial bathymetric coastal surveys in accordance with Order 1a of the International Hydrographic Organization (IHO) Standard (Fifth Edition February 2008) for Hydrographic Surveys or better, and using one or more "lasers" with wavelengths exceeding 400 nm but less than 600 nm;

Note 1: LIDAR equipment specially designed for surveying is specified only in 6A008.j.3.

Note 2: 6A008.j. does not control LIDAR equipment specifically designed for meteorological observation.

Note 3: Parameters in IHO Order 1a of the Fifth Edition Standard of February 2008, are summarized as follows:

- Horizontal accuracy (Confidence level 95%) = 5 m + 5% depth.

*ÿ Depth accuracy for reduced depth (Confidence level 95%) = ±ÿ(a2+(b*d)2), where:*

a = 0.5 m = constant depth error, i.e. sum of all constant depth errors

b = 0.013 = depth-dependent error factor

*b*d = depth-dependent error, i.e. the sum of all depth-dependent errors*

d = depth

6A008 *ÿ Determination of properties = Volumetric properties*

> 2 m in depths up to 40 m; 10% of depth over 40 m.

k. If it contains a "signal processing" subsystem with "pulse compression" having the following characteristics:

1. "Pulse compression" ratio greater than 150; or

2. Compressed pulse width less than 200 ns; or

Note: 6A008.k.2. does not control two-dimensional 'maritime radar' or 'vessel traffic control' radar having the following characteristics:

a. "Impulse compression" less than 150;

b. Compressed pulse width greater than 30 ns;

c. Single and rotating antenna with mechanical search;

d. Peak output power less than 250W; and

e. It does not have the possibility of "frequency hopping".

l. It contains a data processing subsystem with any of the following characteristics:

1. 'Automatic target tracking' which ensures, at any rotation of the antenna, a prediction the position of the target in a time longer than the next passage of the antenna beam; or

Note: 6A008.l.1. does not control the capability of ATC collision warning systems or 'naval radars'.

Technical note:

For the purposes of 6A008.l.1., ``automatic target tracking'' is a processing technique that automatically determines and provides as an output the extrapolated value of the most likely position of the target in real time.

2. Not used.

3. Not used.

4. Configured to provide superposition and correlation or pooling of target data with two or more 'geographically remote' radar sensors for a maximum of 6 seconds to improve overall performance beyond that of any individual sensor specified in 6A008.f. or 6A008.i.

Technical note:

For the purposes of 6A008.l.4., sensors are considered 'geographically remote' when each location is distant from any other more than 1500 m in any direction. Mobile sensors are always considered 'geographically remote'.

NB: See also NKL NGO.

Note: 6A008.l.4. it does not control the systems, equipment and assemblies designed in 'vessel traffic control'.

Technical note:

1. For the purposes of 6A008 'maritime radar' is a radar designed for use in safe navigation by sea, inland waterways or near-shore belts.

2. For the purposes of 6A008 'vessel traffic control' is vessel traffic monitoring and control service similar to air traffic control with "aircraft".

6A102 Radiation resistant 'detectors', other than those defined in 6A002, specially designed or modified for protection against nuclear effects (eg electromagnetic pulses (EMP), X-rays, combined explosive and thermal effects) usable for "missiles", designed or qualified to withstand radiation levels equal to or greater than a total radiation dose of 5 x 105 rad (silicon).

Technical note:

In 6A102, a 'detector' is defined as a mechanical, electrical, optical or chemical device that automatically identifies and records or registers stimuli such as changes in ambient pressure or temperature, electrical or electromagnetic signals or radiation from radioactive material. This

includes devices that detect changes once or through failure.

6A107 Gravity meters (gravimeters) and components therefor, as follows:

a. Gravimeters, other than those defined in 6A007.b., designed or modified for aviation or naval use and having a static or operational accuracy equal to or less (better) than 0.7 milligal (mgal) and having a time-to-steady-state registration two minutes or less;

b. Specially designed components for gravimeters defined in 6A007.b. or 6A107.a. and gradiometers defined in 6A007.c.

6A108 Radar systems, tracking systems and radar turrets, other than those defined in 6A008, as follows:

a. Radar and "laser" radar systems designed or modified for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104:

Note: 6A108.a. includes the following:

a. Terrain contour mapping equipment;

b. Equipment for mapping and correlation equipment (digital and analog);

c. Equipment for navigation with Doppler radar;

d. Passive interferometer equipment;

e. Equipment for image sensors (active and passive).

b. Precision tracking systems usable for "missiles" such as:

1. Tracking systems using a code translator in conjunction with ground or airborne reference or satellite navigation systems to provide real-time measurements of position and velocity in flight;

2. Range-finding radars including suitable optical/infrared tracking devices having the following characteristics:

a. Angular resolution better than 1.5 milliradians;

b. Range up to 30 km or greater with range resolution better than 10 m rms;

c. Velocity resolution better than 3 m/s.

Technical note:

In 6A108.b. "missile" means complete missile systems and range-capable unmanned aerial vehicles over 300 km.

6A108 c. Radar turrets designed to withstand a combined thermal shock greater than 4,184 x 106 J/m2, accompanied by pressure greater than 50 kPa, and may be used to protect "missiles" from nuclear effects (eg, electromagnetic pulse (EMP), X-rays, combined blasts and thermal effects).

6A202 Image intensifier tubes having both of the following characteristics:

a. Photocathode with a surface area of more than 20 cm2; and

b. The rise time of the anode pulse is shorter than 1ns.

6A203 Cameras and components, not specified in 6A003, as follows:

NB 1: In 6D203. "Software" specially designed to improve or remove performance limitations camera or imaging device performance to meet the characteristics of 6A203.a., 6A203.b. or 6A203.c.

NB 2: In 6E203. "Technology" in the form of codes or enhancement or removal buttons is specified operational performance limitations of a camera or imaging device to meet the characteristics of 6A203.a., 6A203.b. or 6A203.c.

Note: 6A203.a., to 6A203.c. does not apply to cameras or imaging devices if they have limitations in terms of hardware, "software" or "technology" that set the limit for working

performance less than the above provided they meet any of the following characteristics:

1. They should be returned to the original manufacturer for improvement or removal of restrictions;

2. Requiring "software" as specified in 6D203 to enhance or remove operational performance limitations thereby meeting the characteristics of 6A203; or

3. They require "technology" in the form of codes or keys, as specified in 6E203, to enhance or remove operational performance limitations thereby meeting the characteristics of 6A203.

a. Continuous recording cameras and specially designed components therefor, as follows:

1. Continuous recording cameras with a recording speed greater than 0.5 mm/μs;

2. Electronic cameras with continuous recording with a time resolution of 50 ns or less;

3. Continuous recording tubes for cameras defined in 6A203.a.2.;

4. Plugs specially designed for use with continuous recording cameras and having modular structure and enable the achievement of operational performance from 6A203.a.1. or 6A203.a.2.;

5. Electronic synchronization units and rotor assemblies consisting of turbines, mirrors and bearings, specially designed for cameras specified in 6A203.a.1.;

6A203 b. Imaging cameras and specially designed components therefor, as follows:

1. Cameras that produce images with recording speeds greater than 225,000 images per second;

2. Cameras that produce images capable of exposure times of 50 ns or less;

3. Imaging tubes and semiconductor imaging devices having high-speed image shutter times of 50 ns or less, specially designed for cameras specified in 6A203.b.1. or 6A203.b.2.;

4. Plugs specially designed for use with cameras that create images and have a modular structure and which enable fulfillment of the performance from 6A203.b.1. or 6A203.b.2.;

5. Electronic synchronization units and rotor assemblies consisting of turbines, mirrors and bearings, specially designed for cameras specified in 6A203.b.1. or 6A203.b.2.;

Technical note:

In 6A203.b. high-speed cameras, which produce half-images, can be used independently to produce a single image of a dynamic event, or several such cameras can be coupled into a sequence system to produce multiple images of the event.

c. Semiconductor or electron tube cameras and specially designed for them components as follows:

1. Solid-state or electron tube cameras having high-speed image shutter times of 50 ns or less;

2. Semiconductor imaging devices and timed image intensifier tubes high-speed image shutters of 50 ns or less, specially designed for cameras specified in 6A203.c.1.;

3. Electro-optical gating devices (Kerr or Pockels gating cells) that have high-speed shutter times of 50 ns or less;

4. Plugs specially designed for use with cameras having a modular structure and which enable fulfillment of the performance from 6A203.c.1.

d. Radiation-resistant TV cameras, and lenses therefor, specially designed or characterized to withstand a total radiation dose of 50 x 103 Gy (silicon) (5 x 106 rad (silicon)) without reduction in performance.

Technical note:

The term Gy (silicon) denotes the energy in joules per kg absorbed in an unshielded silicon sample exposed to ionizing radiation.

6A205 "Lasers", "laser" amplifiers and oscillators other than those defined in 0B001.g.5., 0B001.h.6. and 6A005.; such as:

NB: For copper vapor based lasers see 6A005.b.

6A205 a. Argon ion "lasers" with the following characteristics:

1. They work at wavelengths between 400 nm and 515 nm; and

2. Average output power greater than 40 W;

b. Oscillators for pulse tunable dye monomode lasers having all of the following characteristics:

1. They work at wavelengths between 300 nm and 800 nm;

2. Average output power greater than 1 W;

3. Repetition rate (impulse repetition frequency) greater than 1 kHz; and

4. Pulse width less than 100 ns;

c. Pulse tunable dye laser amplifiers and oscillators having all of the following:

1. They work at wavelengths between 300 nm and 800 nm;

2. Average output power greater than 30 W;

3. Repetition rate (impulse repetition frequency) greater than 1 kHz; and

4. Pulse width less than 100 ns;

Note: 6A205.c. does not control single-mode oscillators;

d. Pulsed carbon dioxide (CO2) "lasers" having all of the following:

1. They work at wavelengths between 9,000 nm and 11,000 nm;

2. Repetition rate (impulse repetition frequency) greater than 250 Hz;

3. Average output power greater than 500 W; and

4. Pulse width less than 200 ns;

e. Para-hydrogen Raman shifters operating at 16 µm output wavelength and speed repetitions (impulse repetition frequency) higher than 250 Hz;

f. Neodymium-doped (other than glass) "lasers" with an output wavelength between 1000 nm and 1100 nm nm, having any of the following:

1. a pulse-excited laser with a Q-switch (Q-switched) whose pulse duration is longer or equal to 1 ns, having any of the following:

a. mono-transverse modulated output with an average power greater than 40 W or

b. multiple-transverse modulated output with an average power greater than 50 W or

2. include frequency doubling that gives a wavelength output between 500 nm and 550 nm with with an average output power greater than 40 W;

Mr. Pulsed carbon monoxide (CO) "lasers", other than those specified in 6A005.d.2., having all of the following:

1. Work at wavelengths between 5000 nm and 6000 nm;

2. Repetition rate (impulse repetition frequency) higher than 250 Hz;

3. Average output power greater than 200 W; and

4. Pulse width less than 200 ns.

6A225 Velocity interferometers for measuring velocities greater than 1 km/s at a time interval of less than 10 microseconds.

Note: 6A225 includes velocity interferometers such as VISAR (interferometer systems velocities for any reflector) and DLI (Doppler laser interferometers) and PDV (Doppler photon velocimeters), also known as Het-V (heterodyne velocimeters).

6A226 Pressure sensors, as follows:

a. Impact pressure gauges capable of measuring pressure greater than 10 GPa, including gauges made of manganin, ytterbium and polyvinylidene fluoride (PVDF and polyvinyl difluoride (PVF2);

b. Quartz pressure transducers for pressures greater than 10 GPa.

6B Equipment for testing, verification and production

6B002 Masks and reticles, specially designed for optical sensors specified in 6A002.a.1.b. or 6A002.a.1.d.

6B004 Optical equipment, as follows:

a. Equipment for measuring absolute reflectivity "accuracy" of ± 0.1% of the reflectivity value;

b. Equipment that does not belong to equipment for optical measurement of scattering from a surface with a transparent aperture greater than 10 cm, intended especially for non-contact optical measurements of non-planar optical surface shapes (profiles) with an "accuracy" of 2 nm or less (better) in relation to the required profile.

Note: 6B004 does not control microscopes.

6B007 Equipment for the manufacture, adjustment and calibration of terrestrial gravity meters with a static "accuracy" of less (better) than 0.1 mGal.

6B008 Measuring systems for measuring the intersection of radar pulses with the width of the transmitted pulse of 100 ns or less and their components.

NB: SEE ALSO 6B108.

6B108 Systems, other than those defined in 6B008, designed for profile measurement radars, usable in "missiles" and their subsystems.

Technical note:

In 6D108 "missile" means complete missile systems and unmanned aerial vehicles capable of a range exceeding 300 km.

6C Materials

6C002 Optical sensor materials, as follows:

a. Elemental tellurium (Te) of purity level 99.9995% and higher;

b. Single crystals (including epitaxial wafers) as follows:

1. Cadmium-zinc telluride (CdZnTe) with a zinc percentage of less than 6% by 'mole fraction';

2. Cadmium telluride (CdTe) of any purity; or

3. Mercury-cadmium telluride (HgCdTe) of any purity.

Technical note:

For the purposes of 6C002.b.1., 'mole fraction' is defined as the ratio of the moles of ZnTe to the sum of the moles of CdTe and ZnTe present in the crystal.

6C004 Optical materials as follows:

a. Zinc selenide (ZnSe) and zinc sulfide (ZnS) "starting pieces" obtained by the process of chemical deposition from the gas phase with the following characteristics:

1. Volumes greater than 100 cm3; or

2. Diameter greater than 80 mm and thickness 20 mm or more;

b. Electro-optical materials and non-linear optical materials, as follows:

1. Potassium titanyl arsenate (KTA) (CAS 59400-80-5);

2. Silver-gallium selenide (AgGaSe2, also known as AGSE), (CAS 12002-67-4);

3. Thallium-arsenic selenide (Tl3AsSe3, also known as TAS) (CAS 16142-89-5);

4. Zinc germanium phosphide (ZnGeP2, , also known as ZGP, zinc germanium biphosphide or zinc germanium diphosphide); or

5. Gallium selenide (GaSe) (CAS 12024-11-2);

c. Non-linear optical materials, other than those specified in 6C004.b., having any of the following:

1. They have all of the following:

a. Third-order dynamic (also known as transient) non-linear sensitivity (c(3), hi 3) of 10-6 m2/V2 or greater; and

b. Response time shorter than 1ms; or

2. Second-order nonlinear sensitivity (c(2), hi 2) of 3.3´10-11 m/V or greater;

d. "Start pieces" with silicon carbide or beryllium/beryllium (Be/Be) deposited materials exceeding 300 mm in diameter or major axis length;

e. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconia fluoride (ZrF4) (CAS 7783-64-4) and hafnium fluoride (HfF4) (CAS 13709-52-9) having all of the following characteristics:

1. Concentration of hydroxyl ions (OH-) less than 5 *ppm;*

6C004 2. Integrated metal purity less than 1 *ppm;* and

3. High homogeneity (variance index of refraction) less than 5 x 10-6;

f. Synthetically produced diamond material with an absorption of less than 10-5cm-1 for wavelengths length greater than 200 nm, but not over 14000 nm.

6C005 "Laser" materials as follows:

a. The basic material of the synthetic crystal "laser" in unfinished form as follows:

1. Titanium doped sapphire;

2. Not used.

b. Optical fibers double-coated with polymers of rare earth metals having any of the following characteristics:

1. The nominal wavelength of the "laser" from 975 nm to 1150 nm and all the following characteristics:

a. Average core diameter equal to or greater than 25 µm; and

b. 'Numerical aperture' (NA) (numerical aperture) of the core less than 0.065; or

Note: 6C005.b.1. does not control double coated fibers with an inner diameter glass coatings greater than 150 µm, but not greater than 300 µm.

2. A nominal "laser" wavelength greater than 1530 nm, and any of the following characteristics:

a. Average core diameter equal to or greater than 20 µm; and

b. 'Numerical aperture' of the core less than 0.1.

Technical notes:

1. For the purposes of 6C005.b.1.b., the 'numerical aperture' (NA) of the core is measured at the emission wavelength of the fiber.

2. 6C005.b. includes fibers that are collected by the end caps.

6D Software

6D001 "Software" specially designed for the "development" or "production" of equipment specified in 6A004, 6A005, 6A008 or 6B008.

6D002 "Software" specially designed for "use" in equipment specified in 6A002.b., 6A008 or 6B008.

6D003 Other "software" as follows:

a. "Software" as follows:

1. "Software" specially designed for the formation of an acoustic beam that serves for "processing in real time" of acoustic data in passive reception of towed hydrophone arrays;

2. "Source code" for "real-time processing" of acoustic data in passive reception of towed hydrophone arrays;

6D003 3. "Software" specially designed for the formation of an acoustic beam for "processing in real time" of acoustic data in passive reception of underwater cable systems;

4. "Source code" for "real-time processing" of acoustic data in passive reception of underwater cable systems;

5. "Software" or "source code" specially designed for all of the following purposes:

a. "Real-time processing" of acoustic data obtained from sonar systems specified in 6A001.a.1.e.; and

b. Automatic detection, classification and location of divers or swimmers.

NB: For diver detection "software" or "source code" specially designed or modified for military use, see Military Goods Checklist.

b. Not used.

c. "Software" designed or adapted for cameras having "matrix detectors" specified in 6A002.a.3.f., and designed or modified to remove the frame rate limitation and enable the camera to achieve a frame rate greater than that specified in 6A003.b.4. Note 3.a.

d. "Software" specially designed to maintain the alignment and phase of segmented mirror systems consisting of mirror parts with a diameter or major axis length of 1 m or more;

e. Not used.

f. "Software", as follows:

1. "Software" specially designed for magnetic or electric field "compensation systems" of magnetic sensors designed to operate on mobile platforms;

2. "Software" specially designed for the detection of magnetic or electric field anomalies on mobile devices platforms;

3. "Software" specially designed for "real-time processing" of electromagnetic signals using underwater receivers of electromagnetic signals specified in 6A006.e.;

4. "Source program" for "real-time processing" of electromagnetic signals using underwater receivers of electromagnetic signals specified in 6A006.e.;

Mr. "Software" specially designed to correct for motion effects on gravity meters or gravity gradiometers;

h. "Software", as follows:

1. Air traffic control (ATS) "software" hosted on general purpose computers in air traffic control centers, which can receive target radar data from more than four primary radars;

2. Radar turret design or "production" software having all of the following:

6D003 a. It is specially designed to protect electronically steerable phased array antennas defined in 6A008.e.; and

b. It results in an antenna mode that has a 'mean side rejection level' greater than 40 dB below

of the peak level of the main beam.

Technical note:

For the purposes of 6D003.h.2.b., 'intermediate lateral thrust level' in 6D003.h.2.b. it is measured along the whole string trusses excluding the angular deviation of the main beam *and the first two side lobes on either side of the main beam* bundle.

6D102 "Software" specially designed or modified for "use" in means defined in 6A108.

6D103 "Software" that processes the recorded data after the flight and enables determining the position of aircraft based on their trajectories, and is specially designed or modified for use in "missiles".

Technical note:

In 6D103 "missile" means complete missile systems and unmanned aerial vehicles capable of a range exceeding 300 km.

6D203 "Software" specially designed to enhance or remove performance limitations of a camera or imaging device to meet the characteristics specified in 6A203.a. to 6A203.c.

6E Technology

6E001 "Technology" according to the General Technology Note for the "development" of equipment or materials specified in 6A, 6B, 6C or 6D.

6E002 "Technology" according to the General Technology Note for the "production" equipment, materials or "software" defined in 6A, 6B, 6C.

6E003 Other "technology", such as:

a. "Technology" as follows:

1. "Technology" for coating and protecting optical surfaces "required" to achieve 'optical thickness' uniformity of 99.5% or better for optical coatings of 500 mm or more in diameter or major axis length and with total losses (absorption and scattering) smaller than 5x10-3;

NB: SEE ALSO 2E003.f.

Technical note:

For the purposes of 6E003.a.1., 'optical thickness' is the mathematical product of the refractive index and the physical thickness of the coating.

2. Optics manufacturing "technology" using single point diamond turning techniques, which serves to produce a finished surface "accuracy" of better than 10 nm rms on uneven surfaces greater than 0.5 m2

6E003 b. "Technology" "required" for "development", "production" or "use" separately

designed diagnostic instruments or targets in testing facilities for "SHPL" testing or testing or evaluation of materials irradiated with "SHPL" rays;

6E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" defined in 6A002, 6A007.b. and c., 6A008, 6A102, 6A107, 6A108, 6B108, 6D102 or 6D103.

Note: 6E101 only defines "technology" for equipment defined in 6A002, 6A007 and 6A008 when it is intended for aviation applications and can be used in "missiles".

6E201 "Technology" according to the General Technology Note for the "use" of equipment defined in 6A003, 6A005.a.2., 6A005.b.2., 6A005.b.3., 6A005.b.4., 6A005.b.6 ., 6A005.c.2., 6A005.d.3.c., 6A005.d.4.c., 6A202, 6A203, 6A205, 6A225 or 6A226.

Note 1: 6E201 only applies to "technology" for cameras specified in 6A003, if the cameras determined by any parameter and from 6A203.

Note 2: 6E201 applies only to "technology" for "lasers" specified in

6A005.b.6. neodymium coated and specified by any parameter and from 6A205.f.

6E203 "Technology" in the form of codes or keys for enhancement or removal camera or imaging device performance to meet the characteristics of 6A203.a. to 6A203.c.

CATEGORY 7

NAVIGATION AND AIRCRAFT ELECTRONICS

7A Systems, equipment and components

NB: For automatic pilots of underwater vehicles, see Category 8.

For radar, see Category 6.

7A001 Linear accelerometers (accelerometers) and specially designed therefor components:

NB: SEE ALSO 7A101.

a. Linear accelerometers having any of the following:

1. Specified to operate at linear acceleration levels less than or equal to 15 g and having any of the following:

a. "Stability" of "dispersion" less (better) than 130 µg relative to the fixed calibrated value for one year; or

b. "Scaling factor" "stability" of less (better) than 130 ppm relative to fixed calibrated value for one year;

2. Specified to operate at linear acceleration levels exceeding 15 g but less than or equal to 100 g and having any of the following:

7A001 a. "Repeatability" of "dispersion" less (better) than 1250 µg in one year; and

b. "Reproducibility" of "scaling factor" less (better) than 1250 ppm in one year; or

3. Designed for use in inertial navigation or guidance systems and specified to operate at linear acceleration levels exceeding 100 g;

Note: 7A001.a.1. and 7A001.a.2. they do not control accelerometers limited to measuring vibrations and shocks.

b. Angular or rotary accelerometers specified for operation at linear acceleration levels exceeding 100 g.

7A002 Gyroscopes or angle sensors and specially designed therefor components having any of the following characteristics:

NB: SEE ALSO 7A102.

NB: For angular or rotational accelerometers see 7A001.b.

a. Specified to operate at linear acceleration levels up to 100g and having any of the following feature:

1. Speed range less than 500 degrees per second and having any of the following characteristics:

a. "Stability" of "dispersion" of less (better) than 0.5º per hour, when measured under conditions of 1 g in for a period of one month and in relation to a fixed calibrated value; or

b. "Random Angle Deviation" less (better) or equal to 0.0035º per square root of the hour; or

Note: 7A002.a.1.b. it does not control "rotating mass gyroscopes".

2. Velocity ranges greater than or equal to 500º per second and having any of the following:

a. "Stability" of "dispersion" of less (better) than 4º per hour when measured in 1 g environment for a period of three minutes and in relation to a fixed calibration value; or

b. "Random Angle Deviation" less (better) or equal to 0.1º per square root of the hour; or

Note: 7A002.a.2.b. it does not control "rotating mass gyroscopes".

b. Specified to operate at linear acceleration levels exceeding 100g.

7A003 'Inertial measuring equipment or systems' having any of the following:

NB: SEE ALSO 7A103.

Note: 7A003 does not control 'inertial measuring equipment or systems' which are competent authorities civil aviation of one or more EU member states or states participating in the Wassenaar Arrangement certified for use on "civil aircraft".

Technical notes:

1. For the purposes of 7A003, 'Inertial measuring equipment or systems' includes accelerators or gyroscopes for measuring change in speed and orientation, to determine or hold heading or position without the need for external compasses once pointed 'inertial measuring equipment or systems' include:

- reference systems for positioning and direction (Attitude and Heading Reference Systems - AHRSs);

– gyrocompasses;

- inertial measurement units (Inertial Measurement Units - IMUs);

- inertial navigation systems (Inertial Navigation Systems - INSs);

- inertial reference systems (Inertial Reference Systems - IRSs);

- inertial reference units (Inertial Reference Units - IRUs);

2. *For the purposes of 7A003, 'navigational aids' independently determine position and include:*

a. "satellite navigation systems";

b. "data-based reference navigation" (Data-Based Referenced Navigation - DBRN).

a. Designed for "aircraft", ground vehicles or vessels, determine position without the use of 'navigational aids' and have any of the following "accurate data" after normal orientation:

1. A degree of "Circular Error Probability - CEP" of 0.8 nautical miles per hour (nm/hr) or less (better);

2. 0.5% of “CEP” at distance or less (better) or

3. A total deviation of one nautical mile "CEP" or less (better) during a 24-hour period;

Technical note:

For the purposes of 7A003.a.1., 7A003.a.2. and 7A003.a.3. performance parameters are commonly applied to "inertial measuring equipment and systems" which is designed for "aircraft", vehicles, i.e. vessels... These parameters are the result of the use of special non-navigation aids (eg altimeter, odometer, speed records). The consequence is that the stated performance cannot be so easily recalculated between those parameters. Equipment designed for multiple parameters is evaluated against each applicable item in 7A003.a.1., 7A003.a.2. or 7A003.a.3.

7A003 b. Designed for "aircraft", vehicles, i.e. vessels with built-in 'navigational aids', which indicates the position after the loss of all 'navigational aids' within a period of four minutes and has an "accuracy" of less (better) than ten meters of "CEP";

Technical note:

For the purposes of 7A003.b., this item refers to systems in which 'inertial measuring equipment and systems' and other independent 'navigational aids' are incorporated into a single unit to achieve improved performance.

c. Designed for "aircraft", vehicles, or vessels for determining direction or geographic north and has any of the following characteristics:

1. a maximum operating angular velocity of less (lower) than 500 deg/s and a heading "accuracy" without the use of 'navigational aids' equal to or less (better) than 0.07 deg sec (Lat) (equivalent to six minutes of arc rms at 45 degrees of latitude) or

2. the highest operating angular speed equal to or greater (higher) than 500 deg/s and the "accuracy" of direction determination without the use of 'navigation aids' equal to or less (better) than 0.2 deg sec (Lat) (equivalent to 17 arc minutes rms at 45 degrees latitude) or

d. It measures accelerations or angular velocity, in multiple dimensions, and has any of the following characteristics:

1. Operational performance from 7A001 or 7A002 along any axis, without the use of any navigation aids; aids, or

2. "suitable for use in space" and measures angular velocity with "random angular drift" along any which axes in an amount less (better) or equal to 0.1 degrees per square root of the hour;

Note: 7A003.d.2. does not apply to 'inertial measuring equipment and systems' which contain "rotating mass gyroscopes" as the only type of gyroscope.

7A004 'Star tracking systems' and components therefor as follows:

NOTE: SEE ALSO 7A104.

a. 'star tracking systems' with an azimuth "accuracy" of 20 angular degrees or less (better) seconds during the specified lifetime of the equipment;

b. components specially designed for equipment specified in 7A004.a. as follows:

1. optical heads or turning plates;

2. data processing units.

Technical note:

For the purposes of 7A004.a., 'star tracking systems' are also referred to as body position sensors or gyro-astro compasses.

7A005 Receivers for "satellite navigation systems" and specially designed equipment for them, having any of the above characteristics and specially designed components therefor:

NB: SEE ALSO 7A105.

7A005 NB: For equipment specially designed for military use, see NKL NVO.

a. They use a decryption algorithm specially designed or modified for use by government institutions to access codes for determining position and time; or

b. They use 'tunable antenna systems'.

Note: 7A005.b. it does not control the receiving equipment of the "satellite navigation system" which only uses components designed to filter, combine, or combine signals from multiple broadband antennas that do not have the ability to use adaptive antenna techniques.

Technical note:

For the purposes of 7A005.b. 'tunable adaptive antenna systems' dynamically generate one or more spatial nulls in the antenna array structure using time or frequency domain signal processing.

7A006 Aeronautical altimeters operating at frequencies other than 4.2 GHz up to and including 4.4 GHz and having any of the following characteristics:

NB: SEE ALSO 7A106.

a. 'Power Management'; or

b. Using phase shift modulation.

Technical note:

For the purposes of 7A006.a., 'power management' is the ability to change the transmitted (transmitted) power of the altimeter signal so that the received power at the aircraft's altitude is always at the minimum required for altitude determination.

7A008 Underwater sonar navigation systems using the Doppler effect or correlation velocity records integrated with the leading source, which have a lower positioning "accuracy".

(better) or equal to 3% "Circular Error Probable" ("CEP"), and special components for that.

Note: 7A008 does not control systems specially designed for installation in surface vessels or to systems that require acoustic supports to obtain position data.

NB: See category 6A001.a. for acoustic systems and 6A001.b. for equipment for sonar records on basis of correlation and Doppler velocity. See 8A002 for other marine systems.

7A101 Linear accelerometers (accelerometers), other than those specified in 7A001, designed for use in inertial navigation or guidance systems of any type, usable in 'missiles', and specially designed components therefor, having all of the following:

a. "Repeatability" of "dispersion" less (better) than 1250 µg; and

b. "Repeatability" of "scalping factor" less (better) than 1250 ppm;

7A101 *Note: 7A101. it does not control accelerometers that are specially designed and developed as (Measurement While Drilling) MWD sensors for use in shaft drilling operations.*

Technical notes:

1. In 7A101. "missiles" means a complete missile system and unmanned aerial vehicles with a range exceeding 300 km;

2. In 7A101. measurements of "dispersion" and "scaling factor" refer to one sigma standard deviation (deviation) in relation to the fixed calibration during a period of one year.

7A102 All types of gyroscopes, other than those specified in 7A002, usable in 'missiles', with a measured "stability" of "rate of deviation" of less than 0.5º (1 sigma (deviation) or rms (root mean square)) per hour in a 1g environment, and components specially designed for them.

Technical note:

1. In 7A102 'missiles' means complete missile systems and unmanned aerial vehicles with a range exceeding 300 km;

2. In 7A102 'stability' is defined as a measure of the capability of a specific mechanism or coefficient of performance, to remain unchanged under constant conditions (IEEE STD 528-2001 paragraph 2.247).

7A103 Instruments, navigational equipment and systems, other than those specified in 7A003, and specially designed components therefor, as follows:

a. 'Inertial systems and other equipment' using accelerometers or gyroscopes and systems incorporating such equipment:

1. Accelerometers specified in 7A001.a.3., 7A001.b. or 7A101 or gyroscopes specified in 7A002 or 7A102; or

Note: 7A103.a.1. does not control equipment containing accelerometers specified in 7A001.a.3. which one are designed to measure vibration or shock.

2. Accelerometers specified in 7A001.a.1. or 7A001.a.2. designed for use in inertial navigation or guidance systems of any kind and usable in 'missiles';

Note: 7A103.a. does not apply to equipment containing accelerometers specified in 7A001.a.1. or 7A001.a.2. where such accelerometers are specifically designed and developed as MWD (Measurement While Drilling) sensors for use in shaft drilling operations.

Technical note:

'Inertial systems and other equipment' specified in 7A103.a. with built-in accelerometers or gyroscopes to measure changes in velocity and orientation to determine or maintain position or position without the need for an external reference.

Note: 'Inertial systems and other equipment' in 7A103.a. include:

– Attitude and Heading Reference Systems (AHRSs);

7A103 *– Gyro compasses;*

– Inertial measurement units (IMUs);

– Inertial navigation systems (INSs);

– Inertial reference systems (IRSs);

– Inertial reference units (IRUs).

b. Integrated flight systems, incorporating gyro stabilizers or autopilots and designed or modified for use in 'missiles';

c. 'Integrated navigation systems', designed or modified for 'missiles' carrying them navigation accuracy of 200 m probable radial error 'CEP' or less.

Technical note:

1. An 'integrated navigation system' usually includes the following components:

a. Inertial measuring device (eg reference system for determining position and heading, inertial reference unit or inertial navigation system);

b. One or more external sensors to update position and/or speed, either periodically or continuously during flight (eg satellite navigation receiver, radar altimeter and/or Doppler radar); and

c. Integration hardware and software.

2. In 7A103.c. 'CEP' (circular error probability or circle of equal probability) is a measure of accuracy defined as the radius of the circle in which the probability of locating is 50%.

d. Three-axis magnetic guidance sensors, designed and modified to be integrated into flight control and navigation systems, other than those specified in 6A006, having the following characteristics and specially designed components therefor:

1. Internal tilt compensation along the axis of rotation (±90º) and along the axis of rotation (±180º);

2. Azimuth accuracies less (better) than 0.5º rms at ±80º range, depending on local magnetic fields.

Note: Flight control and navigation systems in 7A103.d. include gyrostabilizers, autopilots, and inertial navigation systems.

Technical note:

In 7A103 *'missiles' means complete missile systems or unmanned aerial vehicles with a range greater than 300 km.*

7A104 Astronomical gyro compasses and other devices and specially designed therefor parts, other than those specified in 7A004, which provide position or orientation, by automatic tracking of celestial bodies or satellites.

7A105 Receivers for 'navigation satellite systems', other than those specified in 7A005, which have any of the following features as well as specially designed components for them:

7A105 a. Designed or modified for use in space launch vehicles specified in 9A004, sounding rockets specified in 9A104 or unmanned aerial vehicles specified in 9A012 or 9A112.a.; or

b. Designed or modified for use on aircraft and having any of the following:

1. The possibility of providing navigation information at speeds greater than 600 m/s;

2. The use of encryption, designed or modified for military or governmental use, to provide access to confidential 'navigation satellite system' signals/data;
or

3. Specially designed with protection against radio interference (eg antenna with zeroing or electronic

steerable antenna) to function in an environment of active or passive anti-electronic action.

Note: 7A105.b.2. and 7A105.b.3. they do not control equipment designed for commercial, civilian use or safety ('Safety of Life' - eg data integrity, flight safety) services in the 'navigation satellite system'.

Technical note:

In 7A105, 'navigation satellite system' includes global navigation satellite systems (GNSS; eg GPS, GLONASS, Galileo or BeiDou) and regional navigation satellite systems (RNSS; eg NavIC, QZSS).

7A106 Radar or laser-radar altimeters, other than those specified in 7A006, designed or modified for use on space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

7A115 Passive sensors for determining course (direction) relative to specified sources electromagnetic radiation (radio-goniometry equipment) or terrain features, designed or modified for use on space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

Note: 7A105, 7A106 and 7A115 include sensors for the following equipment:

a. Equipment for determining terrain contour maps;

b. Equipment for mapping and correlation (digital and analog) equipment;

c. Doppler navigation radar devices;

d. Equipment for passive interferometry;

e. Sensor imaging equipment (both active and passive).

7A116 Flight control systems and servo valves, as follows, designed or modified for use on space launch vehicles specified in 9A004 or sounding rockets specified in 9A104 or "missiles".

a. Pneumatic, hydraulic, mechanical, electro-optical or electromechanical systems for flight control (including electric controls (fly-by-wire and fly-by-light));

b. Position control equipment;

c. Flight control servo valves designed or modified for systems specified in 7A116.a. or 7A116. b. and designed or modified to operate in a vibration environment greater than 10 g rms in the range between 20 Hz and 2 kHz.

Note: For the conversion of manned aircraft to operate as a "missile", 7A116 includes systems, equipment and valves designed or modified to enable the manned aircraft to operate as an unmanned aircraft.

7A117 "Guidance kits" usable in "missiles" capable of achieving a system accuracy of 3.33% or less relative to range (eg 'CEP' **of 10 km or less for a range of 300 km).**

Technical note:

In 7A117 'CEP' (circular error probability or circle of equal probability) is a measure of accuracy, defined as the radius of a circle centered on the target, within a specified range, within which 50% of the payload is affected.

7B Equipment for testing, verification and production

7B001 Test, calibration or adjustment equipment specially designed for equipment specified in 7A.

Note: 7B001 does not control 'Maintenance Level I and II' test, calibration or adjustment equipment.

Technical notes:

For the purposes of 7B001:

1. 'Maintenance of the first degree'

A failure of the inertial navigation unit is detected on "aircraft" by an indication on the control and display unit (CDU) or by a status message from the corresponding subsystem. By following the manufacturer's instructions, the cause of the failure can be localized at the level of the line replaceable unit (LRU). The operator then replaces the failed LRU with a spare.

2. 'Level II maintenance'

The defective LRU is sent to a workshop (either the manufacturer or the operator responsible for level II maintenance) where it is thoroughly examined to determine the failure at the shop replaceable assembly (SRA) level. This assembly is removed and replaced with a correct replacement part. Defective
The SRA (and possibly the complete LRU) is delivered to the manufacturer. 'Level II maintenance' does not include the removal of accelerometers or gyroscopes from the SRA.

7B002 Equipment, as follows, specially designed to specify the characteristics ring laser gyroscope mirrors:

NB: SEE ALSO 7B102.

a. Scatter meters having a measurement "accuracy" of 10 ppm or less (better);

b. Profilometers that have a measurement "accuracy" of 0.5 nm (5 angstroms) or less (better).

7B003 Equipment specially designed for the "production" of equipment specified in 7A.

Note: 7B003 includes:

a. Gyroscope adjustment test station;

b. Stations for dynamic balancing of gyroscopes;

c. Test stations for running in gyroscopes and motors;

d. Stations for charging and discharging gyroscopes;

e. Centrifugal holders for gyro housings;

f. Accelerometer axis adjustment stations;

Mr. Machines for winding fiber-optic gyroscopic coils.

7B102 Reflectance meters with an accuracy of 50 ppm or less (better), designed to determine the mirror characteristics of laser gyroscopes.

7B103 "Production facilities" and "production equipment" as follows:

a. "Production facilities" specially designed for equipment specified in 7A117;

b. Production equipment and other equipment for testing, calibration and adjustment, except that specified in 7B001 to 7B003, designed or modified for use with equipment specified in 7A.

7C Materials

Does not have.

7D Software

7D001 "Software" specially designed or modified for "development" or "production" equipment specified in 7A or 7B.

7D002 "Source code" for the operation or maintenance of any inertial navigation equipment, including inertial equipment not controlled by 7A003 or 7A004, or Attitude and Heading Reference Systems ('AHRS').

Note: 7D002 does not control "source code" for "use" in mechanical 'AHRS'.

Technical note:

For the purposes of 7D002, an 'AHRS' differs from an inertial navigation system (INS) in that it provides position and heading, and normally does not provide the acceleration, speed and position provided by an INS.

7D003 Other "software", as follows:

a. "Software" specially designed or modified to improve or reduce operating performance system navigation error to levels specified in 7A003, 7A004 or 7A008;

b. "Source code" for hybrid integrated systems that improve operational performance or reduce system navigation error to the level specified in 7A003 or 7A008 by continuously combining heading data with any of the following navigation data:

1. Speed given by Doppler radar or sonar radar;

2. Data from the "satellite navigation system"; or

3. Data from the system "Navigation with reference database" ("DBRN");

c. Not used;

d. Not used;

e. Computer-aided-design (CAD) "software" designed for the "development" of "active flight control systems", helicopter electrical or optical control systems, or "circular counter-torque or circular directional control systems" the "technology" of which specified in 7E004.b.1, 7E004.b.3. to 7E004.b.5, 7E004.b.7., 7E004.b.8., 7E004.c.1. or 7E004.c.2.

7D004 "Source code" containing "development" "technology" specified in 7E004.a.2., 7E004.a.3., 7E004.a.5., 7E004.a.6. or 7E004.b., for any of the following:

a. digital flight management systems where there is "full flight control";

b. integrated propulsion and flight control systems;

c. " *fly-by-wire* systems " or " *fly-by-light systems";*

d. "Active flight control systems" that are fault-tolerant or self-reconfigurable;

e. not used;

f. air data systems based on static surface data or

Mr. three-dimensional screens.

Note: 7D004. does not refer to "source code" associated with common computing elements and functions (eg, receiving an input signal, transmitting an output signal, loading computer "programs" and data, built-in verification, task scheduling mechanisms) the result of which is not a specific function of the flight control system.

7D005 "Software" specially designed for decoding the code of "satellite navigation system" which is intended for the needs of the Government.

7D101 "Software" specially designed or modified for "use" in the specified equipment in 7A001 through 7A006, 7A101 through 7A106, 7A115, 7A116.a., 7A116.b., 7B001, 7B002, 7B003, 7B102 or 7B103.

7D102 Integration "software", as follows:

a. Integration "software" for equipment specified in 7A103.b.;

b. Integration "software" specially designed for equipment specified in 7A003 or 7A103.a.;

c. Integration "software" designed or modified for equipment specified in 7A103.c.

Note: The usual form of integration "software" involves Kalman filters.

7D103 "Software" specially designed to modify or simulate "guidance sets" specified in 7A117 or to integrate their designs with space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

Note: "Software" specified in 7D103 remains controlled when combined with a separate designed hardware specified in 4A102.

7D104 "Software" specially designed or designed for the operation or maintenance of "sets for listing" specified in 7A117

Note: 7D104. includes "software" specially designed or designed to improve the operation of the "kit

for guidance" or to achieve or exceed the accuracy specified in 7A117.

7E Technology

7E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 7A, 7B, 7D001, 7D002, 7D003, 7D005 and 7D101 to 7D103.

Note: 7E001 includes code management "technology" exclusively for equipment specified in 7A005.a.

7E002 "Technology" in accordance with the General Technology Note for the "production" of equipment specified in 7A and 7V.

7E003 "Technology" according to the General Technology Note for the repair, overhaul or remachining of equipment specified in 7A001 to 7A004.

Note: 7E003 does not include maintenance "technology" relating to the calibration, removal or replacement of damaged or unserviceable replaceable units and assemblies of "civil aircraft" as described in 'Maintenance Level I' or 'Maintenance Level II'.

NB: See technical notes in 7B001.

7E004 Other "technology", as follows:

a. "Technology" for "development" or "production":

1. Not used

2. Air data systems based only on external static data, i.e. those who they receive from conventional probes that provide data from the air;

7E004 3. Spatial (three-dimensional) displays for "aircraft";

4. Not used;

5. Electric actuators (ie electromechanical, electrohydrostatic or integrated actuators) specially designed for 'primary flight control';

Technical note:

For the purposes of 7E004.a.5., 'primary flight control' is "aircraft" stability or maneuvering control using force/momentum generators, i.e. aerodynamic control surfaces or thrust vector control.

6. 'Flight Control Optical Sensor Arrays' specially designed for the application of 'active flight management system";

Technical note:

For the purposes of 7E004.a.6., an 'optical flight control sensor array' is a network of distributed optical sensors, using "laser" beams, to provide real-time flight control data for processing in the aircraft.

7. "DBNR" systems designed for underwater navigation using sonar or a gravity base data that enable positioning "accuracy" less (better) or equal to 0.4 nautical miles.

b. "Development" "technology" as follows for "active flight control systems" (including "fly-by-wire systems" or "fly-by-light systems"):

1. Photonic "technology" for registering the status of "aircraft" or flight control components, transmission flight control data or control of actuator movements, which is "required" for "fly-by-light systems" of "active flight control systems";

2. It is not used;

3. Real-time algorithms for analyzing information from sensors about components, works the prediction and preemptive reduction of impending deterioration and failure of components in the "active flight control system";

Note: 7E004.b.3. does not apply to self-maintenance algorithms.

4. Real-time algorithms for component failure recognition and re-establishment

force and torque control to reduce deterioration and malfunctions in the "active flight control system";

Note: 7E004.b.4. it does not apply to algorithms for removing the effects of failures by comparison redundant data sources or pre-planned independent responses to expected failures.

5. Integration of digital flight control data, navigation and propulsion system in digital flight management system for "total flight control";

7E004 *Note: 7E004.b.5. does not include:*

a. "Technology" for integrating digital flight control, navigation and propulsion system data into a digital flight control system for 'flight path optimization';

b. "Technology" for "aircraft" flight instrument systems integrated exclusively for VOR, DME and ILS (Instrument Landing System) or MLS (Microwave Landing System) landing navigation systems.

Technical note:

'Flight path optimization' is a procedure that minimizes deviations from a desired path in four dimensions (space and time) based on maximizing mission task performance or efficiency.

6. Not used.

7. "Technology" "required" to meet functional requirements for "fly-by-wire systems" that have all of the above:

a. 'Inner loop' airframe stability controls require loop closure rates of 40 Hz or greater; and

Technical note:

For the purposes of 7E004.b.7.a., 'inner loop' refers to functions of "active control systems of flight" that automate the stability controls of the aircraft frame.

b. It has any of the following characteristics:

1. Corrects aerodynamically unstable airframes, measured at any point in a flight curve that would irretrievably lose control if not corrected within 0.5 seconds;

2. Pairs of controls in two or more axes, compensating for 'abnormal changes in state aircraft';

Technical note:

For the purposes of 7E004.b.7.b.2., 'abnormal changes in aircraft condition' include in-flight structural damage, loss of engine thrust, disabled control surfaces or destabilizing payload movement.

3. Performs the functions specified in 7E004.b.5.; or

Note: 7E004.b.7.b.3. it does not control the autopilots.

4. Enables stable controlled flight of the "aircraft", except during take-off or landing, with attack angle greater than 18 degrees, sideslip of 15 degrees, pitch or yaw rate of 15 degrees/second or roll rate of 90 degrees/second;

7E004 8. "Technology" "required" to meet the functional requirements for "fly-by-wire systems" to achieve all of the above:

a. The impossibility of losing control over the "aircraft" in the case of consecutive strings of two individual ones malfunction in the "fly-by-wire system"; and

b. Probability of loss of control over the "aircraft" less (better) than 1 x 10-9 failures per flight hour;

Note: 7E004.b. it does not refer to the "technology" associated with common computing elements and functions (eg, receiving an input signal, transmitting an output signal, loading computer "programs" and data, built-in checking, task scheduling mechanisms) the result of which is not a specific function of the flight control system.

c. "Technology" for the "development" of helicopter systems, as follows:

1. Multi-axis "fly-by-fly" or "fly-by-light" electric or optical controllers that combine at least two

of the following functions into one:

a. Unified Management Commands;

b. Cyclic control commands;

c. Steering controls;

2. "Circular counter-torque control or circular direction control control systems";

3. Rotor blades including 'variable geometry airfoils' for use in systems u
with which it is possible to control individual vanes.

Technical note:

For the purposes of 7E004.c.3., 'variable geometry airfoils' use flaps or tongues accompanying edges or slats of the leading edge or swiveling nose, the position of which can be controlled in flight.

7E101 "Technology" According to the general technology for "use" of the equipment listed in 7A001 to 7A006, from 7A101 to 7A106, 7B001, 7B002, 7B003, 7B102, 7B103, 7D101 to 7D103.

7E102 "Technology" to protect avionics and electronic subsystems against electromagnetic shock (EMP) and electromagnetic interference (EMI) from external sources such as:

a. "Technology" of protection system design;

b. "Technology" of design for configuring resistive electronic circuits and subsystems;

c. Design "technology" for defining criteria for increasing the resistance of 7E102.a. and 7E102.b.

7E104 "Technology" for integrating flight control, guidance and propulsion data into a system for flight control to optimize the trajectory of the missile system.

CATEGORY 8
SHIPPING

8A Systems, equipment and components

8A001 Underwater craft and surface ships, as follows:

NB: For the control status of underwater craft equipment, see:

– Category 6 for sensors;

– Categories 7 and 8 for navigation equipment;

– Category 8A for underwater equipment.

a. Underwater floating objects, connected by cables, with a human crew, designed to work at depths greater than 1,000 m.

b. Underwater vessels, not connected by cables (autonomous), manned and which
have any of the following:

1. They are designed to 'operate autonomously' and have a lifting capacity for all of the following:

a. 10% or more of its weight in air; and

b. 15 kN or more;

2. They are designed to work at depths greater than 1000 m; or

3. They have all of the following:

a. They are designed for 'autonomous operation' of 10 or more hours;

b. Have a 'radius of effect' of 25 nautical miles or greater;

Technical notes:

1. For the purposes of 8A001.b., 'autonomous operation' means a fully submerged underwater a vessel without a snorkel, where all systems are functioning and the underwater vessel is sailing at the minimum speed at which it can safely dynamically control the depth using depth rudders alone, without the need for the support of a ship or base on the surface, on the seabed or from the shore, and which has an underwater or surface propulsion system.

2. In 8A001.b., 'radius of action' means half of the maximum distance that an underwater vessel can reach by 'autonomous operation'.

c. Unmanned underwater craft having any of the following:

1. Unmanned underwater craft having any of the following characteristics:

a) Designed to determine the position on any geographical references without human assistance in real time;

8A001 b) Having an acoustic or command link for data exchange; or

c) have a wireless data exchange connection or fiber optic command that is greater than 1,000m;

2. Unmanned underwater craft, not specified in 8A001.c.1., having the following characteristics:

a) designed to work on a cable;

b) designed to work at depths greater than 1,000 m;

c) have any of the following:

1. Designed for self-propelled maneuvering using propulsion engines or thrusters specified in 8A002.a.2.; or

2. connecting data with the help of optical fibers;

d. Not used;

e. Ocean rescue systems with a lifting capacity of 5 MN for retrieving objects from the depths exceeding 250 m and having any of the following:

1. Dynamic positioning systems that have the ability to maintain a position up to 20 m from set points with the help of the navigation system; or

2. Navigation systems for movement towards the seabed and navigation integration systems for depths greater than 1,000 m with positioning "accuracy" up to 10 m from the given point;

f. Not used;

Mr. Not used;

h. Not used;

and. Not used.

8A002 Marine systems, equipment and components, as follows:

Note: For underwater communication systems, see Category 5, Part 1 - Telecommunications.

a. Systems, equipment and components, specially designed or modified for underwater craft, intended for operation at depths greater than 1,000 m, as follows:

1. Casings (vessels) or pressure hulls with a maximum diameter greater than 1.5 m;

2. Propulsion using a direct current engine with a classic marine propeller or propeller in the nozzle;

3. Connecting cables and connectors therefor using synthetic-reinforced optical fibers materials;

4. Components manufactured from materials specified in 8S001.

8A002 *Technical Note:*

For the purposes of 8A002.a.4., 8A002.a.4. the subject of control refers to the export of syntactic foam which

controlled by 8S001 for cases where it is an intermediate stage in production and when the component is not in final form.

b. Systems specially designed or modified for automatic control of underwater movements vessels specified in 8A001 using navigational data and having closed-loop servo control, enabling the vessel to:

1. Movement up to 10 m from a defined point in the water column;

2. Maintaining a position up to 10 m from a defined point in the water column; or

3. Maintaining a position up to 10 m as far as the cable reaches on the seabed or below it;

c. Fiber optic cable inlets in the solid hull of the vessel;

d. Underwater video systems, having any of the following:

1. specially designed or modified for remote control of an underwater vessel; and,

2. apply any of the following background effect minimization techniques;

a. Scope illuminators; or

b. Notch laser systems;

e. Not used;

f. Not used;

Mr. Lighting systems, as follows, specially designed or modified for underwater use:

1. Strobe light systems having a light output energy greater than 300 J per flash and a frequency of 5 flashes per second;

2. Argon port light systems specially designed for use below 1,000 m;

h. "Robots" specially designed for underwater use, controlled by a computer with a stored program and having any of the following:

1. Systems that control the "robot" using information from sensors that measure force or torque the moment applied to an object in the external environment, the distance to the object in the external environment, or the contact between the "robot" and the object in the external environment; or

2. The ability to act with a force of 250 N or more or a torque of 250 Nm or more and which have titanium alloys or "fibrous or filamentary" "composite" materials in their structure;

8A002 and. Remote controlled articulated manipulators specially designed or modified for use on underwater vessels, having any of the following:

1. Systems that control manipulators using information from sensors that measure any of the following:

a. Torque or force acting on an external object, or

b. The touch of the manipulator and the object in the external environment; or

2. They use the main-minor proportional technique and have 5 degrees of 'freedom of movement' or more;

Technical note:

For the purposes of 8A002.i.2., when determining the number of degrees of 'freedom of movement', only those functions having proportional motion control using positional feedback shall be considered.

j. Air-independent power systems specially designed for underwater use, such as which follows:

1. Air-independent Brayton or Rankine propulsion systems having any of the following:

a. Chemical or absorption systems specially designed for the removal of carbon dioxide, carbon monoxide and particles of exhaust gases circulating in a closed system;

b. Systems specially designed for the use of monatomic gas;

c. Devices or cages specially designed to reduce underwater noise at lower frequencies of 10 kHz, or specially mounted shock load mitigation devices; or

d. Systems specially designed for:

1. Pressurizing reaction products or fuel recovery;

2. Storage of reaction products; and

3. Discharge of reaction products at a pressure of 100 kPa or more;

2. Diesel-powered, air-independent engines having all of the following:

a. Chemical or absorption systems specially designed for the removal of carbon dioxide, carbon monoxide and particles of exhaust gases circulating in a closed system;

b. Systems specially designed for the use of monatomic gas;

c. Devices or cages specially designed to reduce underwater noise at lower frequencies of 10kHz, or specially mounted shock load mitigation devices; and

8A002 d. Specially designed exhaust systems that do not continually blow out products combustion;

3. Air-independent fuel cell propulsion systems with an output power greater than 2 kW who have any of the following:

a. Devices or cages specially designed for the reduction of underwater underwater noise at frequencies below 10 kHz, or specially fitted devices for mitigating shock loads;
or

b. Systems specially designed for:

1. Pressurizing reaction products or for fuel recovery;

2. Storage of reaction products; and

3. Discharge of reaction products at a pressure of 100 kPa or more;

4. Air-independent closed Stirling cycle propulsion systems having all of the following:

a. Devices or cages specially designed to reduce underwater noise at frequencies lower than 10 kHz, or specially mounted shock load mitigation devices; and

b. Specially designed exhaust systems for discharging combustion products at a pressure of 100 kPa or more;

k. Not used;

l. Not used;

m. Not used;

n. Not used;

about. Propellers, power transmission systems, power generation systems and noise reduction systems, as follows:

1. It is not used;

2. Marine propeller systems and power generation and transmission systems designed for use on ships, as follows:

a. Propellers with controlled pitch of the propeller blades (controllable pitch or pitch of the wings propeller) and a corresponding hub with a power greater than 30 MW;

b. Electric drive motors with internal liquid cooling and with an output power greater than 2.5 MW;

c. "Superconducting" propulsion motors, with an output power greater than 0.1 MW;

d. Power transmission shaft systems, with components of "composite" materials, capable of transmitting power greater than 2 MW;

8A002 e. Ventilated or wing root ventilated propeller systems with power greater than 2.5 MW;

3. Noise reduction systems designed for use on ships of 1,000 t displacement or greater, as follows:

a. Systems that suppress underwater noise at a frequency below 500 Hz and contain complex circuits-elements for acoustic insulation of diesel engines, diesel generators, gas turbines, generators that drive gas turbines, drive motors and drive reducers, specially designed for sound and anti-vibration isolation, with a medium-sized mass exceeding 30% of the mass of the equipment to be mounted;

b. 'Active noise reduction or cancellation systems', or magnetic bearings, esp
made for power transmission systems.

Technical note:

For the purposes of 8A002.o.3.b., 'Active noise reduction or cancellation systems' have incorporated electronic systems to actively reduce vibrations by generating and sending anti-noise or anti-vibration signals directly to the source.

4. Permanent magnet electric drive motors specially designed for underwater vehicles, with output power greater than 0.1 MW;

Note: 8A002.o.4. includes rim drive systems.

p. Water jet propulsion systems with a pump having all of the following characteristics:

1. Output power over 2.5 MW, i

2. use divergent nozzles and water jet control techniques using vanes for improving drive efficiency or reducing drive-generated underwater noise;

q. Underwater swimming and diving equipment, namely:

1. Breathing apparatus with exhaust air recycling with a closed circuit;

2. Breathing apparatus with exhaust air recycling with a semi-closed circuit;

Note: 8A002.q. does not control individual devices for personal use (when they are with the user).

NB: For equipment and devices specifically intended for military use, see NKL NGO.

r. Acoustic diver deterrent systems specially designed or modified to interfere divers and having a sound pressure equal to or greater than 190 dB (reference 1 µPa at 1 m) at frequencies of 200 Hz and below.

Note 1: 8A002.r. does not control underwater based diver deterrent systems explosive devices, air cannons or combustible sources.

Note 2: *8A002.r. includes systems to deter divers using spark sources, also known as plasma-sound sources.*

8B Equipment for testing, verification and production

8B001 Water tunnels, having a background noise of less than 100 dB (reference 1 µPa, 1 Hz), in a frequency range greater than 0 Hz but not greater than 500 Hz, designed to measure the acoustic field generated by water flow around model propulsion systems.

8C Materials

8C001 'Syntactic foam' for underwater use, having all of the following:

NB: SEE ALSO 8A002.a.4.

a. Intended for a depth of over 1,000 m; and

b. Densities less than 561 kg/m3.

Technical note:

For the purposes of 8C001, 'syntactic foam' is a mixture of synthetic material containing spherical voids

plastic materials or glass pressed into the "matrix" resin.

8D Software

8D001 "Software" specially designed or modified for "development", "production" or "use" of equipment or materials specified in 8A, 8B or 8C.

8D002 Special "software" specially designed or modified for the "development", "production", repair, overhaul or remachining of propellers specially designed for underwater noise reduction.

8E Technology

8E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or materials specified in 8A, 8B or 8C.

8E002 Other "technology", as follows:

a. "Technology" for "development", "production", repair, overhaul or re-engineering machining of propellers specially made for underwater noise reduction;

b. "Technology" for overhaul or remachining of equipment specified in 8A001, 8A002.b., 8A002.j., 8A002.o. or 8A002.p.

c. "Technology" in accordance with the General Technology Note for the "development" or "production" of any of the following:

1. Hoverboards (completely curtain lined) having all of the following characteristics:

8E002 a. Maximum design speed, at full load, greater than 30 knots at significant wave height of 1.25 m or more;

b. Air bag pressure over 3,830 Pa; and

c. Light and full displacement ratio less than 0.70;

2. Hovercraft (with solid sidewalls) with maximum designed speed, at full capacity load, greater than 40 knots at a significant wave height of 3.25 m or greater;

3. Hydrofoils with active systems for automatic control of underwater wing systems, with a maximum designed speed, at full load, greater than 40 knots at a significant wave height of 3.25 m or greater; or

4. 'Vessels of small waterline area' having any of the following characteristics:

a. Full displacement greater than 500 tons with maximum design speed at full load greater than 35 knots at a significant wave height of 3.25 m or greater; or

b. Full displacement greater than 1,500 tons with maximum design speed at full load greater than 25 knots at a significant wave height of 4 m or greater.

Technical note:

For the purposes of 8E002.c.4., a 'small waterline area vessel' is defined according to the following formula: waterline area at design draft less than 2 x (displaced volume at design draft) 2/3.

CATEGORY 9
AIR AND SPACE AND PROPULSION SYSTEMS

9A Systems, equipment and components

NB: For propulsion systems designed or classified according to neutron or transient ionizing radiation, see NKL NVO.

9A001 Aircraft gas turbine engines incorporating any of the following:

NB: SEE ALSO 9A101.

a. Includes any of the "technology" specified in 9E003.a., 9E003.h. or 9E003.i.;

Note 1: 9A001.a does not control aircraft gas turbine engines satisfying

the following:

a. Approved by the national civil aviation authorities of one or more countries
a member of the EU or a country participating in the Vasenar Arrangement; and

9A001 *b. Intended for the operation of civil "aircraft" with a crew that has been issued by the national civil aviation authorities of one or more EU member states or countries participating in the Wassenaar Arrangement for "aircraft" with this type of propulsion:*

1. Civil certificate; or

2. Appropriate document recognized by the International Civil Aviation Organization (ICAO).

Note 2: 9A001.a does not control aircraft gas turbine engines designed for
use in auxiliary power units (Auxiliary Power Units (APUs)) approved by the national civil aviation authorities of EU member states or states participating in the Wassenaar Arrangement.

b. Not used.

9A002 'Naval gas turbine plants' using liquid fuel and having
the following characteristics and specially designed assemblies and components for them:

a. Maximum continuous power when operating in "stationary mode" at standard reference
under the conditions specified in ISO 3977-2: 1997 (or national equivalent) of 24 245 kW or more; and

b. 'Corrected specific fuel consumption' does not exceed 0.219 kg/kWh at 35% of maximum constant
power when using liquid fuel.

Note: The term 'naval gas turbine plants' includes those industrial or aeronautical gas turbine plants adapted for the generation of electricity on ships or for propulsion.

Technical note:

For the purposes of 9A002, 'corrected specific fuel consumption' is the specific fuel consumption of an engine corrected for a liquid fuel distillate having a specific energy (ie net calorific value) of 42MJ/ kg (ISO 3977-2: 1997).

9A003 Specially designed assemblies or components incorporating any of the "technology" specified
in 9E003.a. 9E003.h., 9E003.i. or 9E003.k., for any of the following aircraft gas turbine engines:

a. Those specified in 9A001; or

b. The construction or production origin of which is unknown to the manufacturer or belongs to a country that is not a member of the EU or a participant of the Vasenar Arrangement.

9A004 Space launch vehicles, "spacecraft", "spacecraft body",
"spacecraft payloads", "spacecraft" onboard system or equipment, ground-use equipment, launch platforms and "suborbital vehicles", as follows:

NB: SEE ALSO 9A104.

9A004 a. Space launch vehicles;

b. "Spacecraft";

c. "Spacecraft Body";

d. "Spacecraft payloads" including items specified in 3A001.b.1.a.4., 3A002.g.,
5A001.a.1., 5A001.b.3., 5A002.c., 5A002.e., 6A002.a.1., 6A002.a.2., 6A002.b., 6A002.d., 6A003. b., 6A004.c., 6A004.e.,
6A008.d., 6A008.e., 6A008.k., 6A008.l. or 9A010.c.;

e. Embedded systems or equipment specially designed for "spacecraft" and having
any of the following functions:

1. 'Use of command and telemetry data';

Note: For the purposes of 9A004.e.1., 'use of command and telemetry data' includes
cargo data management, storage and processing.

2. 'Use of payload data'; or

Note: For the purposes of 9A004.e.2., 'use of payload data' includes payload data management, storage and processing.

3. 'Position and orbit control';

Note: For the purposes of 9A004.e.3. "attitude and orbit control" includes reading data and launching to determine and control the position and orientation of the "spacecraft".

NB: For equipment specially designed for military use, see NKL NGO.

f. Equipment for ground use, specially designed for "spacecraft", as follows:

1. Telemetry and equipment for remote measurement and remote control specially designed for any which of the following data processing functions:

a. processing of telemetry data on synchronization and error correction, for monitoring work the status (also known as the health and safety condition) of the "spacecraft body"; or

b. Command data processing to format command data sent to the "spacecraft" to control the "spacecraft body";

2. Simulators specially designed for "operational procedure verification" of "spacecraft".

9A004 *Technical Note:*

For the purpose of 9A004.f.2., 'verification of operational procedures' is one of the following:

1. Confirmation of command sequence;

2. Operational training;

3. Operational trials; or

4. Operational analysis.

Mr. "Aircraft" specially designed or modified as air launch platforms space launch vehicles or "suborbital vehicles".

h. "suborbital spacecraft".

9A005 Liquid propellant propulsion systems incorporating any systems or components 00specified in 9A006.

NB: SEE ALSO 9A105 and 9A119.

9A006 Systems and components specially designed for liquid rocket propulsion systems propellant, as follows:

NB: SEE ALSO 9A106 , 9A108 and 9A120.

a. Low-temperature coolers, dewar vessels that maintain gases in a liquid state on spacecraft, low-temperature piping or low-temperature systems specially designed for use on spacecraft and capable of reducing low-temperature fluid loss to less than 30% per year;

b. Low-temperature containers or closed-cycle refrigeration systems capable of providing temperatures of 100K (–173 °C) or below for sustained flight “aircraft” at speeds above Mach 3, launch vehicles and “spacecraft”;

c. Systems for storage or transfer of liquid hydrogen;

d. High pressure turbo pumps (over 17.5 MPa), pump parts or related parts gas generator systems or systems for starting the expansion turbine cycle;

e. High pressure pressure chambers (over 10.6 MPa) and their nozzles;

f. Fuel storage systems using the principle of capillarity or positive dispersion (ie with elastic vanes);

Mr. Liquid fuel injectors, with individual orifices of 0.381 mm or less in diameter

(surface area of 1.14 x 10-3 cm² or less for non-circular openings), specially designed for liquid rocket engines;

h. One-piece carbon (carbon-carbon) fiber pressure chambers or one-piece carbon (carbon-carbon) fiber nozzle exit cones with a density greater than 1.4 g/cm³ and a tensile strength greater than 48 MPa.

9A007 Solid propellant rocket propulsion systems with any of the following:

NB: SEE ALSO 9A107 and 9A119.

a. With the possibility of creating a total pulse of over 1.1 MNs;

b. By a specific impulse of 2.4 kNs/kg or greater when the flow through the nozzle is expanded to ambient conditions at sea level and for a set chamber pressure of 7 MPa;

c. Mass fractions by degrees that exceed 88% and fillings of solid propellant greater than 86%;

d. Any component specified in 9A008; or

e. Systems for isolating the chamber and binding the propellant charge using the construction direct bonding to provide a 'strong mechanical bond' or prevent chemical migration between the solid fuel and the chamber wall insulating material.

Technical note:

For the purposes of 9A007.e. 'strong mechanical bond' means that the strength of the bond is equal to or greater than the strength of the solid fuel itself.

9A008 Components, as follows, specially designed for rocket propulsion systems of solid propellant:

NB: SEE ALSO 9A108.

a. Chamber isolation and propellant bonding systems that use a backing layer to provide a 'strong mechanical bond' or prevent chemical migration between the solid propellant and chamber insulation material;

Technical note:

For the purposes of 9A008.a., 'strong mechanical connection' means that the strength of the connection is equal to or greater than of the propellant charge itself.

b. Engine chambers of "composite" fiber structure exceeding 0.61 m in diameter or having a 'ratio structural efficiency (PV/W)' greater than 25 km;

Technical note:

For the purposes of 9A008.b., 'structural efficiency ratio (PV/W)' is the chamber explosion pressure (P) multiplied by the volume of the chamber (V) and divided by the total weight of the chamber (W).

c. Nozzles with a thrust level over 45 kN or with a nozzle throat erosion rate of less than 0.075 mm/s;

d. Movable nozzles or secondary fluid injection thrust vector control systems capable of:

1. Multi-axis rotation of more than ±5°;

2. An angular velocity of rotation of the thrust vector of 20°/s or greater; or

3. Angular acceleration of the thrust vector of 40°/s² or greater.

9A009 Hybrid rocket propulsion systems with:

NB: SEE ALSO 9A109 and 9A119.

a. With the possibility of giving a total pulse greater than 1.1 MNs; or

b. With thrust levels over 220 kN in vacuum conditions at the exit from the nozzle.

9A010 Specially designed components, systems and structures for launch vehicles, their propulsion systems or "spacecraft", as follows:

NB: SEE ALSO 1A002 and 9A110.

a. Components and structures each exceeding 10 kg, specially designed for launch vehicles vehicles, and manufactured using one of the following materials:

1. "Composite" materials consisting of "fibrous or filamentary materials" specified in 1C010.e. and resins specified in 1C008 or 1C009.b.;

2. Metal "matrixes" of "composites" reinforced with any of the following:

a. Materials specified in 1C007;

b. "Fibrous or filamentary materials" specified in 1C010; or

c. Aluminides specified in 1C002.a.; or

3. Ceramic "matrix" "composite" materials specified in 1C007;

Note: The weight limit does not apply to tip (nose) cones.

b. Components and structures specially designed for launch vehicle propulsion systems specified in 9A005 to 9A009, and manufactured using any of the following materials:

1. "Fibrous or filamentary materials" specified in 1C010.e. and resins specified in 1C008 or 1C009.b.;

2. Metal "matrixes" of "composites" reinforced with any of the following:

a. Materials specified in 1C007;

b. "Fibrous or filamentary materials" specified in 1C010; or

c. Aluminides specified in 1C002.a.; or

3. Ceramic "matrix" "composite" materials specified in 1C007;

c. Structural components and isolation systems specially designed to actively control the dynamic response or distortion of the "spacecraft" structure;

d. Pulsating liquid propellant rocket motors with a thrust/mass ratio equal to or greater than 1 kN/kg and a 'response time' of less than 30 ms.

Technical note:

For the purposes of 9A010.d., "Response time" is the time required to achieve 90% of the total prescribed thrust from the moment of starting.

9A011 Jet, supersonic jet engines or 'combination engines work cycle' and specially designed parts for them.

NB: SEE ALSO 9A111 AND 9A118.

Technical note:

For the purposes of 9A011, 'combined duty cycle engines' combine two or more of the following engine types:

– Gas turbine engine (turbojet, turboprop and turbofan);

– charge jet or supersonic charge jet engine;

– rocket engine or engine (liquid/ gel/ solid fuel and hybrid).

9A012 "Unmanned aerial vehicles" (BL), unmanned "lighter-than-air flying objects", related equipment and components, as follows:

NB 1.: SEE ALSO 9A112.

NB 2: For "UAVs" that are "suborbital vehicles", see 9A004.h.

a. Unmanned aerial vehicles (UAVs) or unmanned "lighter-than-air flying objects" that have been designed

so that they can be flown in a controlled manner outside the direct 'natural line of sight' of the 'operator' and having any of the following:

1. They have all of the following:

a. A maximum 'endurance' of 30 minutes or more but less than one hour; and

b. They are designed to take off and fly in a stable controlled manner in wind gusts of 46.3 km/h (25 knots) or stronger; or

2. A maximum 'endurance' of one hour or longer;

Technical note:

1. For the purposes of 9A012.a. 'operator' is the person who initiates or controls the flight of an unmanned aerial vehicle (UAV) or unmanned "lighter-than-air flying object".

2. For the purposes of 9A012.a. 'endurance' is calculated for ISA (ISO 2533:1975) conditions at sea level without wind.

3. For the purposes of 9A012.a. 'natural visual contact' means unaided human vision with or without corrective lenses.

b. Appropriate systems, equipment or components as follows:

1. Not used

2. Not used

3. Equipment or components specially designed for translation of manned aircraft or "lighter-than-air flying objects" in BL or unmanned "lighter-than-air flying objects" specified in 9A012.a.;

4. Air-injecting reciprocating or rotary engines, specially designed or modified to propel BL or unmanned "lighter-than-air flying objects" at altitudes above 50,000 feet (15,240 m).

9A101 Turbojet and two-flow turbojet (turbofan) engines other than those which are specified in 9A001, as follows:

a. Engines having both of the following characteristics:

1. A 'total thrust value' exceeding 400 N except for engines approved for civil use with a 'total thrust value' exceeding 8,890 N; and

2. Specific fuel consumption of 0.15 kg/N-1/h-1 or less (at maximum continuous power in static conditions at sea level and ICAO standard atmosphere);

3. 'Dry weight' less than 750 kg; and

4. 'First stage rotor diameter' less than 1 m;

Technical note:

1. For the purposes of 9A101.a.1. 'total thrust' is the maximum engine thrust, guaranteed by the manufacturer, not installed at statistical sea level conditions using the ICAO standard atmosphere. The thrust value for civil certified engines shall be equal to or less than the maximum thrust as per the manufacturer's evidence for the non-installed engine.

2. Specific fuel consumption is determined at maximum continuous thrust for non-installed engine in static conditions at sea level and ICAO standard atmosphere.

3. 'Dry weight' is the weight of the engine without fluids (fuel, hydraulic fluid, oil, etc.) and does not include the housing.

4. 'First stage rotor diameter' is the diameter of the motor, whether fan or compressor, measured at the leading edge of the blade tip.

b. Engines designed or modified for use in "missiles" or unmanned aerial vehicles specified in 9A012 or 9A112.a.,

9A102 'Turboprop engine systems' specially designed for unmanned aerial vehicles

specified in 9A012 or 9A112.a. and for them specially designed components with a 'maximum power' of more than 10 kW.

Note: 9A102 does not control engines approved for civil use.

Technical notes:

1. For the purposes of 9A102 'turboprop engine systems' include all of the following:

a. Turbo-reciprocating engines; and

b. Propeller power transmission systems.

2. For the purposes of 9A102 the 'maximum power' of the engine is achieved under static conditions at sea level with application of ICAO atmospheric standards.

9A104 Sounding missiles with a range of at least 300 km.

NB: SEE ALSO 9A004.

9A105 Liquid propellant or gelatin propellant rocket motors, as follows:

NB: SEE ALSO 9A119.

a. Liquid-propellant or gelatin-propellant rocket motors usable in "rockets", not specified in 9A005, which are integrated, designed or modified to be integrated into liquid-propellant or gelatin-propellant rocket systems capable of delivering a total impulse of 1.1 MNs or greater;

b. Liquid-propellant or gelatin rocket motors usable in complete rocket systems or unmanned aerial vehicles, with a range of 300 km, not specified in 9A005 or 9A105.a., which are integrated, designed or modified to be integrated into liquid-propellant rocket systems or gelatinous propellants capable of generating a total impulse of 0.841 MNs or greater.

9A106 Systems or components, other than those specified in 9A006, usable in "rockets", specially designed for liquid or gelatin rocket propulsion systems, as follows:

a. Not used;

b. Not used;

c. Thrust vector control subsystems usable in "missiles";

Technical note:

Examples of how to achieve thrust vector control specified in 9A106.c. are:

1. Flexible nozzle;

2. Injection of secondary liquid or gas;

3. Movable rocket motor or nozzle;

4. Deflection of the output stream of combustion products (jet vanes or sensors); or

5. Spoilers (interceptors).

d. Liquid and gelatinous rocket propellant flow control systems (including oxidizers) and special system components usable in "rockets" designed or modified to operate under vibration conditions exceeding 10 g rms between 20 Hz and 2,000 Hz.

Note: The only servo valves, pumps and gas turbines specified in 9A106.d. are as follows:

a. Servo-valves designed for a flow of 24 l/ min or more, at an absolute pressure of 7 MPa or higher, and having an actuator response time of less than 100 ms;

b. Pumps, for liquid rocket propellants, with a shaft speed equal to or greater than 8 000 rpm at maximum mode of operation or with a compression pressure equal to or greater than 7 MPa.

9A106 c. *Gas turbines, for turbopumps for liquid rocket propellants, with a shaft speed equal to or greater than 8,000 rpm at maximum operating mode.*

e. Combustion chambers and nozzles of liquid or gelatin rocket engines, defined in 9A005 and 9A105.

9A107 Solid propellant rocket motors for use in complete missile systems or unmanned aerial vehicles, with a range of 300 km, not specified in 9A007, capable of delivering a total impulse of 0.841 MNs or greater.

NB: SEE ALSO 9A119.

9A108 Components, other than those specified in 9A008, specially designed for solid propellant and hybrid rocket systems, as follows:

a. Rocket engine chambers and "isolation" components, which can be used in subsystems specified in 9A007, 9A107, 9A009 or 9A109.a.;

b. Rocket nozzles usable in subsystems specified in 9A007, 9A107, 9A009 or 9A109.a.;

c. Thrust vector control subsystems that can be used in "missiles".

Technical note:

Examples of thrust vector control implementations specified in 9A108.c. are:

1. Flexible nozzle;

2. Secondary injection of liquid or gas;

3. A mobile rocket engine or jet;

4. Diverting the output flow of combustion products (jet vanes or probes); or

5. Spoilers (interceptors).

9A109 Hybrid rocket motors and specially designed components therefor, as follows:

a. Hybrid rocket motors usable in complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, other than those specified in 9A009, capable of producing a total impulse equal to or greater than 0.841 MNs, and specially designed components therefor;

9A109 b. Specially designed components for hybrid rocket motors specified in 9A009 which can be used in "rockets".

NB: SEE ALSO 9A009 and 9A119.

9A110 Composite structures, laminates and products therefor, not specified in 9A010, specially designed for use in "missiles" or subsystems specified in 9A005, 9A007, 9A105, 9A106.c., 9A107, 9A108.c., 9A116 or 9A119.

NB: SEE ALSO 1A002.

Technical note:

In 9A110 "missile" means a complete missile system and an unmanned aerial vehicle with a range of over 300 km.

9A111 Pulse jet or detonation engines, usable in "missiles" or unmanned aerial vehicles specified in 9A012 or 9A112.a., and specially designed parts therefor.

NB SEE ALSO 9A011 AND 9A118.

Technical note:

In 9A111, detonation engines use detonation to create an effective pressure increase across combustion chambers. Examples of detonation engines include pulse detonation engines, rotary detonation engines or continuous wave detonation engines.

9A112 "Unmanned aerial vehicles" (BL), other than those specified in 9A012, as follows:

a. "Unmanned aerial vehicles" (UAVs) with a range of 300 km;

b. "Unmanned aerial vehicles" (UAVs) having all of the following:

1. Have any of the following:

a. Autonomous flight control and navigation ability; or

b. The ability to control flight beyond the direct line of sight of the human operator; and

2. Have any of the following:

a. They contain a system/mechanism for spraying aerosols with a capacity greater than 20 liters; or

b. Designed or modified to contain an aerosol dispersal system/mechanism with a capacity greater than 20 liters.

Technical note:

1. Aerosol consists of particles or liquids that are not fuel components, its by-products or fuel additives, and which are part of the payload that needs to be dispersed into the atmosphere. Aerosols are, e.g. pesticides for crop dusting and dry chemicals for cloud seeding.

2. The aerosol spraying system/ mechanism contains all devices (mechanical, electrical, hydraulic, etc.) that are necessary for storing and dispersing aerosols into the atmosphere. This includes the possibility of injecting aerosols into the exhaust gases and propeller air stream.

9A115 Launch support equipment, as follows:

a. Apparatus and devices for handling, control, starting or launching; projected or modified for space launch vehicles specified in 9A004, sounding rockets specified in 9A104 or "rockets";

Technical note:

1. In 9A115.a. "missile" means complete missile systems and unmanned aerial vehicle systems with a range greater than 300 km.

2. Apparatus and devices specified in 9A115.a. include those installed on manned aircraft or unmanned aerial vehicles.

9A115 b. Transport, handling, control, launch or launch vehicles designed or modified for space launch vehicles specified in 9A004, sounding rockets specified in 9A104 or "rockets".

9A116 Re-entry vehicles usable in "missiles" and equipment designed or modified therefor, as follows:

a. Re-entry vehicles;

b. Heat shields and components thereof made of ceramic or ablative materials;

c. Heat sinks and their components made of lightweight materials with high thermal conductivity capacity;

d. Electronic equipment specially designed for re-entry aircraft.

9A117 Rocket stage mechanisms, stage separation and coupling mechanisms degree, usable in "rockets".

NB: SEE ALSO 9A121.

9A118 Combustion control devices in engines, usable on "missiles" or unmanned aerial vehicles specified in 9A012 or 9A112.a., and listed in 9A011 or 9A111.

9A119 Separate rocket stages, usable in complete missile systems or unmanned aerial vehicles, with a range of 300 km other than those specified in 9A005, 9A007, 9A009, 9A105, 9A107 and 9A109.

9A120 Liquid and gelatin fuel tanks, other than those specified in 9A006, specially designed for fuel specified in 1C111 or 'other liquid and gelatinous propellants', used for rocket systems capable of carrying at least 500 kg of payload to a range of at least 300 km.

Note: In 9A120 'other liquid fuel' includes, but is not limited to, fuel specified in NCL

NGO.

9A121 Mating and intermediate electrical connectors specially designed for "missiles", spacecraft launch vehicles from 9A004 or sounding rockets from 9A104.

Technical note:

The intermediate connectors of 9A121 also include electrical connectors placed between "missiles", vehicles for launching spacecraft or sounding rockets and their cargo.

9A350 Spraying and fogging systems, specially designed or modified for installation on aircraft, "lighter-than-air vehicles", or unmanned aerial vehicles and specially designed components therefor, as follows:

a. Complete atomizing or fogging systems capable of delivering, from liquid suspension, initial droplet volume 'VMD' less than 50 µm with a flow rate greater than two liters per minute;

9A350 b. Units for the generation and delivery of an aerosol in the form of a cloud or jet, created from a liquid suspension, initial droplet volume 'VMD' less than 50 µm with a flow rate greater than two liters per minute;

c. Aerosol generating assemblies, specially designed for installation in systems specified in 9A350.a i b.

Note: Aerosol generating units are specially designed or modified devices such as nozzles, rotating drums and similar devices, which are mounted on the aircraft.

Note: 9A350 does not cover atomizing or fogging systems and their components for which are known to be unable to expel biological agents in the form of infectious aerosols.

Technical notes:

1. Droplet size of spray equipment or specially designed nozzle opening size for use on aircraft, "lighter-than-air vehicles" or unmanned aerial vehicles, must be measured using one of the following:

a. Laser Doppler method;

b. Advanced laser diffraction method.

2. In 9A350 'VMD' means volume mean diameter and for systems based on water use corresponds to the mass mean diameter (MMD).

9B Equipment for testing, verification and production

9B001 Manufacture of equipment, tools and clamps:

NB SEE 2B226

a. Casting equipment by directional solidification or single crystallisation “shaped for superalloys”;

b. Casting tools, specially shaped for the manufacture of gas turbine blades, airfoils or "Interior wall cladding" manufactured from refractory materials or ceramics;

1. core;

2. formwork (moulds);

3. in combination, core and formwork (mould);

c. Equipment for directional solidification or the production of individual crystal additives, designed for "superalloys".

9B002 Real-time direct control systems, instruments (incl sensors) or equipment for automatic data acquisition and processing, having all of the following characteristics:

a. Specially designed for the "development" of gas turbines, assemblies or components; and

9B002 b. Incorporating "technology" specified in 9E003.h. or 9E003.i.

9B003 Equipment specially designed for the "production" or testing of brush seals

gas turbines, designed to operate at rotor leading edge speeds exceeding 335 m/s, and temperatures exceeding 773 K (500 °C) and specially designed components or accessories therefor.

9B004 Tools, dies or clamps for rigidly joining "superalloy", titanium or intermetallic airfoil-disc combinations described in 9E003.a.3. or 9E003.a.6. for the needs of gas turbines.

9B005 Real-time direct control systems, instruments (including sensors) or automatic data acquisition and processing equipment, specially designed for use with any of the following:

NB: SEE ALSO 9B105.

a. Wind tunnels designed for speeds of Mach 1.2 or greater;

Note: 9B005.a. does not apply to wind tunnels specially constructed for educational purposes which have a 'working chamber size' (measured laterally) of less than 250 mm.

Technical note:

For the purposes of 9B005.a. Note, 'working chamber size' means the diameter of a circle or the side of a square or the longest side of the rectangle at the point where the working chamber is widest.

b. Means for simulating ambient flow speeds greater than Mach 5, including hot tunnels by air, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns; or

c. Wind tunnels or devices, other than two-dimensional compartments, capable of simulating flow whose Reynolds numbers are greater than 25 x 106.

9B006 Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (standardized to 20 µPa), with a rated output of 4 kW or more, at a test cell temperature exceeding 1,273 K (1000 °C) and specially designed quartz heaters for them.

9B006 NB: SEE ALSO 9B106.

9B007 Equipment specially designed for checking the integrity of rocket motors using it non-destructive testing (NDT) techniques that do not belong to planar analysis by means of X-rays or basic physical or chemical analysis.

9B008 Transducers for direct measurement of boundary layer friction on walls during flow testing specially designed to operate in a current with a total (stop) temperature greater than 833 K (560 °C).

9B009 Tools specially designed for making turbine engine rotor parts on a base powder metallurgy, having all of the following:

a. Designed to operate in a load mode of 60% of the ultimate tensile strength (UTS) or more and at temperatures of 873 K (600 °C); and

b. Designed to operate at temperatures of 873 K (600 °C) or higher.

Note: 9V009 does not control powder making tools.

9B010 Equipment specially designed for the manufacture of items specified in 9A012.

9B105 'Aerodynamic test devices' for speeds of Mach 0.9 or greater, usable for "missiles" and their subsystems.

NB: SEE ALSO 9B005.

Note: 9B105 does not control Mach 3 or less wind tunnels whose dimensions are 'test section sizes' equal to or less than 250 mm.

Technical note:

1. In 9B105 'aerodynamic test equipment' includes wind tunnels and shock tubes for study air flow over objects.

2. In the Note to 9B105 'test section size' means the diameter of a circle or side square or the longer side of the rectangle or the longer axis of the ellipse, at the point of the largest 'test section'. A 'test section' is a section that is vertical to the direction of flow.

3. In 9B105 "missile" means a complete missile system and an unmanned aerial vehicle with a range exceeding 300 km.

9B106 Ambient simulation chambers and deaf chambers, as follows:

a. Environmental simulation chambers having any of the following characteristics:

1. They can simulate the following flight conditions:

a. An altitude of 15 km or more; or

b. Temperature range below 223 K (–50 °C) to above 398 K (+125 °C); and

2. Containing or 'designed or modified' to contain a vibration unit or other vibration test equipment, for vibrations equal to or greater than 10 g rms, measured on a 'test bench', between 20 Hz or 2 kHz and an applied force of 5 kN or greater;

Technical notes:

1. 9B106.a.2. describes systems that are able to generate vibrations in an environment with one signal (ie sinusoidal signal) and systems capable of generating random broadband vibrations (ie power spectrum);

2. In 9B106.a.2. 'designed or modified' means that the environmental simulation chamber has suitable connections (eg sealing devices) for the installation of a vibration unit or other vibration test equipment as specified in 2B116.

3. In 9B106.a.2. 'test table' means a flat table or surface without inserts or other parts.

9B106 b. Deaf chambers capable of simulating the following flight conditions:

1. Acoustic environment at a total sound pressure level of 140 dB or more (standardized to 20 µPa) or a total nominal acoustic output with a power of 4 kW or more; and

2. Flight altitudes of 15,000 m or more; or

3. Temperature ranges from below 223 K (–50 °C) to above 398 K (+125 °C).

9V107 'Aerodynamic test facilities' usable for 'missiles', 'rocket' propulsion systems and re-entry vehicles and equipment specified in 9A116, having any of the following:

a. Electrical power supply equal to or greater than 5 MW; or

b. Gas supply with a total pressure equal to or greater than 3 MRa.

Technical note:

1. 'Aerodynamic test facilities' include plasma arc jet facilities or plasma air tunnels for researching thermal and mechanical effects during building construction.

2. In 9V107 the term 'missile' means missile systems or range unmanned aerial vehicle systems over 300 km.

9B115 Specially designed "production equipment" for systems, subsystems and components specified in 9A005 to 9A009, 9A011, 9A101, 9A102, 9A105 to 9A109, 9A111, 9A116 to 9A120.

9B116 Specially designed "production facilities" for space launch vehicles specified in 9A004 or systems, subsystems and components specified in 9A005 to 9A009, 9A011, 9A101, 9A102, 9A104 to 9A109, 9A111, 9A116 to 9A119 or "missiles".

Technical note:

In 9A116 "missile" means a complete missile system and an unmanned aerial vehicle with a range greater than 300 km.

9B117 Test benches and test benches for solid or liquid propellant rockets or rocket motors, having any of the following:

a. Ability to operate with more than 68 kN thrust; or

b. Possibility of simultaneous measurement of three components of axial thrust.

9C Materials

9C108 Bulk "insulating" material and "interior wall cladding", other than those specified in 9A008, for rocket motor housings usable in 'missiles' or specially designed for solid propellant rocket motors specified in 9A007 or 9A107.

9C110 Resin-impregnated prepreg fibers and metal-coated fiber preforms therefor, for composite structures, laminates and products specified in 9A110, made with either an organic base or a metal base using fibrous or filamentary reinforcements having a "specific tensile strength" exceeding 7.62 x 104 m and a "specific modulus" greater than 3.18 x 106 m.

NB: SEE ALSO 1C010 and 1C210.

Note: The only resin-impregnated fibrous webs specified in entry 9C110 are those using resins with a glass transition temperature (Tg), after crosslinking, exceeding 418 K (145 °C) as determined by ASTM D4065 or an equivalent standard.

9D Software

9D001 "Software", not specified in 9D003 or 9D004, specially designed or Modified for the "development" of equipment or "technology" specified in 9A001 to 9A119, 9B or 9E003.

9D002 "Software", not specified in 9D003 or 9D004, specially designed or modified for the "production" of equipment specified in 9A001 through 9A119 or 9B.

9D003 "Software" incorporating technology specified in 9E003.h. and used in FADEC systems for systems specified in 9A or equipment specified in 9B.

9D004 Other "software", as follows:

a. Data-verified "software" for two-dimensional or three-dimensional viscous flow from wind tunnels or test flights, required for detailed modeling of the flow through the engine;

b. "Software" for testing gas turbine aircraft engines, assemblies or components, which have all of the above characteristics:

1. Specially designed to test any of the following:

a. Gas turbine aircraft engines, assemblies or components, including "technology" specified in 9E003.a., 9E003.h. or 9E003.i.; or

b. Multistage compressors providing either bypass or core flow, specially designed for gas turbine engines incorporating "technology" specified in 9E003.a. or 9E003.h.; and

2. Specially designed for all of the above:

a. Collection and processing of data in real time; and

b. Feedback control of the tested product or test conditions (e.g. temperature, pressure, flow rate) during the test;

Note: 9D004.b. does not control the software for the operation of the security institution or the operator (eg shutdown, fire detection and suppression), or manufacturing, repair or maintenance testing limited to determining whether the item has been properly assembled or repaired.

9D004 c. "Software" specifically designed to manage directional solidification casting processes or growth of material by individual crystallization in equipment specified in 9B001.a. or 9B001.c.;

d. Not used.

e. "Software" specially designed or modified for the operation of items specified in 9A012;

f. "Software" specially designed for the design of internal passages for cooling in blades, blade wheels and lining of blade ends in gas turbines;

Mr. "Software" having all of the following features:

1. Specially designed for predicting flow and aeromechanical conditions, and combustion conditions in gas turbines; and

2. Prediction according to the theoretical model, thermal and aeromechanical conditions, and combustion conditions which are compared with actual (experimental or production) gas turbine performance data.

9D005 "Software" specially designed or modified for the operation of items specified in 9A004.e. or 9A004.f.

NB: For "software" for items specified in 9A004.d. which are incorporated into the “payload spacecraft", see the corresponding categories.

9D101 "Software" specially designed or modified for the "use" of goods specified in 9B105, 9B106, 9B116 or 9B117.

9D103 "Software" specially designed for modelling, simulation or structural integration of launch vehicles specified in 9A004 or sounding rockets specified in 9A104 or "missiles" or subsystems specified in 9A005, 9A007, 9A105., 9A106.c., 9A107, 9A108.c. , 9A116 or 9A119.

Note: "Software" specified in 9D103 remains controlled when combined with specially designed hardware specified in 4A102.

9D104 "Software" as follows:

a. "Software" specially designed or modified for the "use" of goods specified in 9A001, 9A005, 9A006.d., 9A006.g., 9A007.a., 9A009.a., 9A010.d., 9A011, 9A101, 9A102, 9A105 , 9A106.d., 9A107, 9A109, 9A111, 9A115.a., 9A117 or 9A118.

b. "Software" specially designed or adapted for the operation and maintenance of subsystems or equipment specified in 9A008.d., 9A106.c., 9A108.c. or 9A116.d.

9D105 "Software" coordinating the operation of more than one subsystem, except that specified in 9D004.e., and specially designed or modified for "use" in launch vehicles specified in 9A004 or sounding rockets specified in 9A104 or 'missiles'.

Note: 9D105 includes "software" specially designed for manned "aircraft". converted to function as "unmanned aerial vehicles", as follows:

9D105 *a. "Software" specially designed or modified to integrate conversion equipment with "aircraft" system functions; and*

b. "Software" specially designed or modified to operate an "aircraft" as an "unmanned aerial vehicle".

Technical note:

In 9D105 'missile' means a complete missile system and an unmanned aerial vehicle system with a range greater than 300 km.

9E Technology

Note: "Development" or "production" "technology" specified in 9E001 to 9E003 for gas turbine engine remains under control when used for repair or general overhaul. Out of control are: technical data, drawings or documentation for maintenance activities directly related to the calibration, removal or replacement of damaged or irreparable field-replaceable units, including the replacement of entire engines or their modules.

9E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 9A004 to 9A012, 9A350, 9B or 9D.

9E002 "Technology" according to the General Technology Note intended for "production" of equipment specified in 9A004 to 9A011, 9A350 or 9B .

NB: For "technology" intended for the repair of controlled structures, laminates or materials, see 1E002.f.

9E003 Other "technology", as follows:

a. "Technology" "required" for the "development" or "production" of any of the following components or systems for gas turbine engines:

1. Blades, blade wheels or blade end protective covers made of directional alloys

solidified (DS) or single crystallized (SC), having (in 001 Miller Index Guide) a life to failure due to loading in excess of 400 hours, at 1,273 K (1,000 °C) and at a stress of 200 MPa, based on mean characteristic values;

Technical note:

For the purposes of 9E003.a.1. the life to failure test is usually performed on a test specimen.

2. Combustion chambers, having any of the following characteristics:

a. 'Thermally disassembled liners' that are designed to work at the 'exit temperature of the chamber combustion' higher than 1,883 K (1,610 °C);

b. Non-metallic coatings;

9E003 c. Non-metallic sheath; or

d. Liners designed to operate at a 'combustion chamber exit temperature' exceeding 1 883 K (1 610 °C) with openings meeting the parameters of 9E003.c.;

e. Using "pressure boosted combustion";

Technical note:

For the purposes of 9E003.a.2.e., in "pressure boost combustion" the average stagnation pressure at at the exit from the combustion chamber is higher than the average stagnation pressure at the entrance to the combustion chamber primarily due to the combustion process, when the engine is operating in the "stationary mode" of operation.

Note: The "required" hatch "technology" of 9E003.a.2. it is limited to the geometry of the derivations and the determination of the opening position.

Technical note:

1. For the purposes of 9E003.a.2.a., 'thermally decoupled linings' are linings that have at least the role of a supporting structure designed to carry mechanical loads and a lining of structures exposed to the products of combustion designed to protect the supporting structure from the heat of combustion. The lining of the structure exposed to combustion products and the supporting structure have independent thermal expansions.

2. For the purposes of 9E003.a.2.d., 'combustion chamber exit temperature' is the high average overall steady gas flow (stagnation) temperature between the exit surface and the leading edge of the turbine inlet deflector blade (ie measured on the T40 engine section as defined in SAE ARP 755A) when the engine is operating at 'steady state' at the confirmed maximum continuous operating temperature.

NB: See 9E003.c. for the "technology" "required" for the production of cooling vents.

3. Components that are any of the following:

a. Manufactured from organic "composite" materials designed to operate at temperatures higher than 588 K (315 °C);

b. Manufactured from any of the following:

1. Metal "matrix" "composite" reinforced with any of the following:

a. Materials specified in 1C007;

b. "Fibrous or filamentary materials" specified in 1C010; or

c. Aluminides specified in 1C002.a.; or

2. "Composites" with a ceramic "matrix" specified in 1C007.; or

9E003 c. Stators, vane wheels, vanes, protective covers of the tip of the vanes, couplings of the rotating disc, rotating disc retainers, or 'pipe splitter', which are all of the following:

1. Not specified in 9E003.a.3.a.;

2. Designed for compressors or fans; and

3. Manufactured from materials specified in 1C010.e. with resins specified in 1C008;

Technical note:

For the purposes of 9E003.a.3.c., the pipe splitter' performs the initial separation of the air mass flow between bypass and motor cores.

4. Uncooled turbine blades, blade wheels or protective covers of the ends of the blades designed to operate at a 'gas stream temperature' of 1 373 K (1 100 °C) or higher;

5. Cooled turbine blades, impellers, blade tip liners or other components designed to operate at a 'gas stream temperature' of 1,693 K (1,420 °C) or higher, not specified in 9E003.a.1.;

Technical notes:

For the purposes of 9E003.a.5., 'gas stream temperature' is the high average total constant temperature of the stream of gas (stagnation) at the leading edge of the turbine component surface when the engine is operating at 'steady state' at the confirmed or specified maximum continuous operating temperature.

6. Airfoil-disc blade combinations connected by solid links;

7. Not used;

8. Rotating components of gas turbines 'damage tolerant', made of materials obtained by powder metallurgy according to 1C002.b; or

Technical note:

For the purposes of 9E003.a.8., 'damage tolerant' components are designed using a methodology to achieve the prediction and limitation of crack development.

9. Not used;

10. Not used

11. 'Propeller blades' having all of the following:

a. 20% or more of the total volume is made up of one or more closed cavities containing only vacuum or gas; and

b. One or more closed cavities with a volume of 5 cm 3 or more;

Technical note:

For the purposes of 9E003.a.11., 'Propeller blade' is the airfoil of a rotary stage or staircase, which provides compressor and bypass flow in a gas turbine engine.

9E003 b. "Technology" "required" for the "development" or "production" of any of the following:

1. Aeromodels for wind tunnels equipped with non-intrusive sensors that can transmit data from sensors to data collection systems; or

2. "Composite" propeller blades or propulsion fans capable of more than 2,000 kW at flight speed above Mach 0.55;

c. "Technology" "required" for the production of cooling ports in gas turbine components, using any of the "technology" specified in 9E003.a.1., 9E003.a.2. or 9E003.a.5. and having any of the following characteristics:

1. All of the following:

a. A minimum 'cross-sectional area' of less than 0.45 mm2;

b. 'Aperture aspect ratio' greater than 4.52; and

c. 'Incident angles' equal to or less than 25°; or

2. All of the following:

a. A minimum 'cross-sectional area' of less than 0.12 mm2;

b. 'Aperture aspect ratio' greater than 5.65; and

c. 'Incident angles' greater than 25°;

Note: 9E003.c. does not refer to the "technology" for the production of cylindrical openings of constant diameters that are regular and enter and exit on the outer surfaces of the component.

Technical note:

1. For the purposes of 9E003.c. 'cross-sectional area' is the area of the opening in the plane normal to the relationship on the opening axis.

2. For the purposes of 9E003.c. 'aperture aspect ratio' is the nominal axis length of the aperture divided by by the square root of its minimum 'cross-sectional area'.

3. For the purposes of 9E003.c. 'angle of incidence' is the acute angle measured between the planes tangent to the surface of the airfoil and the axis of the opening at the point where the axis of the opening penetrates the surface of the airfoil.

4. For the purposes of 9E003.c., techniques for producing openings in 9E003.c. include the following methods: machining with "laser" rays, water jet, Electro-Chemical Machining (ECM) or Electrical Discharge Machining (EDM)-erozimate.

d. "Technology" "required" for the "development" or "production" of helicopter power transmission systems or rotor-turning or wing-turning propulsion systems for "aircraft";

e. "Technology" for the "development" or "production" of ground vehicle propulsion systems using reciprocating diesel engines, having all of the following:

1. 'Cylinder volume' of 1.2 m^3 or less;

2. Total power output greater than 750 kW based on 80/1269/EEC, ISO 2534 or equivalent national standards; and

3. Power density greater than 700 kW/m^3 of 'case volume';

9E003 *Technical Note:*

For the purposes of 9E003.e., 'enclosure volume' in 9E003.e. is the product of three mutually perpendicular dimensions measured as follows:

Length: The length of the crankshaft from the front flange to the flywheel;

Width: The widest of the following:

a. Outer dimension from valve cover to valve cover;

b. Dimensions of the outer edges of the cylinder heads; or

c. Flywheel housing diameter.

Height: Greater of the following:

a. The dimension from the crankshaft center line to the top plane of the valve cover (or cylinder head) plus twice the piston stroke value; or

b. Flywheel housing diameter.

f. The "technology" "required" for the "production" of specially designed components for diesel engines of high output performance, as follows:

1. "Technology" "required" for the "production" of engine systems containing all of the following components using ceramic materials specified in 1C007:

a. Cylinder liners;

b. Clips;

c. Cylinder heads; and

d. One or more other components (including exhausts, turbochargers, valve guides, valve assemblies or isolated fuel injectors);

2. "Technology" "required" for the "production" of a turbocharger system, with single-stage compressors, and which have all of the following:

a. They operate at pressure ratios of 4:1 or higher;

b. Mass flow from 30 to 130 kg/min; and

c. The possibility of changing the flow surface inside the compressor or turbine section;

3. "Technology" "required" for the "production" of fuel injection systems in specially designed engines using various fuels (eg diesel or jet fuel) with a viscosity range of diesel fuel (2.5 cSt at 310.8 K (37.8 °C)) to gasoline (0.5 cSt at 310.8 K (37.8 °C)), which have all of the following:

a. Quantitative injection power greater than 230 mm³ per injector and per cylinder; and

b. Specially designed features for electronic control of switching regulator characteristics so that they automatically depend on the properties of the fuel and provide the same torque characteristics using the appropriate sensors;

9E003 Mr. "Technology" "required" for the "development" or "production" of high output diesel engines performance' which serves to lubricate the cylinder wall with a gas phase, a solid phase or a liquid film (or a combination thereof) which enables operation at temperatures higher than 723 K (450 °C), measured on the cylinder wall at the upper limit of the upper piston ring path.

Technical note:

For the purposes of 9E003.g., 'high output diesel engines' are diesel engines with with a specified mean effective braking pressure of 1.8 MPa or greater at a speed of 2300 rpm, provided that the rated speed is 2300 rpm or greater.

h. "Technology" for gas turbine engine "FADEC systems" as follows:

1. "Development" "technology" to establish functional requirements for components needed for "FADEC system" to regulate engine thrust or shaft power (eg time constants and accuracy of feedback sensors, fuel valve closing speed);

2. "Development" or "production" "technology" for control and diagnostic components that used only in "FADEC systems" and used to regulate engine thrust or shaft power;

3. "Development" "technology" for control law algorithms including "source code", used only in "FADEC systems" and used to regulate engine thrust or shaft power;

Note: 9E003.h. does not control the technical data related to the integration of the engine with the "aircraft", which at the request of the competent authorities of one or more EU member states or states participating in the Wassenaar Arrangement responsible for the control of civil aviation must be published for the general use of airlines (e.g. installation instructions, instructions for use, instructions for continued airworthiness) or interface function (eg input/ output signal processing, design requirement for engine thrust or shaft power).

and. "Technology" for adjustable flow direction systems designed to maintain stable operation gas-generator turbines, fan or drive nozzles, as follows:

1. "Development" "technology" for establishing functional requirements for components that maintain engine stability;

2. "Development" or "production" "technology" for components used only in systems adjustable flow direction designed to maintain engine operation stability;

3. "Development" "technology" for control law algorithms including "source code", which they are used only in the system of adjustable flow direction and which maintain the stability of the engine.

Note: 9E003.i. does not control "technology" for any of the following:

a. Intake directional circuits;

9E003 *b. Fans or propeller fans with variable pitch;*

c. Adjustable compressor circuits;

d. Compressor bleed valves; or

e. Adjustable flow direction geometry for reverse thrust.

j. "Technology" "required" for the "development" of wing folding systems designed for fixed wing "aircraft" powered by gas turbine engines.

NB: For the "technology" "required" for the "development" of wing folding systems designed for Fixed-wing "aircraft" powered by gas turbine engines see also NKL NVO.

k. "Technology", not specified in 9E003.a., 9E003.h. or 9E003.i., "required" for the "development" of either which of the following components or systems, specially designed for aero-gas turbine engines to enable an "aircraft" to cruise at Mach 1 or more for more than 30 minutes:

1. Drive input systems;

2. Driven exhaust systems;

3. 'Reheat systems';

4. 'Active thermal management systems' for conditioning fluids used to lubricate or cool 'engine rotor mounts';

5. 'Engine rotor mounts' without oil; or

6. Systems for removing heat from the gas flow in the core of the "compression system".

Technical notes:

For the purposes of 9E003.k.:

1. Propulsion inlet systems include pre-coolers in the core.

2. 'Reheat systems' provide additional thrust by burning fuel in the exhaust and/or by-pass downstream of the last stage of the turbomachine. 'Reheat systems' are also called afterburners.

3. 'Active thermal management systems' use methods other than passive oil-to-air cooling or oil-to-fuel cooling, such as vapor cycle systems.

4. 'Compression system' means any stage or combination of stages between the engine inlet surface and combustion chamber that increases the pressure in the gas path by mechanical operation.

5. 'Motor rotor mount' is the bearing that supports the main shaft of the motor that drives the system compression or turbine rotors.

NB. 1: *See 9E003.h. for engine management technology.*

NB. 2: *See 9E003.i. for the technology of adjustable flow path systems*

9E101 "Technology" as follows:

a. "Technology" according to the General Technology Note for the "development" of goods specified in 9A101, 9A102, 9A104 to 9A111, 9A112.a. or 9A115 to 9A121.

b. "Technology" according to the General Technology Note for the "production" of 'BL' specified in 9A012 or goods specified in 9A101, 9A102, 9A104 to 9A111, 9A112.a. or 9A115 to 9A121.

Technical Note: In 9E101.b. 'BL' stands for unmanned aerial vehicle system with a range greater than 300 km.

9E102 "Technology" according to the General Technology Note for "use" space launch vehicles specified in 9A004 or goods specified in 9A005 to 9A011, 'BL' specified in 9A012 or goods specified in 9A101, 9A102, 9A104 to 9A111, 9A112.a., 9A115 to 9A121, 9B105, 9B106, 9B115, 9B116, 9B117 , 9D101 or 9D103.

Technical Note: In 9E102 'BL' means an unmanned aerial vehicle system with a range greater than 300 km.