
DUAL-USE LIST - CATEGORY 8 - MARINE

8. A. 2. Systems and equipment, as follows:
N.B. For underwater communications systems, see Category 5, Part 1 - Telecommunications.
8. A. 2. a. Systems and equipment, specially designed or modified for submersible vehicles, designed to operate at depths exceeding 1,000 m, as follows:
1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;
 2. Direct current propulsion motors or thrusters;
 3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;
8. A. 2. b. Systems specially designed or modified for the automated control of the motion of submersible vehicles controlled by 8.A.1. using navigation data and having closed loop servo-controls:
1. Enabling a vehicle to move within 10 m of a predetermined point in the water column;
 2. Maintaining the position of the vehicle within 10 m of a predetermined point in the water column; or
 3. Maintaining the position of the vehicle within 10 m while following a cable on or under the seabed;
8. A. 2. c. Fibre optic hull penetrators or connectors;
8. A. 2. d. Underwater vision systems, as follows:
1. Television systems and television cameras, as follows:
 - a. Television systems (comprising camera, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 800 lines and specially designed or modified for remote operation with a submersible vehicle;
 - b. Underwater television cameras having a limiting resolution when measured in air of more than 1,100 lines;
 - c. Low light level television cameras specially designed or modified for underwater use containing all of the following:
 1. Image intensifier tubes controlled by 6.A.2.a.2.a.; and
 2. More than 150,000 "active pixels" per solid state area array;
- Technical Note*
Limiting resolution in television is a measure of horizontal resolution usually expressed in terms of the maximum number of lines per picture height discriminated on a test chart, using IEEE Standard 208/1960 or any equivalent standard.
8. A. 2. d. 2. Systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range-gated illuminators or "laser" systems;

DUAL-USE LIST - CATEGORY 8 - MARINE

8. A. 2. e. Photographic still cameras specially designed or modified for underwater use below 150 m having a film format of 35 mm or larger, and having any of the following:
1. Annotation of the film with data provided by a source external to the camera;
 2. Automatic back focal distance correction; or
 3. Automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000 m;
8. A. 2. f. Electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;
8. A. 2. g. Light systems, as follows, specially designed or modified for underwater use:
1. Stroboscopic light systems capable of a light output energy of more than 300 J per flash and a flash rate of more than 5 flashes per second;
 2. Argon arc light systems specially designed for use below 1,000 m;
8. A. 2. h. "Robots" specially designed for underwater use, controlled by using a dedicated "stored programme controlled" computer, having any of the following:
1. Systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; or
 2. The ability to exert a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "fibrous or filamentary" "composite" materials in their structural members;
8. A. 2. i. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles, having any of the following:
1. Systems which control the manipulator using the information from sensors which measure the torque or force applied to an external object, or tactile sense between the manipulator and an external object; or
 2. Controlled by proportional master-slave techniques or by using a dedicated "stored programme controlled" computer, and having 5 degrees of freedom of movement or more;
- Note* Only functions having proportional control using positional feedback or by using a dedicated "stored programme controlled" computer are counted when determining the number of degrees of freedom of movement.

DUAL-USE LIST - CATEGORY 8 - MARINE

8. A. 2. j. Air independent power systems, specially designed for underwater use, as follows:
1. Brayton or Rankine cycle engine air independent power systems having any of the following:
 - a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
 - b. Systems specially designed to use a monoatomic gas;
 - c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; or
 - d. Systems specially designed:
 1. To pressurise the products of reaction or for fuel reformation;
 2. To store the products of the reaction; and
 3. To discharge the products of the reaction against a pressure of 100 kPa or more;
 2. Diesel cycle engine air independent systems, having all of the following:
 - a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
 - b. Systems specially designed to use a monoatomic gas;
 - c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; and
 - d. Specially designed exhaust systems that do not exhaust continuously the products of combustion;
 3. Fuel cell air independent power systems with an output exceeding 2 kW having any of the following:
 - a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; or
 - b. Systems specially designed:
 1. To pressurise the products of reaction or for fuel reformation;
 2. To store the products of the reaction; and
 3. To discharge the products of the reaction against a pressure of 100 kPa or more;

DUAL-USE LIST - CATEGORY 8 - MARINE

8. A. 2. j. 4. Stirling cycle engine air independent power systems, having all of the following:
- a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; and
 - b. Specially designed exhaust systems which discharge the products of combustion against a pressure of 100 kPa or more;
8. A. 2. k. Skirts, seals and fingers, having any of the following:
- 1. Designed for cushion pressures of 3,830 Pa or more, operating in a significant wave height of 1.25 m (Sea State 3) or more and specially designed for surface effect vehicles (fully skirted variety) controlled by 8.A.1.f.; or
 - 2. Designed for cushion pressures of 6,224 Pa or more, operating in a significant wave height of 3.25 m (Sea State 5) or more and specially designed for surface effect vehicles (rigid sidewalls) controlled by 8.A.1.g.;
8. A. 2. l. Lift fans rated at more than 400 kW specially designed for surface effect vehicles controlled by 8.A.1.f. or 8.A.1.g.;
8. A. 2. m. Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels controlled by 8.A.1.h.;
8. A. 2. n. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels controlled by 8.A.1.f., 8.A.1.g., 8.A.1.h. or 8.A.1.i.;
8. A. 2. o. Propellers, power transmission systems, power generation systems and noise reduction systems, as follows:
- 1. Water-screw propeller or power transmission systems, as follows, specially designed for surface effect vehicles (fully skirted or rigid sidewall variety), hydrofoils or small waterplane area vessels controlled by 8.A.1.f., 8.A.1.g., 8.A.1.h. or 8.A.1.i.:
 - a. Supercavitating, super-ventilated, partially-submerged or surface piercing propellers rated at more than 7.5 MW;
 - b. Contrarotating propeller systems rated at more than 15 MW;
 - c. Systems employing pre-swirl or post-swirl techniques for smoothing the flow into a propeller;
 - d. Light-weight, high capacity (K factor exceeding 300) reduction gearing;
 - e. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 1 MW;

DUAL-USE LIST - CATEGORY 8 - MARINE

8. A. 2. o. 2. Water-screw propeller, power generation systems or transmission systems designed for use on vessels, as follows:
- a. Controllable-pitch propellers and hub assemblies rated at more than 30 MW;
 - b. Internally liquid-cooled electric propulsion engines with a power output exceeding 2.5 MW;
 - c. "Superconductive" propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0.1 MW;
 - d. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 2 MW;
 - e. Ventilated or base-ventilated propeller systems rated at more than 2.5 MW;
8. A. 2. o. 3. Noise reduction systems designed for use on vessels of 1,000 tonnes displacement or more, as follows:
- a. Systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30% of the equipment to be mounted;
 - b. Active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source;
8. A. 2. p. Pumpjet propulsion systems having a power output exceeding 2.5 MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater-radiated noise;
8. A. 2. q. Self-contained, closed or semi-closed circuit (rebreathing) diving and underwater swimming apparatus.
- Note* 8.A.2.q. does not control an individual apparatus for personal use when accompanying its user.

8. B. TEST, INSPECTION AND PRODUCTION EQUIPMENT

8. B. 1. Water tunnels, having a background noise of less than 100 dB (reference 1 μ Pa, 1 Hz) in the frequency range from 0 to 500 Hz, designed for measuring acoustic fields generated by a hydro-flow around propulsion system models.

DUAL-USE LIST - CATEGORY 8 - MARINE

8. C. MATERIALS

8. C. 1. Syntactic foam designed for underwater use, having all of the following:
- Designed for marine depths exceeding 1,000 m; and
 - A density less than 561 kg/m³.

Technical Note

Syntactic foam consists of hollow spheres of plastic or glass embedded in a resin matrix.

8. D. SOFTWARE

8. D. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials controlled by 8.A., 8.B. or 8.C.
8. D. 2. Specific "software" specially designed or modified for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction.

8. E. TECHNOLOGY

8. E. 1. "Technology" according to the General Technology Note for the "development" or "production" of equipment or materials controlled by 8.A., 8.B. or 8.C.
8. E. 2. Other "technology", as follows:
- "Technology" for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;
 - "Technology" for the overhaul or refurbishing of equipment controlled by 8.A.1., 8.A.2.b., 8.A.2.j., 8.A.2.o. or 8.A.2.p.

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. A. SYSTEMS, EQUIPMENT AND COMPONENTS

N.B. For propulsion systems designed or rated against neutron or transient ionizing radiation, see the Munitions List.*

9. A. 1. Aero gas turbine engines incorporating any of the "technologies" controlled by 9.E.3.a., as follows:
- a. Not certified for the specific "civil aircraft" for which they are intended;
Note For the purpose of the "civil aircraft" certification process, a number of up to 16 civil certified engines, assemblies or components including spares, is considered appropriate.
 - b. Not certified for civil use by the aviation authorities in a participating state;
 - c. Designed to cruise at speeds exceeding Mach 1.2 for more than thirty minutes.
9. A. 2. Marine gas turbine engines with an ISO standard continuous power rating of 24,245 kW or more and a specific fuel consumption not exceeding 0.219 kg/kWh in the power range from 35 to 100%, and specially designed assemblies and components therefor.
Note The term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for a ship's electric power generation or propulsion.
9. A. 3. Specially designed assemblies and components, incorporating any of the "technologies" controlled by 9.E.3.a., for the following gas turbine engine propulsion systems:
- a. Controlled by 9.A.1.;
 - b. Whose design or production origins are either non-participating states or unknown to the manufacturer.
9. A. 4. Space launch vehicles and "spacecraft".
Note 9.A.4. does not control payloads.
N.B. For the control status of products contained in "spacecraft" payloads, see the appropriate Categories.
9. A. 5. Liquid rocket propulsion systems containing any of the systems or components controlled by 9.A.6.
9. A. 6. Systems and components specially designed for liquid rocket propulsion systems, as follows:
- a. Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30% per year;

* France, the Russian Federation and Ukraine view this list as reference drawn up to help in the selection of dual-use goods which could contribute to the indigenous development, production or enhancement of conventional munitions capabilities.

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. A. 6. b. Cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (-173°C) or less for "aircraft" capable of sustained flight at speeds exceeding Mach 3, launch vehicles or "spacecraft";
- c. Slush hydrogen storage or transfer systems;
- d. High pressure (exceeding 17.5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;
- e. High-pressure (exceeding 10.6 MPa) thrust chambers and nozzles therefor;
- f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);
- g. Liquid propellant injectors, with individual orifices of 0.381 mm or smaller in diameter (an area of 1.14×10^{-3} cm² or smaller for non-circular orifices) specially designed for liquid rocket engines;
- h. One-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones with densities exceeding 1.4 g/cm³ and tensile strengths exceeding 48 MPa.
9. A. 7. Solid rocket propulsion systems with any of the following:
- a. Total impulse capacity exceeding 1.1 MNs;
- b. Specific impulse of 2.4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;
- c. Stage mass fractions exceeding 88% and propellant solid loadings exceeding 86%;
- d. Any of the components controlled by 9.A.8.; or
- e. Insulation and propellant bonding systems using direct-bonded motor designs to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material.
- Technical Note*
For the purposes of 9.A.7.e., a strong mechanical bond means bond strength equal to or more than propellant strength.
9. A. 8. Components, as follows, specially designed for solid rocket propulsion systems:
- a. Insulation and propellant bonding systems using liners to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;
- Technical Note*
For the purposes of 9.A.8.a., a strong mechanical bond means bond strength equal to or more than propellant strength.
- b. Filament-wound "composite" motor cases exceeding 0.61 m in diameter or having structural efficiency ratios (PV/W) exceeding 25 km.
- Technical Note*
The structural efficiency ratio (PV/W) is the burst pressure (P) multiplied by the vessel volume (V) divided by the total pressure vessel weight (W).
- c. Nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0.075 mm/s;
- d. Movable nozzle or secondary fluid injection thrust vector control systems capable of any of the following:
1. Omni-axial movement exceeding $\pm 5^\circ$;
 2. Angular vector rotations of 20°/s or more; or
 3. Angular vector accelerations of 40°/s² or more.

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. A. 9. Hybrid rocket propulsion systems with:
- Total impulse capacity exceeding 1.1 MNs; or
 - Thrust levels exceeding 220 kN in vacuum exit conditions.
9. A. 10. Specially designed components, systems and structures for launch vehicles, launch vehicle propulsion systems or "spacecraft", as follows:
- Components and structures each exceeding 10 kg, specially designed for launch vehicles manufactured using metal "matrix", "composite", organic "composite", ceramic "matrix" or intermetallic reinforced materials controlled by 1.C.7. or 1.C.10.;
- Note The weight cut-off is not relevant for nose cones.*
- Components and structures specially designed for launch vehicle propulsion systems controlled by 9.A.5 to 9.A.9. manufactured using metal matrix, composite, organic composite, ceramic matrix or intermetallic reinforced materials controlled by 1.C.7. or 1.C.10.;
 - Structural components and isolation systems specially designed to control actively the dynamic response or distortion of "spacecraft" structures;
 - Pulsed liquid rocket engines with thrust-to-weight ratios equal to or more than 1 kN/kg and a response time (the time required to achieve 90% of total rated thrust from start-up) of less than 30 ms.
9. A. 11. Ramjet, scramjet or combined cycle engines and specially designed components therefor.
9. A. 12. Unmanned aerial vehicles having any of the following:
- An autonomous flight control and navigation capability (e.g., an autopilot with an Inertial Navigation System); or
 - Capability of controlled-flight out of the direct vision range involving a human operator (e.g., televisual remote control).
- Note 9.A.12. does not control model aircraft.*

9. B. TEST, INSPECTION AND PRODUCTION EQUIPMENT

9. B. 1. Specially designed equipment, tooling and fixtures, as follows, for manufacturing gas turbine blades, vanes or tip shroud castings:
- Directional solidification or single crystal casting equipment;
 - Ceramic cores or shells.
9. B. 2. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for the "development" of gas turbine engines, assemblies or components incorporating "technologies" controlled by 9.E.3.a.
9. B. 3. Equipment specially designed for the "production" or test of gas turbine brush seals designed to operate at tip speeds exceeding 335 m/s, and temperatures in excess of 773 K (500°C), and specially designed components or accessories therefor.

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. B. 4. Tools, dies or fixtures for the solid state joining of "superalloy", titanium or intermetallic airfoil-to-disk combinations described in 9.E.3.a.3. or 9.E.3.a.6. for gas turbines.
9. B. 5. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with any of the following wind tunnels or devices:
- a. Wind tunnels designed for speeds of Mach 1.2 or more, except those specially designed for educational purposes and having a test section size (measured laterally) of less than 250 mm;
Technical Note
Test section size: the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test section location.
- b. Devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns; or
- c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25×10^6 .
9. B. 6. Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 μ Pa) with a rated output of 4 kW or more at a test cell temperature exceeding 1,273 K (1,000°C), and specially designed quartz heaters therefor.
9. B. 7. Equipment specially designed for inspecting the integrity of rocket motors using non-destructive test (NDT) techniques other than planar X-ray or basic physical or chemical analysis.
9. B. 8. Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560°C).
9. B. 9. Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operating at stress levels of 60% of ultimate tensile strength (UTS) or more and metal temperatures of 873 K (600°C) or more.
9. C. MATERIALS - None
9. D. SOFTWARE
9. D. 1. "Software" specially designed or modified for the "development" of equipment or "technology" controlled by 9.A., 9.B. or 9.E.3.
9. D. 2. "Software" specially designed or modified for the "production" of equipment controlled by 9.A. or 9.B.

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. D. 3. "Software" specially designed or modified for the "use" of full authority digital electronic engine controls (FADEC) for propulsion systems controlled by 9.A. or equipment controlled by 9.B., as follows:
- a. "Software" in digital electronic controls for propulsion systems, aerospace test facilities or air breathing aero-engine test facilities;
 - b. Fault-tolerant "software" used in "FADEC" systems for propulsion systems and associated test facilities.

9. D. 4. Other "software", as follows:
- a. 2D or 3D viscous "software" validated with wind tunnel or flight test data required for detailed engine flow modelling;
 - b. "Software" for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyse data in real time, and capable of feedback control, including the dynamic adjustment of test articles or test conditions, as the test is in progress;
 - c. "Software" specially designed to control directional solidification or single crystal casting;
 - d. "Software" in "source code", "object code" or machine code required for the "use" of active compensating systems for rotor blade tip clearance control.

Note 9.D.4.d. does not control "software" embedded in uncontrolled equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.

9. E. TECHNOLOGY

9. E. 1. "Technology" according to the General Technology Note for the "development" of equipment or "software" controlled by 9.A.1.c., 9.A.4. to 9.A.11., 9.B. or 9.D.
9. E. 2. "Technology" according to the General Technology Note for the "production" of equipment controlled by 9.A.1.c., 9.A.4. to 9.A.11. or 9.B.

N.B. For "technology" for the repair of controlled structures, laminates or materials, see 1.E.2.f.

Note "Development" or "production" "technology" controlled by 9.E. for gas turbine engines remains controlled when used as "use" "technology" for repair, rebuild and overhaul. Excluded from control are: technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

9. E. 3. Other "technology", as follows:
- a. "Technology" "required" for the "development" or "production" of any of the following gas turbine engine components or systems:
 1. Gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K

DUAL-USE LIST - CATEGORY 9 - PROPULSION

- (1,000°C) at a stress of 200 MPa, based on the average property values;
9. E. 3. a. 2. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,813 K (1,540°C) or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;
3. Components manufactured from any of the following:
- Organic "composite" materials designed to operate above 588 K (315°C);
 - Metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials controlled by 1.C.7.; or
 - "Composite" material controlled by 1.C.10. and manufactured with resins controlled by 1.C.8.
4. Uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050°C) or more;
5. Cooled turbine blades, vanes or tip-shrouds, other than those described in 9.E.3.a.1., exposed to gas path temperatures of 1,643 K (1,370°C) or more;
6. Airfoil-to-disk blade combinations using solid state joining;
7. Gas turbine engine components using "diffusion bonding" "technology" controlled by 2.E.3.b.;
8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials controlled by 1.C.2.b.;
9. "FADEC" for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;
10. Adjustable flow path geometry and associated control systems for:
- Gas generator turbines;
 - Fan or power turbines;
 - Propelling nozzles; or
- Note 1* Adjustable flow path geometry and associated control systems in 9.E.3.a.10. do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.
- Note 2* 9.E.3.a.10. does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.
11. Wide chord hollow fan blades without part-span support;

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. E. 3. b. "Technology" "required" for the "development" or "production" of any of the following:
1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; or
 2. "Composite" propeller blades or propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;
9. E. 3. c. "Technology" "required" for the "development" or "production" of gas turbine engine components using "laser", water jet, ECM or EDM hole drilling processes to produce holes having any of the following sets of characteristics:
1. All of the following:
 - a. Depths more than four times their diameter;
 - b. Diameters less than 0.76 mm; and
 - c. Incidence angles equal to or less than 25°; or
 2. All of the following:
 - a. Depths more than five times their diameter;
 - b. Diameters less than 0.4 mm; and
 - c. Incidence angles of more than 25°;
9. E. 3. d. "Technology" "required" for the "development" or "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems;
9. E. 3. e. "Technology" for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:
1. A box volume of 1.2 m³ or less;
 2. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; and
 3. A power density of more than 700 kW/m³ of box volume;

Technical Note

For the purposes of 9.E.3.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

Technical Note

Box volume: the product of three perpendicular dimensions is measured in the following way:

Length: *The length of the crankshaft from front flange to flywheel face;*

Width: *The widest of the following:*

- a. *The outside dimension from valve cover to valve cover;*
- b. *The dimensions of the outside edges of the cylinder heads; or*
- c. *The diameter of the flywheel housing;*

Height: *The largest of the following:*

- a. *The dimension of the crankshaft centre-line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or*
- b. *The diameter of the flywheel housing.*

DUAL-USE LIST - CATEGORY 9 - PROPULSION

9. E. 3. f. "Technology" "required" for the "production" of specially designed components, as follows, for high output diesel engines:
1. "Technology" "required" for the "production" of engine systems having all of the following components employing ceramics materials controlled by I.C.7:
 - a. Cylinder liners;
 - b. Pistons;
 - c. Cylinder heads; and
 - d. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);
 2. "Technology" "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:
 - a. Operating at pressure ratios of 4:1 or higher;
 - b. A mass flow in the range from 30 to 130 kg per minute; and
 - c. Variable flow area capability within the compressor or turbine sections;
 3. "Technology" "required" for the "production" of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)), having both of the following:
 - a. Injection amount in excess of 230 mm³ per injection per cylinder; and
 - b. Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;
9. E. 3. g. "Technology" "required" for the "development" or "production" of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.

Technical Note

High output diesel engines: diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.

Sensitive List

THE SENSITIVE LIST OF DUAL-USE GOODS AND TECHNOLOGIES

N.B. Where abbreviated entries are used, see the List of Dual-Use Goods and Technologies for full details. Text that differs from that in the List of Dual-Use Goods and Technologies is shaded.

Category 1

- 1.A.2. "Composite" structures or laminates...
- 1.C.1. Materials specially designed for use as absorbers of electromagnetic waves...
- 1.C.7.c. & 1.C.7.d. Ceramic-ceramic "composite" materials...
- 1.C.10.c. & 1.C.10.d. Fibrous or filamentary materials...
- 1.C.12. Materials as follows...
- 1.D. 2 "Software" for the "development" of organic "matrix", metal "matrix" or carbon "matrix" laminates or "composites" listed on this List.
- 1.E.1. "Technology" according to the General Technology Note for the "development" or "production" of equipment and materials in 1.A.2. or 1.C. of this List.
- 1.E. 2.e. & 1.E.2.f. Other "technology"...

Category 2

- 2.B.1.a. Deleted
- 2.B.1.b. Deleted
- 2.B.1.d. Deleted
- 2.B.1.f. Deleted
- 2.B.3. Deleted
- 2.D.1. "Software", other than that controlled by 2.D.2., specially designed for the "development" or "production" of the following equipment:
- a. Machine tools for turning, having all of the following characteristics:
1. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6 \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 2. Two or more axes which can be coordinated simultaneously for "contouring control".

Sensitive List

Category 2 contd.

- 2.D.1. b. Machine tools for milling, having any of the following characteristics:
- 1.a. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6 \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 - b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";
 2. Five or more axes which can be coordinated simultaneously for "contouring control" and have a positioning accuracy with "all compensations available" equal to or less (better) than $3.6 \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; or
 3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than $3 \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis;
- c. Electrical discharge machines (EDM)....
- d. Deep-hole-drilling machines....
- e. "Numerically controlled" or manual machine tools...
- 2.E.1. "Technology" according to the General Technology Note for the "development" of "software" in 2.D. of this List or for the "development" of the following equipment:
- a. Machine tools for turning, having all of the following characteristics:
 1. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6 \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 2. Two or more axes which can be coordinated simultaneously for "contouring control".

Sensitive List

Category 2 contd.

- 2.E.1. b. Machine tools for milling, having any of the following characteristics:
- 1.a. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 - b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";
 2. Five or more axes which can be coordinated simultaneously for "contouring control" and have a positioning accuracy with "all compensations available" equal to or less (better) than $3.6\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; or
 3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than $3\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis;
- c. Electrical discharge machines (EDM)....
- d. Deep-hole-drilling machines....
- e. "Numerically controlled" or manual machine tools...
- 2.E.2. "Technology" according to the General Technology Note for the "production" of the following equipment:
- a. Machine tools for turning, having all of the following characteristics:
1. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 2. Two or more axes which can be coordinated simultaneously for "contouring control".

Sensitive List

Category 2 contd.

- 2.E.2.
- b. Machine tools for milling, having any of the following characteristics:
 - 1.a. Positioning accuracy with "all compensations available" equal to or less (better) than $3.6\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; and
 - b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control"; or
 - 2. Five or more axes which can be coordinated simultaneously for "contouring control" and have a positioning accuracy with "all compensations available" equal to or less (better) than $3.6\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis; or
 - 3. A positioning accuracy for jig boring machines, with "all compensations available", equal to or less (better) than $3\ \mu\text{m}$ according to ISO 230/2 (1997) or national equivalents along any linear axis;
 - c. Electrical discharge machines (EDM)....
 - d. Deep-hole-drilling machines....
 - e. "Numerically controlled" or manual machine tools...

Category 3

- 3.A.2.g.2. Atomic frequency standards....
- 3.B.1.a.2. Metal organic chemical vapour deposition reactors....
- 3.D.1. "Software" specially designed for the "development" or "production" of equipment in 3.A.2.g. or 3.B. of this List.
- 3.E.1. "Technology" according to the General Technology Note for the "development" or "production" of equipment in 3.A. or 3.B. of this List.

Sensitive List

Category 4

- 4.A.1.a.2. Electronic computers.....radiation hardened;
 4.A.3.b. Deleted
 4.A.3.c. Deleted
- 4.D.1. "Software" specially designed for the "development" or "production" of equipment in 4.A. of this List or for the "development" or "production" of "digital computers" having a "composite theoretical performance" ("CTP") exceeding 75,000 Mtops.
- 4.E.1. "Technology" according to the General Technology Note for the "development" or "production" of the following equipment or "software":
 - Equipment in 4.A. of this List;
 - "Digital computers" having a "composite theoretical performance" ("CTP") exceeding 75,000 Mtops; or
 - "Software" in 4.D. of this List.

Category 5 - Part 1

- 5.A.1.b.3. Being radio equipment
- 5.A.1.b.5. Being digitally controlled radio receivers...
- 5.B.1.a. Equipment and specially designed components or accessories therefor, specially designed for the "development", "production" or "use" of equipment, functions or features in Category 5 - Part 1 of this List.
- 5.D.1.a. "Software" specially designed for the "development" or "production" of equipment, functions or features in Category 5 - Part 1 of this List.
- 5.D.1.b. "Software" specially designed or modified to support "technology" listed under 5.E.1. of this List.
- 5.E.1.a. "Technology" according to the General Technology Note for the "development" or "production" of equipment, functions, features or "software" in Category 5 - Part 1 of this List.

Category 5 - Part 2 - None

 Sensitive List

Category 6

- 6.A.1.a.1.b. Object detection or location systems having any of the following:
1. A transmitting frequency below 5 kHz or a sound pressure level exceeding 224 dB (reference 1 μ Pa at 1 m) for equipment with an operating frequency in the band from 5 kHz to 10 kHz inclusive;
 2. Sound pressure level exceeding 224 dB (reference 1 μ Pa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;
 3. Sound pressure level...;
 4. Forming beams of ...;
 5. Designed to operate...;
 6. Designed to withstand...;
- 6.A.1.a.2.a.1. Hydrophones...Incorporating...
- 6.A.1.a.2.a.2. Hydrophones...Having any...
- 6.A.1.a.2.a.4. Hydrophones...When designed...
- 6.A.1.a.2.a.5. Hydrophones...Designed for...
- 6.A.1.a.2.b. Towed acoustic hydrophone arrays...
- 6.A.1.a.2.c. Processing equipment, specially designed for real time application with towed acoustic hydrophone arrays, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;
- 6.A.1.a.2.d. Heading sensors....
- 6.A.1.a.2.e. Bottom or bay cable systems having any of the following:
1. Incorporating hydrophones... or
 2. Incorporating multiplexed hydrophone group signal modules...;
- 6.A.1.a.2.f. Processing equipment, specially designed for real time application with bottom or bay cable systems, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;
- 6.A.2.a.1.a., b., and c. "Space-qualified" solid-state detectors...

Sensitive List

Category 6 contd.

- 6.A.2.a.2.a. Image intensifier tubes ...
1. A peak response...
 2. A microchannel plate...
 3. Photocathodes, as follows:
 - a. S-20, S-25 or multialkali photocathodes with a luminous sensitivity exceeding 700 $\mu\text{A}/\text{lm}$;
 - b. GaAs or GaInAs photocathodes;
 - c. Other III-V compound semiconductor photocathodes.

- 6.A.2.a.3. Non-space qualified "focal plane arrays" ...;

Note 3

In 6.A.2.a.3. the following "focal plane arrays" are not included in this List:

- a. *Platinum Silicide (PtSi) "focal plane arrays" having less than 10,000 elements;*
- b. *Iridium Silicide (IrSi) "focal plane arrays".*

Note 4

In 6.A.2.a.3. the following "focal plane arrays" are not included in this List:

- a. *Indium Antimonide (InSb) or Lead Selenide (PbSe) "focal plane arrays" having less than 256 elements;*
- b. *Indium Arsenide (InAs) "focal plane arrays";*
- c. *Lead Sulphide (PbS) "focal plane arrays";*
- d. *Indium Gallium Arsenide (InGaAs) "focal plane arrays".*

Note 5

In 6.A.2.a.3. Mercury Cadmium Telluride (HgCdTe) "focal plane arrays" as follows are not included in this List:

1. *Scanning Arrays having any of the following:*
 - a. *30 elements or less; or*
 - b. *incorporating time delay-and-integration within the element and having 2 elements or less;*
2. *Staring Arrays having less than 256 elements.*

Technical Notes

'Scanning Arrays' are defined as "focal plane arrays" designed for use with a scanning optical system that images a scene in a sequential manner to produce an image;

'Staring Arrays' are defined as "focal plane arrays" designed for use with a non-scanning optical system that images a scene.

Sensitive List

Category 6 contd.

6.A.2.a.3.

Note 6

In 6.A.2.a.3. the following "focal plane arrays" are not included in this List:

- a. Gallium Arsenide (GaAs) or Gallium Aluminum Arsenide (GaAlAs) quantum well "focal plane arrays" having less than 256 elements;*
- b. Pyroelectric or Ferroelectric (including barium-strontium titanate, lead zirconate titanate or lead scandium titanate) "focal plane arrays" having less than 8,000 elements;*
- c. Vanadium Oxide-Silicon nitride microbolometer "focal plane arrays" having less than 8,000 elements.*

6.A.2.b.

"Monospectral imaging sensors" and "multispectral imaging sensors"....

6.A.2.c.

Direct view imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:

1. Image intensifier tubes having the characteristics listed in 6.A.2.a.2.a. of this List; or
2. "Focal plane arrays" having the characteristics listed in 6.A.2.a.3. of this List;

6.A.2.e.

"Space-qualified" "focal plane arrays"....

6.A.3.b. 3

Imaging cameras incorporating image intensifier tubes having the characteristics listed in 6.A.2.a.2.a. of this List;

6.A.3.b.4

Imaging cameras incorporating "focal plane arrays" having the characteristics listed in 6.A.2.a.3. of this List;

6.A.4.c.

"Space-qualified" components for optical systems....

6.A.4.d.

Optical control equipment....

6.A.6.g.

Magnetic compensation systems...

Note In 6.A.6.g. those compensators which provide only absolute values of the earth's magnetic field as output, (i.e., the frequency bandwidth of the output extends from DC to at least 0.8 Hz) are not included in this List.

6.A.6.h.

"Superconductive" electromagnetic sensors.....

6.A.8.d.

Radar systems.....Capable of...

6.A.8.h.

Radar systems...Employing processing

6.A.8.k.

Radar systems...Having "signal processing"...

6.A.8.l.3.

Radar systems...Having data processing... Processing for...

6.B.8.

Pulse radar cross-section...

Sensitive List

Category 6 contd.

- 6.D.1. "Software" specially designed for the "development" or "production" of equipment in 6.A.4., 6.A.8. or 6.B.8. of this List.
- 6.D.3.a. "Software", as follows:...
- 6.E.1. "Technology" according to...
- 6.E.2. "Technology" according to the General Technology Note for the "production" of equipment in 6.A. or 6.B. of this List.

Category 7

- 7.D.2. "Source code" for the "use"...
- 7.D.3.a. "Software" specially designed or modified to...
- 7.D.3.b. "Source code" for...
- 7.D.3.c. "Source code" for...
- 7.D.3.d.1. to 4. & 7. "Source code" for the "development" of...
- 7.E.1. & 7.E.2. "Technology" according to the General Technology Note...

Category 8

- 8.A.1.b. Manned, untethered submersible vehicles...
- 8.A.1.c. Unmanned, tethered submersible vehicles.....
- 8.A.1.d. Unmanned, untethered submersible vehicles...
- 8.A.2.b. Systems specially designed or modified for the automated control of the motion of submersible vehicles in 8.A.1. of this List using navigation data and having closed loop servo-controls:
1. Enabling...;
 2. Maintaining...; or
 3. Maintaining...;
- 8.A.2.h. "Robots" specially designed for underwater use.....
- 8.A.2.j. Air independent power systems.....
- 8.A.2.o.3. Noise reduction systems for use on vessels...
- 8.A.2.p. Pumpjet propulsion systems....
- 8.D.1. "Software" specially designed for the "development" or "production" of equipment in 8.A. of this List.
- 8.D.2. Specific "software" ...
- 8.E.1. "Technology" according to the General Technology Note for the "development" or "production" of equipment in 8.A. of this List.
- 8.E.2.a. Other "technology".....

Sensitive List

Category 9

- 9.A.11. Ramjet, scramjet or combined cycle engines...
- 9.B.1.b. Ceramic cores or shells
- 9.D.1. "Software" specially designed or modified for the "development" of equipment or "technology" in 9.A., 9.B. or 9.E.3. of this List.
- 9.D.2. "Software" specially designed or modified for the "production" of equipment in 9.A. or 9.B. of this List.
- 9.D.4.a. Other "software"...2D or 3D...
- 9.D.4.c. Other "software"... "Software" specially...
- 9.E.1. "Technology" according to the General Technology Note.....
- 9.E.2. "Technology" according to the General Technology Note...
- 9.E.3.a.1. Other "technology"...Gas turbine blades...
- 9.E.3.a.2. to 5. & Other "technology"...
- 9.E.3.a.8., 9.E.3.a.9.

Very Sensitive List

VERY SENSITIVE LIST OF THE LIST OF DUAL-USE GOODS AND TECHNOLOGIES

N.B. Where abbreviated entries are used, see List of Dual-Use Goods and Technologies for full details. Text that differs from that in the List of Dual-Use Goods and Technologies is shaded.

Category 1

- | | |
|----------|---|
| 1.A.2.a. | "Composite" structures or laminates having an organic "matrix" and made from materials listed under 1.C.10.c. or 1.C.10.d. |
| 1.C.1. | Materials specially designed for use as absorbers of electromagnetic waves... |
| 1.C.12. | Materials as follows... |
| 1.E.1. | "Technology" according to the General Technology Note for the "development" or "production" of equipment and materials in 1.A.2 or 1.C. of this List. |

Category 2

None

Category 3

None

Category 4

- | | |
|----------|--|
| 4.A.3.b. | Deleted |
| 4.A.3.c. | Deleted |
| 4.D.1. | "Software" specially designed for the "development" or "production" of "digital computers" having a "composite theoretical performance" ("CTP") exceeding 150,000 Mtops. |
| 4.E.1. | "Technology" according to the General Technology Note for the "development" or "production" of "software" in 4.D. of this List or for the "development" or "production" of "digital computers" having a "composite theoretical performance" ("CTP") exceeding 150,000 Mtops. |

Category 5 - Part 1

- | | |
|------------|---|
| 5.A.1.b.5. | Digitally controlled radio receivers... |
| 5.D.1.a. | "Software" specially designed for the "development" or "production" of equipment, functions or features in Category 5, Part 1 of this List. |

Very Sensitive List

5.E.1.a.

"Technology" according to the General Technology Note for the "development" or "production" of equipment, functions, features or "software" in Category 5, Part 1 of this List.

Very Sensitive List

Category 5 - Part 2

None

Category 6

6.A.1.a.1.b.1.

Object detection or location systems having a sound pressure level exceeding 210 dB (reference 1 μ Pa at 1 m) and an operating frequency in the band from 30 Hz to 2 kHz.

6.A.1.a.2.a.1.

Hydrophones...Incorporating...

6.A.1.a.2.a.2.

Hydrophones...Having any...

6.A.1.a.2.a.4.

Hydrophones...When designed...

6.A.1.a.2.a.5.

Hydrophones...Designed for...

6.A.1.a.2.b.

Towed acoustic hydrophone arrays...

6.A.1.a.2.c.

Processing equipment, specially designed for real time application with towed acoustic hydrophone arrays, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

6.A.1.a.2.e.

Bottom or bay cable systems having any of the following:

1. Incorporating hydrophones... or
2. Incorporating multiplexed hydrophone group signal modules ...;

6.A.1.a.2.f.

Processing equipment, specially designed for real time application with bottom or bay cable systems, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

6.A.2.a.1.c.

"Space-qualified" solid-state detectors...

6.A.8.l.3.

Radar systems...Having data processing... Processing for...

6.B.8.

Pulse radar cross-section...

6.D.1.

"Software" specially designed for the "development" or "production" of equipment in 6.A.8., or 6.B.8. of this List.

6.D.3.a.

"Software", as follows:...

6.E.1.

"Technology" according to the General Technology Note for the "development" of equipment or "software" in 6.A., 6.B., or 6.D. of this List.

6.E.2.

"Technology" according to the General Technology Note for the "production" of equipment in 6.A. or 6.B. of this List.

Very Sensitive List

Category 7

- 7.D.3.a. "Software" specially designed or modified to...
 7.D.3.b. "Source code" for...

Category 8

- 8.A.1.b. Manned, untethered submersible vehicles...
 8.A.1.d. Unmanned, untethered submersible vehicles...
 8.A.2.o.3.b. Active noise reduction or cancellation systems...
 8.D.1. "Software" specially designed for the "development" or "production" of equipment in 8.A. of this List.
 8.E.1. "Technology" according to the General Technology Note for the "development" or "production" of equipment in 8.A. of this List.

Category 9

- 9.A.11. Ramjet, scramjet or combined cycle engines...
 9.D.1. "Software" specially designed or modified for the "development" of equipment or "technology" in 9.A. or 9.E.3. of this List.
 9.D.2. "Software" specially designed or modified for the "production" of equipment in 9.A. of this List.
 9.E.1. "Technology" according to the General Technology Note for the "development" of equipment or "software" in 9.A.11. or 9.D. of this List.
 9.E.2. "Technology" according to the General Technology Note for the "production" of equipment in 9.A.11. of this List.
 9.E.3.a.1. Other "technology"...Gas turbine blades...
 9.E.3.a.3.a. "Technology" "required" for ...
 Components manufactured from...
 Organic "composite" materials designed to operate above 588 K (315°C).

MUNITIONS LIST*

Note 1 Terms in "quotations" are defined terms. Refer to 'Definitions of Terms used in these Lists' annexed to this List.

Note 2 Chemicals are listed by name and CAS number. Chemicals of the same structural formula (including hydrates) are controlled regardless of name or CAS number. CAS numbers are shown to assist in identifying whether a particular chemical or mixture is controlled, irrespective of nomenclature. CAS numbers cannot be used as unique identifiers because some forms of the listed chemical have different CAS numbers, and mixtures containing a listed chemical may also have different CAS numbers.

GENERAL TECHNOLOGY NOTE

The export of "technology" which is "required" for the "development", "production" or "use" of items controlled in the Munitions List is controlled according to the provisions in the Munitions List entries. This "technology" remains under control even when applicable to any uncontrolled item.

Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those items which are not controlled or whose export has been authorised.

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

* France, the Russian Federation and Ukraine view this list as a reference list drawn up to help in the selection of dual-use goods which could contribute to the indigenous development, production or enhancement of conventional munitions capabilities.

MUNITIONS LIST

ML1. Smooth-bore weapons with a calibre of less than 20 mm, other arms and automatic weapons with a calibre of 12.7 mm (calibre 0.50 inches) or less and accessories, as follows, and specially designed components therefor:

a. Rifles, carbines, revolvers, pistols, machine pistols and machine guns:

Note ML1.a. does not control the following:

1. *Muskets, rifles and carbines manufactured earlier than 1938;*
2. *Reproductions of muskets, rifles and carbines the originals of which were manufactured earlier than 1890;*
3. *Revolvers, pistols and machine guns manufactured earlier than 1890, and their reproductions;*

b. Smooth-bore weapons, as follows:

1. Smooth-bore weapons specially designed for military use;
2. Other smooth-bore weapons, as follows:
 - a. Of the fully automatic type;
 - b. Of the semi-automatic or pump-action type;

c. Weapons using caseless ammunition;

d. Silencers, special gun-mountings, clips, weapons sights and flash suppressers for arms controlled by sub-items ML1.a., ML1.b. or ML1.c.

Note 1 ML1. does not control smooth-bore weapons used for hunting or sporting purposes. These weapons must not be specially designed for military use or of the fully automatic firing type.

Note 2 ML1. does not control firearms specially designed for dummy ammunition and which are incapable of firing any controlled ammunition.

Note 3 ML1. does not control weapons using non-centre fire cased ammunition and which are not of the fully automatic firing type.

MUNITIONS LIST

ML2. Smooth-bore weapons with a calibre of 20 mm or more, other weapons or armament with a calibre greater than 12.7 mm (calibre 0.50 inches), projectors and accessories, as follows, and specially designed components therefor:

- a. Guns, howitzers, cannon, mortars, anti-tank weapons, projectile launchers, military flame throwers, recoilless rifles and signature reduction devices therefor;

Note ML2.a. includes injectors, metering devices, storage tanks and other specially designed components for use with liquid propelling charges for any of the equipment controlled by ML2.a.

- b. Military smoke, gas and pyrotechnic projectors or generators.

Note ML2.b. does not control signal pistols.

- c. Weapons sights.

ML3. Ammunition and fuze setting devices, as follows, and specially designed components therefor:

- a. Ammunition for the weapons controlled by ML1., ML2. or ML12.;

- b. Fuze setting devices specially designed for ammunition controlled by ML3 a.

Note 1 Specially designed components include:

- a. Metal or plastic fabrications such as primer anvils, bullet cups, cartridge links, rotating bands and munitions metal parts;
- b. Safing and arming devices, fuses, sensors and initiation devices ;
- c. Power supplies with high one-time operational output;
- d. Combustible cases for charges;
- e. Submunitions including bomblets, minelets and terminally guided projectiles.

Note 2 ML3.a. does not control ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.

Note 3 ML3.a. does not control cartridges specially designed for any of the following purposes:

- a. Signalling;
- b. Bird scaring; or
- c. Lighting of gas flares at oil wells.

MUNITIONS LIST

ML4. Bombs, torpedoes, rockets, missiles, other explosive devices and charges and related equipment and accessories, as follows, specially designed for military use, and specially designed components therefor:

N.B. For guidance and navigation equipment, see ML11, Note g.

- a. Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition-charges, demolition-devices and demolition-kits, "pyrotechnic" devices, cartridges and simulators (i.e. equipment simulating the characteristics of any of these items);

Note ML4.a. includes:

1. Smoke grenades, fire bombs, incendiary bombs and explosive devices;
2. Missile rocket nozzles and re-entry vehicle nosetips.

- b. Equipment specially designed for the handling, control, activation, powering with one-time operational output, launching, laying, sweeping, discharging, decoying, jamming, detonation or detection of items controlled by ML4.a.

Note ML4.b. includes:

1. Mobile gas liquefying equipment capable of producing 1,000 kg or more per day of gas in liquid form;
2. Buoyant electric conducting cable suitable for sweeping magnetic mines.

Technical Note

Hand-held devices, limited by design solely to the detection of metal objects and incapable of distinguishing between mines and other metal objects, are not considered to be specially designed for the detection of items controlled by ML4.a.

ML5. Fire control, and related alerting and warning equipment, and related systems, test and alignment and countermeasure equipment, as follows, specially designed for military use, and specially designed components and accessories therefor:

- a. Weapon sights, bombing computers, gun laying equipment and weapon control systems;
- b. Target acquisition, designation, range-finding, surveillance or tracking systems; detection, data fusion, recognition or identification equipment; and sensor integration equipment;
- c. Countermeasure equipment for items controlled by ML5.a. or ML5.b.
- d. Field test or alignment equipment, specially designed for items controlled by ML5.a. or ML5.b.

MUNITIONS LIST

ML6. Ground vehicles and components, as follows:

N.B. For guidance and navigation equipment, see ML11, Note g.

- a. Ground vehicles and components therefor, specially designed or modified for military use;

Technical Note

For the purposes of ML6.a. the term ground vehicles includes trailers.

- b. All wheel-drive vehicles capable of off-road use which have been manufactured or fitted with materials to provide ballistic protection to level III (NIJ 0108.01, September 1985, or comparable national standard) or better.

N.B. See also ML13.a.

Note 1 ML6.a. includes:

- a. Tanks and other military armed vehicles and military vehicles fitted with mountings for arms or equipment for mine laying or the launching of munitions controlled under ML4;
- b. Armoured vehicles;
- c. Amphibious and deep water fording vehicles;
- d. Recovery vehicles and vehicles for towing or transporting ammunition or weapon systems and associated load handling equipment.

Note 2 Modification of a ground vehicle for military use controlled by ML6.a. entails a structural, electrical or mechanical change involving one or more specially designed military components. Such components include:

- a. Pneumatic tyre casings of a kind specially designed to be bullet-proof or to run when deflated;
- b. Tyre inflation pressure control systems, operated from inside a moving vehicle;
- c. Armoured protection of vital parts, (e.g., fuel tanks or vehicle cabs);
- d. Special reinforcements or mountings for weapons;
- e. Black-out lighting.

Note 3 ML6. does not control civil automobiles, or trucks designed or modified for transporting money or valuables, having armoured or ballistic protection.

MUNITIONS LIST

ML7. Chemical or biological toxic agents, "tear gases", radioactive materials, related equipment, components, materials and "technology", as follows:

- a. Biological agents and radioactive materials "adapted for use in war" to produce casualties in humans or animals, degrade equipment or damage crops or the environment, and chemical warfare (CW) agents;

Note ML7.a. includes the following:

1. CW nerve agents:
 - a. O-Alkyl (equal to or less than C₁₀, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) - phosphonofluoridates, such as:
Sarin (GB): O-Isopropyl methylphosphonofluoridate (CAS 107-44-8); *and*
Soman (GD): O-Pinacolyl methylphosphonofluoridate (CAS 96-64-0);
 - b. O-Alkyl (equal to or less than C₁₀, including cycloalkyl) N,N-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphoramidocyanidates, such as:
Tabun (GA): O-Ethyl N,N-dimethylphosphoramidocyanidate (CAS 77-81-6);
 - c. O-Alkyl (H or equal to or less than C₁₀, including cycloalkyl) S-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl)-aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonothiolates and corresponding alkylated and protonated salts, such as:
VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (CAS 50782-69-9);
2. CW vesicant agents:
 - a. Sulphur mustards, such as:
2-Chloroethylchloromethylsulphide (CAS 2625-76-5);
Bis(2-chloroethyl) sulphide (CAS 505-60-2);
Bis(2-chloroethylthio) methane (CAS 63869-13-6);
1,2-bis (2-chloroethylthio) ethane (CAS 3563-36-8);
1,3-bis (2-chloroethylthio) -n-propane (CAS 63905-10-2);
1,4-bis (2-chloroethylthio) -n-butane (CAS 142868-93-7);
1,5-bis (2-chloroethylthio) -n-pentane (CAS 142868-94-8);
Bis (2-chloroethylthiomethyl) ether (CAS 63918-90-1);
Bis (2-chloroethylthioethyl) ether (CAS 63918-89-8);
 - b. Lewisites, such as:
2-chlorovinylchloroarsine (CAS 541-25-3);
Tris (2-chlorovinyl) arsine (CAS 40334-70-1);
Bis (2-chlorovinyl) chloroarsine (CAS 40334-69-8);
 - c. Nitrogen mustards, such as:
HN1: bis (2-chloroethyl) ethylamine (CAS 538-07-8);
HN2: bis (2-chloroethyl) methylamine (CAS 51-75-2);
HN3: tris (2-chloroethyl) amine (CAS 555-77-1);

MUNITIONS LIST

ML 7.a. Note Contd.

3. *CW incapacitating agents, such as:*
3-Quinuclidinyl benzilate (BZ) (CAS 6581-06-2);
4. *CW defoliants, such as:*
Butyl 2-chloro-4-fluorophenoxyacetate (LNF);
2,4,5-trichlorophenoxyacetic acid mixed with
2,4-dichlorophenoxyacetic acid (Agent Orange).

- b. CW binary precursors and key precursors, as follows:
 1. Alkyl (Methyl, Ethyl, n-Propyl or Isopropyl Phosphonyl Difluorides, such as:
DF: Methyl Phosphonyldifluoride (CAS 676-99-3);
 2. O-Alkyl (H or equal to or less than C₁₀, including cycloalkyl) O-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonites and corresponding alkylated and protonated salts, such as:
QL: O-Ethyl-2-di-isopropylaminoethyl methylphosphonite (CAS 57856-11-8);
 3. Chlorosarin: O-Isopropyl methylphosphonochloridate (CAS 1445-76-7);
 4. Chlorosoman: O-Pinacolyl methylphosphonochloridate (CAS 7040-57-5);
- c. "Tear gases" and "riot control agents" including:
 1. Bromobenzyl cyanide (CA) (CAS 5798-79-8);
 2. o-Chlorobenzylidenemalononitrile (o-Chlorobenzalmononitrile) (CS) (CAS 2698-41-1);
 3. Phenylacetyl chloride (ω-chloroacetophenone) (CN) (CAS 532-27-4);
 4. Dibenz-(b,f)-1,4-oxazepine (CR) (CAS 257-07-8);

Note ML7.c. does not control tear gases or riot control agents individually packaged for personal self defence purposes.

- d. Equipment specially designed or modified for military use, for the dissemination of any of the following and specially designed components therefor:
 1. Materials or agents controlled by ML7.a. or c.; or
 2. CW made up of precursors controlled by ML7.b.

MUNITIONS LIST

ML 7. Contd.

ML7. e. Protective and decontamination equipment, specially designed components therefor, and specially formulated chemical mixtures, as follows:

1. Equipment, specially designed or modified for military use, for defence against materials controlled by ML7.a. or c. and specially designed components therefor;
2. Equipment, specially designed or modified for military use, for the decontamination of objects contaminated with materials controlled by ML7.a. and specially designed components therefor;
3. Chemical mixtures specially developed/formulated for the decontamination of objects contaminated with materials controlled by ML7.a.;

Note *ML7.e.1. includes:*

- a. *Air conditioning units specially designed or modified for nuclear, biological or chemical filtration;*
- b. *Protective clothing.*

N.B. *For civil gas masks, protective and decontamination equipment see, also entry 1.A.4. on the Dual-Use List.*

f. Equipment, specially designed or modified for military use, for the detection or identification of materials controlled by ML7.a. or c. and specially designed components therefor;

Note *ML7.f. does not control personal radiation monitoring dosimeters.*

N.B. *See also entry 1.A.4. on the Dual-Use List.*

g. "Biopolymers" specially designed or processed for the detection or identification of CW agents controlled by ML7.a., and the cultures of specific cells used to produce them;

h. "Biocatalysts" for the decontamination or degradation of CW agents, and biological systems therefor, as follows:

1. "Biocatalysts" specially designed for the decontamination or degradation of CW agents controlled by ML7.a. resulting from directed laboratory selection or genetic manipulation of biological systems;
2. Biological systems, as follows: "expression vectors", viruses or cultures of cells containing the genetic information specific to the production of "biocatalysts" controlled by ML7.h.1.;

MUNITIONS LIST

ML 7. Contd.

ML 7. i. "Technology" as follows:

1. "Technology" for the "development", "production" or "use" of toxicological agents, related equipment or components controlled by ML7.a. to ML7.f.;
2. "Technology" for the "development", "production" or "use" of "biopolymers" or cultures of specific cells controlled by ML7.g.;
3. "Technology" exclusively for the incorporation of "biocatalysts", controlled by ML7.h.1., into military carrier substances or military material.

Note 1 ML7.a. and ML7.c. do not control:

- a. Cyanogen chloride (CAS 506-77-4);
- b. Hydrocyanic acid (CAS 74-90-8);
- c. Chlorine (CAS 7782-50-5);
- d. Carbonyl chloride (phosgene) (CAS 75-44-5);
- e. Diphosgene (trichloromethyl-chloroformate) (CAS 503-38-8);
- f. Ethyl bromoacetate (CAS 105-36-2);
- g. Xylyl bromide, ortho: (CAS 89-92-9), meta: (CAS 620-13-3), para: (CAS 104-81-4);
- h. Benzyl bromide (CAS 100-39-0);
- i. Benzyl iodide (CAS 620-05-3);
- j. Bromo acetone (CAS 598-31-2);
- k. Cyanogen bromide (CAS 506-68-3);
- l. Bromo methylethylketone (CAS 816-40-0);
- m. Chloro acetone (CAS 78-95-5);
- n. Ethyl iodoacetate (CAS 623-48-3);
- o. Iodo acetone (CAS 3019-04-3);
- p. Chloropicrin (CAS 76-06-2).

Note 2 The "technology", cultures of cells and biological systems listed in ML7.g., ML7.h.2. and ML7.i.3. are exclusive and these sub-items do not control "technology", cells or biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry.