

**(Annexure to Notification No. 37(RE-2012)/2009-2014 Dated 14.03.2013)**

**Special Chemicals, Organisms, Materials, Equipment and Technologies (SCOMET) export  
of which is regulated**

Export of Special Chemicals, Organisms, Materials, Equipment and Technologies (SCOMET) listed below shall be permitted only against an export licence issued in this behalf unless export is prohibited or is permitted without licence subject to fulfillment of conditions, if any, as indicated under/against any specific category or item.

Provisions of Chapter IV A of the FT(D&R) Act,1992 as amended in 2010 shall apply to the goods, services and technologies specified in the list below.

**Supply of SCOMET Items from DTA to SEZ**

No export permission is required for supply of SCOMET items from DTA to SEZ. However, all supplies of SCOMET items from DTA to SEZ will be reported to the Development Commissioner of the respective SEZ by the supplier in the prescribed proforma (Annexure 1) within one (1) week of the supplies getting effected. An annual report of such supplies from DTA to SEZ shall be sent to SCOMET Cell, DGFT (Hqrs), Department of Commerce, Udyog Bhawan, Maulana Azad Road, New Delhi-110011, by the Development Commissioner (DC), SEZ in the prescribed proforma (Annexure 2) . Report by the DC, SEZ to be filed by 15<sup>th</sup> May of every financial year for the supplies effected during the preceding financial year.

**Export of SCOMET Items from SEZ to outside the country**

Export permission is required if the SCOMET items are to be physically exported outside the country from SEZ i.e. to another country (Refer Rule 26 of the SEZ Rules, 2006).

It is mandatory for all companies and their subsidiaries registered in India and all other business entities operating in India and involved in the manufacture, processing and use of Special Chemicals, Organisms, Materials, Equipment and Technologies (SCOMET) listed below to obtain permission of the Central Government before entering into any arrangement or understanding that involves an obligation to facilitate or undertake site visits, on-site verification or access to records/ documentation, by foreign Governments or foreign third parties, either acting directly or through an Indian party or parties. Requests for such permissions shall be considered in the manner in which requests for export/import licence are considered.

Provided that where obligations involving site visits, on-site verification or access to records/ documentation by foreign governments or foreign third parties are to be undertaken pursuant to a bilateral agreement or a multilateral treaty to which India is a party, the provisions of the relevant agreement or treaty shall apply.

Exporters are advised to refer to the relevant guidelines relating to the export of SCOMET items in the Handbook of Procedures (Vol.I), as issued from time to time.

**Glossary: Expressions used in the SCOMET List have the following meanings:**

**“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.

**“Active flight control systems”** are systems that function to prevent undesirable “aircraft” and missile motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventive commands to effect automatic control.

**“Aircraft”**: A fixed wing, swivel wing, rotary wing (helicopter), tilt rotor or tilt-wing airborne vehicle.

**“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.

**“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.

**“Composite theoretical performance” (“CTP”)** is a measure of computational performance given in millions of theoretical operations per second (Mtops), calculated using the aggregation of computing elements (CE).

**“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.

**“CTP”** is equivalent to “composite theoretical performance

**“Designed or modified”** describes equipment, parts or components which, as a result of “development,” or modification, have become endowed with specified properties that make them fit for a particular application.

**“Development”**: Activity related to all phases prior to “production” such as design, design research, design analysis, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

**“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 interconnections.

**“Explosives”**: Solid, liquid or gaseous substances or mixtures of substances which, in their application as primary, booster, or main charges in warheads, demolition and other applications, are required to detonate.

**“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.

**“Hybrid computer”** means equipment which can perform all of the following:

- a. Accept data;
- b. Process data, in both analogue and digital representations; and
- c. Provide output of data.

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

**“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”**: An assembly of components which produce both spatially and temporally coherent light that is amplified by stimulated emission of radiation.

**“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.

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

**“Measurement uncertainty”** is the characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95 %. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations.

**“Microcircuit”**: 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.

**“Microprogrammes”**: A sequence of elementary instructions maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction register.

**“Missiles”** means complete rocket systems and unmanned aerial vehicle systems.

**“Modified”** in the context of “software” describes “software” which has been intentionally changed such that it has properties that make it fit for specified purposes or applications. Its properties may also make it suitable for purposes or applications other than those for which it was “modified.”

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

**“Monolithic integrated circuit”** means a combination of passive or active ‘circuit elements’ or both which:

- a. Are formed by means of diffusion processes, implantation processes or deposition processes in or on a single semiconducting piece of material, a so-called ‘chip’;
- b. Can be considered as indivisibly associated; and
- c. Perform the function(s) of a circuit.

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

**“Neural computer”** means a computational device designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e., a computational device which is distinguished by its hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data.

**“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.

**“Optical integrated circuit”** means a “monolithic integrated circuit” or a hybrid integrated circuit, containing one or more parts designed to function as a photo sensor or photo emitter or to perform (an) optical or (an) electro-optical function(s).

**“Precursors”**: Speciality chemicals used in the manufacture of explosives.

**“Pressure transducers”** are devices that convert pressure measurements into an electrical signal.

**“Production”** means all production stages (e.g., product engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance);

**“Production equipment”**: 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”**: Equipment and specially designed “software” therefor integrated into installations for “development” or for one or more phases of “production”.

**“Programmes”**: A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

**“Propellants”**: Substances or mixtures that react chemically to produce large volumes of hot gases at controlled rates to perform mechanical work.

**“Public domain”** means a domain that has no restrictions upon dissemination of information within or from it; the existence of any legal rights to the intellectual property in that information does not remove the information from being in “public domain”.

**“Radiation hardened”**: Means that the component or equipment is designed or rated to withstand radiation levels which meet or exceed a total radiation dose of  $5 \times 10^3$  Gy or  $5 \times 10^5$  rads (Si).

**“Required”**: As applied to “technology”, refers to only that portion of “technology” which is peculiarly responsible for achieving or exceeding the controlled performance levels, characteristics or functions. Such “required” “technology” may be shared by different products.

**“Resolution”** means the least increment of a measuring device; or on digital instruments, the least significant bit.

**“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.

**“Settling time”** means the time required for the output to come within one-half bit of the final value when switching between any two levels of the converter.

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

**“Software”**: A collection of one or more “programmes”, or “micro-programmes”, fixed in any tangible medium of expression. However, unless otherwise provided for against any item on the SCOMET List, the List does not control “software” which is either in the public domain or is generally available to the public by being :

- a. Sold from stock at retail selling points without restriction, by means of:
  1. Over-the-counter transactions;
  2. Mail order transactions; or
  3. Telephone call transactions; and
- b. Designed for installation by the user without further substantial support by the supplier.

**“Space qualified”**: Products designed, manufactured and tested to meet the special electrical, mechanical or environmental requirements for use in the launch and deployment of satellites or high altitude flight systems operating at altitudes of 100 km or higher.

**“Stability”** means the standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

**“Specially designed”** qualifies the description of equipment, parts, components or “software” which, as a result of “development”, have unique properties that distinguish them for certain predetermined purposes. For example, a piece of equipment that is “specially designed” will only be considered so if it has no other function or use. Thus a piece of manufacturing equipment that is “specially designed” to produce a certain type of component will only be considered such if it is not capable of producing other types of components.

**“Tape”** is a material constructed of interlaced or unidirectional “monofilaments”, ‘strands’, “rovings”, “tows”, or “yarns”, etc., usually preimpregnated with resin.

N.B.: ‘Strand’ is a bundle of “monofilaments” (typically over 200) arranged approximately parallel.

**“Technology”** means, except as otherwise provided for against any item in the SCOMET List, information (including information embodied in “software”) other than information in the “public domain”, that is capable of being used in:

- a. the development, production or use of any goods or software;
- b. the development of, or the carrying out of, an industrial or commercial activity or the provision of a service of any kind.

Explanation: When technology is described wholly or partly by reference to the uses to which it (or the goods to which it relates) may be put, it shall include services which are provided or used, or which are capable of being used, in the development, production or use of such technology or goods.

**“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”.

**“Unmanned Aerial Vehicle” (“UAV”)** means any aircraft capable of initiating flight and sustaining controlled flight and navigation without any human presence on board.

**“Usable in,” “usable for,” “usable as” or “capable of”** qualifies the description of equipment, parts, components, materials, technology or “software” which are suitable for a particular purpose. There is no requirement that the equipment, parts, components, technology or “software” should have been configured, modified or specified for that particular purpose. (Contrast with “specially designed” – see above).

**“Use”** includes operation; installation (including on site installation); maintenance; repair; overhaul; refurbishing.

**“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 “monofilaments” (typically over 200) arranged approximately parallel.

**Items on the SCOMET List are organized in the following categories.**

**Category 0** Nuclear materials, nuclear-related other materials, equipment and technology

- 0A Prescribed Substances
- 0A1 Source Material
- 0A2 Special Fissionable Material
- 0A3 Other Materials
- 0B Prescribed Equipment
- 0C Technology

**Category 1** Toxic chemical agents and other chemicals

- 1A Prohibited chemicals
- 1B Chemicals permitted only to States party to the Chemical Weapons Convention
- 1C Chemicals permitted also to States not party to the Chemical Weapons Convention

**Category 2** Micro-organisms, toxins

- 2A Bacteria
- 2B Fungi
- 2C Parasites
- 2D Viruses
- 2E Rickettsials
- 2F Toxins
- 2G Plant pathogens
- 2H Genetically Modified Organisms

**Category 3** Materials, Materials Processing Equipment and related technologies

- 3A Materials
- 3A1 Special materials
- 3A2 Structural materials
- 3A3 Rocket propellants and constituent chemicals
- 3A4 High explosives
- 3A5 Stealth materials
- 3B Materials processing and production equipment, related technology and specially designed components and accessories therefor.
- 3C [Reserved]
- 3D Chemical and biomaterial manufacturing and handling equipment and facilities

**Category 4** Nuclear-related other equipment and technology, not controlled under Category 0

- 4A Equipment, assemblies, components including test and production equipment
- 4B Equipment, assemblies, components including test and measurement equipment usable in development of nuclear explosive devices
- 4C Technology

- Category 5** Aerospace systems, equipment, including production and test equipment, related technology and specially designed components and accessories therefor.
- 5A Rocket systems
  - 5A1 Systems
  - 5A2 Production and test equipment
  - 5A3 Technology
  - 5B Unmanned aerial vehicles
  - 5C Avionics and navigation systems
  - 5D Manned-aircraft, aero-engines, related equipment and components
  - 5E Micro-light aircraft and powered 'hang-gliders'

**Category 6** [Reserved]

- Category 7** Electronics, computers, and information technology including information security
- 7A Electronics
  - 7B Electronic test equipment
  - 7C Computers
  - 7D Information technology including information security
  - 7E [Reserved]

**Category 0 Nuclear materials, nuclear-related other materials, equipment and technology**

*Note:* Export of these items is regulated under the Atomic Energy Act, 1962 and rules framed, and notifications/orders issued thereunder from time-to-time by the Department of Atomic Energy. The licensing authority for items in this category is the Department of Atomic Energy. An application for licences to export prescribed equipment or/an prescribed substances shall be made in writing to the Joint Secretary, Department of Atomic Energy, Anushakti Bhavan, CSM Marg, Mumbai 400 001.

**0A Prescribed Substances**

*Note:* Any radioactive material in Category 0A shall additionally attract the provisions of Radiation Protection Rules, 2004 made under the Atomic Energy Act, 1962 and the provisions of Section-16 of the Atomic Energy Act, 1962.

**0A1 Source Material**

**0A101** Uranium containing the mixture of isotopes occurring in nature.

**0A102** Uranium depleted in the isotope 235.

**0A103** Thorium.

**0A104** Any of the foregoing in the form of metal, alloy, chemical compound, or concentrate or any substance.

**0A105** Any other material containing one or more of the foregoing.

*Prescribed quantitative limits:* as given below and in any period of 12 months:

- a. Uranium (containing the mixture of isotopes in nature) exceeding 100 kilograms.
- b. Depleted uranium (uranium depleted in the isotope 235 below that occurring in nature) exceeding 1000 kilograms.
- c. Thorium exceeding 1000 kilograms.

**0A2 Special Fissionable Material**

**0A201** Plutonium-239.

**0A202** Uranium-233.

**0A203** Uranium enriched in the isotopes 235 or 233.

**0A204** Neptunium.

**0A205** Any material containing one or more of the foregoing.

**0A206** Such other fissionable material determined by the Central Government from time to time, but the term “special fissionable material” does not include source material.

*Note:* Any quantity of special fissionable material is prescribed substance.

**0A3 Other Materials**

‘Other Materials’ means non-nuclear materials for reactors, nuclear related dual-use materials indicated below and such materials as determined by the Central Government from time to time.

**0A301** Deuterium, heavy water (deuterium oxide) and any other deuterium compound, in which the ratio of deuterium to hydrogen atoms exceeds 1:5000, in quantities exceeding 5 kilograms of deuterium in one consignment or 25 kilograms of deuterium in any period of 12 months.

**0A302** Nuclear grade graphite / carbon, having a purity level better than 5 parts per million (ppm) boron equivalent and with a density greater than 1.5 gram/cc in quantities exceeding 30 metric tons in any period of 12 months.

**0A303** Zirconium with hafnium content of less than 1 part to 500 parts of zirconium by weight (i.e. less than 2000 ppm) in the form of metal, its alloys, compounds, manufactures thereof, waste or scrap of any of the foregoing.

**0A304** Beryllium, its compounds, alloys and its minerals / concentrates including Beryl but excluding:  
a. beryllium windows used for x-ray machines and gamma ray detectors and  
b. beryl in the form of emeralds or aquamarines.

**0A305** Lithium enriched in the Lithium-6 (<sup>6</sup>Li) isotope to greater than its natural isotopic abundance (i.e. more than 7.5%) and the products or devices containing enriched lithium such as elemental lithium, alloys, compounds, mixtures containing lithium, manufactures thereof, waste or scrap of any of the foregoing.

**0A306** Niobium and Tantalum, their metals, alloys and minerals including columbite and tantalite.

**0A307** Titanium alloys having both of the following characteristics:

- a. 'Capable of' an ultimate tensile strength of 900 MPa or more at 293 K (20 degrees C); and
- b. In the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm.

*Technical note:* The phrase 'capable of' encompasses titanium alloys before or after heat treatment.

**0A308** Tritium, tritium compounds or mixtures containing tritium in which the ratio of tritium to hydrogen atoms exceeds 1 part in 1000, except when utilized in such quantities and for such purposes as for organic labelled compounds, Gas Filled Light Sources and as Tritiated Water for radiotracer studies.

**0A309** Hafnium: (CAS 7440-58-6)

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.

**0A310** Radium-226:

Radium-226 (<sup>226</sup>Ra), radium-226 alloys, radium-226 compounds, mixtures containing radium-226, manufactures thereof, and products or devices containing any of the foregoing, except medical applicators and a product or device containing less than 0.37 GBq (10mCi) of Ra-226 in any form.

**0A311** Boron (CAS 7740-42-8)

Boron enriched in the Boron-10 (<sup>10</sup>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.

**0A312** Helium-3

Helium-3 (<sup>3</sup>He), mixtures containing helium-3, and products or devices containing any of the foregoing.

*Note:* A product or device containing less than 1gm of Helium-3 is excluded.

**0A313** Alpha-emitting radionuclides:

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

- a. Elemental;
- b. Compounds having a total alpha activity of 37 GBq per kg or greater;
- c. Mixtures having a total alpha activity of 37 GBq per kg or greater;
- d. Products or devices containing any of the foregoing.

**Alpha emitters controlled by this item include:**

Actinium-225	Actinium-227	Americium-242m
Californium-248	Californium-250	Californium-252
Californium-253	Californium-254	Curium-240
Curium-241	Curium-242	Curium-243
Curium-244	Einsteinium-252	Einsteinium-253
Einsteinium-254	Einsteinium-255	Fermium-257
Gadolinium-148	Mendelevium-258	Neptunium-235
Plutonium-236	Plutonium-237	Plutonium-238
Plutonium-241	Polonium-209	Polonium-210
Polonium-208	Radium-223	Thorium-228
Thorium-227	Uranium-230	Uranium-232

**0B Prescribed Equipment**

**0B001** Nuclear Reactors; associated equipment, components, and systems specially designed, prepared, or adapted or used or intended to be used in such reactors:-

- a. Complete nuclear reactors
- b. Nuclear reactor vessels
- c. Nuclear reactor fuel charging and discharging machines
- d. Nuclear reactor control rods and equipment
- e. Nuclear reactor pressure tubes
- f. Zirconium tubes and assemblies of tubes in which hafnium to zirconium ratio is 1:500 or less
- g. Primary coolant pumps
- h. Nuclear reactor internals
- i. Heat exchangers (steam generators) for use in the primary coolant circuit of a nuclear reactor
- j. Neutron detection and measuring instruments for determining neutron flux levels within the core of a nuclear reactor.

**0B002** Plants for processing, production, concentration, conversion or recovery of Prescribed Substances (such as uranium, plutonium, thorium, deuterium, heavy water, tritium, lithium); associated equipment, components and systems specially designed, prepared or adapted or used or intended to be used in such plants including but not limited to:

- a. Plants for production or concentration of deuterium, heavy water-
  - 1. Water - Hydrogen Sulphide Exchange Towers
  - 2. Blowers and Compressors for hydrogen-sulphide gas circulation
  - 3. Ammonia-Hydrogen Exchange Towers greater than or equal to 35 m in height with diameters of 1.5 m to 2.5 m
  - 4. Tower Internals and Stage Pumps
  - 5. Ammonia Crackers with operating pressures greater than or equal to 3 MPa
  - 6. Infrared Absorption Analyzers capable of 'on-line' hydrogen/ deuterium ratio analysis
  - 7. Catalytic Burners for conversion of enriched deuterium gas into heavy water
  - 8. Complete heavy water upgrade systems or columns therefor
- b. Plants for the conversion of uranium
- c. Plants for the conversion of plutonium
- d. Tritium facilities or plants, and equipment therefor
- e. Lithium isotope separation facilities or plants, and equipment therefor

**0B003**

Plants for reprocessing of irradiated nuclear fuel and equipment, components and systems specially designed, prepared or adapted or used or intended to be used in such plants, including but not limited to:

- a. Irradiated fuel element chopping machines designed for remote operation
- b. Dissolvers capable of withstanding hot and highly corrosive liquid for dissolution of irradiated nuclear fuel and which can be remotely loaded and maintained
- c. Solvent extractors and solvent extraction equipment resistant to the corrosive effect of nitric acid
- d. Chemical holding or storage vessels resistant to the corrosive effect of nitric acid
- e. Industrial equipment including assemblies and components as follows:
  - 1. High density (lead glass or other) radiation shielding windows
  - 2. Radiation hardened TV cameras, or lenses therefor
  - 3. 'Robots' or 'end effectors' specially designed for handling high explosives; and control units therefor
  - 4. Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells

**0B004**

Plants for treatment, handling, storage and transportation of radioactive wastes from nuclear reactors or from plants for processing Source Materials or Special Fissionable Materials or from nuclear reprocessing plants; irradiated nuclear fuel; Special Fissionable Materials, and equipment specially designed, prepared, adapted, or intended to be used therefor.

**0B005**

All systems, associated equipment, components for separation or enrichment of isotopes of uranium, plutonium, lithium or boron, other than analytical instruments, specially designed, prepared, adapted, used or intended to be used therefor as follows:

- a. Gas centrifuges and assemblies and components specially designed or prepared for use in gas Centrifuges
- b. Specially designed or prepared auxiliary systems, equipment and components for gas centrifuge enrichment plants

- c. Specially designed or prepared assemblies and components for use in gaseous diffusion enrichment
- d. Specially designed or prepared auxiliary systems, equipment and components for use in gaseous diffusion enrichment
- e. Specially designed or prepared systems, equipment and components for use in aerodynamic enrichment plants
- f. Specially designed or prepared systems, equipment and components for use in chemical exchange or ion exchange enrichment plants.
- g. Specially designed or prepared systems, equipment and components for use in laser-based enrichment plants.
- h. Specially designed or prepared systems, equipment and components for use in plasma separation enrichment plants.
- i. Specially designed or prepared systems, equipment and components for use in electromagnetic enrichment plants.

**0B006** Plants for the fabrication of nuclear reactor fuel elements, and equipment specially designed or prepared therefor including but not limited to:

- a. fully automatic pellet inspection stations specially designed or prepared for checking final dimensions and surface defects of the fuel pellets;
- b. automatic welding machines specially designed or prepared for welding end caps onto the fuel pins (or rods);
- c. automatic test and inspection stations specially designed or prepared for checking the integrity of completed fuel pins (or rods).

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.

**0B007** Plants or systems for production, handling, storage and transportation of Radioisotopes in quantities exceeding 100 Curies (3.7 X 10<sup>12</sup> Becquerel).

**0B008** Neutron generators including neutron chain reacting assemblies and fusion assemblies of all kinds for producing fissile materials

**0C** **Technology**  
Technology and software for the development, production or use of prescribed substances or prescribed equipment specified in 0A or 0B.

**Category 1 Toxic chemical agents and other chemicals**

**1A** **Export of the following chemicals is prohibited:**  
*(This corresponds to Schedule 1 to the Chemical Weapons Convention (CWC))*

*Note:* Where reference is made below to groups of di-alkylated chemicals, followed by a list of alkyl groups in parentheses, all chemicals possible by all possible combinations and alkyl groups listed in parentheses are considered prohibited unless explicitly exempted.

(1).O-Alkyl (  $\leq$ C10 , incl. cycloalkyl) alkyl (Me, Et,n-Pr or i-Pr) phosphonofluoridates

e.g. Sarin: O-Isopropyl methylphosphonofluoridate

Soman: O-Pinacolyl methylphosphonofluoridate

(2).O-Alkyl, (  $\leq$ C10, incl. cycloalkyl) N,N-dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidocyanidates

e.g. Tabun: O-Ethyl N,N,-dimethyl phosphoramidocyanidate

(3).O-Alkyl (H or  $\leq$  C10, incl. cycloalkyl) S-2-Dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts

e.g. VX: O-Ethyl S-2 diisopropylaminoethyl methyl phosphonothiolate

(4).Sulphur mustards:

2-Chloroethylchloromethylsulphide

Mustard gas: Bis (2-chloroethyl) sulphide

Bis (2-chloroethylthio) methane

Sesquimustard:1,2-Bis (2-chloroethylthio) ethane

1,3-Bis (2-chloroethylthio)-n-propane

1,4-Bis (2-chloroethylthio)-n-butane

1,5-Bis (2-chloroethylthio)-n-Pentane

Bis (2-Chloroethylthiomethyl) ether

O-Mustard: Bis (2-Chloroethylthiomethyl) ether

(5).Lewisites:

Lewisite 1: 2-Chlorovinylchloroarsine

Lewisite 2: Bis (2-Chlorovinyl) chloroarsine

Lewisite 3: Tris (2-Chlorovinyl) arsine

(6).Nitrogen mustards:

HN1: Bis (2-chloroethyl) ethylamine

HN2: Bis (2-chloroethyl) Chloroarsine

HN3: Tris (2-chloroethyl) amine

(7).Saxitoxin

(8).Ricin

(9).Alkyl (Me, Et, n-Pr or I-Pr) phosphonyldifluorides

e.g. DF: Methyl phosphonyldifluoride

(10).O-Alkyl (H or  $\leq$  C10, incl. cycloalkyl) O-2 dialkyl (Me, Et, n-Pr or i-Pr)-aminoethylalkyl (Me, Et N-Pr or i-Pr) phosphonites and corresponding alkylated or protonated salts

e.g.QL: O-Ethyl O-2-diisopropylaminoethyl methyl phosphonite

(11).Chlorosarin: O-Isopropyl methylphosphonochloridate

(12).Chlorosoman: O-Pinacolyl methylphosphonochloridate

**1B****Export of chemicals listed in 1B below is permitted only to States party to the Chemical Weapons Convention**

*(This corresponds to Schedule 2 to the Chemicals Weapons Convention)*

*Note to exporter:*

(a) A list of States Parties can be obtained from the Disarmament & International Security Affairs Division of the Ministry of External Affairs (Room No. 40G, South Block, New Delhi) or at the official website of the Organization for the Prohibition of Chemical Weapons at [www.opcw.org](http://www.opcw.org).

(b) A general permission valid for a period of two years may be applied for export of chemicals in this category. This permission shall be subject to the condition that for each export consignment, exporters shall, within 30 days of exports, notify the details to the National Authority, Chemical Weapons Convention, Cabinet Secretariat ; Ministry of External Affairs (D&ISA); Department of Chemicals and Petrochemicals and the Directorate General of Foreign Trade and submit to DGFT, a copy of Bill of Entry into the destination State Party within 30 days of delivery.

Note: Where reference is made below to groups of dialkylated chemicals, followed by a list of alkyl groups in parentheses, all chemicals possible by all possible combinations and alkyl groups listed in parentheses are included unless explicitly exempted.

1. Amiton 0,0-Diethyl S-[2-(diethylamino) ethyl]] phosphorothiolate and corresponding alkylated or protonated salts
2. PFIB: 1,1,3,3,3,-Pentafluoro-2-(trifluoromethyl)1-propene
3. BZ: 3-Quinuclidinyl benzilate
4. Chemicals, except for those listed in Schedule 1, containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms,  
e.g. Methylphosphonyl dichloride  
Dimethyl methylphosphonate  
Exemption:- Fonofos: O-Ethyl S-phenyl ethylphosphonothiolothionate
5. N, N-Dialkyl (ME, Et, n-Pr or i-Pr) phosphoramidic dihalides
6. Dialkyl (Me, Et, n-Pr or i-Pr) N, N-dialkyl (Me, Et, n-Pr or i-Pr)-phosphoramidates
7. Arsenic trichloride
8. 2,2-Diphenyl-2 hydroxyacetic acid
9. Quinuclidine-3-ol

10. N,H-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethyl-2 -chlorides and corresponding protonated salts
11. N, N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-ols and corresponding protonated salts  
Exemptions: N,N-Dimethylaminoethanol and corresponding protonated salts  
N,N-Diethylaminoethanol and corresponding protonated salts
12. N, N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-thiols and corresponding protonated salts
13. Thiodiglycol: Bis(2-hydroxyethyl) sulphide
14. Pinacolyl alcohol: 3,3-Dimethylbutane-2-ol

*A List of commercially important Schedule-2 Chemicals of CWC is given below :*

<b>Sl. No.</b>	<b>Name of Chemical</b>	<b>Entry into Schedule</b>	<b>CAS (Chemical Abstract Service) Numbers</b>	<b>ITC(HS) codes</b>
1.	2-Chloro N, N-Di-isopropyl ethylamine	2B10	4261-68-1	29211911
2.	Diethyl amino Ethanethiol	2B12	100-38-9	29221910
3.	O, O, Dimethyl Methyl Phosphonate	2B04	756-79-6	29209045
4.	2-Hydroxy N, N-Diisopropyl Ethylamine	2B11	96-80-0	29221111
5.	N, N-Diethyl Amino ethyl Chloride Hydrochloride	2B10	869-24-9	29221112
6.	Di-ethyl Amino ethanethiol Hydrochloride	2B12	1942-52-5	29221113
7.	Di-Methyl Amino ethyl chloride Hydrochloride	2B10	4584-46-7	29221114
8.	Di-Methyl Amino ethanethiol	2B12	108-02-1	29221115
9.	Di-Methyl Amino ethanethiol Hydrochloride	2B12	13242-44-9	29221116
10.	Phosphorothioic acid, S [2-(diethylamino) ethyl] O, O – diethyl ester	2A01	78-53-5	29201910
11.	1-Propene, 1,1, 3, 3, 3, - Pentafluoro – 2- (trifluoromethyl) (PFIB)	2A02	382-21-8	29033911
12.	Benzeneacetic acid, alphahydroxy – alpha-phenyl, 1 – azabicyclo [2.2.2.] oct-3-yl ester	2A03	6581-06-2	29392050
13.	Phosphonic Acid, Methyl-compound with (aminoimino methyl) urea (1: 1)	2B04	84402-58-4	29209047
14.	1-Propanaminium N, N, N-trimethyl – 3- [1-oxo-9 octadecenyl] amino]-. (Z)-methyl methylphosphonate	2B04	70055-71-9	29209048

15.	Phosphonic acid, [methyl bis (5-ethyl-2-methyl-2-oxido-1, 3, 2-dioxaphosphorinan-5-yl) methyl] ester	2B04	42595-45-9	29209051
16.	Phosphonic acid, [methyl-(5-ethyl-2-methyl 2-oxido-1,3,2-dioxaphosphorinan-5-yl) methyl] ester	2B04	41203-81-0	29209052
17.	Phosphonic acid, propyl-dimethyl ester	2B04	18755-43-6	29209053
18.	Phosphonous acid, methyl-diethyl ester	2B04	15715-41-0	29209054
19.	Phosphonic acid, ethyl-	2B04	6779-09-5	29209055
20.	Phosphonic acid, propyl-	2B04	4672-38-2	29209056
21.	Phosphinic acid, methyl-	2B04	4206-94-4	29209057
22.	Phosphonochloridic acid, methyl-, methyl ester	2B04	1066-52-0	29209058
23.	Phosphonothioic dichloride, ethyl-	2B04	993-43-1	29209061
24.	Phosphonic acid methyl-	2B04	993-13-5	29209062
25.	Phosphonic acid, methyl-, dimethyl ester	2B04	756-79-6	29209063
26.	Phosphonic dichloride, methyl-	2B04	676-97-1	29209064
27.	Phosphonous dichloride, methyl-	2B04	676-83-5	29209065
28.	Phosphonic acid, ethyl-, diethyl ester	2B04	78-38-6	29209066
29.	Arsenous trichloride	2B07	7784-34-1	28121060
30.	Benzeneacetic acid, alpha-hydroxy-alpha-phenyl	2B08	76-93-7	29181910
31.	1-Azabicyclo (2.2.2.) octan-3-ol	2B09	1619-34-7	29333930
32.	Ethanamine, 2-Chloro-N, N-dimethyl-	2B10	107-99-3	29211914
33.	Ethanol, 2-[bis(1-methylethyl ) amino ]-	2B11	96-80-0	29221920
34.	Ethanethiol, 2-(diethylamino)-	2B12	100-38-9	29221930
35.	Ethanol, 2, 2'-thiobis-	2B13	111-48-8	29309091
36.	2-Butanol, 3, 3-dimethyl-	2B14	464-07-3	29051910

**1C**            **Export of Chemicals as specified below is allowed to State Parties to the CWC without an export licence subject to the condition that the exporter shall notify within 30 days of export to the National Authority, Chemicals Weapons Convention, Cabinet Secretariat; the Ministry of External Affairs (D&ISA); the Department of Chemicals & Petro-chemicals, and the DGFT of such exports in the prescribed format (Aayat Niryat Form ) along with the End-Use Certificate and submit to the DGFT a copy of the bill of entry into the destination State Party within 30 days of delivery. Export of chemicals as specified below to states not party to the Chemical Weapons Convention shall continue to be restricted and will be allowed only against an export licence, and in that case also exporters shall submit to the DGFT a copy of the bill of entry into the destination country within 30 days of export.**

Sl.No.	Name of Chemical	Entry into Schedule	CAS Numbers	ITC (HS) codes
1.	Phosgene : ( Carbonyl dichloride)	3A01	75-44-5	28121010
2.	Cyanogen chloride [(CN) C1]	3A02	506-77-4	28530091
3.	Hydrocyanic acid	3A03	74-90-8	28111910
4.	Chloropicrin:Trichloronitro-Methane	3A04	76-06-2	29049080
5.	Phosphorus Oxychloride	3B05	10025-87-3	28121030
6.	Phosphorus trichloride	3B06	7719-12-2	28121021

7.	Phosphorous Pentachloride	3B07	10026-13-8	28121022
8.	Trimethyl Phosphite	3B08	121-45-9	29209041
9.	Triethyl Phosphite	3B09	122-52-1	29209042
10.	Dimethyl Phosphite	3B10	868-85-9	29209043
11.	Diethyl Phosphite	3B11	762-04-9	29209044
12.	Sulphur monochloride	3B12	10025-67-9	28121042
13.	Sulphur dichloride	3B13	10545-99-0	28121043
14.	Thionyl Chloride	3B14	7719-09-7	28121047
15.	Ethyldiethanolamine	3B15	139-87-7	29221211
16.	Methyldiethanolamine	3B16	105-59-9	29221212
17.	Triethanolamine	3B17	102-71-6	29221300

## Category 2 Micro-organisms, toxins

**2A 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 for the following:**

<b>2A001</b>	Bacillus anthracis
<b>2A002</b>	Bordetella bronchiseptica
<b>2A003</b>	Brucella abortus,
<b>2A004</b>	Brucella melitensis
<b>2A005</b>	Brucella suis
<b>2A006</b>	Chlamydia psittaci
<b>2A007</b>	Clostridium botulinum
<b>2A008</b>	Clostridium perfringes
<b>2A009</b>	Corynebacterium diphtheriae
<b>2A010</b>	Francisella tularensis
<b>2A011</b>	Klebsiella pneumoniae
<b>2A012</b>	Legionella pneumophila
<b>2A013</b>	Leptospira interrogans - all serotypes reported in India
<b>2A014</b>	Mycobacterium bovis
<b>2A015</b>	Mycobacterium tuberculosis
<b>2A016</b>	Mycoplasma mycoides - var mycoides
<b>2A017</b>	Mycoplasma mycoides - var Capri
<b>2A018</b>	Neisseria meningitidis
<b>2A019</b>	Pasteurella multocida type B
<b>2A020</b>	Pseudomonas mallei
<b>2A021</b>	Pseudomonas pseudomallei
<b>2A022</b>	Salmonella paratyphi
<b>2A023</b>	Shigella dysenteriae
<b>2A024</b>	Staphylococcus aureus
<b>2A025</b>	Streptococcus pneumoniae
<b>2A026</b>	Vibrio cholerae elter
<b>2A027</b>	Vibrio Cholerae 0139
<b>2A028</b>	Yersinia pestis

**2B 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 for the following:**

- 2B001 Blastomyces dermatitidis
- 2B002 Coccidioides immitis
- 2B003 Histoplasma capulatum
- 2B004 Nocardia asteroides
- 2B005 Paracoccidioides braziliensis

**2C Parasites, 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 for the following:**

- 2C001 Entamoeba histolytica
- 2C002 Babesia microti
- 2C003 Babesia divergens
- 2C004 Blastidium coli
- 2C005 Cryptosporidium spp.
- 2C006 Leishmania species
- 2C007 Naegleria australiensis
- 2C008 Naegleria fowleri
- 2C009 Plasmodium falciparum
- 2C010 Pneumocystis carinii
- 2C011 Schistosoma mansoni
- 2C012 Schistosoma japonicum
- 2C013 Schistosoma hemotobium
- 2C014 Toxoplasma gondii
- 2C015 Trichinella spiralis
- 2C016 Trypanosoma bruieii

**2D 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 for the following:**

- 2D001 African Horse Sickness virus
- 2D002 African Swine Fever virus
- 2D003 Avian influenza virus
- 2D004 Blue tongue virus
- 2D005 Camel pox virus
- 2D006 Chikungunya virus
- 2D007 Crimean-Congo hemorrhagic fever virus
- 2D008 Dengue virus
- 2D009 Eastern equine encephalitis virus
- 2D010 Ebola fever virus
- 2D011 Encephalomyocarditis virus (EMC)
- 2D012 Foot and Mouth Disease virus (all serotypes and subtypes)
- 2D013 Guanirito virus
- 2D014 Goatpox virus
- 2D015 Hantaan virus
- 2D016 Herpes virus simiae (monkey B virus)
- 2D017 Herpes ateles, Herpes saimiri
- 2D018 HIV- 1 & HIV-2 and other strains of SIV
- 2D019 Hog cholera virus
- 2D020 Human T-cell Leukemia virus
- 2D021 Junin virus

2D022	Japanese encephalitis virus
2D023	Kyasanur Forest Disease virus and Central European encephalitis viruses.
2D024	Korean hemorrhagic fever virus
2D025	Lymphocytic choriomeningitis virus (LCM)
2D026	Lassa virus
2D027	Marburg virus
2D028	Murrey valley encephalitis virus
2D029	Marchupo virus
2D030	Mason-pfizer monkey virus
2D031	Monkey pox virus
2D032	Newcastle disease virus
2D033	Omsk hemorrhagic fever virus
2D034	Peste des petits ruminant virus
2D035	Porcine enterovirus type I
2D036	Powassan virus
2D037	Rabies virus -all strains
2D038	Respiratory syncytial virus
2D039	Rift Valley Fever virus
2D040	Rinderpest virus
2D041	Sabia virus
2D042	Sheep pox (field strain)
2D043	Sin Nombre virus
2D044	Smallpox virus
2D045	St.Louis encephalitis virus
2D046	Swine Fever virus
2D047	Tick-borne encephalitis virus (Russian Spring Summer Encephalitis virus)
2D048	Teschen disease virus (Porcine entero virus type 1)
2D049	Variola virus
2D050	Venezuelan encephalitis virus
2D051	Vesicular stomatitis virus
2D052	Western encephalitis virus
2D053	Yellow fever virus, 17 D vaccine strain

**2E                    Rickettsials, 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 for the following:**

2E001	Coxiella burnetti
2E002	Rickettsiae rickettsii
2E003	Rickettsia quintana
2E004	Rickettsia prowazebi

**2F                    Toxins**

2F001	Abrins
2F002	Aflatoxins
2F003	Anatoxins
2F004	Botulinum toxin (s) (clostradium botulinum)
2F005	Bungarotoxins
2F006	Clostridium perfringens toxins
2F007	Corynebacterium diphtheriae toxins
2F008	Cyanginosins (Microcystins) (Microcystic aeuginosa)

<b>2F009</b>	Enterotoxin ( <i>Staphylococcus aureus</i> )
<b>2F010</b>	Neurotoxin ( <i>Shigella dysenteriae</i> )
<b>2F011</b>	Ricins
<b>2F012</b>	Shigatoxins
<b>2F013</b>	Saxitoxins
<b>2F014</b>	Trichothecene mycotoxins
<b>2F015</b>	Tetanus toxin ( <i>Clostridium tetani</i> )
<b>2F016</b>	Tetrodotoxin ( <i>Spherooides rufripes</i> )
<b>2F017</b>	Verrucologen ( <i>M. verrucadia</i> )

**2G Plant pathogens**

<b>2G001</b>	<i>Bemisia tabaci</i>
<b>2G002</b>	<i>Colletotrichum coffeanum</i> var. <i>virulans</i>
<b>2G003</b>	<i>Claviceps purpurea</i>
<b>2G004</b>	<i>Dothistroma pini</i> ( <i>Scirrhia pini</i> )
<b>2G005</b>	<i>Erwinia amylovora</i>
<b>2G006</b>	<i>Frankliniella occidentalis</i>
<b>2G007</b>	<i>Microcyclus ulei</i>
<b>2G008</b>	<i>Peronospora hyoscyami</i> de Bary f.sp. <i>tabacina</i> (Adam) skalicky
<b>2G009</b>	<i>Phytophthora infestans</i>
<b>2G010</b>	<i>Puccinia graminis</i>
<b>2G011</b>	<i>Puccinia erianthi</i>
<b>2G012</b>	<i>Puccinia striiformis</i> ( <i>Puccinia glumarum</i> )
<b>2G013</b>	<i>Pyricularia oryzae</i>
<b>2G014</b>	<i>Pseudomonas solanacearum</i>
<b>2G015</b>	<i>Peronospora hyscyami</i> de Bary
<b>2G016</b>	<i>Ralstonia solanacearum</i>
<b>2G017</b>	Sugar cane Fiji disease virus
<b>2G018</b>	<i>Sclerotinia sclerotiorum</i>
<b>2G019</b>	<i>Tilletia indica</i>
<b>2G020</b>	<i>Thrips palmi</i>
<b>2G021</b>	<i>Ustilago Maydis</i>
<b>2G022</b>	<i>Xanthomonas albilineans</i>
<b>2G023</b>	<i>Xanthomonas campestris</i> pv <i>citri</i>
<b>2G024</b>	<i>Xanthomonas campestris</i> pv <i>oryzae</i>

**2H Genetically Modified Organisms**

**2H001** Genetically-modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms specified above in 2A, 2B, 2C, 2D, 2E and 2H.

Genetically-modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins specified above in 2F.

**Category 3 Materials, Materials Processing Equipment and related technologies**

**3A Materials**

**3A1 Special Materials**

- 3A101** Zirconium, beryllium, magnesium, and alloys of these in particle size less than 60 µm
- 3A102** Maraging steel in any form in which any linear dimension exceeds 75 mm, or in the form of sheet, plate or tubing with a wall or plate thickness equal or less than 5 mm.
- 3A103** Tungsten (CAS 12070-12-1), molybdenum(CAS 1317-33-5), and alloys of those metals in the form of uniform spherical or atomized particles of size less than 500 µm
- 3A104** Germanium
- 3A105** Gallium
- 3A106** Indium
- 3A107** Titanium alloys including Titanium-stabilised Duplex Stainless Steel (Ti-DSS) (other than as specified at 0A307)
- 3A108** Aluminium alloys in any form ‘capable of acquiring’ an ultimate tensile strength of 460 MPa or more at 293 K (20 degrees C)
- Note:* The phrase ‘capable of acquiring’ encompasses alloys before or after heat treatment
- 3A109** Bismuth having a purity of 99.99% or greater by weight and containing less than 10 parts per million by weight of silver
- 3A110** Calcium containing less than 1000 parts per million by weight of metallic impurities other than magnesium and containing less than 10 parts per million by weight of Boron
- 3A111** Chlorine trifluoride (ClF<sub>3</sub>)
- 3A112** Magnesium containing less than 200 parts per million by weight of metallic impurities other than calcium and containing less than 10 parts per million by weight of boron
- 3A113** (a) Tungsten, tungsten carbide, and alloys containing more than 90% tungsten by weight in forms with a hollow cylindrical symmetry (including cylinder segments) with an inside diameter between 100 and 300 mm and a mass greater than 20 kg.
- (b) Tungsten materials in the solid form usable for the fabrication of missile components in complete rocket systems of 5A and unmanned aerial vehicles of 5B, having all of the following:
1. Any of the following material compositions:
    - i. Tungsten and alloys containing 97% by weight or more of tungsten;
    - ii. Copper infiltrated tungsten containing 80% by weight or more of tungsten; or
    - iii. Silver infiltrated tungsten containing 80% by weight or more of tungsten; and

2. Able to be machined to any of the following products:
- i. Cylinders having a diameter of 120 mm or greater and a length of 50 mm or greater;
  - ii. 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
  - iii. Blocks having a size of 120 mm x 120 mm x 50 mm or greater.

- 3A114**
- a. Nickel powder of purity 99.0% or greater by weight and having a mean particle size of less than 10  $\mu\text{m}$ ;
  - b. Porous nickel metal produced from the nickel powder specified above

- 3A115** Natural boron, boron carbide or metal borides having a boron purity of 85% or more.

- 3A116** Fibrous or filamentary materials, and prepregs, as follows:

- a. Carbon or aramid fibrous or filamentary materials having 'specific modulus' of  $12.7 \times 10^6$  m or greater; or 'specific tensile strength' of  $23.5 \times 10^4$  m or greater;
- b. Glass fibrous or filamentary materials having 'specific modulus' of  $3.18 \times 10^6$  m or greater; and 'specific tensile strength' of  $7.62 \times 10^4$  m or greater;
- c. Thermoset resin impregnated continuous yarns, rovings, tows or tapes with a width of 15 mm or less (prepregs), made from carbon or glass fibrous or filamentary materials specified in (a) or (b) above.

- 3A117** Carbon - carbon composites.

**3A2 Structural Materials**

- 3A201** Structural materials such as:

- a. Composite structures, laminates, resin impregnated fibre prepregs and metal coated fibre preforms made either with an organic matrix or metal matrix utilizing fibrous or filamentary reinforcements, and manufactures thereof, specially designed for use in rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets), unmanned aerial vehicles and cruise missiles and subsystems thereof;
- b. Resaturated pyrolyzed (i.e. Carbon-Carbon) materials specially designed for rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets), unmanned aerial vehicles and cruise missiles;
- c. Fine grain re-crystallised bulk graphites and pyrolytic or fibrous reinforced graphites usable for rocket nozzles and re-entry vehicles nose tips;
- d. Ceramic composite materials (dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz) for use in missile radomes;
- e. Materials and coatings for reduced radar reflectivity;
- f. Bulk machinable silicon-carbide reinforced unfired ceramic usable in re-entry vehicles nose tips.
- g. Reinforced silicon-carbide ceramic composites usable for nose tips, re-entry vehicles, nozzle flaps, usable in complete rocket systems of 5A and complete unmanned aerial vehicles of 5B .

### **3A3 Rocket propellants and constituent chemicals:**

**3A301** Propulsive substances – Hydrazine (CAS-302-01) and its derivatives usable as rocket fuel substances including Monomethylhydrazine (MMH)(CAS 60-34), Unsymmetrical di-methyl hydrazine (UDMH), (CAS 57-14-7) Hydrazine nitrate, (except aromatic hydrazines and their salts, adipic acid dihydrazide), ammonium perchlorate, spherical or spheroidal aluminium powder(CAS 7429-90-5);

**3A302** Metal fuels containing any of the following: Zirconium(CAS 7440-67-7), beryllium(CAS 7440-41-7), magnesium, titanium, tungsten, boron and boron alloys, zinc, and alloys of magnesium(CAS 7439-95-4);

**3A303** Polymeric substances:  
Carboxyl-terminated polybutadiene (CTPB)  
Hydroxy-Terminated Polybutadiene (HTPB)  
Glycidyl azide polymer (GAP)  
Polybutadiene acrylic acid (PBAA)  
Polybutadiene acrylonitrile (PBAN)  
Polytetrahydrofuran polyethylene glycol (TPEG)

**Technical Note:**

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

**3A304** Composite propellants and composite modified double base propellants;

**3A305** High energy density materials such as boron slurry;

**3A306** Oxidizers/fuels - Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components; Dinitrogen trioxide, Nitrogen dioxide / Dinitrogen tetroxide, Mixed Oxides of Nitrogen (MON), Dinitrogen pentoxide, Inhibited red fuming nitric acid (IRFNA) (CAS 8007-58-7), Ammonium perchlorate (CAS 7790-98-9), Ammonium Dinitramide (ADN) (CAS 140456-78-6), Hydrazinium Nitroformate (HNF), 2,4,6,8,10,12-Hexanitrohexaazaisowurtzitane (CL-20) (CAS 135285-90-4), Compounds composed of fluorine and one more of other halogens, oxygen or nitrogen.

**3A307** Bonding agents - Tris (1-2 (2-methyl)) aziridinyl phosphine oxide (MAPO)(CAS 57-39-6), Trimesoyl-1-(2-ethyl) aziridene (HX-868, BITA)(CAS 7722-73-8), Tepanol (HX-878)(CAS 68412-46-4), Tepan (HX-879) reaction product of tetraethylenepentamine and acrylonitrile (CAS 68412-45-3), and Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group including 1,1'-Isophthaloyl-bis(2-methylaziridene (CAS 7652-64-4), (HX-752, HX-874, and HX-877);

**3A308** Curing agents and reaction catalysts - Triphenyl bismuth (TPB)(CAS 603-33-8);

**3A309**

Burning rate modifiers –

- a. Carboranes, decaboranes, pentaboranes and derivatives thereof;
- b. Ferrocene derivatives, as follows:
  1. Catocene (CAS 37206-42-1);
  2. Ethyl ferrocene;
  3. Propyl ferrocene(CAS 1273-89-8)
  4. n-Butyl ferrocene(CAS 31904-29-7);
  5. Pentyl ferrocene (CAS 1274-00-6);
  6. Dicyclopentyl ferrocene(CAS 20773-28-8);
  7. Dicyclohexyl ferrocene;
  8. Diethyl ferrocene;
  9. Dipropyl ferrocene;
  10. Dibutyl ferrocene(CAS 1274-08-4);
  11. Dihexyl ferrocene (CAS 93894-59-8);
  12. Acetyl ferrocenes;
  13. Ferrocene Carboxylic acids;
  14. Butacene;
- c. Other ferrocene derivatives usable as rocket propellant burning rate modifiers.

**3A310**

Nitrate esters and nitrated plasticisers as follows:

- a. Triethylene glycol dinitrate (TEGDN);
- b. Trimethylolethane trinitrate (TMETN)(CAS 3032-55-1) ;
- c. 1,2,4-butanetriol trinitrate (BTTN)(CAS 6659-60-5) ;
- d. Diethylene glycol dinitrate (DEGDN);
- e. 4,5 diazidomethyl-2-methyl-1,2,3-triazole (iso-DAMTR);
- f. Nitrate ethylnitramine (NENA) based plasticisers, as follows:
  1. Methyl-NENA (CAS 17096-47-8);
  2. Ethyl-NENA (CAS 85068-73-1);
  3. Butyl-NENA (CAS 82486-82-6);
- g. Dinitropropyl based plasticisers, as follows:
  1. Bis (2,2-dinitropropyl) acetal (BDNPA) (CAS 5108-69-0);
  2. Bis (2,2-dinitropropyl) formal (BDNPF) (CAS 5917-61-3).

**3A311**

Stabilisers as follows:

- a. 2-Nitrodiphenylamine (CAS 119-75-5);
- b. N-methyl-p-nitroaniline (CAS 100-15-2).

**3A4****High explosives****3A401**

High explosives, and propellants or mixtures containing any of the following;

- a. Cyclotramethylenetetranitramine (HMX);
- b. Cyclotrimethylenetrinitramine (RDX);
- c. Triaminotrinitrobenzene (TATB);
- d. Hexanitrostilbene (HNS);
- e. Any explosive with a crystal density greater than 1.8 g/cm<sup>3</sup> and having a detonation velocity greater than 8000 m/s.

License applications for the export of items at 3A401a and 3A401b will normally be denied.

- 3A5**            **Stealth materials**
- 3A501**        a.     Materials for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures;
- b.     Devices, including made from non-stealth material, for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures;
- 3A502**        Materials and coatings (including paints) specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet spectra other than coatings (including paints) when specially used for thermal control of satellites.
- 3A503**        Technology related to the development, production or use of items in 3A.
- 3B**            **Materials processing and “production equipment”, related “technology” and specially designed components and accessories therefor.**
- 3B001**        Remote manipulators that provide mechanical translation of human operator actions by electrical, hydraulic or mechanical means and operating arm and terminal fixture that can be used to provide remote actions;
- 3B002**        Multidirectional, multidimensional weaving and interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres to fabricate composite structures except textile machinery which has not been modified for rocket systems;
- 3B003**        Equipment designed or modified for production of fibrous or filamentary materials as follows: converting polymeric substances; vapour deposition on heated filament substrates; wet spinning of refractory ceramics.
- 3B004**        Equipment designed or modified for special fibre surface treatment or for producing prepregs and preforms, including rollers, tension stretchers, coating equipment, cutting equipment and clicker dies;
- 3B005**        Chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.
- 3B006**        Pyrolytic deposition and densification equipment including:
- a.     Technology for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases.
- b.     Specially designed nozzles for the above process.
- c.     Equipment and process controls and specially designated software thereof, specially designed or modified for densification and pyrolysis of structural composite rocket nozzles and re-entry vehicle nose tips.
- 3B007**        Production equipment usable for or specially designed or modified for production, handling, mixing, curing, casting, pressing, machining, extruding or acceptance testing of the solid or liquid rocket propellants or rocket propellant constituents and related technology.

- 3B008** Refrigeration units and equipment capable of cooling hydrogen or helium to -250 degrees Celsius (23K) or lower.
- 3B009** Continuous nitrators.
- 3B010** Dehydration presses.
- 3B011** Screw extruders usable for or specially designed or modified for high explosive extrusion.
- 3B012** Cutting machines for the sizing of extruded propellant.
- 3B013** Sweetie barrels (tumblers) 1.85 m or more in diameter and having over 227 kg product capacity;
- 3B014** Continuous mixers or batch mixers with provision for mixing under vacuum.
- 3B015** Fluid energy mills usable for grinding or milling any of the items in 3A3.
- 3B016** Equipment to achieve both sphericity and uniform particle size in metal powders.
- Metal powder production equipment usable for production, in a controlled environment, of spherical or atomized materials including:
  - Plasma generators (high frequency arc-jets) usable for obtaining sputtered or spherical metallic powders with organisation of the process in an argon-water environment
  - Electroburst equipment usable for obtaining sputtered or spherical metallic powders with organisation of the process in an argon-water environment.
- 3B017** Sputter ion pumps
- 3B018** Technical data (including processing conditions) and procedures for the regulation of temperature, pressure or atmosphere in autoclaves or hydroclaves when used for the production of composites or partially processed composites.
- 3B019** Software specially designed or modified for the use of equipment for the production and handling of materials specified in 3A
- 3B020** Technology for the development, production or use of items in 3B
- 3C** **[Reserved]**
- 3D** **Chemical and biomaterial manufacturing and handling equipment and facilities:**
- 3D001** Reaction vessels, reactors or agitators, storage tanks, containers or receivers, heat exchangers or condensers, distillation or absorption columns, valves, remotely operated filling equipment, multi-walled piping, bellows, diaphragm pumps, vacuum pumps, fans, compressors, blowers, gas (including air) handling or other substance-transfer equipment wholly or partly made from any of the following materials;

- a. Nickel or alloys with more than 40% nickel by weight
- b. Alloys with more than 25% nickel and 20% chromium by weight (e.g. ‘Hastelloy’, ‘Inconel’, ‘Incoloy’)
- c. Fluoropolymers
- d. Glass or glass lined (including vitrified or enamelled coating)
- e. Graphite
- f. Tantalum or tantalum alloys
- g. Titanium or titanium alloys
- h. Zirconium or zirconium alloys
- i. Ceramics
- j. Ferrosilicon

*Note:* 3D001 does not control the following items:

- a. Open vessels fabricated from glass sheets (such as aquariums, water tanks etc.); or cookware, table-ware, decorative glass or ceramic items (such as vases, art objects, etc.)
- b. Glass-ware (whether or not metal-jacketed) or glass-lined reaction vessels or reactors, whether or not equipped with agitators, provided that the total internal (geometric) volume of each vessel or reactor is greater than 20,000 litres (20 m<sup>3</sup>) or less than or equal to 100 litres (0.1 m<sup>3</sup>). Examples of the latter capacity glass or ceramic-ware include standard laboratory equipment such as test tubes, flasks, retorts etc.

**3D002** Incinerators designed to destroy any chemicals specified in Category 1.

**3D003** Combustors or pyrolysers capable of a heat-zone (‘burner’) temperature greater than 1,273 K (1000 Degree Centigrade), and in which any surfaces that come into direct contact with material coming into the containing chamber are made from, or lined with, any of the following materials:

- a. Alloys with more than 25% nickel and 25% chromium by weight; (e.g., ‘Hastelloy’, ‘Inconel’, ‘Incoloy’)
- b. Nickel, or alloys with more than 40% nickel by weight; or
- c. Titanium;
- d. Ceramics.

**3D004** Equipment related to P3, P4 facilities such as protective suits and class III safety cabinets.

No licenses shall be granted for complete containment facilities at P3, P4, containment level as specified in the World Health Organization (WHO) bio-safety manual.

**3D005** Technology related to the development, production or use of items in 3D.

**Category 4** **Nuclear-related other equipment, assemblies and components; test and production equipment; and related technology not controlled under Category 0**

**4A** **Equipment, assemblies, components including test and production equipment**

**4A001**

Flow-forming machines, spin-forming machines capable of flow-forming functions, and mandrels, as follows:

- a. For flow forming machines refer to 5A205.
- b. Spin forming machines having both of the following characteristics:
  1. Three or more rollers (active or guiding); and
  2. which can be equipped with 'numerical control' units or a computer control.
- c. Rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 and 400 mm.

*Note:* Item 4A001a and 4A001b include 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.

**4A002**

Machine tools, as follows, for removing or cutting metals, ceramics, or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous contouring control in two or more axes:

- a. Machine tools for turning, that have positioning accuracies with all compensations available better (less) than 6  $\mu\text{m}$  along any linear axis (overall positioning) for machines capable of machining diameters greater than 35mm;

*Note:* Item 4A002a does not control bar machines, limited to machining only bar feed through, 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 better (less) than 6  $\mu\text{m}$  along any linear axis (overall positioning); or
  2. Two or more contouring rotary axes;

*Note:* Item 4A002b does not control milling machines having both of the following characteristics:

1. X-axis travel greater than 2 m; and
  2. Overall positioning accuracy on the x-axis worse (more) than 30  $\mu\text{m}$ .
- c. Machine tools for grinding, having any of the following characteristics:
    1. Positioning accuracies with all compensations available better (less) than 4  $\mu\text{m}$  along any linear axis (overall positioning); or
    2. Two or more contouring rotary axes;

*Note:* Item 4A002c does not control grinding machines as follows:

1. Cylindrical external, internal, and external-internal grinding machines having all the following characteristics:
  - a. Limited to cylindrical grinding;
  - b. A maximum work-piece outside diameter or length of 150 mm;
  - c. Not more than two axes that can be coordinated simultaneously for contouring control; and
  - d. No contouring c-axis;

2. Jig grinders with axes limited to x, y, c, and a, where c-axis is used to maintain the grinding wheel normal to the work surface, and the a-axis is configured to grind barrel cams;
  3. Tool or cutter grinding machines with software specially designed for the manufacturing of tools or cutters;
  4. Crankshaft or camshaft grinding machines.
- d. Non-wire type Electrical Discharge Machines (EDM) that have two or more contouring rotary axes and that can be coordinated simultaneously for contouring control.

*Note:* Stated positioning accuracy levels derived under the following procedures 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.

Stated positioning accuracy are to be derived as follows:

1. Select five machines of a model to be evaluated;
2. Measure the linear axis accuracies according to ISO 230/2 (1988);
3. Determine the accuracy values (A) for each axis of each machine. The method of calculating the accuracy value is described in the ISO 230/2 (1988) standard;
4. Determine the average accuracy value of each axis. This average value becomes the stated positioning accuracy of each axis for the model ( $\hat{A}_x$ ,  $\hat{A}_y$ ...);
5. Since Item 4A002 refers to each linear axis, there will be as many stated positioning accuracy values as there are linear axes;
6. If any axis of a machine tool not controlled by Items 4A002a, 4A002b, or 4A002c has a stated positioning accuracy of 6  $\mu\text{m}$  or better (less) for grinding machines, and 8  $\mu\text{m}$  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.

#### *Technical Notes*

1. Axis nomenclature shall be in accordance with International Standard ISO 841, Numerical Control Machines Axis and Motion Nomenclature.
2. Not counted in the total number of contouring rotary axes are secondary parallel contouring rotary axes the centre line of which is parallel to the primary rotary axis.
3. 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.

### **4A003**

Dimensional inspection machines, instruments, or systems, as follows:

- a. Computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:
  1. Two or more axes; and
  2. A one-dimensional length measurement uncertainty equal to or better (less) than  $(1.25 + L/1000)$   $\mu\text{m}$  tested with a probe of an accuracy of

- better (less) than  $0.2\ \mu\text{m}$  (L is the measured length in millimetres);
- b. 'Linear displacement' measuring instruments, as follows:
    1. Non-contact type measuring systems with a resolution equal to or better (less) than  $0.2\ \mu\text{m}$  within a measuring range up to 0.2 mm;
    2. Linear variable differential transformer (LVDT) systems having both of the following characteristics:
      - a. Linearity equal to or better (less) than 0.1% within a measuring range up to 5 mm; and
      - b. Drift equal to or better (less) than 0.1% per day at a standard ambient test room temperature  $\pm 1\ \text{K}$ ;
    3. Measuring systems having both of the following characteristics:
      - a. Contain a laser; and
      - b. Maintain for at least 12 hours, over a temperature range of  $\pm 1\ \text{K}$  around a standard temperature and a standard pressure:
        1. A resolution over their full scale of  $0.1\ \mu\text{m}$  or better; and
        2. With a measurement uncertainty equal to or better (less) than  $(0.2 + L/2000)\ \mu\text{m}$  (L is the measured length in millimetres);

*Note:* Item 4A003b3 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.

*Technical Note:* In Item 4A003b 'linear displacement' means the change of distance between the measuring probe and the measured object.

- c. Angular displacement measuring instruments having an angular position deviation equal to or better (less) than  $0.00025^\circ$ ;

*Note:* Item 4A003c does not control optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

- d. Systems for simultaneous linear-angular inspection of hemi-shells, having both of the following characteristics:
  1. Measurement uncertainty along any linear axis equal to or better (less) than  $3.5\ \mu\text{m}$  per 5 mm; and
  2. Angular position deviation equal to or less than  $0.02^\circ$ .

*Notes:* 1. Item 4A003 includes machine tools that can be used as measuring machines if they meet or exceed the criteria specified for the measuring machine function.

2. Machines described in Item 4A003 are controlled if they exceed the threshold specified anywhere within their operating range.

*Technical Note:* All parameters of measurement values in this item represent plus/minus, i.e., not total band.

**4A004** Controlled atmosphere (vacuum or inert gas) induction furnaces, and power supplies therefor, as follows:

- a. Furnaces having all of the following characteristics:
  1. Capable of operation at temperatures 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;

*Note:* Item 4A004a does not control furnaces designed for the processing of semiconductor wafers.

- b. Power supplies, with a specified output power of 5 kW or more, specially designed for furnaces specified in Item 4A004a.

**4A005** ‘Isostatic presses’, and related equipment, as follows:

- a. ‘Isostatic presses’ as specified in 5A208;
- b. Dies, moulds, and controls specially designed for the ‘isostatic presses’ specified in Item 4A005a.

*Technical Notes:*

1. In Item 4A005 ‘Isostatic presses’ means equipment capable of pressurizing a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal pressure in all directions within the cavity upon a work piece or material.
2. In Item 4A005 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.

**4A006** Vibration test systems, equipment, and components as follows:

- a. Electrodynamic vibration test systems, having all of the following characteristics:
  1. Employing feedback or closed loop control techniques and incorporating a digital control unit;
  2. Capable of vibrating at 10 g RMS or more between 20 and 2000 Hz; and
  3. Capable of imparting forces of 50 kN or greater measured ‘bare table’;
- b. Digital control units, combined with software specially designed for vibration testing, with a real-time bandwidth greater than 5 kHz and being designed for a system specified in Item 4A006a;
- c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN or greater measured ‘bare table’, which are usable for the systems specified in Item 4A006a;
- d. Test piece support structures and electronic units designed to combine multiple shaker units into a complete shaker system capable of providing an effective combined force of 50 kN or greater, measured ‘bare table,’ which are usable for the systems specified in Item 4A006a.

*Technical Note* : In Item 4A006 'bare table' means a flat table, or surface, with no fixtures or fittings.

**4A007** Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment, as follows:

- a. Arc re-melt and casting furnaces having both of the following characteristics:
  1. Consumable electrode capacities between 1000 and 20000 cm<sup>3</sup>; and
  2. Capable of operating with melting temperatures above 1973 K (1700 °C);
- b. Electron beam melting furnaces and plasma atomisation and melting furnaces, having both of the following characteristics:
  1. A power of 50 kW or greater; and
  2. Capable of operating with melting temperatures above 1473 K (1200 °C);
- c. Computer control and monitoring systems specially configured for any of the furnaces specified in Item 4A007a or 4A007b.

**4A008** 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<sup>3</sup> (150 ml) and 8000 cm<sup>3</sup> (8 litres); and
  2. Made of or coated with any of the following materials, having a purity of 98% or greater by weight:
    - a. Calcium fluoride (CaF<sub>2</sub>);
    - b. Calcium zirconate (metazirconate) (CaZrO<sub>3</sub>);
    - c. Cerium sulphide (Ce<sub>2</sub>S<sub>3</sub>);
    - d. Erbium oxide (erbia) (Er<sub>2</sub>O<sub>3</sub>);
    - e. Hafnium oxide (hafnia) (HfO<sub>2</sub>);
    - f. Magnesium oxide (MgO);
    - g. Nitrided niobium-titanium-tungsten alloy (approximately 50% Nb, 30% Ti, 20% W);
    - h. Yttrium oxide (yttria) (Y<sub>2</sub>O<sub>3</sub>); or
    - i. Zirconium oxide (zirconia) (ZrO<sub>2</sub>);
- b. Crucibles having both of the following characteristics:
  1. A volume of between 50 cm<sup>3</sup> (50 ml) and 2000 cm<sup>3</sup> (2 litres); 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<sup>3</sup> (50 ml) and 2000 cm<sup>3</sup> (2 litres);
  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.

**4A009** 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.

**4A010** Composite structures in the form of tubes having both of the following characteristics:

- a. An inside diameter of between 75 and 400 mm; and
- b. Made with any of the materials specified in Item 3A116.

**4A011**

Frequency changers or generators having all of the following characteristics:

- a. Multiphase output capable of providing a power of 40 W or greater;
- b. Capable of operating in the frequency range between 600 and 2000 Hz;
- c. Total harmonic distortion better (less) than 10%; and
- d. Frequency control better (less) than 0.1%.

*Note:* Frequency changers and generators especially designed or prepared for the gas centrifuge process are controlled under Prescribed Equipment (OB Category).

*Technical Note:* Frequency changers in Item 4A011 are also known as converters or inverters.

**4A012**

Lasers, laser amplifiers and oscillators as follows:

- a. Copper vapour lasers having both of the following characteristics:
  1. Operating at wavelengths between 500 and 600 nm; and
  2. An average output power equal to or greater than 40 W;
- b. Argon ion lasers having both of the following characteristics:
  1. Operating at wavelengths between 400 and 515 nm; and
  2. An average output power greater than 40 W;
- c. Neodymium-doped (other than glass) lasers with an output wavelength between 1000 and 1100 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 and 550 nm with an average output power of greater than 40 W;
- d. Tuneable pulsed single-mode dye laser oscillators having all of the following characteristics:
  1. Operating at wavelengths between 300 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;
- e. Tuneable pulsed dye laser amplifiers and oscillators having all of the following characteristics:
  1. Operating at wavelengths between 300 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:* Item 4A012e does not control single mode oscillators.

- f. Alexandrite lasers having all of the following characteristics:
  1. Operating at wavelengths between 720 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;
- g. Pulsed carbon dioxide lasers having all of the following characteristics:
  1. Operating at wavelengths between 9000 and 11000 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 4A012g does not control the higher power (typically 1 to 5 kW) industrial CO<sub>2</sub> 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.

- h. Pulsed excimer lasers (XeF, XeCl, KrF) having all of the following characteristics:
  1. Operating at wavelengths between 240 and 360 nm;
  2. A repetition rate greater than 250 Hz; and
  3. An average output power greater than 500 W;
- i. Para-hydrogen Raman shifters designed to operate at 16  $\mu$ m output wavelength and at a repetition rate greater than 250 Hz.

#### **4A013**

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 diameter, the nominal size parameter in Item 4A013a refers to the smallest diameter.

#### **4A014**

Superconducting solenoidal electromagnets having all of the following characteristics:

- a. Capable of creating magnetic fields greater than 2 T;
- b. A ratio of length to inner diameter greater than 2;
- c. Inner diameter greater than 300 mm; and
- d. Magnetic field uniform to better than 1% over the central 50% of the inner volume.

*Note:* Item 4A014 does not control magnets specially designed for and exported as part of medical nuclear magnetic resonance (NMR) imaging systems. ('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 the 'as part of' relationship.)

**4A015** 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.

**4A016** 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.

**4A017** Pressure transducers capable of measuring absolute pressures at any point in the range 0 to 13 kPa and having both of the following characteristics:

- a. Pressure sensing elements made of or protected by aluminium, aluminium alloy, nickel, or nickel alloy with more than 60% nickel by weight; and
- b. Having either of the following characteristics:
  1. A full scale of less than 13 kPa and an accuracy of better than  $\pm 1\%$  of full scale; or
  2. A full scale of 13 kPa or greater and an accuracy of better than  $\pm 130$  Pa.

*Technical Notes:*

1. In Item 4A017 pressure transducers are devices that convert pressure measurements into an electrical signal.
2. In Item 4A017 accuracy includes non-linearity, hysteresis and repeatability at ambient temperature.

**4A018** 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<sup>3</sup>/s; and
- c. Capable of producing an ultimate vacuum better than 13.3 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.

**4A019** Electrolytic cells for fluorine production with an output capacity greater than 250 g of fluorine per hour.

**4A020** 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:* Item 4A020a 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 Item 4A020b 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:* The bellows referred to in Item 4A020c have all of the following characteristics:

1. Inside diameter between 75 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.

#### **4A021**

Centrifugal multi-plane 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. Capable of balancing to a residual imbalance equal to or less than 0.010 kg x mm/kg per plane; and
  4. Belt drive type.

#### **4A022**

Filament winding machines and related equipment, as follows:

- a. Filament winding machines as specified in 5A206.
- b. Coordinating and programming controls for the filament winding machines specified in Item 4A022a;
- c. Precision mandrels for the filament winding machines specified in Item 4A022a.

**4A023** Electromagnetic isotope separators designed for, or equipped with, single or multiple ion sources capable of providing a total ion beam current of 50 mA or greater.

*Notes:*

1. Item 4A023 includes separators capable of enriching stable isotopes as well as those for uranium.
2. A separator capable of separating the isotopes of lead with a one-mass unit difference is inherently capable of enriching the isotopes of uranium with a three-unit mass difference.
3. Item 4A023 includes separators with the ion sources and collectors both in the magnetic field and those configurations in which they are external to the field.

**Technical Note:** A single 50 mA ion source cannot produce more than 3 g of separated highly enriched uranium (HEU) per year from natural abundance feed.

**4A024** Mass spectrometers capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, as follows, and ion sources therefor:

- a. Inductively coupled plasma mass spectrometers (ICP/MS);
- b. Glow discharge mass spectrometers (GDMS);
- c. Thermal ionisation mass spectrometers (TIMS);
- d. Electron bombardment mass spectrometers which have a source chamber constructed from, lined with or plated with materials resistant to UF<sub>6</sub>;
- e. Molecular beam mass spectrometers having either of the following characteristics:
  1. A source chamber constructed from, lined with or plated with stainless steel or molybdenum, and equipped with a cold trap capable of cooling to 193 K (-80 °C) or less; or
  2. A source chamber constructed from, lined with or plated with materials resistant to UF<sub>6</sub>;
- f. Mass spectrometers equipped with a micro-fluorination ion source designed for actinides or actinide fluorides.

*Note:* Mass spectrometers especially designed or prepared for analyzing on-line samples of uranium hexafluoride are controlled under Prescribed Equipment (OB Category).

**4A025** 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.

**4A026** Pumps capable of circulating solutions of concentrated or dilute potassium amide catalyst in liquid ammonia (KNH<sub>2</sub>/NH<sub>3</sub>), having all of the following characteristics:

- a. Airtight (i.e., hermetically sealed);
- b. A capacity greater than 8.5 m<sup>3</sup>/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.

**4A027** Turbo-expanders or turbo-expander-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.

**4A028** Water-hydrogen sulphide exchange tray columns and internal contactors, as follows:

- a. Water-hydrogen sulphide exchange tray columns, having all of the following characteristics:
  - 1. Can operate at pressures of 2 MPa or greater;
  - 2. Constructed of carbon steel having an austenitic ASTM (or equivalent standard) grain size number of 5 or greater; and
  - 3. With a diameter of 1.8 m or greater;
- b. Internal contactors for the water-hydrogen sulphide exchange tray columns specified in Item 4A028a.

*Note:* For columns which are especially designed or prepared for the production of heavy water, see Prescribed Equipment (OB002).

*Technical Note:* Internal contactors of the columns are segmented trays which have an effective assembled diameter of 1.8 m or greater; are designed to facilitate counter current contacting and are constructed of stainless steels with a carbon content of 0.03% or less. These may be sieve trays, valve trays, bubble cap trays or turbo grid trays.

**4A029** Hydrogen-cryogenic distillation columns having all of the following characteristics:

- a. Designed for operation at internal temperatures of 35 K (-238 °C) or less;
- b. Designed for operation at internal pressures of 0.5 to 5 MPa;
- c. Constructed of either:
  - 1. Stainless steel of the 300 series with low sulphur content and with an austenitic ASTM (or equivalent standard) grain size number of 5 or greater; or
  - 2. Equivalent materials which are both cryogenic and H<sub>2</sub>-compatible; and
- d. With internal diameters of 1 m or greater and effective lengths of 5 m or greater.

**4A030** Ammonia synthesis converters or synthesis units, in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high-pressure exchange column and the synthesized ammonia is returned to said column.

**4B Equipment, assemblies and components, including test and measurement equipment usable in development of nuclear explosive devices**

**4B001** Photomultiplier tubes having both of the following characteristics:

- a. Photocathode area of greater than 20 cm<sup>2</sup>; and
- b. Anode pulse rise time of less than 1 ns.

**4B002** Flash X-ray generators or pulsed electron accelerators having either of the following sets of characteristics:

- 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
- a. An accelerator peak electron energy of 25 MeV or greater; and
- b. A peak power greater than 50 MW.

*Note:* Item 4B002 does not control accelerators that are component parts of devices designed for purposes other than electron beam or X-ray radiation (electron microscopy, for example) nor those designed for medical purposes.

*Technical Notes:*

1. The figure of merit K is defined as:  $K=1.7 \times 10^3 V^{2.65}Q$ . V is the peak electron energy in million electron volts. If the accelerator beam pulse duration is less than or equal to 1  $\mu$ s, then Q is the total accelerated charge in Coulombs. If the accelerator beam pulse duration is greater than 1  $\mu$ s, then Q is the maximum accelerated charge in 1  $\mu$ s. Q equals the integral of i with respect to t, over the lesser of 1  $\mu$ s or the time duration of the beam pulse ( $Q=\int idt$ ) where i is beam current in amperes and t is the time in seconds.
2. Peak power = (peak potential in volts) x (peak beam current in amperes).
3. In machines based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1  $\mu$ s 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.

**4B003** Multistage light gas guns or other high-velocity gun systems (coil, electromagnetic, and electrothermal types, and other advanced systems) capable of accelerating projectiles to 2 km/s or greater.

**4B004** Mechanical rotating mirror cameras, as follows, and specially designed components therefor:

- a. Framing cameras with recording rates greater than 225000 frames per second;
- b. Streak cameras with writing speeds greater than 0.5 mm/ $\mu$ s.

*Note:* In Item 4B004 components of such cameras include their synchronizing electronics units and rotor assemblies consisting of turbines, mirrors, and bearings.

**4B005** Electronic streak cameras, electronic framing cameras, tubes and devices, as follows:

- a. Electronic streak cameras capable of 50 ns or less time resolution;
- b. Streak tubes for cameras specified in Item 4B005a;
- c. Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;
- d. Framing tubes and solid-state imaging devices for use with cameras specified in Item 4B005c, as follows:
  1. Proximity focused image intensifier tubes having the photocathode deposited on a transparent conductive coating to decrease photocathode sheet resistance;
  2. Gate silicon intensifier target (SIT) vidicon tubes, where a fast system allows gating the photoelectrons from the photocathode before they impinge on the SIT plate;
  3. Kerr or Pockels cell electro-optical shuttering;
  4. Other framing tubes and solid-state imaging devices having a fast image gating time of less than 50 ns specially designed for cameras specified in Item 4B005c.

**4B006** Specialized instrumentation for hydrodynamic experiments, as follows:

- a. Velocity interferometers for measuring velocities exceeding 1 km/s during time intervals of less than 10  $\mu$ s;
- b. Manganin gauges for pressures greater than 10 GPa;
- c. Quartz pressure transducers for pressures greater than 10 GPa.

*Note:* Item 4B006a includes velocity interferometers such as VISARs (Velocity interferometer systems for any reflector) and DLIs (Doppler laser interferometers).

**4B007** High-speed pulse generators having both of the following characteristics:

- a. Output voltage greater than 6 V into a resistive load of less than 55 ohms; and
- b. 'Pulse transition time' less than 500 ps.

*Technical Note:* In Item 4B007b 'pulse transition time' is defined as the time interval between 10% and 90% voltage amplitude.

**4B008** 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 an area greater than 5000 mm<sup>2</sup> from a single firing signal with an initiation timing spread over the surface of less than 2.5  $\mu$ s.

*Note:* Item 4B008 does not control detonators using only primary explosives, such as lead azide.

*Technical Note:* In Item 4B008 the detonators of concern all utilize a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporizes when a fast, high-current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (pentaerythritol tetranitrate). In slapper detonators, the explosive vaporization of the electrical conductor drives a flyer or slapper across a gap, and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator. Also, the word initiator is sometimes used in place of the word detonator.

**4B009** Firing sets and equivalent high-current pulse generators, as follows:

- a. Explosive detonator firing sets designed to drive multiple controlled detonators specified by Item 4B008 above;
- b. Modular electrical pulse generators (pulsers) having all of the following characteristics:
  1. Designed for portable, mobile, or ruggedized-use;
  2. Enclosed in a dust-tight enclosure;
  3. Capable of delivering their energy in less than 15  $\mu$ s;
  4. Having an output greater than 100 A;
  5. Having a 'rise time' of less than 10  $\mu$ s into loads of less than 40 ohms;
  6. No dimension greater than 25.4 cm;
  7. Weight less than 25 kg ; and
  8. Specified to operate over an extended temperature range of 223° to 373° K (-50 °C to 100 °C) or specified as suitable for aerospace applications.

*Note:* Item 4B009b includes xenon flashlamp drivers.

*Technical Note:* In Item 4B009b5 'rise time' is defined as the time interval from 10% to 90% current amplitude when driving a resistive load.

**4B010** 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  $\mu$ s or less;

*Note:* Item 4B010a includes gas krytron tubes and vacuum sprytron tubes.

- b. Triggered spark-gaps having both of the following characteristics:
  - 1. Anode delay time of 15  $\mu$ s 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  $\mu$ s or less.

**4B011** Pulse discharge capacitors having either of the following sets of characteristics:

- a.
  - 1. Voltage rating greater than 1.4 kV;
  - 2. Energy storage greater than 10 J;
  - 3. Capacitance greater than 0.5  $\mu$ F; and
  - 4. Series inductance less than 50 nH;
 or
- b.
  - 1. Voltage rating greater than 750 V;
  - 2. Capacitance greater than 0.25  $\mu$ F; and
  - 3. Series inductance less than 10 nH.

**4B012** Neutron generator systems, including tubes, having both of the following characteristics:

- a. Designed for operation without an external vacuum system; and
- b. Utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

**4C Technology**

Technology for the development, production or use of items in 4A and 4B.

**5 Aerospace systems, equipment including production and test equipment, related technology, and specially designed components and accessories therefor**

**5A Rocket Systems (including ballistic missiles, space launch vehicles and sounding rockets)**

**5A1 Systems**

**5A101** Systems for missiles and rockets, including:

- a. complete rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets);
- b. complete rocket stages with engines;
- c. solid or liquid fuel rocket engines and their control systems including liquid propellant apogee engines designed or modified for satellites.

*Note:* 5A101 does not control JATO units, propulsion units for flares, ejection seats, emergency escape equipment and rockets for display fireworks.

- 5A102** Subsystems and components usable in missiles and rockets including:
- a. rocket motor cases, interior lining, insulation and nozzles;
  - b. rocket staging mechanisms, separation mechanisms and inter-stages;
  - c. liquid and slurry propellant (including oxidizers), control systems, and components thereof, specially designed or modified for resistance to vibration;
  - d. re-entry vehicles and equipment including
    1. Heat-shields and components thereof, fabricated of ceramic or ablative materials;
    2. Heat sinks and components thereof, fabricated of light weight, high heat capacity materials;
    3. Electronic equipment specially designed for re-entry vehicles.
  - e. guidance systems and their components such as gyros and inertial reference units;
  - f. thrust-vector control subsystems including methods of achieving thrust vector control such as flexible nozzle, fluid or secondary gas injection, movable engine or nozzle, deflection of exhaust gas stream (jet vanes or probes) and use of thrust tabs;
  - g. hybrid rocket motors and components thereof;
  - h. safing, arming, fusing and firing mechanisms for weapons or warhead;
  - i. software specially designed for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures.

**5A2            Production and Test Equipment**

**5A201** Transonic, supersonic, hypersonic wind tunnels; shock tunnels; gun tunnels; aeroballistic ranges.

**5A202** Test and production equipment and facilities designed to handle systems in 5A1.

**5A203** Test benches/stands, usable for complete rocket systems and subsystems (including ballistic missile systems, space launch vehicles and sounding rockets) which have the capacity to handle solid or liquid propellant rockets, motors or engines, or which are capable of simultaneously measuring the three axial thrust components.

**5A204** Vibration test equipment (vibration test systems and vibration thrusters) and components using digital control techniques and feedback or closed loop test equipment and software thereof (Refer 4A006).

**5A205** Flow-forming machines and specially designed components thereof which, according to the manufacturers technical specification,

1. can be equipped with numerical control units or a computer control, even when not equipped with such units at delivery; and
2. have more than two axes which can be coordinated simultaneously for contouring control.

*Note:* Item 5A205 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.

- 5A206** Filament winding machines or fibre placement machines for which the motion for positioning wrapping and winding fibres can be coordinated and programmed in two or more axes; precision mandrels thereof, and coordinating and programming controls.
- 5A207** Tape-laying machines of which the motions for positioning and laying tape and sheets can be coordinated and programmed in two or more axes;
- 5A208** Isostatic presses having all of the characteristics of maximum working pressure equal to or greater than 69 MPa or greater; designed to achieve and maintain a controlled thermal environment of 600°C or greater; and possessing a chamber cavity with an inside diameter of 152 mm or greater.
- 5A209** Environmental chambers simulating vibration environments, with altitudes equal to or greater than 15 km, or temperature ranging between minus 50 and plus 125 degrees centigrade.
- 5A210** Environmental chambers simulating acoustic pressure level of 140 dB or greater or rated acoustic power output of 4 KW or greater, with altitudes equal to or greater than 15 km, or temperature ranging between minus 50 and plus 125 degrees centigrade.
- 5A211** Accelerators delivering electro-magnetic radiation produced by Bremsstrahlung from accelerated electrons.
- 5A212** Pulsed electron accelerators
- 5A213** Radial ball bearings having all tolerances specified in accordance with ISO 492 Tolerance Class 2 or better and having all the following characteristics:
- An inner ring bore diameter between 12 and 50 mm;
  - An outer ring outside diameter between 25 and 100 mm; and
  - A width between 10 and 20 mm.
- 5A214** Liquid propellant tanks specially designed for the propellants controlled in Item 3A3 or other liquid propellants used in the systems specified in 5A and 5B.
- 5A215** Production facilities and production equipment specially designed for equipment or materials for 5A101 and 5A102.
- 5A216** Production equipment and specially designed components thereof, for the production, handling or acceptance testing of liquid propellants or propellant constituents as referred in 3A3;
- 5A217** Launch and ground support equipment and facilities usable for rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets), unmanned airborne system and cruise missiles as follows:-

- a. apparatus, devices and vehicles, designed or modified for the transport, handling, control, activation and launching of the systems.
- b. gravity meters (gravimeters), gravity gradiometers, and specially designed components thereof, designed or modified for airborne or marine use usable for complete rocket systems and for complete unmanned aerial vehicle systems (including cruise missile systems target drones and reconnaissance drones)
- c. telemetry and tele-command equipment, including ground equipment, designed or modified for complete rocket systems and complete unmanned aerial vehicle systems and cruise missiles, excluding equipment designed or modified for manned aircraft or satellites, ground based equipment designed or modified for terrestrial or marine application, and equipment designed for commercial, civil or 'safety of life' (e.g. data integrity, flight safety) GNSS services.
- d. radomes designed to withstand a combined thermal and pressure shock usable in protecting rocket systems, unmanned aerial vehicles and cruise missiles against nuclear effects (eg. electro-magnetic pulse (EMP), X-rays, combined blast and thermal effects).
- e. Software which processes post-flight, recorded data, enabling determination of vehicle position throughout its flight path.
- f. Thermal batteries designed or modified for complete rocket systems of 5A or complete unmanned aerial vehicles of 5B  
 Note: '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.

**5A218** Systems, specially designed for radar cross section measurement, usable for rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets), unmanned airborne system and cruise missiles and their subsystems.

**5A3 Technology**

**5A301** Technology related to the development, production, testing and use of items in 5A1 and 5A2.

**5A302** Software for the development, production, and testing and use of items in 5A1 and 5A2.

**5A303** Software which coordinates the function of more than one subsystem, specially designed or modified for use in the systems specified in 5A1 and 5A2.

**5B Unmanned aerial vehicles including cruise missiles, target drones and reconnaissance drones and related equipment, and specially designed components therefor:**

- a. Unmanned aerial vehicles including Remotely Piloted air Vehicles (RPVs) and autonomous programmable vehicles;
- b. Associated launchers and ground support equipment;
- c. Related equipment for command and control;
- d. Complete unmanned aerial vehicle systems (including cruise missile systems, target drones and reconnaissance drones);
- e. Light weight Turbojet and turbofan engines (including turbo compound engines);
- f. Ramjet / Scramjet / pulse jet/ combined cycle engines, including devices to regulate combustion, and specially designed components;
- g. Complete unmanned aerial vehicle systems having an autonomous flight control and navigation capability or capability of controlled flight out of the direct vision range involving a human operator, designed or modified to incorporate an aerosol dispensation mechanism, or capable of carrying elements of a payload in the form of a particulate or liquid other than fuel components of such vehicles;  
*Note:* This category does not control unpowered airborne vehicles such as gliders, hot air balloons etc.;
- h. Safing, arming, fusing and firing mechanisms for weapons or warhead;
- i. Production facilities and Production equipment specially designed for equipment or materials for 5;
- j. Technology, for the development, production or use of equipment, materials or software specified for 5B;
- k. Software, for the development, production or use of equipment or materials specified for 5B;
- l. Software which coordinates the function of more than one subsystem, specially designed or modified for use in the systems specified in 5B;
- m. 'Turboprop engine systems' specially designed for the systems in 5B.d, and specially designed components therefor, having a maximum power greater than 10 kW (achieved uninstalled at sea level standard conditions), excluding civil certified engines.

*Note:* For the purposes of this entry, a 'turboprop engine system' incorporates all of the following:

- i. Turboshaft engine; and
- ii. Power transmission system to transfer the power to a propeller.

**5C Avionics and navigation systems designed or modified for use in, or usable in rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets), unmanned aerial vehicles and cruise missiles**

**5C001** Guidance systems and their components such as gyros and inertial reference units, and specially designed components therefor;

**5C002** Integrated flight instrument systems which include gyrostabilizers or automatic pilots, and specially designed components therefor;

- 5C003** Compasses (including gyro-astro compasses), gyroscopes, accelerometers and inertial equipment and specially designed software thereof and specially designed components therefor.
- 5C004** Inertial or other equipment using accelerometers or systems incorporating such equipment, and specially designed integration software therefor;
- 5C005** Encrypted telemetry systems, equipment and software thereof.
- 5C006** Flight control system (including servo valves) designed or modified for the systems as follows:
- a. Hydraulic, mechanical, electro-optical or electro-mechanical flight control systems (including fly-by-wire systems);
  - b. Attitude control equipment;
  - c. Design technology for integration of flight control, guidance, and propulsion data into a flight management system for optimisation of rocket system trajectory;
  - d. Specially designed test, calibration, and alignment thereof.
- 5C007**
1. Integrated navigation system incorporating an inertial measurement device (example: an attitude and heading reference system, inertial reference unit, or inertial navigation system); one or more external sensor used to update the position and/or velocity, either periodically or continuously throughout the flight (example: satellite navigation receiver, radar altimeter and/or Doppler radar); integration hardware and software.
  2. Three axis magnetic heading sensors having all of the following characteristics, and specially designed components therefor:
    - a. Internal tilt compensation in pitch (+/- 90 degrees) and having roll (+/- 180 degrees) axes.
    - b. Capable of providing azimuthal accuracy better (less) than 0.5 degrees rms at latitudes of +/- 80 degrees, referenced to local magnetic field; and
    - c. Designed or modified to be integrated with flight control and navigation systems.
- Note: Flight control and navigation systems in this item include gyrostabilizers, automatic pilots and inertial navigation systems.
- 5C008** Production equipment and other test, calibration and alignment equipment, designed or modified to be used with equipment specified in 5C001 – 5C004 and 5C007.
- 5C009** Equipment used to characterize mirrors for laser gyros such as scatterometer, reflectometer and profilometer and for other inertial equipments such as Inertial measurement unit (IMU Module) tester, IMU Platform tester, IMU stable element handling fixture, Gyro tuning test station, Gyro dynamic balance station, Gyro run-in/motor test station, Gyro evacuation and filling station, Centrifuge fixture for gyro bearings, Accelerometer axis align station and Accelerometer test station.

- 5C010** Avionics equipment and embedded or specially designed software and components thereof, including but not limited to:
- a. Radar and laser radar system including altimeter;
  - b. Electronic assemblies and components including umbilical and interstage electrical connectors  
Technical Note: Interstage connectors also include electrical connectors installed between systems and their payload.
  - c. Design technology for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards from external sources.
  - d. Passive sensors for determining bearings to electromagnetic sources (direction finding devices) or terrain characteristics
  - e. Receiving equipment for Global Navigation Satellite Systems (GNSS: e.g. GPS, GLONASS, GALILEO), capable of operating at aircraft speeds and altitudes or above.
  - f. Terrain contour mapping equipment, Scene mapping and correlation (both digital and analogue) equipment, Doppler navigation radar equipment, Passive interferometer equipment and Imaging sensor equipment (both active and passive)
  - g. Design technology for electromagnetic shielding systems, the configuration of hardened electrical circuits and subsystems and for the determination of hardening criteria.
- 5C011** On-board electronic equipment, devices and their design and manufacturing know-how (except warhead fuses, timers and sequencers), and embedded or specially designed software thereof.
- 5C012** Detectors designed or modified, in protecting rocket systems, unmanned aerial vehicles and cruise missiles against nuclear effects (eg. electro-magnetic pulse (EMP), X-rays, combined blast and thermal effects).
- 5C013** Radiation Hardened microcircuits usable in protecting rocket systems, unmanned aerial vehicles and cruise missiles against nuclear effects (e.g. electro-magnetic pulse (EMP), X-rays, combined blast and thermal effects).
- 5C014** Precision tracking systems using 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 measurement of inflight position and velocity; Range instrumentation radars including associated optical/infrared trackers and related software.
- 5C015** Balancing machines capable of balancing rotors/assemblies and correcting unbalance in two planes or more.
- 5C016** Indicator heads or balancing instrumentation designed or modified for use with balancing machines.

**5C017** Motion simulators or rate tables having all of the following characteristics:

- a. Two axes or more;
- b. Designed or modified to incorporate slip rings or integrated non-contact devices capable of transferring electrical power, signal information, or both; and
- c. Having any of the following characteristics:
  1. For any single axis having all of the following:
    - a. Capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and
    - b. A rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s;
  2. Having a worst-case rate stability equal to or better (less) than plus or minus 0.05 % averaged over 10 degrees or more; or
  3. A positioning 'accuracy' equal to or less (better) than 5 arc second.

Note 1: 5C017 does not control rotary tables designed or modified for machine tools or for medical equipment.

Note 2: Motion simulators or rate tables specified in 5C017 remain controlled whether or not slip rings or integrated non-contact devices are fitted at time of export.

**5C018** Position tables (equipment capable of precise rotary positioning in any axes) having two axes or more and a position accuracy equal to or better than 5 arc second.

**5C019** Centrifuges capable of imparting accelerations above 100 g and designed or modified to incorporate slip rings or integrated non-contact devices capable of transferring electrical power, signal information, or both.

Note: Centrifuges specified in 5C019 remain controlled whether or not slip rings or integrated non-contact devices are fitted at time of export.

**5C020** Design technology for integration of air vehicle fuselage, propulsion system and lifting control surfaces designed or modified for the unmanned aerial vehicle systems to optimize aerodynamic performance throughout the flight regime of an unmanned aerial vehicle system.

**5C021** Design technology for integration of the flight control, guidance, and propulsion data into a flight management system, designed or modified for the complete rocket systems, unmanned aerial vehicles and cruise missiles for optimization of the trajectory.

**5C022** Technology for the development, production, or use of items in 5C.

**5C023** Software for the development, production and use of items in 5C.

**5C024** Software specially designed or modified for use in the systems specified in 5C.

**5D Manned-aircraft, aero-engines, related equipment and components:**

*Note:* This category does not control foreign military aircraft or an Indian aircraft carrying a military registration number.

**5D001**

Combat aircraft and specially designed components thereof;

- a. Other aircraft specially designed or modified for military use, including military reconnaissance, assault, military training, transporting and air-dropping troops or military equipment, logistics support, and specially designed components thereof;
- b. Aero-engines specially designed or modified for military use, and specially designed components thereof;
- c. Airborne equipment, including airborne refuelling equipment, specially designed for use with the aircraft controlled by 5D001a or 5D001b or the aero-engines controlled by 5D001c, and specially designed components thereof;
- d. Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for aircraft controlled by 5D001a or 5D001b or for aero-engines controlled by 5D001c;
- e. Pressurized breathing equipment and partial pressure suits for use in aircraft anti-g suits, military crash helmets and protective masks, liquid oxygen converters used for aircraft or missiles, and catapults and cartridge actuated devices for emergency escape of personnel from aircraft;
- f. Parachutes:
  1. Paragliders, drag parachutes, drogue parachutes for stabilization and attitude control of dropping bodies, (e.g. recovery capsules, ejection seats, bombs);
  2. Drogue parachutes for use with ejection seat systems for deployment and inflation sequence regulation of emergency parachutes;
  3. Recovery parachutes for guided missiles, drones or space vehicles;
  4. Approach parachutes and landing deceleration parachutes.
- g. Automatic piloting systems for parachuted loads, equipment specially designed or modified for military use for controlled opening jumps at any height, including oxygen equipment.

*Note 1:* 5D001b does not control aircraft or variants of those aircraft specially designed for military use which:

1. Have been certified for civil use by the civil aviation authority of India, and
2. Are not configured for military use and are not fitted with equipment or attachments specially designed or modified for military use;

*Note 2:* The control in 5D001b and 5D001c on specially designed components and related equipment for non-military aircraft or aero-engines modified for military use applies only to those military components and to military related equipment required for the modification to military use.

**5E Microlight aircraft and powered 'hang-gliders'**

**Category 6** [Reserved]

**Category 7:** **Electronics, computers, and information technology including information security**

## **7A Electronics**

- 7A001** High-power microwave devices including tubes, travelling wave tubes (TWT) and phase shifters, and continuous wave and pulsed high power microwave travelling wave tube amplifiers (TWTA) operating at frequencies higher than 31 GHz, and their power supplies.
- 7A002** Microwave monolithic integrated circuits (MMIC) operating at frequencies above 3 GHz and surface acoustic wave (SAW) devices operating at frequencies above 2.5 GHz.
- 7A003** Phased array antennas and their elements.
- 7A004** Radiation-hardened microprocessors, field programmable gate arrays and solid state memory devices.
- 7A005** Microprocessor microcircuits, microcomputer microcircuits, microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analogue-to-digital converter, and digital-to-analogue converter, printed circuit boards or modules, electro-optical or optical integrated circuits designed for signal processing, field programmable logic devices, neural network integrated circuits, custom integrated circuits for which either the function is unknown or the control status of the equipment in which the integrated circuit will be used is unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following:
- a. Rated for operation at an ambient temperature above 398 K (+125°C);
  - b. Rated for operation at an ambient temperature below 218 K (-55°C); or
  - c. Rated for operation over the entire ambient temperature range from 218 K (-55°C) to 398 K (+125°C).
- 7A006** Radiation-hardened analogue-to-digital and digital-to-analogue converter integrated circuits, as follows:
- a. Analogue-to-digital converters having any of the following:
    1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time of less than 5 ns;
    2. A resolution of 12 bit with a total conversion time of less than 200 ns; or
    3. A resolution of more than 12 bit with a total conversion time of less than 2 µs;
  - b. Digital-to-analogue converters with a resolution of 12 bit or more, and a settling time of less than 10 ns.
- 7A007** Detector units operating in the thermal infrared, ultraviolet, x-ray and gamma ray spectrum.
- 7A008** Focal plane assemblies for imaging cameras operating in the visible, near and thermal infrared spectrum.

**7A009** Technology for the development, production or use of items specified in 7A005 and 7A006.

**7B Electronic test equipment**

**7B001** Frequency synthesized signal generators with maximum frequency greater than 31 GHz.

**7B002** Network analysers operating at frequencies above 40 GHz.

**7C Computers**

**7C001** Digital computers and software as follows:

- a. Digital computers having a composite theoretical performance (CTP) exceeding 75000 (seventy-five thousand) million theoretical operations per second (Mtops)
- b. Software, and/or computer inter-connection schemes, whether or not co-supplied with (a) designed to 'parallelise' digital computers (individually of any CTP rating) enabling a CTP of more than 75000 Mtops to be achieved by the 'parallelised' configuration.

*Technical notes:*

1. The Composite Theoretical Performance (CTP) rating is to be calculated in accordance with the calculation scheme separately notified in this regard.
2. Individual digital computers each with a CTP rating of 75000 Mtops or less do not require an export license to any destination or end-user, unless supplied with (b) above.
3. Digital Computers' includes (1) hybrid computers incorporating 'digital computers' or specified in (a) above, systolic array computers, neural computers, optical computers, vector processors, digital signal processors, logical processors (2) digital electronic equipment designed for 'image enhancement' or signal processing other than when supplied as integral adjuncts to medical imaging (eg CAT-scanning) equipment.

**7C002** Analogue, digital or hybrid computers, digital differential analysers, and specially designed software therefor, for use in, or for modelling, simulation, or design integration of rocket systems, unmanned aerial vehicles and cruise missiles.

**7C003** Technology for the development, production or use of items in 7C002.

**7D Information technology including information security**

**7D001** Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes.

**7D002** Identification, authentication and keyloader equipment and key management, manufacturing and distribution equipment.

**7E** [Reserved]