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PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN
MINISTRY OF FOREIGN AFFAIRS

NOTIFICATION

Islamabad, the 12th April, 2022

S. R. O. 551(I)/2022.— In exercise of the powers conferred by section 4 of the Export Control on Goods, Technologies, Material and Equipment related to Nuclear and Biological Weapons and their Delivery Systems Act, 2004 (Act No. V of 2004) the Federal Government is pleased to notify the amended Control Lists of Goods, Technologies, Material and Equipment related to Nuclear and Biological Weapons and their Delivery Systems. The Control Lists notified earlier *vide* S.R.O. 891(I)/2018, Islamabad dated 5th July, 2018 cease to exist.

GENERAL NOTES

1. These lists are in pursuance of the Export Control on Goods, Technologies, Material and Equipment related to Nuclear and Biological Weapon and their Delivery Systems Act, 2004, article 4(1).

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2. The objective of the controls contained in these lists should not be defeated by the export of any non-controlled goods (including plant) containing one or more controlled components when the controlled component or components are the principal element of the goods and can feasibly be removed or used for other purposes.

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

3. Goods specified in these lists include both new and used goods.

NUCLEAR TECHNOLOGY NOTE (NTN)

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

4. The "technology" directly associated with any goods controlled in Category 0 is controlled according to the provisions of Category 0. "Technology" for the "development", "production" or "use" of goods under control remains under control even when applicable to non-controlled goods. The approval of goods for export also authorizes the export to the same end-user of the minimum "technology" required for the installation, operation, maintenance and repair of the goods. Controls on "technology" transfer do not apply to information "in the public domain" or to "basic scientific research".

GENERAL TECHNOLOGY NOTE (GTN)

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

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

6. "Technology" "required" for the "development", "production" or "use" of goods under control remains under control even when applicable to non-controlled goods. Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those goods which are not controlled or whose export has been authorized.

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

GENERAL SOFTWARE NOTE (GSN)

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

8. Categories 0 to 9 of these lists do not control "software" which is either:

a. Generally available to the public by being:

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

a. Over-the-counter transactions; or

b. Mail order transactions; or

c. Electronic transactions; or

d. Telephone order transactions; and

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

b. "In the public domain".

9. The approval of any item for export also authorizes the export, or transfer, to the same end user of the minimum "software", excluding source code, required for the installation, operation, maintenance or repair of the item in order to ensure the item's safe operation as originally intended.

Note: The General Software Note also authorizes export of "software" intended to correct defects (bug fixes) in a previously legally exported item, provided that the capability and/or performance of the item are not otherwise enhanced.

EDITORIAL NOTE

In this document following Editorial Practice is followed:

a. A comma is used to separate the whole number from the decimals.

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

DEFINITIONS OF TERMS USED IN THESE LISTS

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

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

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

"All compensations available" means after all feasible measures available to the manufacturer to minimize all systematic positioning errors for the particular machine-tool models are considered.

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

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

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

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

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

"Composite" means a "matrix" and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes.

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

"Cryptography" means the discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification or prevent its un-authorized use. "Cryptography" is limited to the transformation of information using one or more 'secret parameters' (e.g., crypto variables) or associated key management.

N.B.: 'Secret parameter': a constant or key kept from the knowledge of others or shared only within a group.

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

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

"Digital computer" means equipment, which can, in the form of one or more discrete variables, perform all of the following:

a. Accept data;

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

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

d. Provide output of data.

N.B.: Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or inter-connections.

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

"Effective gramme" of "special fissile material" means:

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

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

c. For uranium enriched below 1 per cent in the isotope uranium-235, the element weight in grammes multiplied by 0,0001.

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

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

"Fibrous or filamentary materials" include:

a. Continuous "monofilaments";

b. Continuous "yarns" and "rovings";

c. "Tapes", fabrics, random mats and braids;

d. Chopped fibres, staple fibres and coherent fibre blankets;

e. Whiskers, either monocrystalline or polycrystalline, of any length;

f. Aromatic polyamide pulp.

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

"Guidance set" means systems that integrate the process of measuring and computing a vehicle's position and velocity (*i.e.* navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.

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

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

"Information security" is all the means and functions ensuring the accessibility, confidentiality or integrity of information or communications, excluding the means and functions intended to safeguard against malfunctions. This includes "cryptography", 'cryptanalysis', protection against compromising emanations and computer security.

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

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

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

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

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

"Laser" is an assembly of components which produce both spatially and temporally coherent light that is amplified by stimulated emission of radiation.

N.B.: See also: "Chemical laser";

"Transfer laser".

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

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

"Matrix" means a substantially continuous phase that fills the space between particles, whiskers or fibres.

"Measurement un-certainty" is the characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95 %. It includes the un-corrected systematic deviations, the un-corrected backlash and the random deviations.

"Microcircuit" means a device in which a number of passive and/or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.

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

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

"Missiles" means complete rocket systems and un-manned air vehicle systems, capable of delivering at least 500 kg "payload" to a "range" of at least 300 km.

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

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

"Nuclear reactor" means a reactor capable of operation so as to maintain a controlled self-sustaining fission chain reaction, it basically includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain or come in direct contact with or control the primary coolant of the reactor core.

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

"Payload" means the total mass that can be carried or delivered by the specified rocket system or unmanned aerial vehicle (UAV) system that is not used to maintain flight.

Note: The particular equipment, sub-systems, or components to be included in the "payload" depends on the type and configuration of the vehicle under consideration.

Technical Notes:

1. *Ballistic Missiles*

   a. *"Payload" for systems with separating re-entry vehicles (RVs) includes:*

1. *The RVs, including:*

   a. *Dedicated guidance, navigation, and control equipment;*

   b. *Dedicated countermeasures equipment;*

2. *Munitions of any type (e.g. explosive or non-explosive);*

3. *Supporting structures and deployment mechanisms for the munitions (e.g. hardware used to attach to, or separate the RV from, the bus/post-boost vehicle) that can be removed without violating the structural integrity of the vehicle;*

4. *Mechanisms and devices for safing, arming, fuzing or firing;*

5. *Any other countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that separate from the RV bus/post-boost vehicle;*

6. *The bus/post-boost vehicle or attitude control/velocity trim module not including systems/subsystems essential to the operation of the other stages.*

b. *"Payload" for systems with non-separating re-entry vehicles includes:*

1. *Munitions of any type (e.g. explosive or non-explosive);*

2. *Supporting structures and deployment mechanisms for the munitions that can be removed without violating the structural integrity of the vehicle;*

3. *Mechanisms and devices for safing, arming, fuzing or firing;*

4. *Any countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle.*

2. *Space Launch Vehicles*

"Payload" includes:

a. *"Spacecraft" (single or multiple), including satellites;*

b. Spacecraft-to-launch vehicle adapters including, if applicable, apogee/perigee kick motors or similar manoeuvering systems and separation systems.

3. Sounding Rockets

"Payload" includes:

a. Equipment required for a mission, such as data gathering, recording or transmitting devices for mission-specific data;

b. Recovery equipment (e.g. parachutes) that can be removed without violating the structural integrity of the vehicle.

4. Cruise Missiles

"Payload" includes:

a. Munitions of any type (e.g. explosive or non-explosive);

b. Supporting structures and deployment mechanisms for the munitions that can be removed without violating the structural integrity of the vehicle;

c. Mechanisms and devices for safing, arming, fuzing or firing;

d. Countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle;

e. Signature alteration equipment that can be removed without violating the structural integrity of the vehicle.

5. Other UAVs

"Payload" includes:

a. Munitions of any type (e.g. explosive or non-explosive);

b. Mechanisms and devices for safing, arming, fuzing or firing;

c. Countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle;

d. Signature alteration equipment that can be removed without violating the structural integrity of the vehicle;

e. Equipment required for a mission such as data gathering, recording or transmitting devices for mission-specific data and supporting structures that can be removed without violating the structural integrity of the vehicle;

f. Recovery equipment (e.g. parachutes) that can be removed without violating the structural integrity of the vehicle.

g. Munitions supporting structures and deployment mechanisms that can be removed without violating the structural integrity of the vehicle.

"Pressure transducers" are devices that convert pressure measurements into a signal.

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

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

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

"Programme" means a sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"Radiation hardened" means that the component or equipment is designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5×10^5 rads (Si).

"Range" means the maximum distance that the specified rocket system or unmanned aerial vehicle (UAV) system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth.

Technical Notes:

1. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining "range".

2. *The "range" for both rocket systems and UAV systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links or other external constraints.*

3. *For rocket systems, the "range" will be determined using the trajectory that maximises "range", assuming ICAO standard atmosphere with zero wind.*

4. *For UAV systems, the "range" will be determined for a one-way distance using the most fuel-efficient flight profile (e.g. cruise speed and altitude), assuming ICAO standard atmosphere with zero wind.*

"Repeatability" means the closeness of agreement among repeated measurements of the same variable under the same operating conditions when changes in conditions or non-operating periods occur between measurements. (Reference: IEEE STD 528-2001, definition section paragraph 2.214)

"Required" as applied to "technology" or "software", refers to only that portion of "technology" or "software" which is peculiarly responsible for achieving or extending the controlled performance levels, characteristics or functions. Different goods may share such "required" "technology" or "software".

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

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

a. Is multifunctional;

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

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

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

N.B. 1: In the above definition 'sensors' means detectors of a physical phenomenon, the output of which (after conversion into a signal that can be interpreted by a control unit) is able to generate "programmes" or modify programmed instructions or numerical "programme" data. This includes 'sensors' with machine vision, infrared imaging, acoustical imaging, tactile feel, inertial position measuring, optical or acoustic ranging or force or torque measuring capabilities.

N.B. 2: The above definition does not include the following devices:

a. *Manipulation mechanisms, which are only manually/teleoperator controllable;*

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

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

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

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

"Roving" is a bundle (typically 12-120) of approximately parallel 'strands'.

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

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

"Software" means a collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

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

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

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

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

"Tape" is a material constructed of interlaced or unidirectional "monofilaments", 'strands', "rovings", "tows", or "yarns", etc., usually pre-impregnated with resin.

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

"Technology" means specific information necessary for the "development", "production" or "use" of goods. This information takes the form of 'technical data' or 'technical assistance'.

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

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

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

"Toxins" means toxins in the form of deliberately isolated preparations or mixtures, no matter how produced, other than toxins present as contaminants

of other materials such as pathological specimens, crops, foodstuffs or seed stocks of "microorganisms".

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

"Uranium enriched in the isotopes 235 or 233" means uranium containing the isotopes 235 or 233, or both, in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is more than the ratio of the isotope 235 to the isotope 238 occurring in nature (isotopic ratio 0,72 per cent).

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

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

a. A physical change in wiring or interconnections; or

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

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

"Yarn" is a bundle of twisted 'strands'.

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

ACRONYMS, ABBREVIATIONS AND UNITS USED IN THESE LISTS

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

Acronym, Abbreviation or Unit	Meaning
A	Ampere
ABEC	Annular Bearing Engineers Committee
AMBA	American Bearing Manufactures Association

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AVLIS	Atomic vapour laser isotope separation
°C	Degree Celsius
CAS	Chemical Abstracts Service
CEP	Circular error probability/circle of equal probability
Ci	Curie
cm	Centimeter
CRISLA	Chemical reaction by isotope selective laser activation
CVD	Chemical vapour deposition
CW	Chemical weapon
°	Degree
dB	Decibel
EDM	Electrical discharge machines
g	Gramme; also, acceleration due to gravity
GBq	Gigabecquerel
GHz	Gigahertz
GLONASS	Global'naya Navigatsionnaya Sputnikovaya Sistema
GNSS	Global navigation satellite system
GPS	Global positioning system
GPa	Gigapascal
Gy (silicon)	Gray
h	Hour

Hz	Hertz
ICAO	International Civil Aviation Organisation
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
J	Joule
K	Kelvin
keV	Kiloelectron volt
kg	Kilogramme
kHz	Kilohertz
km	Kilometer
kN	Kilonewton
kPa	Kilopascal
kV	Kilovolt
kW	Kilowatt
m	Meter
mA	Milliampere
Mach	Ratio of speed of an object to speed of sound (after Ernst Mach)
MeV	Million electon volt/mega electon volt
MHz	Megahertz
min	Minute
MLIS	Molecular laser isotopic separation
mm	Millimeter
µF	Microfarad
µm	Micrometer

µPa	Micropascal
µs	Microsecond
ml	Millilitre
MNs	Meganewton second
MPa	Megapascal
MW	Megawatt
N	Newton
nF	Nanofarad
nH	Nanohenry
nm	Nanometer
ns	Nanosecond
NavIC	Indian Regional Navigation Satellite System
Pa	Pascal
ppm	Parts per million
ps	Picosecond
QZSS	Quasi Zenith Satellite System
rad (silicon)	Radiation absorbed dose
rms	Root mean square
rpm	Revolutions per minute
RNSS	Regional Navigation Satellite System
RV	Re-entry vehicle
s	Second
SAE	Society of Automotive Engineers International
T	Tesla

u	unified atomic mass unit - mass on an atomic or molecular scale
UAV	Unmanned aerial vehicle
V	Volt
VA	Volt-ampere
W	Watt

CATEGORY 0

NUCLEAR MATERIALS, FACILITIES, AND EQUIPMENT

0A Systems, Equipment and Components

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

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

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

Note: In 0A001.b. nuclear reactor vessels include reactor pressure vessels, and calandrias regardless of pressure rating.

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

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

e. Pressure tubes specially designed or prepared to contain fuel elements and the primary coolant in a "nuclear reactor";

Note: Pressure tubes are parts of fuel channels designed to operate at elevated pressure, sometimes in excess of 5 MPa.

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

Note: Zirconium metal tubes or zirconium alloy tubes for use in a nuclear reactor consist of zirconium in which the relation of hafnium to zirconium is typically less than 1:500 parts by weight.

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

Note: Especially designed or prepared pumps or circulators include pumps for water-cooled reactors, circulators for gas-cooled reactors, and electromagnetic and mechanical pumps for liquid-metal-cooled reactors. This equipment may include pumps with elaborate sealed or multi-sealed systems to prevent leakage of primary coolant, canned-driven pumps, and pumps with inertial mass systems. This definition encompasses pumps certified to Section III, Division I, Subsection NB (Class 1 components) of the American Society of Mechanical Engineers (ASME) Code, or equivalent standards.

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

Technical Note:

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

i. Heat exchangers as follows:

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

2. Other heat exchangers especially designed or prepared for use in the primary or intermediate coolant circuit of a "nuclear reactor";

Note: The scope of control for this entry does not include heat exchangers for the supporting systems of the reactor, e.g., the emergency cooling system or the decay heat cooling system.

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

Note: The scope of this entry encompasses in-core and ex-core detectors which measure flux levels in a wide range, typically from 10^4 neutrons per cm^2 per second or more. Ex-core refers to those instruments outside the core of a reactor as defined in "nuclear reactor", but located within the biological shielding.

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

Technical Note:

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

0B Test, Inspection and Production Equipment

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

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

1. Gas centrifuge separation plant;
2. Gaseous diffusion separation plant;
3. Aerodynamic separation plant;
4. Chemical exchange separation plant;
5. Ion-exchange separation plant;
6. Atomic vapour "laser" isotope separation (AVLIS) plant;
7. Molecular "laser" isotope separation (MLIS) plant;
8. Plasma separation plant;
9. Electromagnetic separation plant;

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

Technical Note:

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

a. Maraging steel capable of an ultimate tensile strength of 1,95 GPa or more;

b. Aluminum alloys capable of an ultimate tensile strength of 0,46 GPa or more; or

c. "Fibrous or filamentary materials" with a "specific modulus" of more than 3,18 × 10^6 m and a "specific tensile strength" greater than 76,2 × 10^3 m;

1. Gas centrifuges;

2. Complete rotor assemblies;

3. Rotor tube cylinders with a wall thickness of 12 mm or less, a diameter of between 75 mm and 650 mm, made from 'high strength-to-density ratio materials';

4. Rings or bellows with a wall thickness of 3 mm or less and a diameter of between 75 mm and 650 mm and designed to give local support to a rotor tube or to join a number together, made from 'high strength-to-density ratio materials';

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

6. Top or bottom caps of between 75 mm and 650 mm diameter to fit the ends of a rotor tube, made from 'high strength-to-density ratio materials';

7. Magnetic suspension bearings as follows:

   a. Bearing assemblies consisting of an annular magnet suspended within a housing made of or protected by "materials resistant to corrosion by UF_6" containing a damping medium and having the magnet coupling with a pole piece or second magnet fitted to the top cap of the rotor;

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

c. The magnet may be in a form having an initial permeability of 0.15 H/m or more, or a remanence of 98.5% or more, or an energy product of greater than 80 kJ/m^3. In addition to the usual material properties, it is a prerequisite that the deviation of the magnetic axes from the geometrical axes is limited to very small tolerances (lower than 0.1 mm) or that homogeneity of the material of the magnet is specially called for.

Technical Note:

These bearings usually have the following characteristics:

a. Designed to keep centred a rotor spinning at 600 Hz or more; and

b. Associated to a reliable electrical power supply and/or to an uninterruptible power supply (UPS) unit in order to function for more than one hour;

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

Technical Note:

The pivot is normally a hardened steel shaft with a hemisphere at one end with a means of attachment to the bottom cap at the other.

9. Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores. Typical dimensions are as follows: 75 mm to 650 mm internal diameter, 10 mm or more wall thickness, with the length equal to or greater than the diameter. The grooves are typically rectangular in cross-section and 2 mm or more in depth;

10. Ring-shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum at a frequency of 600 Hz or greater and a power of 40 VA or greater. The stators may consist of multi-phase windings on a laminated low loss iron core comprised of thin layers typically 2 mm thick or less;

11. Centrifuge housing/recipients to contain the rotor tube assembly of a gas centrifuge, consisting of a rigid cylinder of wall thickness up to 30 mm with precision machined ends to locate the bearings and with one or more

flanges for mounting. The machined ends are parallel to each other and perpendicular to the cylinder's longitudinal axis to within 0,05 degrees or less. The housing may also be a honeycomb type structure to accommodate several rotor assemblies;

12. Scoops consisting of tubes for the extraction of UF_6 gas from within a centrifuge rotor tube by a Pitot tube action (that is, with an aperture facing into the circumferential gas flow within the rotor tube, for example by bending the end of a radially disposed tube) and capable of being fixed to the central gas extraction system;

13. Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having both of the following characteristics, and specially designed components therefor:

a. Multiphase frequency output of 600 Hz or greater; and

b. High stability (Frequency control better than 0,2 %);

14. Shut-off and control valves as follows:

a. Shut-off valves specially designed or prepared to act on the feed, product or tails UF_6 gas streams of an individual gas centrifuge;

b. Bellows-sealed valves, manual or automated, shut-off or control, made of or protected by "materials resistant to corrosion by UF_6", with an inside diameter of 10 mm to 160 mm, specially designed or prepared for use in main or auxiliary systems of gas centrifuge enrichment plants;

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

1. Gaseous diffusion barriers (hermetically sealed vessels) and barrier materials made of porous metallic, polymer or ceramic "materials resistant to corrosion by UF_6" with a pore size of 10 to 100 nm, a thickness of 5 mm or less, and, for tubular forms, a diameter of 25 mm or less;

2. Gaseous diffuser housings made of or protected by "materials resistant to corrosion by UF_6";

3. Especially designed or prepared compressors or gas blowers with a suction volume capacity of 1 m^3/min or more of UF_6, with a discharge pressure up to 500 kPa, and designed for long-term operation in the UF_6 environment, as well as

separate assemblies of such compressors and gas blowers. These compressors and gas blowers have a pressure ratio of 10:1 or less and are made of or protected by "materials resistant to corrosion by UF_6";

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

5. Especially designed or prepared heat exchangers made of or protected by "materials resistant to corrosion by UF_6, designed to operate at sub-atmospheric pressure with a leak rate that limits the pressure rise to less than 10 Pa per hour under a pressure differential of 100 kPa;

6. Especially designed or prepared bellows-sealed valves, manual or automated, shut-off or control, made of or protected by "materials resistant to corrosion by UF_6", for installation in main and auxiliary systems of gaseous diffusion enrichment plants;

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

1. Separation nozzles consisting of slit-shaped, curved channels having a radius of curvature less than 1 mm, resistant to corrosion by UF_6, and having a knife-edge contained within the nozzle which separates the gas flowing through the nozzle into two streams;

2. Tangential inlet flow-driven cylindrical or conical tubes, (vortex tubes), made of or protected by "materials resistant to corrosion by UF_6" and with one or more tangential inlets;

3. Compressors or gas blowers made of or protected by "materials resistant to corrosion by UF_6", and rotary shaft seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor or the gas blower rotor with the driver motor so as to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor or gas blower which is filled with a UF_6/carrier gas mixture;

4. Heat exchangers made of or protected by "materials resistant to corrosion by UF_6";

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

6. Bellows valves, manual or automated, shut-off or control, made of or protected by "materials resistant to corrosion by UF6", with a diameter of 40 mm or greater;

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

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

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

   c. Separation nozzle or vortex tube units for the separation of UF_6 from carrier gas;

   d. UF_6 cold traps capable of freezing out UF_6;

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

1. Countercurrent liquid-liquid exchange columns having mechanical power input, with stage residence time of 30 seconds or less and resistant to concentrated hydrochloric acid (e.g. made of or protected by suitable plastic materials such as fluorinated hydrocarbon polymers or glass);

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

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

4. Electrochemical reduction cells feed equipment to take U^{+4} from the organic stream and, for those parts in contact with the process stream, made of or protected by suitable materials (e.g. glass, fluorocarbon polymers, polyphenyl sulphate, polyether sulphone and resin-impregnated graphite);

5. Feed preparation systems for producing high purity uranium chloride solution consisting of dissolution, solvent extraction and/or ion exchange equipment for purification and electrolytic cells for reducing the uranium U^{+6} or U^{+4} to U^{+3};

6. Uranium oxidation systems for oxidation of U^{+3} to U^{+4};

f. Equipment and components, specially designed or prepared for ion-exchange separation process, as follows:

1. Fast reacting ion-exchange resins, pellicular or porous macro-reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inactive porous support structure, and other composite structures in any suitable form, including particles or fibres, with diameters of 0,2 mm or less, resistant to concentrated hydrochloric acid and designed to have an exchange rate half-time of less than 10 seconds and capable of operating at temperatures in the range of 373 K (100 °C) to 473 K (200 °C);

2. Ion exchange columns (cylindrical) with a diameter greater than 1000 mm, made of or protected by materials resistant to concentrated hydrochloric acid (e.g. titanium or fluorocarbon plastics) and capable of operating at temperatures in the range of 373 K (100 °C) to 473 K (200 °C) and pressures above 0,7 MPa;

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

g. Equipment and components, specially designed or prepared for atomic vapour "laser" isotope separation process (AVLIS), as follows:

1. Electron beam guns designed to achieve a delivered power (1 kW or greater) on the target sufficient to generate uranium metal vapour at a rate required for the laser enrichment function; as derived.

N.B.: See also 2A225.

2. Liquid or vapour uranium metal handling systems for molten uranium or molten uranium alloys or uranium metal vapour for use in laser enrichment, consisting of crucibles, made of or protected by suitable corrosion and heat resistant materials (e.g. tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof), and cooling equipment for the crucible.

3. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium metal vapour or liquid, such as yttria-coated graphite or tantalum;

4. Separator module housings (cylindrical or rectangular vessels) for containing the uranium metal vapour source, the electron beam gun and the product and tails collectors;

5. "Lasers" or "laser" systems for the separation of uranium isotopes with a spectrum frequency stabiliser for operation over extended periods of time;

N.B.: See also 6A205.

h. Equipment and components, specially designed or prepared for molecular "laser" isotope separation process (MLIS) or chemical reaction by isotope selective laser activation (CRISLA), as follows:

1. Supersonic expansion nozzles for cooling mixtures of UF_6 and carrier gas to 150 K (–123 °C) or less and made from "materials resistant to corrosion by UF_6";

2. Components or devices for collecting uranium product material or uranium tails material consisting of filter, impact, or cyclone-type collectors or combinations thereof, and made of "materials resistant to corrosion by UF_5/UF_6";

3. Compressors for UF_6/carrier gas mixtures, designed for long term operation in a UF_6 environment made of or protected by "materials resistant to corrosion by UF_6", and rotary shaft seals as mentioned in 0B001.d.3.;

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

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

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

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

   c. UF_6 cold traps capable of freezing out UF_6;

6. "Lasers" or "laser" systems for the separation of uranium isotopes with a spectrum frequency stabiliser for operation over extended periods of time;

   N.B.: See also 6A205.

i. Equipment and components, specially designed or prepared for plasma separation process, as follows:

1. Microwave power sources and antennae for producing or accelerating ions, with an output frequency greater than 30 GHz and mean power output greater than 50 kW;

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

3. Uranium plasma generation systems;

4. Liquid metal handling systems for molten uranium or uranium alloys, consisting of crucibles, made of or protected by suitable corrosion and heat resistant materials (*e.g.* tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof), and cooling equipment for the crucibles;

N.B.: See also 2A225.

5. Product and tails collectors made of or protected by materials resistant to the heat and corrosion of uranium vapour such as yttria-coated graphite or tantalum;

6. Separator module housings (cylindrical) for containing the uranium plasma source, radio-frequency drive coil and the product and tails collectors and made of a suitable non-magnetic material (*e.g.* stainless steel);

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

1. Ion sources, single or multiple, consisting of a vapour source, ioniser, and beam accelerator made of suitable non-magnetic materials (*e.g.* graphite, stainless steel, or copper) and capable of providing a total ion beam current of 50 mA or greater;

2. Ion collector plates for collection of enriched or depleted uranium ion beams, consisting of two or more slits and pockets and made of suitable non-magnetic materials (*e.g.* graphite or stainless steel);

3. Vacuum housings for uranium electromagnetic separators made of non-magnetic materials (*e.g.* stainless steel) and designed to operate at pressures of 0,1 Pa or lower;

4. Magnet pole pieces with a diameter greater than 2 m;

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

   a. Capable of continuous operation;

   b. Output voltage of 20 000 V or greater;

   c. Output current of 1 A or greater; and

   d. Voltage regulation of better than 0,01 % over a period of 8 hours;

   N.B.: See also 3A227.

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

   a. Capable of continuous operation with a current output of 500 A or greater at a voltage of 100 V or greater; and

   b. Current or voltage regulation better than 0,01 % over a period of 8 hours.

   N.B.: See also 3A226.

0B002 Specially designed or prepared auxiliary systems, equipment and components, as follows, for isotope separation plant specified in 0B001, made of or protected by "materials resistant to corrosion by UF_6":

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

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

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

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

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

f. 1. Especially designed or prepared vacuum manifolds or vacuum headers or vacuum pumps having a suction capacity of 5 m^3 per minute or more; or

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

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

1. Capable of measuring ions of 320 u or greater and having a resolution of better than 1 part in 320;

2. Ion sources constructed of or protected by nickel, nickel-copper alloys with a nickel content of 60 % by weight or more, or nickel-chrome alloys;

3. Electron bombardment ionisation sources; and

4. Having a collector system suitable for isotopic analysis.

0B003 Plant for the conversion of uranium and equipment specially designed or prepared therefor, as follows:

a. Systems for the conversion of uranium ore concentrates to uranium trioxide (UO_3);

b. Systems for the conversion of UO_3 to UF_6;

c. Systems for the conversion of UO_3 to uranium dioxide (UO_2);

d. Systems for the conversion of UO_2 to uranium tetrafluoride (UF_4);

e. Systems for the conversion of UF_4 to UF_6;

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

g. Systems for the conversion of UF_6 to UO_2;

h. Systems for the conversion of UF_6 to UF_4;

i. Systems for the conversion of UO_2 to uranium tetrachloride (UCl_4).

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

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

1. Water-hydrogen sulphide exchange plants;

2. Ammonia-hydrogen exchange plants;

b. Equipment and components, as follows:

1. Water-hydrogen sulphide exchange towers with diameters of 1,5 m or greater and capable of operating at pressures greater than or equal to 2 MPa especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process;

2. Single stage, low head (*i.e.* 0,2 MPa) centrifugal blowers or compressors for hydrogen sulphide gas circulation (*i.e.* gas containing more than 70 % by weight hydrogen sulphide, H_2S) with a throughput capacity greater than or equal to 56 m^3/s when operating at pressures greater than or equal to 1,8 MPa suction and having seals designed for wet H_2S service;

3. Ammonia-hydrogen exchange towers greater than or equal to 35 m in height with diameters of 1,5 m to 2,5 m capable of operating at pressures greater than 15 MPa;

4. Tower internals, including stage contactors which promote intimate gas/liquid contact, and stage pumps, including those which are submersible, for heavy water production utilizing the ammonia-hydrogen exchange process;

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

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

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

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

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

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

Note 1: A plant for the fabrication of "nuclear reactor" fuel elements includes equipment which:

a. *Normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;*

b. *Seals the nuclear materials within the cladding;*

c. *Checks the integrity of the cladding or the seal;*

d. *Checks the finish treatment of the sealed fuel; or*

e. *Is used for assembling reactor fuel elements.*

Note 2: Such equipment or systems of equipment may include, for example:

a. *Fully automatic pellet inspection stations especially designed or prepared for checking final dimensions and surface defects of the fuel pellets;*

b. *Automatic welding machines especially designed or prepared for welding end caps onto the fuel pins (or rods);*

c. *Automatic test and inspection stations especially designed or prepared for checking the integrity of completed fuel pins (or rods);*

d. *Systems especially designed or prepared to manufacture nuclear fuel cladding.*

Item c typically includes equipment for: 1) x-ray examination of pin (or rod) end cap welds, 2) helium leak detection from pressurized pins (or rods), and 3) gamma-ray scanning of the pins (or rods) to check for correct loading of the fuel pellets inside.

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

Note: 0B006 includes:

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

b. *Fuel element decladding equipment and chopping or shredding machines, i.e. remotely operated equipment to expose or prepare the irradiated "nuclear material" in fuel assemblies, bundles or rods for processing;*

Technical Note:

This equipment cuts, chops, shears or otherwise breaches the cladding of the fuel to expose the irradiated nuclear material for processing or prepares the fuel for processing. Especially designed cutting shears are most commonly employed, although advanced equipment, such as lasers, peeling machines, or other techniques, may be used. Decladding involves removing the cladding of the irradiated nuclear fuel prior to its dissolution.

c. *Dissolver vessels or dissolvers employing mechanical devices specially designed or prepared for the dissolution of irradiated "nuclear reactor" fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded, operated and maintained;*

Technical Note:

Dissolvers normally receive the solid, irradiated nuclear fuel. Nuclear fuels with cladding made of material including zirconium, stainless steel, or alloys of such materials must be decladded and/or sheared or chopped prior to being charged to the dissolver to allow the acid to reach the fuel matrix. The irradiated nuclear fuel is typically dissolved in strong mineral acids, such as nitric acid, and any undissolved cladding removed. While certain design features, such as small diameter, annular, or slab tanks, may be used to ensure criticality safety, they are not a necessity. Administrative controls, such as small batch size or low fissile material content, may be used instead. Dissolver vessels and dissolvers employing mechanical devices are normally fabricated

of material such as low carbon stainless steel, titanium or zirconium, or other high-quality materials. Dissolvers may include systems for the removal of cladding or cladding waste and systems for the control and treatment of radioactive off-gases. These dissolvers may have features for remote placement since they are normally loaded, operated and maintained behind thick shielding.

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

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

Technical Note:

Holding or storage vessels may have the following features:

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

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

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

f. Neutron measurement systems specially designed or prepared for integration and use with automated process control systems in a plant for the reprocessing of irradiated "natural uranium", "depleted uranium" or "special fissile materials".

Note: These systems involve the capability of active and passive neutron measurement and discrimination in order to determine the fissile material quantity and composition. The complete system is composed of a neutron generator, a neutron detector, amplifiers, and signal processing electronics.

The scope of this entry does not include neutron detection and measurement instruments that are designed for nuclear material accountancy and safeguarding or any other application not related to integration and use with automated process control systems in a plant for the reprocessing of irradiated fuel elements.

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

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

b. Systems for plutonium metal production.

0C Materials

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

Note: 0C001 does not control the following:

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

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

1. Shielding;

2. Packaging;

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

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

c. Alloys containing less than 5 % thorium;

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

0C002 "Special fissile materials"

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

0C003 Deuterium, heavy water (deuterium oxide) and any other deuterium compound in which the ratio of deuterium to hydrogen exceeds 1:5 000 for use in a nuclear reactor in quantities exceeding 200 kg of deuterium atoms for any one recipient country within a period of one calendar year (1 Jan – 31 Dec).

0C004 Graphite, nuclear grade, having a purity level of less than 5 ppm 'boron equivalent' and with a density greater than 1,5 g/cm^3, in quantities exceeding 1 kg.

N.B.: See also 1C107.

Note 1: For the purpose of export control, the Government will determine whether or not the exports of graphite meeting the above specifications are for nuclear reactor use.

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

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

where CF is the conversion factor = $(\sigma_Z \times A_B)/(\sigma_B \times A_Z)$

and σ_B and σ_Z are the thermal neutron capture cross sections (in barns) for naturally occurring boron and element Z respectively; and A_B and A_Z are the atomic masses of naturally occurring boron and element Z respectively.

0C005 Specially prepared compounds or powders for the manufacture of gaseous diffusion barriers, resistant to corrosion by UF_6 (*e.g.* nickel or alloy containing 60 % or more nickel, aluminium oxide and fully fluorinated hydrocarbon polymers), having a purity of 99,9 % or more and a mean particle size of less than 10 µm and a high degree of particle size uniformity, which are especially prepared for the manufacture of gaseous diffusion barriers.

0D Software

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

0E Technology

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

CATEGORY 1

MATERIALS, CHEMICALS, "MICROORGANISMS" & "TOXINS"

1A Systems, Equipment and Components

1A102 Resaturated pyrolized carbon-carbon components designed for and useable in the systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.

1A202 Composite structures in the form of tubes and having both of the following characteristics:

N.B.: See also 1C210 & 9A110.

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

b. Made with any of the "fibrous or filamentary materials" specified in 1C210.a. or with carbon prepreg materials specified in 1C210.c.

1A224 Target assemblies and components for the production of tritium as follows:

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

b. Components specially designed for the target assemblies specified in item 1A224.a.

Technical Note:

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

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

1A226 Specialized packings which may be used in separating heavy water from ordinary water, having both of the following characteristics:

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

b. Designed to be used in vacuum distillation towers.

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

a. A 'cold area' greater than 0,09 m^2;

b. A density greater than 3 g/cm^3; and

c. A thickness of 100 mm or greater.

Technical Note:

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

1B Test, Inspection and Production Equipment

1B101 Equipment for the "production" of structural composites, fibers, prepregs or performs usable in systems specified in 9A104, as follows; and specially designed components and accessories therefor:

N.B.: See also 1B201.

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

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

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

Note: For the purposes of 1B101.a. and 1B101.b., the following definitions apply:

a. *A 'filament band' is a single continuous width of fully or partially resin-impregnated tape, tow, or fibre. Fully or partially resin-impregnated 'filament bands' include those coated with dry powder that tacks upon heating.*

b. *'Fibre/tow-placement machines' and 'tape-laying machines' are machines that perform similar processes that use*

computer-guided heads to lay one or several 'filament bands' onto a mold to create a part or a structure. These machines have the ability to cut and restart individual 'filament band' courses during the laying process.

c. *'Fibre/tow-placement machines' have the ability to place one or more 'filament bands' having widths less than or equal to 25,4 mm. This refers to the minimum width of material the machine can place, regardless of the upper capability of the machine.*

c. Equipment designed or modified for the "production" of "fibrous or filamentary materials" as follows

1. Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon or polycarbosilane) including special provision to strain the fibre during heating;

2. Equipment for the vapour deposition of elements or compounds on heated filament substrates;

3. Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);

d. Equipment designed or modified for special fibre surface treatment or for producing prepregs and preforms specified in entry 9C110.

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

e. Multi-directional, multi-dimensional weaving machines or interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibers to manufacture composite structures;

Note: 1B101.e does not control textile machinery not modified for the end-uses stated.

1B102 Metal powder "production equipment" and components as follows:

N.B.: See also 1B115.b.

a. Metal powder "production equipment" usable for the "production", in a controlled environment, of spherical, spheroidal, or atomised materials specified in 1C111.a.1., 1C111.a.2., and 1C111.a.6.

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

Note: 1B102 includes:

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

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

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

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

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

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

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

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

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

1B117 Batch mixers designed or modified for mixing under vacuum in the range of zero to 13,326 kPa, capable of controlling the temperature of the mixing chamber and having all of the following, and specially designed components therefor:

Technical Note:

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

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

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

b. A capacity greater than 8,5 m^3/h; and

c. Either of the following characteristics:

1. For concentrated potassium amide solutions (1 % or greater), an operating pressure of 1,5 to 60 MPa; or

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

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

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

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

1. Hydrogen or helium refrigeration units capable of cooling to 23 K (–250 °C) or less, with heat removal capacity greater than 150 W;

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

1B232 Turboexpanders or turboexpander-compressor sets having both of the following characteristics:

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

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

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

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

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

1. Packed liquid-liquid exchange columns specially designed for lithium amalgams;

2. Mercury or lithium amalgam pumps;

3. Lithium amalgam electrolysis cells;

4. Evaporators for concentrated lithium hydroxide solution.

c. Ion exchange systems specially designed for lithium isotope separation, and specially designed component parts therefor;

d. Chemical exchange systems (employing crown ethers, cryptands, or lariat ethers) specially designed for lithium isotope separation, and specially designed component parts therefor.

N.B.: Certain lithium isotope separation equipment and components for the plasma separation process (PSP) are also directly applicable to uranium isotope separation and are controlled under 0B001.

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

a. Designed to fully contain an explosion equivalent to 2 kg of TNT or greater; and

b. Having design elements or features enabling real time or delayed transfer of diagnostic or measurement information.

1C Materials

1C101 Materials and devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures usable in systems specified in 7A117, 9A012, 9A104, 9A105, 9A107, 9A109, 9A116 and 9A119 and their subsystems.

Note 1: 1C101 includes:

a. Structural materials and coatings specially designed for reduced radar reflectivity;

b. Coatings, including paints, specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet regions of the electromagnetic spectrum.

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

1C102 Resaturated pyrolized carbon-carbon materials designed for and usable in systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.

1C107 Graphite and ceramic materials as follows:

a. Fine grain graphites having a bulk density of 1,72 g/cm^3 or greater, measured at 288 K (15 °C), and having a particle size of 100 µm or less, usable for rocket nozzles and re-entry vehicle nose tips, which can be machined to any of the following products:

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

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

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

b. Pyrolytic or fibrous reinforced graphites, usable for rocket nozzles and re-entry vehicle nose tips usable in systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.;

c. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 MHz to 100 GHz) for use in radomes usable in systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.;

d. Bulk machinable silicon-carbide reinforced unfired ceramic, usable for nose tips usable in systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.;

e. Reinforced silicon-carbide ceramic composites usable for nose tips, re-entry vehicles, nozzle flaps usable in systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.

f. Bulk machinable ceramic composite materials consisting of an 'Ultra High Temperature Ceramic (UHTC)' matrix with a melting point equal to or greater than 3000°C and reinforced with fibres or filaments, usable for missile components (such as nose-tips, re-entry vehicles, leading edges, jet vanes, control surfaces or rocket motor throat inserts) in the systems specified in 9A104

Note:

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

Technical Note:

'Ultra High Temperature Ceramics (UHTC)' includes:

a. Titanium diboride (TiB_2);

b. Zirconium diboride (ZrB_2);

c. Niobium diboride (NbB_2);

d. Hafnium diboride (HfB_2);

e. Tantalum diboride (TaB_2);

f. Titanium carbide (TiC);

g. Zirconium carbide (ZrC);

h. Niobium carbide (NbC);

i. Hafnium carbide (HfC);

j. Tantalum carbide (TaC).

1C111 Propellants and constituent chemicals for propellants, as follows:

a. Propulsive substances:

1. Spherical or spheroidal aluminium powder, (CAS 7429-90-5) in particle size of less than 200 μm and an aluminium content of 97 % by weight or more, if at least 10 % of the total weight is made up of particles of less than 63 μm, according to ISO 2591:1988 or national equivalents;

Technical Note:

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

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

   a. Zirconium (CAS 7440-67-7);

   b. Beryllium (CAS 7440-41-7);

   c. Magnesium (CAS 7439-95-4); or

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

   Technical Note:

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

3. Oxidisers/fuels as follows:

   a. Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components.

   b. Hydroxylammonium nitrate (HAN) (CAS 13465-08-2).

   c. Liquid oxidiser substances as follows:

      1. Dinitrogen trioxide (CAS 10544-73-7);

      2. Nitrogen dioxide (CAS 10102-44-0)/dinitrogen tetroxide (CAS 10544-72-6);

      3. Dinitrogen pentoxide (CAS 10102-03-1);

      4. Mixed Oxides of Nitrogen (MON);

      5. Inhibited Red Fuming Nitric Acid (IRFNA) (CAS 8007-58-7);

6. Compounds composed of fluorine and one or more of other halogen oxygen or nitrogen;

Technical Note 1:

1C111.a.3.c.6 does not control Nitrogen Trifluoride (NF3) (CAS 7783-54-2) in a gaseous state as it is not usable for missile applications.

Technical Note 2:

*Mixed Oxides of Nitrogen (MON) are solutions of Nitric Oxide (NO) in Dinitrogen Tetroxide/Nitrogen Dioxide (N_2O_4/NO_2) that can be used in missile systems. There are a range of compositions that can be denoted as MONi or MONij, where i and j are integers representing the percentage of Nitric Oxide in the mixture (*e.g. *MON3 contains 3 % Nitric Oxide, MON25 25 % Nitric Oxide. An upper limit is MON40, 40 % by weight).*

d. Oxidiser substances usable in solid propellant rocket motors as follows:

1. Ammonium perchlorate (AP) (CAS 7790-98-9);

2. Ammonium dinitramide (ADN) (CAS 140456-78-6);

3. Nitro-amines (cyclotetramethylene - tetranitramine (HMX) (CAS 2691-41-0); cyclotrimethylene - trinitramine (RDX) (CAS 121-82-4);

4. Hydrazinium nitroformate (HNF) (CAS 20773-28-8);

5. 2,4,6,8,10,12-Hexanitrohexaazaisowurtzitane (CL-20) (CAS 135285-90-4).

4. Hydrazine (CAS 302-01-2) with a concentration of more than 70 % and its derivatives as follows:

a. Trimethylhydrazine (CAS 1741-01-1);

b. Tetramethylhydrazine (CAS 6415-12-9);

c. N,N diallylhydrazine (CAS 5164-11-4) ;

d. Allylhydrazine (CAS 7422-78-8);

e. Ethylene dihydrazine (CAS 6068-98-0);

f. Monomethylhydrazine dinitrate;

g. Unsymmetrical dimethylhydrazine nitrate;

h. Hydrazinium azide (CAS 14546-44-2);

i. 1,1-Dimethylhydrazinium azide (CAS 227955-52-4) / 1,2-Dimethylhydrazinium azide (CAS 299177-50-7);

j. Hydrazinium dinitrate (CAS 13464-98-7) ;

k. 2-hydroxyethylhydrazine nitrate (HEHN);

l. Hydrazinium diperchlorate;

m. Methylhydrazine nitrate (MHN) (CAS 29674-96-2);

n. 1,1-Diethylhydrazine nitrate (DEHN) / 1,2-Diethylhydrazine nitrate (DEHN) (CAS 363453-17-2);

o. 3,6-dihydrazino tetrazine nitrate (1,4-dihydrazine nitrate) (DHTN);

p. Monomethylhydrazine (MMH) (CAS 60-34-4);

q. Unsymmetrical dimethylhydrazine (UDMH) (CAS 57-14-7);

r. Hydrazine mononitrate;

s. Diimido oxalic acid dihydrazine (CAS 3457-37-2);

t. Hydrazinium perchlorate (CAS 27978-54-7).

5. High energy density materials, usable in the systems specified in 9A104, as follows:

a. Mixed fuels that incorporate both solid and liquid fuels, such as boron slurry, having a mass- based energy density of 40×10^6 J/kg or greater;

b. Other high energy density fuels and fuel additives (*e.g.*, cubane, ionic solutions, JP-10) having a volume-based energy density of 37.5 x 10^9 J/m^3 or greater, measured at 20 °C and one atmosphere (101,325 kPa) pressure.

Note: Item 1C111.a.5. does not control fossil refined fuels and biofuels produced from vegetables, including fuels for engines certified for use in civil aviation, unless specifically formulated for systems specified in 9A104.

6. Metal powders of either boron (CAS 7440-42-8) or boron alloys with a boron content of 85 % or more by weight, if at least 90 % of the total particles by particle volume or weight are made up of particles of less than 60 µm (determined by measurement techniques such as using a sieve, laser diffraction or optical scanning), whether spherical, atomised, spheroidal, flaked or ground;

*Note: In a multimodal particle distribution (*e.g. *mixtures of different grain sizes) in which one or more modes are controlled, the entire powder mixture is controlled.*

b. Polymeric substances:

1. Carboxy-terminated polybutadiene (including Carboxyl-terminated polybutadiene) (CTPB);

2. Hydroxy-terminated polybutadiene (including Hydroxyl-terminated polybutadiene) (HTPB) (CAS 69102-90-5);

3. Polybutadiene-acrylic acid (PBAA);

4. Polybutadiene-acrylic acid-acrylonitrile (PBAN) (CAS 25265-19-4 / CAS 68891-50-9);

5. Glycidylazide polymer (GAP) including hydroxyl terminated GAP;

6. Polytetrahydrofuran polyethylene glycol (TPEG);

7. Polyglycidyl nitrate (PGN or poly-GLYN) (CAS 27814-48- 8).

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).

c. Other propellant additives and agents:

1. Triethylene glycol dinitrate (TEG DN) (CAS111-22-8);
2. 2-Nitrodiphenylamine (CAS119-75-5);
3. Trimethylolethanetrinitrate (TMETN) (CAS 3032-55-1);
4. Diethylene glycol dinitrate (DEGDN) (CAS 693-21-0);
5. Ferrocene derivatives as follows:
   a. Ethyl ferrocene (CAS 1273-89-8);
   b. N-propyl ferrocene (CAS 1273-92-3)/ iso-propyl ferrocene (CAS 12126-81-7);
   c. Pentyl ferrocene (CAS1274-00-6);
   d. Dicyclopenty ferrocene (CAS 125861-17-8);
   e. Dicyclohexyl ferrocene;
   f. Diethyl ferrocene;
   g. Dipropyl ferrocene;
   h. Dibutyl ferrocene (CAS1274-08-4);
   i. Dihexyl ferrocene (CAS 93894-59-8);
   j. Acetyl ferrocenes (CAS 1271-55-2) / 1,1'-diacetyl ferrocene (CAS 1273-94-5);
   k. Other ferrocene derivatives usable as rocket propellant burning rate modifiers;
   l. Catocene (CAS 37206-42-1);
   m. N-butyl ferrocene (CAS 31904-29-7);
   n. Ferrocenecarboxlylic acid (CAS 1271-42-7) / 1, 1'-ferrocenedicarboxylic acid (CAS 1293-87-4);

o. Butacene (CAS 125856-62-4);

Note: Item 1C111.c.5.k. does not control ferrocene derivatives that contain a six carbon aromatic functional group attached to the ferrocene molecule.

6. 4,5 diazidomethyl-2-methyl-1,2,3-triazole (iso- DAMTR);

7. Nitratoethylnitramine (NENA) based plasticisers, as follows:

   a. Methyl-NENA (CAS 17096-47-8);

   b. Ethyl-NENA (CAS 85068-73-1);

   c. Butyl-NENA (CAS 82486-82-6);

8. Dinitropropyl based plasticisers, as follows:

   a. Bis (2,2-dinitropropyl) acetal (BDNPA) (CAS 5108-69 0);

   b. Bis (2,2-dinitropropyl) formal (BDNPF) (CAS 5917-61-3);

9. 1,2,4-butanetriol trinitrate (BTTN) (CAS 6659-60-5);

10. N-methyl-p-nitroaniline (CAS 100-15-2);

11. Carboranes, decarboranes, pentaboranes and derivatives thereof;

12. Triphenyl bismuth (TPB) (CAS 603-33-8);

13. Bonding agents as follows:

   a. Tris [1-(2-methyl)aziridinyl] phosphine oxide (MAPO) (CAS 57-39-6);

   b. 1,1',1"-trimesoyl-tris (2-ethylaziridine) (HX-868, BITA) (CAS 7722-73-8);

   c. Tepanol (HX-878), reaction product of tetraethlylenepentamine, acrylonitrile and glycidol (CAS 68412-46-4);

d. Tepan (HX-879), reaction product of tetraethlylenepentamine and acrylonitrile (CAS 68412-45-3);

e. Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group;

Note: Item 1C111.c.13.e. includes:

1. 1,1'-Isophthaloyl-bis (2-methylaziridine) (HX-752) (CAS 7652-64-4);

2. 2,4,6-tris(2-ethyl-1-aziridinyl)-1,3,5-triazine (HX-874) (CAS 18924-91-9);

3. 1,1'-trimethyladipoylbis(2-ethylaziridine) (HX-877) (CAS 71463-62-2).

14. Hydrazine replacement fuels as follows:

2-Dimethylaminoethylazide (DMAZ) (CAS 86147-04-8);

d. Composite and composite modified double base propellants.

e. 'Gel Propellant' specifically formulated for use in the systems specified in 9A104.

Technical Note:

A 'gel propellant' is a fuel or oxidiser formulation using a gellant such as silicates, kaolin (clay), carbon or any polymeric gellant.

1C116 Maraging steels, usable in the systems specified in 9A104.a. and complete rocket systems specified in 9A104.b. having all of the following:

a. Having an ultimate tensile strength, measured at 293 K (20 °C), equal to or greater than:

1. 0,9 GPa in the solution annealed stage; or

2. 1,5 GPa in the precipitation hardened stage; and

b. Any of the following forms:

1. Sheet, plate or tubing with a wall or plate thickness equal to or less than 5,0 mm; or

2. Tubular forms with a wall thickness equal to or less than 50 mm and having an inner diameter equal to or greater than 270 mm.

N.B.: See also 1C216.

Technical Note:

Maraging steels are iron alloys:

a. Generally characterised by high nickel, very low carbon content and use substitutional elements or precipitates to produce strengthening and age-hardening of the alloy; and

b. Subjected to heat treatment cycles to facilitate the martensitic transformation process (solution annealed stage) and subsequently age hardened (precipitation hardened stage).

1C117 Materials for the fabrication of components usable in the systems specified in 9A104, 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 $x10^{-6}$ m (50 µm) or less;

b. Molybdenum and alloys in particulate form with a molybdenum content of 97 % by weight or more and a particle size of 50 $x10^{-6}$ m (50 µm) or less;

c. Tungsten materials in the solid form having all of the following:

1. Any of the following material compositions:

a. Tungsten and alloys containing 97 % by weight or more of tungsten;

b. Copper infiltrated tungsten containing 80 % by weight or more of tungsten; or

c. Silver infiltrated tungsten containing 80 % by weight or more of tungsten; and

2. Able to be machined to any of the following products:

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

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

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

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

a. Having all of the following characteristics:

1. Containing 17,0-23,0 % by weight of chromium and 4,5-7,0 % by weight of nickel;

2. Having a titanium content of greater than 0,10 % by weight; and

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

b. Having any of the following forms:

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

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

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

1C202 Alloys, as follows:

a. Aluminium alloys having both of the following characteristics:

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

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

b. Titanium alloys having both of the following characteristics:

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

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

Technical Note:

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

1C210 "Fibrous or filamentary materials" or prepregs as follows:

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

1. A "specific modulus" of $12,7 \times 10^6$ m or greater; or

2. A "specific tensile strength" of 235×10^3 m or greater;

Note: 1C210.a. does not control aramid "fibrous or filamentary materials" having 0,25 percent or more by weight of an ester based fibre surface modifier;

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

1. A "specific modulus" of $3,18 \times 10^6$ m or greater; and

2. A "specific tensile strength" of $76,2 \times 10^3$ m or greater;

c. Thermoset resin impregnated continuous "yarns", "rovings", "tows" or "tapes" with a width of 15 mm or less (prepregs), made from carbon or glass "fibrous or filamentary materials" specified in 1C210.a. or b.

Technical Note:

The resin forms the matrix of the composite.

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

1C216 Maraging steel, other than that specified in 1C116, 'capable of ' an ultimate tensile strength of 1950 MPa or more, at 293 K (20 °C).

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

Technical Note:

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

1C225 Boron enriched in the boron-10 (^{10}B) isotope to greater than its natural isotopic abundance, as follows: elemental boron, compounds, mixtures containing boron, manufactures thereof, waste or scrap of any of the foregoing.

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

Technical Note:

The natural isotopic abundance of boron-10 is approximately 18,5 weight percent (20 atom percent).

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

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

b. A mass greater than 20 kg.

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

1C227 Calcium having both of the following characteristics:

a. Containing less than 1 000 ppm by weight of metallic impurities other than magnesium; and

b. Containing less than 10 ppm by weight of boron.

IC228 Magnesium having both of the following characteristics:

a. Containing less than 200 ppm by weight of metallic impurities other than calcium; and

b. Containing less than 10 ppm by weight of boron.

1C229 Bismuth having both of the following characteristics:

a. A purity of 99,99 % or greater by weight; and

b. Containing less than 10 ppm by weight of silver.

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

Note: 1C230 does not control the following:

a. Metal windows for X-ray machines, or for bore-hole logging devices;

b. Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits;

c. Beryl (silicate of beryllium and aluminium) in the form of emeralds or aquamarines.

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

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

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

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

Note: 1C233 does not control thermoluminescent dosimeters.

Technical Note:

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

1C234 Zirconium with a hafnium content of less than 1 part hafnium to 500 parts zirconium by weight, as follows: metal, alloys containing more

than 50 % zirconium by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing.

Note: 1C234 does not control zirconium in the form of foil having a thickness of 0,10 mm or less.

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

Note: 1C235 does not control a product or device containing less than 1,48 × 10^3 GBq (40 Ci) of tritium.

1C236 Radionuclides appropriate for making neutron sources based on alpha–n reaction in the following forms:

a. Elemental;

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

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

d. Products or devices containing any of the foregoing.

Note: 1C236 does not control a product or device containing less than 3,7 GBq (100 millicuries) of activity.

Technical Note:

In 1C236 'radionuclides' are any of the following: actinium 225 (^{225}Ac), actinium 227 (^{227}Ac), californium 253 (^{253}Cf), curium 240 (^{240}Cm), curium 241 (^{241}Cm), curium 242 (^{242}Cm), curium 243 (^{243}Cm), curium 244 (^{244}Cm), einsteinium 253 (^{253}Es), einsteinium 254 (^{254}Es), gadolinium 148 (^{148}Gd), plutonium 236 (^{236}Pu), plutonium 238 (^{238}Pu), polonium 208 (^{208}Po), polonium 209 (^{209}Po), polonium 210 (^{210}Po), radium 223 (^{223}Ra), thorium 227 (^{227}Th), thorium 228 (^{228}Th), uranium 230 (^{230}U), and uranium 232 (^{232}U).

1C237 Radium-226 (^{226}Ra), radium-226 alloys, radium-226 compounds, mixtures containing radium-226, manufactures thereof, and products or devices containing any of the foregoing.

Note: 1C237 does not control the following:

a. Medical applicators;

b. *A product or device containing less than 0,37 GBq (10 millicuries) of radium-226.*

1C238 Chlorine Trifluoride (ClF_3)

1C239 High explosives, or substances or mixtures containing more than 2 % by weight of any of the following:

a. Cyclotetramethylenetetranitramine (HMX) (CAS 2691-41-0);

b. Cyclotrimethylenetrinitramine (RDX) (CAS 121-82-4);

c. Triaminotrinitrobenzene (TATB) (CAS 3058-38-6);

d. Aminodinitrobenzo-furoxan or 7-amino-4,6 nitrobenzofurazane-1-oxide (ADNBF) (CAS 97096-78-1);

e. 1,1-diamino-2,2-dinitroethylene (DADE or FOX7) (CAS 145250-81-3);

f. 2,4-dinitroimidazole (DNI) (CAS 5213-49-0);

g. Diaminoazoxyfurazan (DAAOF or DAAF) (CAS78644-89-0);

h. Diaminotrinitrobenzene (DATB) (CAS 1630-08-6);

i. Dinitroglycoluril (DNGU or DINGU) (CAS 55510-04-8);

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

k. 3,3'-diamino-2,2',4,4',6,6'-hexanitrobiphenyl or dipicramide (DIPAM) (CAS 17215-44-0);

l. Diaminoazofurazan (DAAzF) (CAS 78644-90-3);

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

n. Hexanitrostilbene (HNS) (CAS 20062-22-0); or

o. Any explosive with a crystal density greater than 1,8 g/cm^3 and having a detonation velocity greater than 8 000 m/s.

1C240 Nickel powder and porous nickel metal, as follows:

a. Nickel powder having both of the following characteristics:

1. A nickel purity content of 99,0 % or greater by weight; and

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

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

Note: 1C240 does not control the following:

a. Filamentary nickel powders;

b. Single porous nickel sheets with an area of 1 000 cm^2 per sheet or less.

Technical Note:

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

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

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

b. A mass greater than 20 kg.

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

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

1. Andes virus;

2. Chapare virus;

3. Chikungunya virus;

4. Choclo virus;

5. Crimean-Congo haemorrhagic fever virus;

6. Dengue virus;
7. Eastern equine encephalitis virus;
8. Ebolavirus: all members of the Ebolavirus genus;
9. Hantaan virus;
10. Hendra virus (Equine morbillivirus);
11. Japanese encephalitis virus
12. Junin virus;
13. Kyasanur Forest disease virus;
14. Laguna Negra virus;
15. Lassa virus;
16. Louping ill virus;
17. Lujo virus;
18. Lymphocytic choriomeningitis virus;
19. Machupo virus;
20. Marburgvirus: all members of marbugvirus genus;
21. Monkey pox virus;
22. Middle East respiratory syndrome-related corona virus (MERS-related coronavirus)
23. Murray Valley encephalitis virus;
24. Nipah virus;
25. Omsk haemorrhagic fever virus;
26. Oropouche virus;
27. Powassan virus;
28. Pulmonary & renal syndrome-haemorrhagic fever viruses (Seoul, Dobrava, Sin Nombre);

29. Reconstructed 1918 influenza virus;

30. Rift Valley fever virus;

31. Rocio virus;

32. Severe acute respiratory syndrome-related coronavirus (SARS-related coronavirus);

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

34. St. Louis encephalitis virus;

35. Tick-borne encephalitis virus (Far Eastern subtype);

36. Variola virus;

37. Venezuelan equine encephalitis virus;

38. Western equine encephalitis virus;

39. Yellow fever virus;

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

1. *Bacillus anthracis*;

2. *Brucella abortus*;

3. *Brucella melitensis*;

4. *Brucella suis*;

5. *Burkholderia mallei* (*Pseudomonas mallei*);

6. *Burkholderia pseudomallei* (*Pseudomonas pseudomallei*);

7. *Chlamydia psittaci (Chlamydophila psittaci)*;

8. *Clostridium argentinense* (formerly known as *Clostridium botulinum* Type G), botulinum neurotoxin producing strains;

9. *Clostridium baratii*, botulinum neurotoxin producing strains;

10. *Clostridium botulinum*;

11. *Clostridium butyricum*, botulinum neurotoxin producing strains;

12. *Clostridium perfringens* epsilon toxin producing types;

13. *Coxiella burnetii*;

14. Enterohaemorrhagic *Escherichia coli*, serotype O157 and other verotoxin producing serotypes;

15. *Francisella tularensis*;

16. *Rickettsia prowasecki*;

17. *Salmonella enterica subspecies enterica serovar Typhi (Salmonella typhi)*;

18. Shiga toxin producing *Escherichia coli* (STEC) of serogroups O26, O45, O103, O104, O111, O121, O145, O157, and other shiga toxin producing serogroups;

19. *Shigella dysenteriae*;

20. *Vibrio cholerae*;

21. *Yersinia pestis*;

Note: 1C351.b.14. does not control other Clostridium perfringens *strains to be used as positve control cultures for food testing and quality control.*

c. "Toxins", as follows, and "sub-unit of toxins" thereof:

1. Abrin;

2. Aflatoxins;

3. Botulinum toxins;

4. Cholera toxin;

5. Diacetoxyscirpenol toxin

6. *Clostridium perfringens* alpha, beta 1, beta 2, epsilon and iota toxins;

7. Conotoxin;

8. HT-2 toxin;

9. Microcystin (Cyanginosin);

10. Modeccin;

11. Ricin;

12. Saxitoxin;

13. Shiga toxin (shiga-like toxins, verotoxins, and verocytotoxins);

Technical Note:

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

14. *Staphylococcus aureus* enterotoxins, hemolysin alpha toxin, and toxic shock syndrome toxin (formerly known as Staphylococcus enterotoxin F);

15. T-2 toxin;

16. Tetrodotoxin;

17. Verotoxin and shiga-like ribosome inactivating proteins;

18. Viscum album Lectin 1 (Viscumin);

19. Volkensin;

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

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

2. *Are pre-packaged for distribution as medical products;*

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

d. Fungi, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material

which has been deliberately inoculated or contaminated with such cultures, as follows:

1. *Coccidioides immitis*;

2. *Coccidioides posadasii*.

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

1C352 Animal pathogens, as follows:

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

1. African horse sickness virus;

2. African swine fever virus;

3. Avian influenza virus, which are:

a. Uncharacterised; or

b. Having high pathogenicity, as follows:

1. Type A viruses with an IVPI (intravenous pathogenicity index) in 6-week old chickens of greater than 1,2; or

2. Type A viruses H5 or H7 subtype for which nucletide sequencing has demonstrated multiple basic amino acids at the cleavage site of haemagglutinin;

4. Bluetongue virus;

5. Classical swine fever virus (Hog cholera virus);

6. Foot and mouth disease virus;

7. Goatpox virus;

8. Lumpy skin disease virus;

9. Newcastle disease virus;

10. Peste des petits ruminants virus;

11. Porcine entero virus type 9 (swine vesicular disease virus);

12. Porcine Teschovirus;

13. Rabies virus and all other members of the ~~Lyssa virus~~ Lyssavirus genus;

14. Rinderpest virus;

15. Sheep pox virus;

16. Suid herpesvirus 1 (Pseudorabies virus; Aujeszky's disease);

17. Vesicular stomatitis virus;

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

1. *Mycoplasma mycoides* subspecies *mycoides* SC (small colony);

2. *Mycoplasma capricolum* subspecies *capripneumoniae* (strain F38).

Note: 1C352 does not control "vaccines".

1C353 'Genetic elements' and 'genetically modified organisms' as follow:

'Any genetically modified organism' which contains, or 'genetic element' that codes for, any of the following:

1. Any gene or genes specific to any virus specified in 1C351.a. or 1C352.a.;

2. Any gene or genes specific to any bacterium specified in 1C351.b. or 1C354.b., or fungus specified in 1C351.d. or 1C354.c., and which is any of the following:

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

b. Could 'endow or enhance pathogenicity'; or

3. Any "toxins" specified in 1C351.c. or "subunits of toxins" thereof;

Technical Notes:

1. 'Genetically-modified organisms' include organisms in which the nucleic acid sequences have been created or altered by deliberate molecular manipulation.

2. 'Genetic elements' include, inter alia chromosomes, genomes, plasmids, transposons, vectors and inactivated organisms containing recoverable nucleic acid fragments, whether genetically modified or unmodified, or chemically synthesized in whole or in part. For the purposes of the genetic element control, nucleic acids from an inactivated organism, virus, or sample are considered recoverable if the inactivation and preparation of the material is intended or known to facilitate isolation, purification, amplification, detection, or identification of nucleic acids.

3. 'Endow or enhance pathogenicity' is defined as when the insertion or integration of the nucleic acid sequence or sequences is/are likely to enable or increase a recipient organism's ability to be used to deliberately cause disease or death. This might include alterations to inter alia: virulence, transmissibility, stability, route of infection, host range, reproducibility, ability to evade or suppress host immunity, resistance to medical counter measures, or detectability.

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

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

1C354 Plant pathogens, as follows:

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

   1. Andean potato latent virus (Potato Andean latent tymo virus);

   2. Potato spindle tuber viroid;

b. Bacteria, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material which has been

deliberately inoculated or contaminated with such cultures, as follows:

1. *Clavibacter michiganensis* subsp. *sepedonicus* (*Corynebacterium michiganensis* subsp. *sepedonicum* or *Corynebacterium sepedonicum*);

2. "Ralstonia solanacearum, race 3, biovar 2"

3. *Xanthomonas albilineans*;

4. *Xanthomonas axonopodis pv. citri (Xanthomonas campestris pv. citri A) [Xanthomonas campestris pv. citri];*;

5. *Xanthomonas oryzae* pv. Oryzae (*Pseudomonas campestris* pv. *oryzae*);

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

1. *Colletotrichum coffeanum* var. *virulans* (*Colletotrichum kahawae*);

2. *Cochliobolus miyabeanus* (*Helminthosporium oryzae*);

3. *"Magnaporthe oryzae (Pyricularia oryzae)"* ;

4. *Microcyclus ulei* (syn. *Dothidella ulei*);

5. *Peronosclerospora philippinensis* (*Peronosclerospora sacchari*);

6. *Puccinia graminis* ssp. *graminis* var. graminis / *Puccinia graminis* ssp. *graminis* var. *stakmanii* (*Puccinia graminis* (syn. *Puccinia graminis* f. sp. *tritici*));

7. *Puccinia striiformis* (syn. *Puccinia glumarum*);

8. *Sclerophthora rayssiae* var. *zeae*;

9. *Synchytrium endobioticum*;

10. *Tilletia indica*;

11. *Thecaphora solani.*

1D Software

1D101 "Software" specially designed or modified for the "operation or maintenance" of goods specified in 1B101, 1B102, 1B115, 1B117, 1B118 or 1B119 for the "production" and handling of materials specified in 1C111.

1D103 "Software" specially designed for analysis of reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures systems specified in 9A104.a. and their subsystems, 9A104.b and 9A012.

Note: 1D103 includes "software" specially designed for analysis of signature reduction.

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

1E Technology

1E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment, materials or "software" specified in 1A, 1B, 1C or 1D.

1E101 "Technology" according to the General Technology Note for the "use" of goods specified in 1A102, 1B101, 1B102, 1B115 to 1B119, 1C101,1C102, 1C107, 1C111 to 1C117, 1C118, 1D101 or 1D103.

Technical Note:

1E101 includes "databases" specially designed for analysis of signature reduction.

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

1E103 "Technology" for the regulation of temperature, pressure or atmosphere in autoclaves or hydroclaves, when used for the "production" of "composites" or partially processed "composites".

1E104 "Technology" for the "production" of pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1 573 K (1 300 °C) to 3 173 K (2 900 °C) temperature range at pressures of 130 Pa to 20 kPa including "technology" for the composition of precursor gases, flow-rates, and process control schedules and parameters.

1E201 "Technology" according to the General Technology Note for the "use" of goods specified in 1A202, 1A225 to 1A227, 1B201, 1B225 to 1B234, 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 1A202 or 1A225 to 1A227.

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

CATEGORY 2

MATERIALS PROCESSING

2A Systems, Equipment and Components

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

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

a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 (or ANSI/ABMA Std 20 Tolerance Class ABEC-7 or RBEC-7, or other national equivalents), or better, and having both rings and rolling elements (ISO 5593), made from monel or beryllium;

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

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

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

c. Active magnetic bearing systems using any of the following:

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

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

3. High temperature (450 K (177 °C) and above) position sensors.

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

a. An inner ring bore diameter between 12 mm and 50 mm;

b. An outer ring bore diameter between 25 mm and 100 mm; and

c. A width between 10 mm and 20 mm.

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

a. Crucibles having both of the following characteristics:

1. A volume of between 150 cm^3 (150 ml) and 8 000 cm^3 (8 litres); and

2. Made of or coated with any of the following materials or combination of the materials, having an overall impurity level of 2 % or less by weight:

a. Calcium fluoride (CaF_2);

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

c. Cerium sulphide (Ce_2S_3);

d. Erbium oxide (erbia) (Er_2O_3);

e. Hafnium oxide (hafnia) (HfO_2);

f. Magnesium oxide (MgO);

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

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

i. Zirconium oxide (zirconia) (ZrO_2);

b. Crucibles having both of the following characteristics:

1. A volume of between 50 cm3 (50 ml) and 2 000 cm3 (2 liters); and

2. Made of or lined with tantalum, having a purity of 99,9 % or greater by weight;

c. Crucibles having all of the following characteristics:

1. A volume of between 50 cm^3 (50 ml) and 2 000 cm^3 (2 liters);

2. Made of or lined with tantalum, having a purity of 98 % or greater by weight; and

3. Coated with tantalum carbide, nitride, boride, or any combination thereof.

2A226 Valves having all of the following characteristics:

a. A 'nominal size' of 5 mm or greater;

b. Having a bellows seal; and

c. Wholly made of or lined with aluminium, aluminium alloy, nickel, or nickel alloy containing more than 60 % nickel by weight.

Technical Note:

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

2B Test, Inspection and Production Equipment

Technical Notes:

1. Secondary parallel contouring axes, (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the centre line of which is parallel to the primary rotary axis) are not counted in the total number of contouring axes. Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device (e.g., a screw or a rack-and-pinion).

2. For the purposes of 2B, the number of axes which can be coordinated simultaneously for "contouring control" is the number of axes which affect relative movement between any one workpiece and a tool, cutting head or grinding wheel which is cutting or removing material from the workpiece. This does not include any additional axes which affect other relative movement within the machine. Such axes include:

a. Wheel-dressing systems in grinding machines;

b. Parallel rotary axes designed for mounting of separate workpieces;

c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.

3. Axis nomenclature shall be in accordance with International Standard ISO 841 (2001), 'Numerical Control Machines — Axis and Motion Nomenclature'.

4. Stated positioning accuracy levels derived from measurements made according to ISO 230/2 (1988) or national equivalents may be used for each machine tool model instead of individual machine tests.

Determination of Stated Values

a. Select five machines of a model to be evaluated;

b. Measure the linear axis accuracies according to ISO 230/2 (1988);

c. Determine the A-values for each axis of each machine. The method of calculating the A-value is described in the ISO standard;

d. Determine the mean value of the A-value of each axis. This mean value $\hat{A}$ becomes the stated value of each axis for the model ($\hat{A}_x$ $\hat{A}_y$...);

e. Since the Category 2 list refers to each linear axis there will be as many stated values as there are linear axes;

2B104 "Isostatic presses", having all of the following:

N.B.: See also 2B204.

a. Maximum working pressure of 69 MPa or greater;

b. Designed to achieve and maintain a controlled thermal environment of 873 K (600 °C) or greater; and

c. Possessing a chamber cavity with an inside diameter of 254 mm or greater.

2B105 Chemical vapour deposition (CVD) furnaces, designed or modified for the densification of carbon-carbon composites.

2B109 Flow-forming machines, usable in the "production" of propulsion components and equipment (e.g. motor cases and interstages) for systems specified in 9A104.a. and specially designed components as follows:

N.B.: See also 2B209.

a. Flow-forming machines having all of the following:

1. Equipped with, or according to the manufacturer's technical specification are capable of being equipped with, "numerical control" units or computer control; and

2. With more than two axes which can be coordinated simultaneously for "contouring control".

b. Specially designed components for flow-forming machines specified in 2B109.a.

Technical Note:

Machines combining the function of spin-forming and flow-forming are for the purpose of 2B109 regarded as flow-forming machines.

2B116 Vibration test systems, equipment and components therefor, as follows:

a. Vibration test systems employing feedback or closed loop techniques and incorporating a digital controller, capable of vibrating a system at an acceleration equal to or greater than 10 g rms over the entire range 20 Hz to 2 000 Hz while imparting forces equal to or greater than 50 kN, measured 'bare table';

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

Technical Note:

'Real-time control bandwidth' is defined as the maximum rate at which a controller can execute complete cycles of sampling, processing data and transmitting control signal.

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN, measured 'bare table', or greater and usable in vibration test systems specified in 2B116.a.;

d. Test piece support structures and electronic units designed to combine multiple shaker units in a system capable of providing an effective combined force of 50 kN, measured 'bare table', or greater, and usable in vibration systems specified in 2B116.a.

Technical Note:

In 2B116, 'bare table' means a flat table, or surface, with no fixture or fittings.

2B117 Equipment and process controls, other than those specified in 2B104 or 2B105, designed or modified for densification and pyrolysis of structural composite rocket nozzles and re-entry vehicle nose tips.

2B119 Balancing machines and related equipment, as follows:

N.B.: See also 2B219.

a. Balancing machines having all the following characteristics:

1. Not capable of balancing rotors/assemblies having a mass greater than 3 kg;

2. Capable of balancing rotors/assemblies at speeds greater than 12 500 rpm;

3. Capable of correcting unbalance in two planes or more; and

4. Capable of balancing to a residual specific unbalance of 0,2 g mm per kg of rotor mass;

Note: 2B119.a. does not control balancing machines designed or modified for dental or other medical equipment.

b. Indicator heads designed or modified for use with machines specified in 2B119.a.

Technical Note:

Indicator heads are sometimes known as balancing instrumentation.

2B120 Motion simulators or rate tables having all of the following characteristics:

a. Two or more axes;

b. Designed or modified to incorporate slip rings or integrated non-contact devices capable of transferring electrical power, signal information, or both; and

c. Having any of the following characteristics:

1. For any single axis having all of the following:

a. Capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and

b. A rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0,6 degrees/s;

2. Having a worst-case rate stability equal to or better (less) than ± 0,05 % averaged over 10 degrees or more; or

3. A positioning "accuracy" equal to or less (better) than 5 arc second.

Note 1: 2B120 does not control rotary tables designed or modified for machine tools or for medical equipment.

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

2B121 Positioning tables (equipment capable of precise rotary positioning in any axes), other than those specified in 2B120, having all the following characteristics:

a. Two or more axes; and

b. A positioning "accuracy" equal to or less (better) than 5 arc second.

Note: 2B121 does not control rotary tables designed or modified for machine tools or for medical equipment.

2B122 Centrifuges capable of imparting accelerations greater than 100 g and designed or modified to incorporate sliprings or integrated non-contact devices capable of transferring electrical power, signal information, or both.

2B201 Machine tools and any combination thereof, as follows, for removing or cutting metals, ceramics or "composites", which, according to the

manufacturer's technical specification, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

a. Machine tools for turning, having all of the following characteristics:

1. Positioning accuracy with "all compensations available" equal to or less (better) than 6 µm according to ISO 230/2 (1988) or national equivalents along any linear axis (overall positioning) for machines capable of machining diameters greater than 35 mm; and

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

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

b. Machine tools for milling, having any of the following characteristics:

1. Positioning accuracies with "all compensations available" equal to or less (better) than 6 µm according to ISO 230/2 (1988) or national equivalents along any linear axis; or

2. Two or more contouring rotary axes; or

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

Note: 2B201.b. does not control milling machines having the following characteristics:

a. X-axis travel greater than 2 m; and

b. Overall positioning accuracy on the x-axis more (worse) than 30 µm according to ISO 230/2 (1988).

c. Machine tools for grinding, having any of the following characteristics:

1. Positioning accuracies with "all compensations available" equal to or less (better) than 4 µm according to ISO 230/2 (1988) or national equivalents along any linear axis; or

2. Two or more contouring rotary axes;

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

Note: 2B201.c. does not control the following grinding machines:

a. Cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:

1. Limited to a maximum workpiece capacity of 150 mm outside diameter or length; and

2. Axes limited to x, z and c.

b. Jig grinders that do not have a z-axis or a w-axis with an overall positioning accuracy less (better) than 4 microns. Positioning accuracy is according to ISO 230/2 (1988).

d. Non-wire type Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";

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

a. Gears

b. Crankshafts or camshafts

c. Tools or cutters

d. Extruder worms

Technical Note:

1. Axis nomenclature shall be in accordance with ISO 841 (2001), 'Numerical Control Machines — Axis and Motion Nomenclature'.

2. Stated positioning accuracy levels derived from measurements made according to ISO 230/2 (1988) or national equivalents may be used for each machine tool model if provided to, and accepted by, national authorities instead of individual machine tests.

Determination of Stated Values

a. Select five machines of a model to be evaluated;

b. Measure the linear axis accuracies according to ISO 230/2 (1988) (1);

c. Determine the accuracy values (A) for each axis of each machine. The method of calculating the A-value is described in the ISO 230/2 (1988) standard;

d. Determine the average accuracy value of each axis. This average value becomes the stated "positioning accuracy" of each axis for the model ($\hat{A}_x$, $\hat{A}_y$..);

e. Since the Category 2 list refers to each linear axis there will be as many stated values as there are linear axes;

f. If any axis of a machine tool not controlled by items 2B201.a., 2B201.b., or 2B201.c. has a stated "positioning accuracy" of 6 µm or better (less) for grinding machines, and 8 µm or better (less) for milling and turning machines, both according to ISO 230/2 (1988), then the builder should be required to reaffirm the accuracy level once every eighteen months

3. Not counted in the total number of contouring axes are secondary parallel contouring axes (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the centerline of which is parallel to the primary rotary axis).

4. For the purposes of 2B201 the number of axes which can be coordinated simultaneously for "contouring control" is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative motions within the machine are performed, such as:

a. Wheel-dressing systems in grinding machines;

b. Parallel rotary axes designed for mounting of separate workpieces;

c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.

5. A machine tool having at least 2 of the 3 turning, milling or grinding capabilities (e.g., a turning machine with milling

capability) must be evaluated against each applicable entry, 2B201.a., 2B201.b. and 2B201.c.

6. *Items 2B201.b.3. and 2B201.c.3. include machines based on a parallel linear kinematic design (e.g., hexapods) that have 5 or more axes none of which are rotary axes.*

7. *Rotary axes do not necessarily have to rotate over 360 degrees. A rotary axis can be driven by a linear device, e.g., a screw or a rack- and-pinion.*

2B204 "Isostatic presses", other than those specified in 2B104, and related equipment, as follows:

a. "Isostatic presses" having both of the following characteristics:

1. Capable of achieving a maximum working pressure of 69 MPa or greater; and

2. A chamber cavity with an inside diameter in excess of 152 mm;

b. Dies, moulds and controls, specially designed for "isostatic presses" specified in 2B204.a.

Technical Note:

In 2B204 the inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.

2B206 Dimensional inspection machines, instruments or systems, as follows:

a. Computer controlled or numerically controlled dimensional inspection machines having either of the following characteristics:

1. Having only two axes and having a maximum permissible error of length measurement along any axis (one dimensional), identified as any combination of E_{0xMPE}, E_{0yMPE} or E_{0zMPE}, equal to or less (better) than (1,25 + L/1 000) µm (where L is the measured length in mm) at any point within the operating range of the machine (i.e., within the length of the axis), according to ISO 10360-2(2009); or

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

Technical Note:

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

b. Linear and angular displacement measuring instruments, as follows:

1. 'Linear displacement' measuring instruments having any of the following:

Technical Note:

For the purpose of 2B206.b.1. 'linear displacement' means the change of distance between the measuring probe and the measured object.

a. Non-contact type measuring systems with a "resolution" equal to or less (better) than 0,2 µm within a measuring range up to 0,2 mm;

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

1. a. "Linearity" equal to or less (better) than 0,1 % measured from 0 to the full operating range, for LVDTs with an operating range up to 5 mm; or

b. "Linearity" equal to or less (better) than 0,1 % measured from 0 to 5 mm for LVDTs with an operating range greater than 5 mm; and

2. Drift equal to or less (better) than 0,1 % per day at a standard ambient test room temperature ±1 K;

c. Measuring systems having all of the following:

1. Containing a "laser"; and

2. Maintaining, for at least 12 hours, over a temperature range of ±1 K around a standard temperature and at a standard pressure, all of the following:

a. A "resolution" over their full scale of 0,1 µm or less (better); and

b. A "measurement uncertainty" equal to or less (better) than (0,2 + L/2 000) µm (L is the measured length in mm);

Note: 2B206.b.1.c. does not control measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.

2. Angular displacement measuring instruments having an "angular position deviation" equal to or less (better) than 0,00025°;

Note: 2B206.b.2. does not control optical instruments, such as autocollimators, using collimated light (e.g. laser light) to detect angular displacement of a mirror.

c. Systems for simultaneous linear-angular inspection of hemishells, having both of the following characteristics:

1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3,5 µm per 5 mm; and

2. "Angular position deviation" equal to or less than 0,02°.

Note 1: Machine tools, other than those controlled in 2B201, that can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.

Note 2: A machine specified in 2B206 is controlled if it exceeds the control threshold anywhere within its operating range.

Technical Notes:

1. *The probe used in determining the "measurement uncertainty" of a dimensional inspection system shall be described in VDI/VDE 2617 parts 2, 3 and 4.*

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

2B207 "Robots", "end-effectors" and control units, as follows:

a. "Robots" or "end-effectors"

1. Specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives); or

2. Specially designed or rated as radiation hardened to withstand a total radiation dose greater than 5×10^4 Gy (Silicon) without operational degradation.

b. Control units specially designed for any of the "robots" or "end-effectors" specified in 2B207.a.

Note: Item 2B207 does not control 'robots' specially designed for non-nuclear industrial applications such as automobile paint-spraying booths.

2B209 Flow-forming machines, spin-forming machines capable of flow-forming functions, other than those specified in 2B109, and mandrels, as follows:

a. Machines having both of the following characteristics:

1. Three or more rollers (active or guiding); and

2. Which, according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control;

b. Rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm and 400 mm.

Note: 2B209.a. includes machines which have only a single roller designed to deform metal plus two auxiliary rollers which support the mandrel, but do not participate directly in the deformation process.

2B219 Centrifugal multiplane balancing machines, fixed or portable, horizontal or vertical, as follows:

a. Centrifugal balancing machines designed for balancing flexible rotors having a length of 600 mm or more and having all of the following characteristics:

1. Swing or journal diameter greater than 75 mm;

2. Mass capability of from 0,9 to 23 kg; and

3. Capable of balancing speed of revolution greater than 5000 rpm;

b. Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:

1. Journal diameter greater than 75 mm;

2. Mass capability of from 0,9 to 23 kg;

3. A minimum achievable residual specific unbalance equal to or less than 10 g mm/kg per plane; and

4. Belt drive type.

2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics:

a. A capability of penetrating 0,6 m or more of hot cell wall (through-the-wall operation); or

b. A capability of bridging over the top of a hot cell wall with a thickness of 0,6 m or more (over-the-wall operation).

Technical Note:

Remote manipulators provide translation of human operator actions to a remote operating arm and terminal fixture. They may be of 'master/slave' type or operated by joystick or keypad.

2B226 Controlled atmosphere (vacuum or inert gas) induction furnaces, and power supplies therefor, as follows:

N.B.: See also 3B.

a. Furnaces having all of the following characteristics:

1. Capable of operation above 1123 K (850 °C);

2. Induction coils 600 mm or less in diameter; and

3. Designed for power inputs of 5 kW or more;

b. Power supplies, with a specified power output of 5 kW or more, specially designed for furnaces specified in 2B226.a.

Note: 2B226.a. does not control furnaces designed for the processing of semiconductor wafers.

2B227 Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment as follows:

a. Arc remelt furnaces, arc melt furnaces and arc melt and casting furnaces having both of the following characteristics:

1. Consumable electrode capacities between 1000 cm^3 and 20000 cm^3, and

2. Capable of operating with melting temperatures above 1973 K (1700 °C);

b. Electron beam melting furnaces, plasma atomization furnaces and plasma melting furnaces having both of the following characteristics:

1. A power of 50 kW or greater; and

2. Capable of operating with melting temperatures above 1473 K (1200 °C);

c. Computer control and monitoring systems specially configured for any of the furnaces specified in 2B227.a. or 2B227.b;

d. Plasma torches specially designed for the furnaces specified in 2B227.b. having both of the following characteristics:

1. Operating at a power greater than 50 kW; and

2. Capable of operating above 1473 K (1200 °C);

e. Electron beam guns specially designed for the furnaces specified in 2B227.b. operating at a power greater than 50 kW.

2B228 Rotor fabrication or assembly equipment, rotor-straightening equipment, bellows-forming mandrels and dies, as follows:

a. Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles, and end caps;

Note: 2B228.a. includes precision mandrels, clamps, and shrink fit machines.

b. Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis;

Technical Note:

In 2B228.b. such equipment normally consists of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.

c. Bellows-forming mandrels and dies for producing single-convolution bellows.

Technical Note:

In 2B228.c. the bellows have all of the following characteristics:

1. *Inside diameter between 75 mm and 400 mm;*
2. *Length equal to or greater than 12,7 mm;*
3. *Single convolution depth greater than 2 mm; and*
4. *Made of high-strength aluminium alloys, maraging steel or high-strength "fibrous or filamentary materials".*

2B230 All type of pressure transducers capable of measuring absolute pressures and having all of the following characteristics:

a. Pressure sensing elements made of or protected by aluminium, aluminium 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 sealing the pressure sensing element, and in direct contact with the process medium, made of or protected by aluminium, aluminium alloy, aluminium oxide (alumina or sapphire), nickel, nickel alloy with more than 60 % nickel by weight, or fully fluorinated hydrocarbon polymers; and

c. Having either of the following characteristics:

1. A full scale of less than 13 kPa and an "accuracy" of better than 1 % of full scale; or

2. A full scale of 13 kPa or greater and an "accuracy" of better than 130 Pa when measured at 13 kPa.

Technical Note:

For the purposes of 2B230, "accuracy" includes non-linearity, hysteresis and repeatability at ambient temperature.

2B231 Vacuum pumps having all of the following characteristics:

a. Input throat size equal to or greater than 380 mm;

b. Pumping speed equal to or greater than 15 m^3/s; and

c. Capable of producing an ultimate vacuum better than 13 mPa.

Technical Notes:

1. *The pumping speed is determined at the measurement point with nitrogen gas or air.*

2. *The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.*

2B232 High velocity gun systems (propellant, gas, coil, electromagnetic, and electrothermal types, and other advanced systems) capable of accelerating projectiles to 1,5 km/s or greater.

Note: 2B232 does not control guns specially designed for high velocity weapon systems.

2B233 Bellows-sealed scroll-type compressors and bellows-sealed scroll-type vacuum pumps having all of the following characteristics:

a. Capable of an inlet volume flow rate of 50 m^3/h or greater;

b. Capable of a pressure ratio of 2:1 or greater; and

c. Having all surfaces that come in contact with the process gas made from any of the following materials:

1. Aluminium or aluminium alloy;

2. Aluminium oxide;

3. Stainless steel;

4. Nickel or nickel alloy;

5. Phosphor bronze; or

6. Fluoropolymers.

Technical Notes:

1. *In a scroll compressor or vacuum pump, crescent-shaped pockets of gas are trapped between one or more pairs of intermeshed spiral vanes, or scrolls, one of which moves while the other remains stationary. The moving scroll orbits the stationary scroll; it does not rotate. As the moving scroll orbits the stationary scroll, the gas pockets diminish in size (i.e., they are compressed) as they move toward the outlet port of the machine.*

2. *In a bellows-sealed scroll compressor or vacuum pump, the process gas is totally isolated from the lubricated parts of the pump and from the external atmosphere by a metal bellows. One end of the bellows is attached to the moving scroll and the other end is attached to the stationary housing of the pump.*

3. *Fluoropolymers include, but are not limited to, the following materials:*

   a. *Polytetrafluoroethylene (PTFE);*

   b. *Fluorinated Ethylene Propylene (FEP);*

   c. *Perfluoroalkoxy (PFA);*

   d. *Polychlorotrifluoroethylene (PCTFE); and*

   e. *Vinylidene fluoride-hexafluoropropylene copolymer.*

2B350 Chemical manufacturing facilities, equipment and components, as follows:

a. Reaction vessels or reactors, with or without agitators, with total internal (geometric) volume greater than 0,1 m^3 (100 litres) and less than 20 m^3 (20 000 litres), where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

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

2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

3. Glass or glass-lined (including vitrified or enamelled coatings);

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

5. Tantalum or tantalum alloys;

6. Titanium or titanium alloys;

7. Zirconium or zirconium alloys; or

8. Niobium (columbium) or Niobium alloys;

Note: Item 2B350.a. also includes prefabricated repair assemblies and their specially designed components, that:

1. are designed for mechanical attachment to glass-lined reaction vessels or reactors that meet the parameters given in 2B350.a.; and.

2. have metallic surfaces that come in direct contact with the chemical(s) being processed which are made from tantalum or tantalum alloys.

b. Agitators for use in reaction vessels or reactors specified in 2B350.a.; and impellers, blades or shafts designed for such agitators, where all surfaces of the agitator that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

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

2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

3. Glass or glass-lined (including vitrified or enamelled coatings);

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

5. Tantalum or tantalum alloys;

6. Titanium or titanium alloys;

7. Zirconium or zirconium alloys; or

8. Niobium (columbium) or Niobium alloys;

c. Storage tanks, containers or receivers with a total internal (geometric) volume greater than 0,1 m3 (100 litres) where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

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

2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

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

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

5. Tantalum or tantalum alloys;

6. Titanium or titanium alloys; or

7. Zirconium or zirconium alloys;

8. Niobium (columbium) or Niobium alloys;

Note: Item 2B350.c. also includes prefabricated repair assemblies and their specially designed components, that:

1. are designed for mechanical attachment to glass-lined storage tanks, containers or receivers that meet the parameters given in 2B350.c.; and.

2. have metallic surfaces that come in direct contact with the chemical(s) being processed which are made from tantalum or tantalum alloys.

d. Heat exchangers or condensers with a heat transfer surface area greater than 0,15 m^2, and less than 20 m^2; and tubes, plates, coils or blocks (cores) designed for such heat exchangers or condensers, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

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

2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

3. Glass or glass-lined (including vitrified or enamelled coatings);

4. Graphite or 'carbon graphite';

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

6. Tantalum or tantalum alloys;

7. Titanium or titanium alloys;

8. Zirconium or zirconium alloys;

9. Silicon carbide;

10. Titanium carbide; or

11. Niobium (columbium) or Niobium alloys;

e. Distillation or absorption columns of internal diameter greater than 0,1 m; and liquid distributers, vapour distributers or liquid collectors designed for such distillation or absorption columns, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

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

2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

3. Glass or glass-lined (including vitrified or enamelled coatings);

4. Graphite or 'carbon graphite';

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

6. Tantalum or tantalum alloys;

7. Titanium or titanium alloys;

8. Zirconium or zirconium alloys; or

9. Niobium (columbium) or Niobium alloys;

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

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

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

g. Valves and components as follows:

1. Valves with 'nominal sizes' greater than 10 mm and casings (valve bodies) or preformed casing liners designed for such valves, in which all surfaces that come in direct contact with the chemical(s) being produced, processed or contained are made from 'corrosion resistant materials':

2. Valves, other than those specified in 2B350.g.1., having all of the following;

a. A 'nominal size' equal to or greater than 25,4 mm and equal to or less than 101,6 mm;

b. Casings (valve bodies) or preformed casing liners;

c. A closure element designed to be interchangeable; and

d. All surfaces of the casing (valve body) or preformed case liner that come in direct contact with the chemical(s) being produced, processed, or contained are made from 'corrosion resistant materials';

3. Components, designed for valves specified in 2B350.g.1. or 2B350.g.2., in which all surfaces that come in direct contact with the chemical(s) being produced, processed, or contained are made from 'corrosion resistant materials', as follows:

a. Casings (valve bodies);

b. Preformed casing liners;

Technical Notes:

1. *The 'nominal size' is defined as the smaller of the inlet and outlet diameters.*

2. *For the purposes of 2B350.g. 'corrosion resistant materials' means any of the following materials:*

   a. *Alloys with more than 25 % nickel and 20 % chromium by weight;*

   b. *Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);*

   c. *Glass or glass-lined (including vitrified or enamelled coating);*

   d. *Nickel or alloys with more than 40 % nickel by weight;*

   e. *Tantalum or tantalum alloys;*

   f. *Titanium or titanium alloys;*

   g. *Zirconium or zirconium alloys;*

   h. *Niobium (columbium) or Niobium alloys; or*

   i. *Ceramic materials as follows:*

      1. *Silicon Carbide with a purity of 80 % or more by weight;*

      2. *Aluminum oxide (alumina) with a purity of 99,9 % or more by weight;*

      3. *Zirconium oxide (zirconia)*

h. Multi-walled piping incorporating a leak detection port, in which all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

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

   2. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

3. Glass or glass-lined (including vitrified or enamelled coating);

4. Graphite or 'carbon graphite';

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

6. Tantalum or tantalum alloys;

7. Titanium or titanium alloys;

8. Zirconium or zirconium alloys; or

9. Niobium (columbium) or Niobium alloys;

i. Multiple-seal and seal-less pumps, with manufacturer's specified maximum flow-rate greater than 0,6 m^3/hour, or vacuum pumps with manufacturer's specified maximum flow-rate greater than 5 m^3/hour (under standard temperature (273 K (0 °C)) and pressure (101,3 kPa) conditions); and casings (pump bodies), preformed casing liners, impellers, rotors or jet pump nozzles designed for such pumps, in which all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

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

2. Ceramics;

3. Ferrosilicon (high silicon iron alloys);

4. Fluoropolymers (polymeric or elastomeric materials with more than 35 % fluorine by weight);

5. Glass or glass-lined (including vitrified or enamelled coating);

6. Graphite or 'carbon graphite';

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

8. Tantalum or tantalum alloys;

9. Titanium or titanium alloys;

10. Zirconium or zirconium alloys; or

11. Niobium (columbium) or Niobium alloys;

Technical Note:

The seals referred to in this control come into direct contact with the chemical(s) being processed (or are designed to), and provide a sealing function where a rotary or reciprocating drive shaft passes through a pump body.

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

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

2. Ceramics; or

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

Technical Note:

1. 'Carbon graphite' is a composition consisting of amorphous carbon and graphite, in which the graphite content is eight percent or more by weight.

2. For the listed materials in the above entries, the term 'alloy' when not accompanied by a specific elemental concentration is understood as identifying those alloys where the identified metal is present in a higher percentage by weight than any other element.

2B351 Toxic gas monitors and monitoring systems, as follows; and their dedicated detecting components including detectors, sensor devices and replaceable sensor cartridges therefor:

a. Designed for continuous operation and usable for the detection of chemical warfare agents, at concentrations of less than 0,3 mg/m^3; or

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

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

a. Complete containment facilities at P3, P4 containment level and related equipment as follows:

1. Double-door pass-through decontamination autoclaves;

2. Breathing air suit decontamination showers; or

3. Mechanical-seal or inflatable-seal walkthrough doors;

Technical Note:

P3 or P4 (BL3, BL4, L3, L4) containment levels are as specified in the WHO Laboratory Biosafety manual (3rd edition, Geneva 2004).

b. Fermenters and components as follows:

1. Fermenters capable of cultivation of "micro-organisms" viruses or capable of toxin production, without the propagation of aerosols, and having a total capacity of 20 litres or more;

2. Components designed for such fermenters, as follows:

a. Cultivation chambers designed to be sterilized or disinfected in situ;

b. Cultivation chamber holding devices; or

c. Process control units capable of simultaneously monitoring and controlling two or more fermentation system parameters (e.g. temperature, pH, nutrients, agitation, dissolved oxygen, air flow, foam control).

Technical Note:

1. Fermenters include bioreactors (including single use (disposable) bioreactors), chemostats and continuous-flow systems.

2. "Cultivation chamber holding devices include single use cultivation chambers with rigid walls."

c. Centrifugal separators, capable of continuous separation without the propagation of aerosols, having all the following characteristics:

1. Flow rate exceeding 100 litres per hour;

2. Components of polished stainless steel or titanium;

3. One or more sealing joints within the steam containment area; and

4. Capable of in-situ steam sterilisation in a closed state;

Technical Note:

Centrifugal separators include decanters.

d. Cross (tangential) flow filtration equipment and components as follows:

1. Cross (tangential) flow filtration equipment capable of separation of pathogenic micro-organisms, viruses, toxins or cell cultures, without the propagation of aerosols, having both of the following characteristics:

a. A total filtration area equal to or greater than 1 m^2; and

b. Having any of the following characteristics:

1. Capable of being sterilised or disinfected in-situ; or

2. Using disposable or single-use filtration components.

Technical Note:

In 2B352.d.1.b. sterilised denotes the elimination of all viable microbes from the equipment through the use of either physical (e.g. steam) or chemical agents. Disinfected denotes the destruction of potential microbial infectivity in the equipment through the use of chemical agents with a germicidal effect. Disinfection and sterilisation are distinct from sanitisation, the latter referring to cleaning procedures designed to lower the microbial content of equipment without necessarily achieving elimination of all microbial infectivity or viability.

2. Cross (tangential) flow filtration components (e.g. modules, elements, cassettes, cartridges, units or plates) with filtration area equal to or greater than 0,2 m^2 for each component and designed for use in cross (tangential) flow filtration equipment specified in 2B352.d.;

Note: 2B352.d. does not control reverse osmosis equipment, as specified by the manufacturer.

e. Steam, gas or vapour sterilisable freeze drying equipment with a condenser capacity of 10 kg of ice or greater in 24 hours and less than 1 000 kg of ice in 24 hours;

f. Protective and containment equipment, as follows:

1. Protective full or half suits, or hoods dependent upon a tethered external air supply and operating under positive pressure;

Note: 2B352.f.1. does not control suits designed to be worn with self-contained breathing apparatus.

2. Biocontainment chambers, isolators, or biological safety cabinets having all of the following characteristics, for normal operation:

a. Fully enclosed workspace where the operator is separated from the work by a physical barrier;

b. Able to operate at negative pressure;

c. Means to safely manipulate items in the workspace; and

d. Supply and exhaust air to and from the workspace is HEPA filtered.

Note 1: 2B352.f.2. includes class III biosafety cabinets, as described in the latest edition of the WHO Laboratory Biosafety Manual or constructed in accordance with national standards, regulations or guidance.

Note 2: 2B352.f.2. does not include isolators specially designed for barrier nursing or transportation of infected patients.

g. Aerosol inhalation equipment designed for aerosol challenge testing with "microorganisms", viruses or "toxins" as follows:

1. Whole body exposure chambers having a capacity of 1 m^3 or greater;

2. Nose-only exposure apparatus utilising directed aerosol flow and having capacity for exposure of 12 or more rodents, or 2

or more animals other than rodents; and, closed animal restraint tubes designed for use with such apparatus;

h. Spray drying equipment capable of drying toxins or pathogenic "microorganisms" having all of the following characteristics:

1. A water evaporation capacity of ≥ 0,4 kg/h and ≤ 400 kg/h;

2. The ability to generate a typical mean product particle size of ≤ 10 µm with existing fittings or by minimal modification of the spray-dryer with atomization nozzles enabling generation of the required particle size; and

3. Capable of being sterilized or disinfected in situ.

i. Spraying or fogging systems and components therefor, as follows:

1. Complete spraying or fogging systems, specially designed or modified for fitting to aircraft, lighter than air vehicles or UAVs, capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 microns at a flow rate of greater than two litres per minute;

2. Spray booms or arrays of aerosol generating units, specially designed or modified for fitting to aircraft, lighter than air vehicles or UAVs, capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 microns at a flow rate of greater than two litres per minute;

3. 'Aerosol generating units' specially designed for fitting to systems that fulfil all the criteria specified in 2B352.i.1. and 2B352.i.2.

Technical Notes:

1. *'Aerosol generating units' are devices specially designed or modified for fitting to aircraft such as nozzles, rotary drum atomisers and similar devices.*

2. *This entry does not control spraying or fogging systems and components as specified in 2B352.i. above that are demonstrated not to be capable of delivering biological agents in the form of infectious aerosols.*

3. *Droplet size for spray equipment or nozzles specially designed for use on aircraft or UAVs should be measured using either of the following methods:*

a. Doppler laser method

b. Forward laser diffraction method

4. In 2B352.i., 'VMD' means Volume Median Diameter and for water-based systems this equates to Mass Median Diameter (MMD).

j. Nucleic acid assemblers and synthesizers, which are partly or entirely automated, and designed to generate continuous nucleic acids greater than 1.5 kilobases in length with error rates less than 5 % in a single run.

2C Material

Blank

2D Software

2D101 "Software" specially designed or modified for the "use" of equipment specified in 2B104, 2B105, 2B109, 2B116, 2B117 or 2B119 to 2B122.

2D201 "Software" specially designed or modified for the "use" of equipment specified in 2B204, 2B206, 2B104, 2B207, 2B209, 2B116, 2B219 or 2B226, 2B227, 2B351.

Note: "Software" specially designed or modified for systems specified in item 2B206.d. includes "software" for simultaneous measurements of wall thickness and contour.

2D202 "Software" specially designed or modified for the "development", "production" or "use" of equipment specified in 2B201.

Note: 2B201 does not control part programming "software" that generates "numerical control" command codes but does not allow direct use of equipment for machining various parts.

2D203 "Software" for any combination of electronic devices or system enabling such device(s) to function as a "numerical control" unit for machine tools, that is capable of controlling five or more interpolating axes that can be coordinated simultaneously for "contouring control".

Note 1: "Software" is controlled whether exported separately or residing in a "numerical control" unit or any electronic device or system.

Note 2: Item 2D203 does not control "software" specially designed or modified by the manufacturers of the control unit or machine tool to operate a machine tool that is not specified in item 2B201.

2E Technology

2E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or "software" specified in 2A, 2B, or 2D.

2E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 2B104, 2B105, 2B109, 2B116, 2B117, 2B119 to 2B122 or 2D101.

2E201 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 2A225, 2A226, 2B201, 2B204, 2B206, 2B207, 2B209, 2B219, 2B225 to 2B233, 2D201 or 2D202.

2E301 "Technology" according to the General Technology Note for the "use" of goods specified in 2B350 to 2B352.

CATEGORY-3

ELECTRONICS

3A Systems, Equipment and Components

3A101 Electronic equipment, devices and components, as follows:

a. Analog to digital converters, usable in "missiles", having any of the following characteristics:

1. Designed to meet military specification for ruggedized equipment; or

2. Designed or modified for military use and being any of the following types:

a. Analogue-to-digital converter "microcircuits", which are "radiation-hardened" or have all of the following characteristics:

1. Rated for operation in the temperature range from below 219 K (–54 °C) to above 398 K (125 °C); and

2. Hermetically sealed; or

b. Electrical input type analogue-to-digital converter printed circuit boards or modules, having all of the following characteristics:

1. Rated for operation in the temperature range from below 228 K (–45 °C) to above 328 K (55 °C); and

2. Incorporating "microcircuits" specified in 3A101.a.2.a.

b. Accelerators capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and equipment containing those accelerators usable for systems specified in 9A104 and their subsystems.

Note: 3A101.b. above does not specify equipment specially designed for medical purposes.

c. Electronic assemblies and components, designed or modified for use in the systems specified in 9A104 or 9A012 and specially designed for military use and operation at temperatures in excess of 398 K (125 °C).

Notes:

1. Equipment specified in 3A101.c. includes the following:

a. Terrain contour mapping equipment;

b. Scene mapping and correlation (both digital and analogue) equipment;

c. Doppler navigation radar equipment;

d. Passive interferometer equipment;

e. Imaging sensor equipment (both active and passive).

2. Equipment specified in 3A101.c. may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

3. Notes 1 and 2 above are also applicable to goods specified in 3A103, 6A108.a., 7A105 and 7A115.

d. "Radiation Hardened" "microcircuits" usable in protecting rocket systems and unmanned aerial vehicles against nuclear effects (e.g. electromagnetic pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems specified in 9A104.a.

3A102 'Thermal batteries' designed or modified for systems specified in 9A104.

Technical Note:

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

3A103 Umbilical and interstage electrical connectors specially designed for systems specified in 9A104.a. and complete rocket systems specified in 9A104.b.

Technical Note:

Interstage connectors referred to in 3A103 also include electrical connectors installed between systems specified in 9A104.a. and complete rocket systems specified in 9A104.b. and their "payload".

N.B.: See also Notes to 3A101.c.

3A201 Electronic components, as follows;

a. Pulse discharge capacitors having either of the following sets of characteristics:

1. a. Voltage rating greater than 1,4 kV;

b. Energy storage greater than 10 J;

c. Capacitance greater than 0,5 µF; and

d. Series inductance less than 50 nH; or

2. a. Voltage rating greater than 750 V;

e. Capacitance greater than 0,25 µF; and

f. Series inductance less than 10 nH;

b. Superconducting solenoidal electromagnets having all of the following characteristics:

1. Capable of creating magnetic fields greater than 2 T;

2. A ratio of length to inner diameter greater than 2;

3. Inner diameter greater than 300 mm; and

4. Magnetic field uniform to better than 1 % over the central 50 % of the inner volume;

Note: 3A201.b. does not control magnets specially designed for and exported 'as parts of' medical nuclear magnetic resonance (NMR) imaging systems. The phrase 'as part of' does not necessarily mean physical part in the same shipment; separate shipments from different sources are allowed, provided the related export documents clearly specify that the shipments are dispatched 'as part of' the imaging systems.

c. Flash X-ray generators or pulsed electron accelerators having either of the following sets of characteristics:

1. a. An accelerator peak electron energy of 500 keV or greater but less than 25 MeV; and

b. With a 'figure of merit' (K) of 0,25 or greater; or

2. a. An accelerator peak electron energy of 25 MeV or greater; and

b. A 'peak power' greater than 50 MW.

Note: 3A201.c. does not control accelerators that are component parts of devices designed for purposes other than electron beam or X-ray radiation (electron microscopy, for example) nor those designed for medical purposes.

Technical Notes:

1. The 'figure of merit' K is defined as:

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

V is the peak electron energy in million electron volts.

If the accelerator beam pulse duration is less than or equal to 1 μs, then Q is the total accelerated charge in Coulombs. If the accelerator beam pulse duration is greater than 1 μs, then Q is the maximum accelerated charge in 1 μs.

Q equals the integral of i with respect to t, over the lesser of 1 μs or the time duration of the beam pulse (Q = ∫idt), where i is beam current in amperes and t is time in seconds.

2. *'Peak power' = (peak potential in volts) × (peak beam current in amperes).*

3. *In machines based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 μs or the duration of the bunched beam packet resulting from one microwave modulator pulse.*

4. *In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.*

3A225 Frequency changers or generators, usable as a variable frequency or fixed frequency motor drive, having all of the following characteristics:

a. Multiphase output providing a power of 40 VA or greater;

b. Operating at a frequency of 600 Hz or more; and

c. Frequency control better (less) than 0, 2 %.

Notes:

1. *Item 3A225 only controls frequency changers intended for specific industrial machinery and/or consumer goods (machine tools, vehicles, etc.) if the frequency changers can meet the characteristics above when removed, and subject to General Note 2.*

2. *For the purpose of export control, the Government will determine whether or not a particular frequency changer meets the characteristics above, taking into account hardware and software constraints.*

Technical Notes:

1. *Frequency changers in 3A225 are also known as converters or inverters.*

2. *The characteristics specified in item 3A225 may be met by certain equipment marketed such as generators, electronic test equipment, AC power supplies, variable speed motor drives, variable speed drives (VSDs), variable frequency drives (VFDs), adjustable frequency drives (AFDs), or adjustable speed drives (ASDs).*

3A226 High power direct current power supplies, having both of the following characteristics:

a. Capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 A or greater; and

b. Current or voltage stability better than 0,1 % over a time period of 8 hours.

3A227 High voltage direct current power supplies, having both of the following characteristics:

a. Capable of continuously producing, over a time period of 8 hours, 20 kV or greater with current output of 1 A or greater; and

b. Current or voltage stability better than 0,1 % over a time period of 8 hours.

3A228 Switching devices, as follows:

a. Cold cathode tubes, whether gas filled or not, operating similarly to a spark gap, having all of the following characteristics:

1. Containing three or more electrodes;

2. Anode peak voltage rating of 2,5 kV or more;

3. Anode peak current rating of 100 A or more; and

4. Anode delay time of 10 µs or less;

Note: 3A228 includes gas krytron tubes and vacuum sprytron tubes.

b. Triggered spark-gaps having both of the following characteristics:

1. An anode delay time of 15 µs or less; and

2. Rated for a peak current of 500 A or more;

c. Modules or assemblies with a fast switching function having all of the following characteristics:

1. Anode peak voltage rating greater than 2 kV;

2. Anode peak current rating of 500 A or more; and

3. Turn on time of 1 µs or less.

3A229 Firing sets and equivalent high current pulse generators as follows:

a. Detonator (initiation systems, firesets), including electronically-charged, explosively-driven and optically-driven firing sets designed to drive multiple controlled detonators specified in 3A232;

b. Modular electrical pulse generators (pulsers) having all of the following characteristics:

1. Designed for portable, mobile, or ruggedized-use;

2. Capable of delivering their energy in less than 15 μs into loads of less than 40 ohms;

3. Having an output greater than 100 A;

4. No dimension greater than 300 mm;

5. Weight less than 30 kg; and

6. Specified for use over an extended temperature range 223 K (–50 °C) to 373 K (100 °C) or specified as suitable for aerospace applications.

c. Micro-firing units having all of the following characteristics:

1. No dimension greater than 35 mm;

2. Voltage rating of equal to or greater than 1 kV; and

3. Capacitance of equal to or greater than 100 nF.

Note: Optically driven firing sets include both those employing laser initiation and laser charging. Explosively-driven firing sets include both explosive ferroelectric and explosive ferromagnetic firing set types. Item 3A229.b. includes xenon flash lamp drivers.

3A230 High-speed pulse generators, and pulse heads therefor, having both of the following characteristics:

a. Output voltage greater than 6 V into a resistive load of less than 55 ohms, and

b. 'Pulse transition time' less than 500 ps.

Technical Notes:

1. *In 3A230, 'pulse transition time' is defined as the time interval between 10 % and 90 % voltage amplitude.*

2. *Pulse heads are impulse forming networks designed to accept a voltage step function and shape it into a variety of pulse forms that can include rectangular, triangular, step, impulse, exponential, or monocycle types. Pulse heads can be an integral part of the pulse generator, they can be a plug-in module to the device or they can be an externally connected device.*

3A231 Neutron generator systems, including tubes, having both of the following characteristics:

a. Designed for operation without an external vacuum system; and

b. 1. Utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction; or

2. Utilizing electrostatic acceleration to induce a deuterium-deuterium nuclear reaction and capable of an output of 3×10^9 neutrons/s or greater.

3A232 Detonators and multipoint initiation systems, as follows:

a. Electrically driven explosive detonators, as follows:

1. Exploding bridge (EB);

2. Exploding bridge wire (EBW);

3. Slapper;

4. Exploding foil initiators (EFI);

b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface over greater than 5 000 mm^2 from a single firing signal with an initiation timing spread over the surface of less than 2,5 µs.

Note: 3A232 does not control detonators using only primary explosives, such as lead azide.

Technical Note:

In 3A232 the detonators of concern all utilise a small electrical conductor (bridge, bridge wire or foil) that explosively vapourises when a fast, high-current electrical pulse is passed through it. In non slapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (Pentaerythritoltetranitrate). In slapper detonators, the explosive vapourisation of the electrical conductor drives a flyer or slapper across a gap and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by a magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator. Also, the word initiator is sometimes used in place of the word detonator.

3A233 Mass spectrometers, capable of measuring ions of 230 u or greater and having a resolution of better than 2 parts in 230, as follows, and ion sources therefor:

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

b. Glow discharge mass spectrometers (GDMS);

c. Thermal ionization mass spectrometers (TIMS);

d. Electron bombardment mass spectrometers; having both of the following features:

1. A molecular beam inlet system that injects a collimated beam of analyte molecules into a region of the ion source where the molecules are ionized by an electron beam; and

2. One or more 'cold traps' that can be cooled to a temperature of 193 K (–80 °C) or less in order to trap analyte molecules that are not ionized by the electron beam;

e. Mass spectrometers equipped with a microfluorination ion source designed for actinides or actinide fluorides.

Technical Notes:

1. Item 3A233.d. describes mass spectrometers that are typically used for isotopic analysis of UF_6 gas samples.

2. Electron bombardment mass spectrometers in item 3A233.d. are also known as electron impact mass spectrometers or electron ionization mass spectrometers.

3. In item 3A233.d.2., a 'cold trap' is a device that traps gas molecules by condensing or freezing them on cold surfaces. For the purposes of this entry, a closed-loop gaseous helium cryogenic vacuum pump is not a 'cold trap'.

3A234 Striplines to provide low inductance path to detonators with the following characteristics:

a. Voltage rating greater than 2 kV; and

b. Inductance of less than 20 nH.

3B Test, Inspection and Production Equipment

Blank

3C Materials

Blank

3D Software

3D101 "Software" specially designed or modified for the "use" of equipment specified in 3A101.b. to 3A101.c. and 3A225.

3D102 "Software" or encryption keys/codes specially designed to enhance or release the performance characteristics of equipment not controlled in item 3A225 so that it meets or exceeds the characteristics specified in item 3A225.

3D103 "Software" specially designed to enhance or release the performance characteristics of equipment controlled in item 3A225.

3E Technology

3E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or "software" specified in 3A, or 3D.

3E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 3A101, 3A102, 3A103 or 3D101.

3E102 "Technology" according to the General Technology Note for the "development" of "software" specified in 3D101, 3D102 or 3D103.

3E201 "Technology" according to the General Technology Note for the "use" of equipment specified in 3A201, 3A225 to 3A234.

CATEGORY 4

COMPUTERS

4A Systems, Equipment and Components

4A101 Analogue computers, "digital computers" or digital differential analysers, which are ruggedized and designed or modified for use in systems specified in 9A104.a., having any of the following characteristics:

a. Rated for continuous operation at temperatures from below 228 K (-45 °C) to above 328K (+55 °C); or

b. Designed as ruggedized or "radiation hardened".

Note: Item 4A101 equipment may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

4A102 Hybrid computers (combined analogue/digital) specially designed for modelling, simulation or design integration of systems specified in 9A104.a. and their subsystems.

Note:

a. This control only applies when the equipment is supplied with "software" specified in 7D103 or 9D103.

b. The modelling includes in particular the aerodynamic and thermodynamic analysis of the systems.

4B Test, Inspection and Production Equipment

Blank

4C Materials

Blank

4D Software

Blank

4E Technology

4E101 "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 4A101 and 4A102.

CATEGORY 5

TELECOMMUNICATIONS AND "INFORMATION SECURITY"

Part 1 - Telecommunications

5A1 Systems, Equipment and Components

5A101 Telemetering and telecontrol equipment, including ground equipment, designed or modified for systems specified in 9A104.

Note: 5A101 does not control:

a. Equipment designed or modified for manned aircraft or satellites;

b. Ground based equipment designed or modified for terrestrial or marine applications;

c. Equipment designed for commercial, civil or 'Safety of Life' (e.g. data integrity, flight safety) GNSS services;

5B1 Test, Inspection and Production Equipment

Blank

5C1 Materials

Blank

5D1 Software

5D101 "Software" specially designed or modified for the "use" of equipment specified in 5A101

5E1 Technology

5E101 "Technology" according to the General Technology Note for the "development", "production" or "use" of equipment specified in 5A101 and software specified in 5D101.

Part 2 – "Information Security"

5A2 Systems, Equipment and Components

Blank

5B2 Test, Inspection and Production Equipment

Blank

5C2 Materials

Blank

5D2 Software

Blank

5E2 Technology

Blank

CATEGORY 6

SENSORS AND LASERS

6A Systems, Equipment and Components

6A102 Radiation hardened 'detectors' specially designed or modified for protecting against nuclear effects (e.g. electromagnetic pulse (EMP), X-rays, combined blast and thermal effects) and usable for "missiles", designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5×10^5 rads (silicon).

Technical Note:

In 6A102, a 'detector' is defined as a mechanical, electrical, optical or chemical device that automatically identifies and records, or registers a stimulus such as an environmental change in pressure or temperature, an electrical or electromagnetic signal or radiation from a radioactive material. This includes devices that sense by one time operation or failure.

6A107 Gravity meters (gravimeters) or gravity gradiometers designed or modified for airborne or marine use, usable for systems specified in 9A104.a., as follows, and specially designed components therefor:

a. Gravity meters having all of the following:

1. A static or operational accuracy of 7 x 10^{-6} m/s^2 (0,7 milli gal) or less (better); and

2. A 'time to steady-state registration' of two minutes or less;

Technical Note:

In 6A107.a.2., 'time to steady-state registration' (also referred to as the gravity meter's response time) is the time over which the disturbing effects of platform-induced acceleration (high frequency noise) are reduced.

b. Gravity gradiometers.

6A108 Radar systems and tracking systems, as follows:

a. Radar and laser radar systems, including altimeters, designed or modified for use in systems specified in 9A104.a.;

Technical Note:

Laser radar systems embody specialised transmission, scanning, receiving and signal processing techniques for utilisation of lasers for echo ranging, direction finding and discrimination of targets by location, radial speed and body reflection characteristics.

N.B.: See also Notes to 3A101.c.

b. Precision tracking systems, usable for systems specified in 9A104, as follows:

1. Tracking systems which use a code translator installed on the rocket or unmanned aerial vehicle in conjunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of in-flight position and velocity;

2. Range instrumentation radars including associated optical/ infrared trackers with all of the following capabilities:

a. Angular resolution better than 1,5 milliradians;

b. Range of 30 km or greater with a range resolution better than 10 m rms;

c. Velocity resolution better than 3 m/s.

6A202 Photomultiplier tubes having both of the following characteristics:

a. Photocathode area of greater than 20 cm^2; and

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

6A203 High-speed cameras and imaging devices and components therefor, as follows:

N.B.: "Software" specially designed to enhance or release the performance of cameras or imaging devices to meet the characteristics below is controlled in 6D101 and 6D102.

a. Streak cameras, and specially designed components therefor, as follows:

1. Streak cameras with writing speeds greater than 0,5 mm per µs;

2. Electronic streak cameras capable of 50 ns or less time resolution;

3. Streak tubes for cameras specified in 6A203.a.2.;

4. Plug-ins specially designed for use with streak cameras which have modular structures and that enable the performance specifications in 6A203.a.1. and 6A203.a.2.;

5. Synchronizing electronics units, rotor assemblies consisting of turbines, mirrors and bearings specially designed for cameras specified in 6A203.a.1.;

b. Framing cameras and specially designed components therefor as follows:

1. Framing cameras with recording rates greater than 2 25 000 frames per second;

2. Framing cameras capable of 50 ns or less frame exposure time;

3. Framing tubes and solid–state imaging devices having a fast image gating (shutter) time of 50 ns or less specially designed for cameras specified in 6A203.b.1. or 6A203.b.2.;

4. Plug-ins specially designed for use with framing cameras which have modular structures and that enable the performance specifications in 6A203.b.1 or 6A203.b.2.;

5. Synchronizing electronics units, rotor assemblies consisting of turbines, mirrors and bearings specially designed for cameras specified in 6A203.b.1 or 6A203.b.2.;

c. Solid state or electron tube cameras and specially designed components therefor as follows:

1. Solid-state cameras or electron tube cameras with a fast image gating (shutter) time of 50 ns or less;

2. Solid-state imaging devices and image intensifiers tubes having a fast image gating (shutter) time of 50 ns or less specially designed for cameras specified in 6A203.c.1.;

3. Electro-optical shuttering devices (Kerr or Pockels cells) with a fast image gating (shutter) time of 50 ns or less;

4. Plug-ins specially designed for use with cameras which have modular structures and that enable the performance specifications in 6A203.c.1.

Technical Note:

High speed single frame cameras can be used alone to produce a single image of a dynamic event, or several such cameras can be combined in a sequentially-triggered system to produce multiple images of an event.

d. Radiation-hardened TV cameras, or lenses therefor, specially designed or rated as radiation hardened to withstand a total radiation dose greater than 50×10^3 Gy (silicon) (5×10^6 rad (silicon)) without operational degradation.

Technical Note:

The term Gy (silicon) refers to the energy in Joules per kilogramme absorbed by an unshielded silicon sample when exposed to ionising radiation.

6A205 "Lasers", laser amplifiers and oscillators, as follows:

a. Argon ion "lasers" having both of the following characteristics:

1. Operating at wavelengths between 400 nm and 515 nm; and

2. An average output power greater than 40 W;

b. Tunable pulsed single-mode dye laser oscillators having all of the following characteristics:

1. Operating at wavelengths between 300 nm and 800 nm;

2. An average output power greater than 1 W;

3. A repetition rate greater than 1 kHz; and

4. Pulse width less than 100 ns;

c. Tunable pulsed dye laser amplifiers and oscillators, having all of the following characteristics:

1. Operating at wavelengths between 300 nm and 800 nm;

2. An average output power greater than 30 W;

3. A repetition rate greater than 1 kHz; and

4. Pulse width less than 100 ns;

Note: 6A205.c. does not control single mode oscillators;

d. Pulsed carbon dioxide (CO_2) "lasers" having all of the following characteristics:

1. Operating at wavelengths between 9 000 nm and 11 000 nm;

2. A repetition rate greater than 250 Hz;

3. An average output power greater than 500 W; and

4. Pulse width of less than 200 ns;

Note: Item 6A205.d. does not control the higher power (typically 1 to 5 kW) industrial CO_2 "lasers" used in applications such as cutting and welding, as these latter "lasers" are either continuous wave or are pulsed with a pulse width greater than 200 ns.

e. Para-hydrogen Raman shifters designed to operate at 16 µm output wavelength and at a repetition rate greater than 250 Hz;

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

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

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

   b. A multiple-transverse mode output with an average output power greater than 50 W;

or

2. Incorporating frequency doubling to give an output wavelength between 500 nm and 550 nm with an average output power of greater than 40 W;

g. Copper vapour "lasers" having both of the following characteristics:

   1. Operating at wavelengths between 500 nm and 600 nm; and

   2. An average output power equal to or greater than 30 W;

h. Alexandrite "lasers" having all of the following characteristics:

   1. Operating at wavelengths between 720 nm and 800 nm;

   2. A bandwidth of 0,005 nm or less;

   3. A repetition rate greater than 125 Hz; and

   4. An average output power greater than 30 W;

i. Pulsed excimer "lasers" (XeF, XeCl, KrF) having all of the following characteristics:

   1. Operating at wavelengths between 240 nm and 360 nm;

   2. A repetition rate greater than 250 Hz; and

   3. An average output power greater than 500 W;

j. Pulsed carbon monoxide (CO) "lasers" having all of the following characteristics:

   1. Operating at wavelengths between 5 000 nm and 6 000 nm;

   2. A repetition rate greater than 250 Hz;

   3. An average output power greater than 200 W; and

4. Pulse width of less than 200 ns.

Note: Item 6A205.j. does not control the higher power (typically 1 to 5 kW) industrial CO "lasers" used in applications such as cutting and welding, as these latter "lasers" are either continuous wave or are pulsed with a pulse width greater than 200 ns.

6A225 Velocity interferometers for measuring velocities exceeding 1 km/s during time intervals of less than 10 µs.

Note: 6A225 includes velocity interferometers such as VISARs (Velocity Interferometer Systems for Any Reflector), DLIs (Doppler Laser Interferometers) and PDV (Photonic Doppler Velocimeters) also known as Het-V (Heterodyne Velocimeters).

6A226 Pressure sensors, as follows:

a. Shock pressure gauges capable of measuring pressures greater than 10 GPa, including gauges made with manganin, ytterbium, and polyvinylidene fluoride (PVDF) / polyvinyl difluoride (PVF_2);

b. Quartz pressure transducers for pressures greater than 10 GPa.

6B Test, Inspection and Production Equipment

6B108 Systems, specially designed for radar cross section measurement usable for systems specified in 9A104 and their subsystems.

6C Materials

Blank

6D Software

6D102 "Software" specially designed or modified for the "use" of goods specified in 6A108.

6D103 "Software" which processes post-flight, recorded data, enabling determination of vehicle position throughout its flight path, specially designed or modified for 'missiles'.

Technical Note:

In 6D103 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

b. Accelerometers or gyros of any type, designed for use in inertial navigation system or in guidance system of all types, specified to function at acceleration levels greater than 100 g.

Note: 7A101.b. does not include accelerometer that are designed to measure vibration or shock.

Technical Note:

In 7A101 the measurement of "bias" and "scale factor" refers to a one sigma standard deviation with respect to a fixed calibration over a period of one year.

7A102 All types of gyros, usable in systems specified in 9A104, with a rated 'drift rate' 'stability' of less than 0,5° (1 sigma or rms) per hour in a 1 g environment and specially designed components therefor.

Technical Notes:

1. *'Drift rate' is defined as the component of gyro output that is functionally independent of input rotation and is expressed as an angular rate (IEEE STD 528-2001 paragraph 2.56).*

2. *'Stability' is defined as a measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition (IEEE STD 528-2001 paragraph 2.247) (This definition does not refer to dynamic or servo stability).*

7A103 Instrumentation, navigation equipment and systems, as follows; and specially designed components therefor:

a. 'Inertial measurement equipment or systems' using accelerometers specified in 7A101 or gyros specified in 7A102 and systems incorporating such equipment;

Note: Item 7A103.a includes:

a. Attitude and heading Reference Systems (AHRSs);

b. Gyrocompasses;

c. Inertial measurement Units (IMUs);

d. Inertial navigation Systems (INSs);

e. Inertial Reference Systems (IRSs);

f. Inertial Reference Units (IRUs);

6D203 "Software" or encryption keys/codes as follows:

1. Specially designed to enhance or release the performance characteristics of equipment not controlled in item6A203 so that it meets or exceeds the characteristics specified in item 6A203.

2. Specially designed to enhance or release the performance characteristics of equipment controlled in item 6A203.

6E Technology

6E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or "software" specified in 6A, 6B, or 6D.

6E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" specified in 6A102, 6A107, 6A108, 6B108, 6D102 or 6D103.

Note: 6E101 only specifies "technology" for equipment specified in 6A when it is designed for airborne applications and is usable in "missiles".

6E201 "Technology" according to the General Technology Note for the "use" of equipment specified in 6A202, 6A203, 6A205, 6A225 or 6A226.

CATEGORY 7

NAVIGATION AND AVIONICS

7A Systems, Equipment and Components

7A101 Accelerometers, as follows, and specially designed components therefor:

a. Linear accelerometers, designed for use in inertial navigation systems or in guidance systems of all types, usable in the systems specified in 9A104, having all of the following characteristics, and specially designed components therefor:

1. "Scale factor" "repeatability" less (better) than 1 250 ppm; and

2. "Bias" "repeatability" less (better) than 1 250 micro g.

Note: 7A101.a. does not specify accelerometers which are specially designed and developed as MWD (Measurement While Drilling) Sensors for use in downhole well service operations.

Technical Note:

'Inertial measurement equipment or systems' specified in item 7A103.a. incorporate accelerometers or gyros to measure changes in velocity and orientation in order to determine or maintain heading or position without requiring an external reference once aligned.

Note: 7A103.a. does not specify equipment containing accelerometers specially designed and developed as MWD (Measurement While Drilling) sensors for use in down-hole well services operations.

b. Integrated flight instrument systems, which include gyrostabilisers or automatic pilots, designed or modified for use in systems specified in 9A104;

c. 'Integrated navigation systems', designed or modified for systems specified in 9A104 and capable of providing a navigational accuracy of 200 m "circle of equal probability (CEP)" or less;

Technical Note:

An 'integrated navigation system' typically incorporates the following components:

1. *An inertial measurement device (e.g., an attitude and heading reference system, inertial reference unit, or inertial navigation system);*

2. *One or more external sensors used to update the position and/or velocity, either periodically or continuously throughout the flight (e.g., satellite navigation receiver, radar altimeter, and/or Doppler radar); and*

3. *Integration hardware and software.*

d. Three axis magnetic heading sensors, designed or modified to be integrated with flight control and navigation systems, having all the following characteristics, and specially designed components therefor;

1. Internal tilt compensation in pitch (±90 degrees) and roll (±180 degrees) axes;

2. Azimuthal accuracy better (less) than 0,5 degrees rms at latitude of ±80 degrees, referenced to local magnetic field.

3. Designed or modified to be integrated with flight control and navigation systems.

Note: Flight control and navigation systems in 7A103.d. Include gyrostabilisers, automatic pilots and inertial navigation systems.

7A104 Gyro-astro compasses and other devices, which derive position or orientation by means of automatically tracking celestial bodies or satellites and specially designed components therefor.

7A105 Receiving equipment for 'navigation satellite system', having any of the following characteristics, and specially designed components therefor:

a. Designed or modified for use in systems specified in 9A104.a.; or

b. Designed or modified for airborne applications and having any of the following:

1. Capable of providing navigation information at speeds in excess of 600 m/s (1165 nautical miles/hour);

2. Employing decryption, designed or modified for military or governmental services, to gain access to a 'navigation satellite system' secured signal/data; or

3. Being specially designed to employ anti-jam features (*e.g.* null steering antenna or electronically steerable antenna) to function in an environment of active or passive countermeasures.

*Note: 7A105.b.2. and 7A105.b.3. do not control equipment designed for commercial, civil or 'Safety of Life' (*e.g.*, data integrity, flight safety) 'navigation satellite system' services.*

Technical Note:

In item 7A105, 'navigation satellite system' includes Global Navigation Satellite Systems (GNSS; e.g. *GPS, GLONASS, Galileo or BeiDou) and Regional Navigation Satellite Systems (RNSS;* e.g. *NavIC, QZSS).*

N.B.: See also Notes to 3A101.c.

7A115 Passive sensors for determining bearing to specific electromagnetic source (direction finding equipment) or terrain characteristics, designed or modified for use in systems specified in 9A104.a.

N.B.: See also Notes to 3A101.c.

7A116 Flight control systems and servo valves, as follows; designed or modified for use in systems specified in 9A104.a.

a. Pneumatic, hydraulic, mechanical, electro optical, or electro mechanical flight control systems (including fly-by-wire and fly-by-light types);

b. Attitude control equipment;

c. Flight control servo valves designed or modified for the systems specified in 7A116.a. or 7A116.b., and designed or modified to operate in a vibration environment of more than 10 g rms over the entire range between 20 Hz and 2 kHz.

Notes:

1. Systems, equipment or valves specified in 7A116 may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

2. For conversion of manned aircraft to operate as unmanned aerial vehicles specified in 9A104.a., Item 7A116 includes the systems, equipment and valves designed or modified to enable operation of manned aircraft as unmanned aerial vehicles.

7A117 "Guidance sets", usable in "missiles" specified in 9A104.a. capable of achieving system accuracy of 3,33 % or less of the range (e.g., a "CEP" of 10 km or less at a range of 300 km).

7B Test, Inspection and Production Equipment

7B102 Reflectometers specially designed to characterise mirrors, for "laser" gyros, having a measurement accuracy of 50 ppm or less (better).

7B103 "Production facilities" and "production equipment" as follows:

a. "Production facilities" specially designed for equipment specified in 7A117.

b. "Production equipment", and other test, calibration and alignment equipment, designed or modified to be used with equipment specified in 7A.

Note: Equipment specified in 7B103.b. includes the following:

a. For laser gyro equipment, the following equipment used to characterise mirrors, having the threshold accuracy shown or better:

1. Scatterometer (10 ppm);

2. Reflectometer (50 ppm);

3. Profilometer (5 Angstroms);

b. For other inertial equipment:

1. Inertial Measurement Unit (IMU) Module Tester;

2. IMU Platform Tester;

3. IMU Stable Element Handling Fixture;

4. IMU Platform Balance Fixture;

5. Gyro Tuning Test Station;

6. Gyro Dynamic Balance Station;

7. Gyro Run-In/Motor Test Station;

8. Gyro Evacuation and Filling Station;

9. Centrifuge Fixture for Gyro Bearings;

10. Accelerometer Axis Align Station;

11. Accelerometer Test Station;

12. Fiber optic Gyro Coil Winding Machines.

7C **Materials**

Blank.

7D **Software**

7D101 "Software" specially designed or modified for the "use" of equipment specified in 7A101 to 7A106, 7A115, 7A116, 7B102 or 7B103, and for operation and maintenance of systems specified in 7A117.

Note: "Software" specified in 7D101 may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

7D102 Integration "software" as follows:

a. Integration "software" for the equipment specified in 7A103.b.;

b. Integration "software" specially designed for the equipment specified in 7A103.a.; and

c. Integration "software" designed or modified for the equipment specified in 7A103.c.

Note: A common form of integration "software" employs Kalman filtering.

7D103 "Software" specially designed for modelling or simulation of the "guidance sets" specified in 7A117 or for their design integration with the sounding rockets specified in 9A104.

Note:

a. "Software" specified in 7D103 remains controlled when combined with specially designed hardware specified in 4A102.

b. 7D103 includes "software", specially designed or modified to enhance the performance of 'guidance sets' to achieve or exceed the accuracy specified in 7A117.

7E Technology

7E101 "Technology", according to the General Technology Note for the "development", "production" or "use" of equipment specified in 7A101 to 7A106, 7A115 to 7A117, 7B102, 7B103, 7D101 to 7D103.

7E102 "Technology" for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards, from external sources, as follows:

a. Design "technology" for shielding systems;

b. Design "technology" for the configuration of hardened electrical circuits and subsystems; and

c. Design "technology" for the determination of hardening criteria of 7E102.a. and 7E102.b.

7E104 "Technology" for the integration of the flight control, guidance, and propulsion data into a flight management system, designed or modified for the complete rocket systems specified in 9A104, for optimisation of rocket system trajectory.

7E105 Design "technology" for integration of air vehicle fuselage, propulsion system and lifting control surfaces, designed or modified for the complete unmanned aerial vehicle systems specified in 9A104, to optimise aerodynamic performance throughout the flight regime of an unmanned aerial vehicle.

CATEGORY 8

MARINE

Blank (For later use)

CATEGORY 9

PROPULSION SYSTEMS, SPACE VEHICLES AND RELATED EQUIPMENT

9A Systems, Equipment and Components

9A011 Ramjet, scramjet, pulse jet, detonation, or 'combined cycle engines' and specially designed components therefor, useable for systems specified in 9A104.a. and UAVs specified in 9A104.b.

N.B.: See also 9A111 and 9A118.

Technical Note:

1. *In item 9A011, 'combined cycle engines' are the engines that employ two or more cycles of the following types of engines: gas-turbine engine (turbojet, turboprop, turbofan and turboshaft), ramjet, scramjet, pulse jet, detonation or rocket motor or rocket engine (liquid/gel/solid-propellant and hybrid).*

2. *In Item 9A011, detonation engines utilise detonation to produce a rise in effective pressure across the combustion chamber. Examples of detonation engines include pulse detonation engines, rotating detonation engines or continuous wave detonation engines.*

9A012 "Unmanned aerial vehicles" "UAVs" having all of the following:

a. Having any of the following:

1. An autonomous flight control and navigation capability; or

2. Capability of controlled-flight out of the direct vision range involving a human operator; and

b. Having any of the following:

1. Incorporating an aerosol dispensing system/mechanism with a capacity greater than 20 litres; or

2. Designed or modified to incorporate an aerosol dispensing system/mechanism with a capacity greater than 20 litres.

Note: Item 9A012 does not control model aircraft, specially designed for recreational or competition purposes.

Technical Notes:

1. An aerosol consists of particulate or liquids other than fuel components, by-products or additives, as part of the "payload" to be dispersed in the atmosphere. Examples of aerosols include pesticides for crop dusting and dry chemicals for cloud seeding.

2. An aerosol dispensing system/mechanism contains all those devices (mechanical, electrical, hydraulic, etc.), which are necessary for storage and dispersion of an aerosol into the atmosphere. This includes the possibility of aerosol injection into the combustion exhaust vapour and into the propeller slip stream.

9A101 Turbojet and turbofan engines as follows;

a. Engines having all of the following characteristics:

1. 'Maximum thrust value' greater than 400 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8 890 N (achieved un-installed),

2. Specific fuel consumption of 0,15 kg/N/h or less (at maximum continuous power at sea level static conditions using the ICAO standard atmosphere);

3. 'Dry weight' less than 750 kg; and

4. 'First-stage rotor diameter' less than 1 m;

b. Engines designed or modified for use in systems specified in 9A104.a. and UAVs specified in 9A104.b., regardless of thrust, specific fuel consumption, 'dry weight' or 'first-stage rotor diameter'.

Technical Notes:

In 9A101:

1. *'Maximum thrust value' is the manufacturer's demonstrated maximum thrust for the engine type un-installed at sea level static conditions using the ICAO standard atmosphere. The civil type certified thrust value will be equal to or less than the manufacturer's demonstrated maximum thrust for the engine type un-installed.*

2. *Specific fuel consumption is determined at maximum continuous thrust for engine type un-installed at sea level static conditions using the ICAO standard atmosphere.*

3. *'Dry weight' is the weight of the engine without fluids (fuel, hydraulic fluid, oil, etc.) and does not include the nacelle (housing).*

4. *'First-stage rotor diameter' is the diameter of the first rotating stage of the engine, whether a fan or compressor, measured at the leading edge of the blade tips.*

Note: Engines specified in 9A101 may be exported as part of a manned aircraft or in quantities appropriate for replacement parts for a manned aircraft.

9A102 'Turboprop engine systems' specially designed for unmanned aerial vehicles specified in 9A104, and specially designed components therefore, having a 'maximum power' greater than 10 kW (achieved un-installed at sea level static conditions using the ICAO standard atmosphere).

Note: 9A102 does not control civil certified engines.

Technical Notes:

1. *For the purposes of 9A102 a 'turboprop engine system' incorporates all of the following:*

   a. *Turboshaft engine; and*

   b. *Power transmission system to transfer the power to a propeller;*

2. *For the purposes of 9A102 the 'maximum power' is achieved un-installed at sea level standard conditions.*

9A104 Complete rocket systems (including ballistic missiles, space launch vehicles, and sounding rockets) and complete unmanned aerial vehicle systems (including cruise missiles, target drones and reconnaissance drones) as follows:

a. Capable of delivering at least a 500 kg "payload" to a "range" of at least 300 km.

b. Capable of a "range" equal to or greater than 300 km.

9A105 Liquid propellant rocket engines or gel propellant rocket engines, as follows:

N.B.: See also 9A119.

a. Liquid propellant rocket engines or gel propellant rocket motors integrated, or designed or modified to be integrated, into a liquid propellant or gel propellant propulsion system usable in "missiles" having a total impulse capacity of 1,1 MNs or greater;

b. Liquid propellant rocket engines or gel propellant rocket motors, integrated, or designed or modified to be integrated, into a liquid propellant or gel propellant propulsion system, usable in complete rocket systems or unmanned air vehicles, capable of a range of 300 km, other than those specified in 9A105.a., having a total impulse capacity of 0,841 MNs or greater, but less than 1,1 MNs.

Note: Liquid propellant apogee engines or station-keeping engines specified in 9A105.a., designed or modified for use on satellites, may be treated as 9A105.b., if the subsystem is exported subject to end-use statements and quantity limits appropriate for the excepted end-use stated above, when having a vacuum thrust not greater than 1kN.

9A106 Subsystems or components, usable in systems specified in 9A104, as follows, specially designed for liquid or gel rocket propulsion systems:

a. Liquid, slurry and gel propellant (including oxidisers) control systems, and specially designed components therefor, usable in systems specified in 9A104.a., designed or modified to operate in vibration environments of more than 10 g rms between 20 Hz and 2000 Hz.

Note 1: The only servo valves, pumps and gas turbines specified in 9A106.a. are the following:

a. Servo valves designed for flow rates of 24 litres per minute or greater, at an absolute pressure of 7 MPa or greater, that have an actuator response time of less than 100 ms;

b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8 000 rpm at the maximum operating mode or with discharge pressures equal to or greater than 7 MPa.

c. Gas turbines, for liquid propellant turbopumps, with shaft speed equal to or greater than 8000 rpm at the maximum operating mode.

Note 2: Systems and components specified in 9A106.a. may be exported as part of a satellite.

b. Combustion chambers and nozzles for liquid propellant rocket engines or gel propellant rocket motors usable in sub-systems specified in 9A105.

9A107 Solid propellant rocket engines as follows:

a. Solid propellant rocket engines having a total impulse capacity of 1,1 MNs or greater;

b. Solid propellant rocket engines, usable in complete rocket systems or unmanned air vehicles, capable of a range of 300 km, having total impulse capacity of 0,841 MNs or greater, but less than 1,1 MNs.

N.B.: See also 9A119.

9A108 Components usable in sub-systems specified in 9A107 and 9A109, as follows; specially designed for solid rocket propulsion systems:

a. Rocket motor cases, and 'insulation' therefor;

b. Rocket nozzles; and

c. Thrust vector control sub-systems.

Technical Note:

1. In 9A108 'insulation' intended to be applied to the components of a rocket motor, i.e. *the case, nozzle inlets, case*

closures, includes cured or semi-cured compounded rubber components comprising sheet stock containing an insulating or refractory material. It may also be incorporated as stress relief boots or flaps.

2. *Thrust vector control sub-systems, usable in the systems specified in 9A012 and 9A104, except as provided in the Note under 9A105 for those designed for rocket systems other than those specified in 9A012 and 9A104.*

3. *9A108.c includes the following methods of achieving thrust vector control:*

   a. *Flexible nozzle;*

   b. *Fluid or secondary gas injection;*

   c. *Movable engine or nozzle;*

   d. *Deflection of exhaust gas streams (jet vanes or probes)*

   e. *Use of thrust tabs*

9A109 Hybrid rocket motors as follows:

a. Usable in "missiles" and specially designed components therefor having a total impulse capacity of 1,1 MNs or greater;

b. Usable in systems specified 9A104.b. having total impulse capacity of 0,841 MNs or greater, but less than 1,1 MNs and specially designed components therefor.

N.B.: See also 9A119.

9A110 Composite structures, laminates and manufactures thereof, specially designed for systems specified in 9A104 or the sub-systems specified in 7A117, 9A105, 9A106 to 9A109, 9A116 or 9A119, or 9A121.

9A111 Pulse jet engines, usable in systems specified in 9A104.a. and UAVs specified in 9A104.b. and specially designed components therefor.

N.B.: See also 9A011 and 9A118.

9A115 Launch support equipment as follows:

a. Apparatus and devices for handling, control, activation or launching, designed or modified for systems specified in 9A104; and

b. Vehicles for transport, handling, control, activation or launching, designed or modified for systems specified in 9A104.a.

9A116 Re-entry vehicles, usable in "missiles" specified in 9A104.a., and equipment designed or modified therefor, as follows:

a. Re-entry vehicles;

b. Heat shields and components therefor fabricated of ceramic or ablative materials;

c. Heat sinks and components therefor fabricated of light-weight, high heat capacity materials; and

d. Electronic equipment specially designed for re-entry vehicles.

9A117 Staging mechanisms, separation mechanisms, and interstages, usable in "missiles" specified in 9A104.a.

Technical Note:

Staging and separation mechanisms specified in 9A117 may contain some of the following components:

a. Pyrotechnic bolts, nuts and shackles;

b. Ball locks;

c. Circular cutting devices;

d. Flexible linear shaped charges (FLSC).

9A118 Devices to regulate combustion usable in engines, which are usable in systems specified in 9A104.a. and UAVs specified in 9A104.b.

9A119 Individual rocket stages, usable in, systems specified in 9A104 and 9A012 other than those specified in 9A105, 9A107 and 9A109.

9A120 Liquid or gel propellant tanks specially designed for propellants specified in 1C111 or other liquid or gel propellants used in rocket systems capable of delivering at least a 500 kg payload to a range of at least 300 km.

9A121 Weapon or warhead safing, arming, fuzing, and firing mechanisms, usable in the systems specified in 9A104.a.

9A123 Radomes designed to withstand a combined thermal shock greater than $4,184 \times 10^6$ J/m^2 accompanied by a peak over pressure of greater than 50 kPa, usable in protecting rocket systems and unmanned aerial vehicles against nuclear effects (e.g., electromagnetic pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems specified in 9A104.a.

9B Test, Inspection and Production Equipment

9B105 'Aerodynamic test facilities' for speeds of Mach 0,9 or more, usable for systems specified in 9A104, or the sub-systems specified in 7A117, 9A105, 9A107, 9A109, 9A116 and 9A119.

Note: Item 9B105 does not control wind-tunnels for speeds of Mach 3 or less with dimension of the 'test cross section size' equal to or less than 250 mm.

Technical Notes:

1. *'Aerodynamic test facilities' includes wind tunnels and shock tunnels for the study of airflow over objects.*

2. *'Test cross section size' means the diameter of the circle, or the side of the square, or the longest side of the rectangle, or the major axis of the ellipse at the largest 'test cross section' location. 'Test cross section' is the section perpendicular to the flow direction.*

9B106 Environmental chambers and anechoic chambers, as follows:

a. Environmental chambers capable of simulating the following flight conditions:

1. Having any of the following

a. Altitude equal to or greater than 15 km; or

b. Temperature range from below 223 K (–50 °C) to above 398 K (+125 °C);

2. Incorporating, or 'designed or modified' to incorporate, a shaker unit or other vibration test equipment to produce vibration environments equal to or greater than 10 g rms, measured 'bare table', between 20 Hz and 2 kHz while imparting forces equal to or greater than 5 kN;

Technical Notes:

1. *9B106.a.2. describes systems that are capable of generating a vibration environment with a single wave*

(e.g., a sine wave) and systems capable of generating a broad band random vibration (i.e., power spectrum).

2. *In 9B106.a.2. 'designed or modified' means the environmental chamber provides appropriate interfaces (e.g., sealing devices) to incorporate a shaker unit or other vibration test equipment as specified in 2B116.*

3. *In 9B106.a.2. 'bare table' means a flat table, or surface, with no fixture or fittings.*

b. Environmental chambers capable of simulating all of the following flight conditions:

1. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to 20 μPa) or with a total rated acoustic power output of 4 kW or greater; and

2. Any of the following:

a. Altitude equal to or greater than 15 km; or

b. Temperature range from below 223 K (–50 °C) to above 398 K (+125 °C).

9B107 'Aerothermodynamic test facilities', usable for the systems specified in 9A102, 9A104 or the subsystems specified in 9A105, 9A107, 9A109 and 9A119, having any of the following characteristics:

a. An electrical power supply equal to or greater than 5 MW; or

b. A gas supply total pressure equal to or greater than 3 MPa.

Technical Note:

'Aerothermodynamic test facilities' include plasma arc jet facilities and plasma wind tunnels for the study of thermal and mechanical effects of airflow on objects.

9B115 Specially designed "production equipment" for the systems, sub-systems and components specified in 9A011, 9A101, 9A102, 9A105 to 9A109, 9A111, 9A116 to 9A119, and 9A120.

9B116 Specially designed "production facilities" for the systems, sub-systems, and components specified in 9A011, 9A101, 9A102, 9A104 to 9A109, 9A111, or 9A116 to 9A119 and 9A120.

9B117 Test benches and test stands usable for systems specified in 9A104 having the capacity to handle solid, gel or liquid propellant rockets or rocket motors or engines, having either of the following characteristics:

a. The capacity to handle more than 68 kN of thrust; or

b. Capable of simultaneously measuring the three axial thrust components.

9C **Materials**

9C108 "Interior lining", and "insulation" material in bulk form usable for rocket motor cases or specially designed for sub-systems specified in 9A107 and 9A109.

Technical Notes:

1. *In 9C108 "interior lining" suited for the bond interface between the solid propellant and the case or insulating liner is usually a liquid polymer based dispersion of refractory or insulating materials* e.g. *carbon filled HTPB or other polymer with added curing agents to be sprayed or screeded over a case interior.*

2. *In 9C108 "insulation" intended to be applied to the components of a rocket motor,* i.e. *the case, nozzle inlets, case closures, includes cured or semi-cured compounded rubber sheet stock containing an insulating or refractory material.*

9C110 Resin impregnated fibre prepregs and metal coated "fibre preforms" therefor, for composite structures, laminates and manufactures specified in 9A110, made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a "specific tensile strength" greater than $7,62 \times 10^4$ m and a "specific modulus" greater than $3,18 \times 10^6$ m.

N.B.: See also 1C210.

Note: The only resin impregnated fibre prepregs specified in entry 9C110 are those using resins with a glass transition temperature (Tg), after cure, exceeding 418 K (145 °C) as determined by ASTM D4065 or equivalent.

9D **Software**

9D101 "Software" specially designed or modified for the "use" of goods specified in 9B105, 9B106, 9B107, 9B116 (except 9A104.b.), or 9B117.

9D103 "Software" specially designed for modelling, simulation or design integration of the systems specified in 9A104, or the sub-systems

specified in 9A105, 9A106, 9A107, 9A108, 9A109, 9A116, 9A119 or 9A121.

Technical Note:

The modelling includes in particular the aerodynamic and thermodynamic analysis of the systems.

Note: "Software" specified in 9D103 remains controlled when combined with specially designed hardware specified in 4A102.

9D104 "Software" specially designed or modified for the "use" of goods specified in 9A011, 9A101, 9A102, 9A105, 9A106.a, 9A107, 9A109, 9A111, 9A115.a., 9A117 or 9A118 and for operation and maintenance of systems specified in 9A116.d and subs-ystems in 9A108.c and 9A121.

Note: "Software" for liquid propellant apogee engines or station-keeping engines specified in 9A105.a., designed or modified for use on satellite applications, may be treated as "software" for 9A105.b., if exported subject to end-use statements.

9D105 "Software" specially designed or modified to coordinate the function of more than one sub-system in systems specified in 9A104.

Note: For a manned aircraft converted to operate as an unmanned aerial vehicle specified in 9A104.a. item 9D105 includes "software", as follows:

a. "Software" specially designed or modified to integrate the conversion equipment with the aircraft system functions;

b. "Software" specially designed or modified to operate the aircraft as an unmanned aerial vehicle.

9D106 "Software" specially designed or modified for the "development" of equipment specified in 9A011, 9A106.a., 9A108.a., 9A108.b., 9A109, 9A111, 9A117, 9A118, 9B107.

9E Technology

9E101 "Technology" according to the General Technology Note for the "development" or "production" of goods specified in 9A011, 9A101, 9A102, 9A104 to 9A111, 9A115 to 9A119, 9A120, 9A121, 9A123, 9B105, 9B106, 9B107, 9B115, 9B116, 9B117, 9C108, 9C110, 9D101, 9D103, 9D104, 9D105 and 9D106.

9E102 "Technology" according to the General Technology Note for the "use" of goods specified in 9A011, 9A101, 9A102, 9A104 to 9A111, 9A115 to 9A119, 9A120, 9A121, 9A123, 9B105, 9B106, 9B107, 9B115, 9B116, 9B117, 9C108, 9C110, 9D101 or 9D103, 9D104, 9D105 and 9D106.

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HAFIZ WASIF MEHMOOD,
Deputy Director (Policy).

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