

LIST OF CONTROLLED ITEMS

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I NUCLEAR MATERIALS, FACILITIES AND EQUIPMENT

1. High-density radiation shielding windows
2. Depleted uranium
3. Any article, material, equipment or device that is specifically designed or modified for use in the design, development or fabrication of nuclear weapons or nuclear explosive devices or to devise, carry out or evaluate nuclear weapons tests or explosions
4. Nuclear radiation detection and measurement devices specifically designed or modified for military applications
5. Naval nuclear propulsion plants, their land prototypes, and special facilities for their construction, support, and maintenance, including any machinery, device, component, or equipment specifically developed, designed or modified for use in such plants or facilities
6. Nuclear reactors, i.e., reactors capable of operation so as to maintain a controlled, self-sustaining fission chain reaction, and equipment and components specially designed or prepared for use in connection with a nuclear reactor
7. Power generating or propulsion equipment specially designed for use with space, marine or mobile nuclear reactors
8. Generators and other equipment specially designed, prepared, or intended for use with nuclear plants
9. Equipment related to nuclear material handling and processing and to nuclear reactors
10. Ring Magnets
11. Plant for the separation of isotopes of natural uranium and depleted uranium, special fissile materials and other fissile materials, and specially designed or prepared equipment and components therefore
12. Specially designed or prepared auxiliary systems, equipment and components for isotope separation plant made of or protected by UF₆ resistant materials
13. Plant for the conversion of uranium and equipment specially designed or prepared for the conversion of uranium ore, UO₂, UO₃, UF₄ and UF₆
14. Plant for the production of heavy water, deuterium or deuterium compounds, and specially designed or prepared equipment and components therefore

15. Plant specially designed for the fabrication of nuclear reactor fuel elements and specially designed equipment therefore
16. Plant for the reprocessing of irradiated nuclear reactor fuel elements, and specially designed or prepared equipment and components therefore
17. Hot cells
18. Glove boxes suitable for use with radioactive materials
19. Natural uranium or depleted uranium or thorium in the form of metal, alloy, chemical compound or concentrate and any other material containing uranium or thorium
20. Fissile materials
21. Deuterium, heavy water, deuterated paraffins and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5000
22. Graphite, nuclear-grade, having a purity level of less than 5 parts per million boron equivalent and with a density greater than 1.5 g/cm³
23. Nickel powder or porous nickel metal, specially prepared for the manufacture of gaseous diffusion barriers
24. Specially prepared compounds or powders, other than nickel, resistant to corrosion by UF₆ (e.g., aluminum oxide and fully fluorinated hydrocarbon polymers)
25. Software specially designed or modified for the development, production, or use of any of the items listed above
26. Software for neutronic calculations/modeling
27. Software for radiation transport calculations/modeling
28. Software for hydrodynamic calculations/modeling
29. Technology, for the development, production, or use of items described above
30. Technical data or defense services related to any of the above items
31. Reinforced silicon-carbide ceramics composites

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II CHEMICAL AND BIOLOGICAL AGENTS AND RELATED ITEMS

- 1. Human Pathogens, Zoonoses, and Toxins**
- 2. Animal Pathogens**
- 3. Plant Pathogens**
- 4. Genetic Elements and Genetically Modified Microorganisms**
- 5. Chemicals That May Be Used as Precursors for Toxic Chemical Agents**
- 6. Chemical Agents That Can Be Used As Weapons**
- 7. Chemical Agent Binary Precursors and Key Precursors**
- 8. Tear Gases and Riot Control Agents**
- 9. Defoliants**
- 10. Biological Agents Adapted or Modified for Ability to Produce Casualties**
- 11. Vaccines, immunotoxins, medical products, analytical kits, diagnostic kits, or food testing kits that contain any of the chemicals or biological organisms listed below**
- 12. Software or technology specifically configured for the development, production, or disposal of any of the chemicals or biological organisms listed below**
- 13. Items and devices that can be used in the dissemination, dispersion, testing, detection, identification, warning, monitoring, collection, processing, protection against, decontamination or remediation of any of the listed chemicals or biological organisms**

- 1. Human Pathogens, Zoonoses, and Toxins**
 - 1) Chikungunya virus
 - 2) Congo-Crimean haemorrhagic fever virus
 - 3) Dengue fever virus
 - 4) Eastern equine encephalitis virus
 - 5) Ebola virus

- 6) Hantaan virus
- 7) Japanese encephalitis virus
- 8) Junin virus
- 9) Lassa fever virus
- 10) Lymphocytic choriomeningitis virus
- 11) Machupo virus
- 12) Marburg virus
- 13) Monkey pox virus
- 14) Rift Valley fever virus
- 15) Tick-borne encephalitis virus (Russian Spring-Summer encephalitis virus)
- 16) Tick-borne encephalitis viruses (Central European):
 - a) Absettarov
 - b) Hanzalova
 - c) Hypr
 - d) Kumlinge
- 17) Variola virus
- 18) Venezuelan equine encephalitis virus
- 19) Western equine encephalitis virus
- 20) White pox
- 21) Yellow fever virus
- 22) Kyasanur Forest virus
- 23) Louping ill virus
- 24) Murray Valley encephalitis virus
- 25) Omsk haemorrhagic fever virus
- 26) Oropouche virus

- 27) Powassan virus
- 28) St. Louis encephalitis virus
- 29) Hendra virus (Equine morbillivirus)
- 30) South American haemorrhagic fever (Sabia, Flexas, Guanarito)
- 31) Pulmonary and renal syndrome haemorrhagic fever viruses (Seoul, Dobrava, Puumala, Sin Nombre)
- 32) Nipah virus
- 33) Cercopithecine herpesvirus 1 (Herpes B virus)
- 34) Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments
- 35) *Coccidioides immitis*
- 36) *Coccidioides posadasii*
- 37) *Bartonella quintana* (*Rochalimea quintana*, *Rickettsia quintana*)
- 38) *Coxiella burnetii*
- 39) *Rickettsia prowasecki*
- 40) *Rickettsia rickettsii*
- 41) *Bacillus anthracis* (anthrax)
- 42) *Brucella abortus*
- 43) *Brucella melitensis*
- 44) *Brucella suis*
- 45) *Burkholderia mallei* (*Pseudomonas mallei*)
- 46) *Burkholderia pseudomallei* (*Pseudomonas pseudomallei*)
- 47) *Chlamydia psittaci*
- 48) *Clostridium botulinum*
- 49) *Francisella tularensis*

- 50) *Salmonella typhi*
- 51) *Shigella dysenteriae*
- 52) *Vibrio cholerae*
- 53) *Yersinia pestis*
- 54) *Clostridium perfringens*, epsilon toxin producing types
- 55) Enterohaemorrhagic *Escherichia coli*, serotype O157 and other verotoxin productin serotypes
- 56) Botulinum toxins
- 57) *Clostridium perfringens* toxins
- 58) Conotoxin
- 59) Microcystin (cyanginosin)
- 60) Ricin
- 61) Saxitoxin
- 62) Shiga toxin
- 63) Shiga-like ribosome inactivating proteins
- 64) *Staphylococcus aureus* toxins
- 65) Tetrodotoxin
- 66) Verotoxin
- 67) Aflatoxin
- 68) Abrin
- 69) Cholera Toxin
- 70) Diacetoxyscirpenol toxin
- 71) T-2 toxin
- 72) HT-2 toxin
- 73) Modeccin toxin
- 74) Volkensin toxin

75) Viscum album lectin 1

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2. Animal Pathogens

- 1) African swine fever virus
- 2) Bluetongue virus
- 3) Foot and mouth disease virus
- 4) Goat pox virus
- 5) Porcine herpes virus (Aujeszky's disease)
- 6) Swine fever virus (Hog cholera virus)
- 7) Lyssa virus
- 8) Newcastle disease virus
- 9) Peste des petits ruminants virus
- 10) Porcine enterovirus type 9 (swine vesicular disease virus)
- 11) Rinderpest virus
- 12) Sheep pox virus
- 13) Teschen disease virus
- 14) Vesicular stomatitis virus
- 15) Avian influenza viruses
- 16) Lumpy skin disease virus
- 17) African horse sickness virus
- 18) Akabane virus
- 19) Bovine spongiform encephalopathy agent
- 20) Camel pox virus

- 21) Malignant catarrhal fever virus
- 22) Menangle virus
- 23) Mycoplasma mycoides
- 24) Mycoplasma capricolum
- 25) Mycoplasma F38
- 26) Rickettsia: Erhlichia ruminantium (a.k.a. Cowdria ruminantium)

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3. Plant Pathogens

- 1) Xanthomonas albilineans
- 2) Xanthomonas campestris pv. citri including strains referred to as Xanthomonas campestris pv. citri types A,B,C,D,E or otherwise classified as Xanthomonas citri, Xanthomonas campestris pv. aurantifolia or Xanthomonas campestris pv. Citrumelo
- 3) Xanthomonas oryzae pv. oryzae (syn. Pseudomonas campestris pv. oryzae)
- 4) Clavibacter michiganensis subspecies sepedonicus (syn. Corynebacterium michiganensis subspecies sepedonicum or Corynebacterium sepedonicum)
- 5) Ralstonia solanacearum Races 2 and 3 (syn. Pseudomonas solanacearum Races 2 and 3 or Burkholderia solanacearum Races 2 and 3)
- 6) Colletotrichum coffeanum var. virulans (Colletotrichum kahawae)
- 7) Cochliobolus miyabeanus (Helminthosporium oryzae)
- 8) Microcyclus ulei (syn. Dothidella ulei)
- 9) Puccinia graminis (syn. Puccinia graminis f. sp. tritici)
- 10) Puccinia striiformis (syn. Puccinia glumarum)
- 11) Magnaporthe grisea (pyricularia grisea/pyricularia oryzae)
- 12) Potato Andean latent tymovirus

- 13) Potato spindle tuber viroid
- 14) Candidatus Liberobacter africanus (a.k.a. Liberobacter africanus)
- 15) Candidatus Liberobacter asiaticus (a.k.a. Liberobacter asiaticus)
- 16) Xylella fastidiosa pv. citrus variegated chlorosis (CVC)
- 17) Peronosclerospora philippinensis
- 18) Sclerophthora rayssiae var. zeae
- 19) Synchytrium endobioticum

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4. Genetic Elements and Genetically-modified Microorganisms

- 1) Genetic elements (e.g., chromosomes, genomes, plasmids, transposons, and vectors, whether genetically modified or unmodified) that contain nucleic acid sequences associated with pathogenicity of human pathogens or zoonoses, animal pathogens or plant pathogens
- 2) Genetic elements that contain nucleic acid sequences coding for any human toxins
- 3) Genetically modified organisms that contain nucleic acid sequences associated with pathogenicity of human pathogens or zoonoses, animal pathogens or plant pathogens
- 4) Genetically modified organisms that contain nucleic acid sequences coding for any human toxins

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5. Chemicals That May Be Used as Precursors for Toxic Chemical Agents

- 1) 0-Ethyl-2-diisopropylaminoethyl methylphosphonite (QL) (C.A.S. #57856-11-8)
- 2) Ethyl phosphonyl difluoride (C.A.S. #753-98-0)
- 3) Methyl phosphonyl difluoride (C.A.S. #676-99-3)

- 4) Arsenic trichloride (C.A.S. #7784-34-1)
- 5) Benzilic acid (C.A.S. #76-93-7)
- 6) Diethyl ethylphosphonate (C.A.S. #78-38-6)
- 7) Diethyl methylphosphonite (C.A.S. #15715-41-0)
- 8) Diethyl-N,N-dimethylphosphoroamidate (C.A.S.#2404-03-7)
- 9) N,N-Diisopropyl-beta-aminoethane thiol (C.A.S. #5842-07-9)
- 10) N,N-Diisopropyl-beta-aminoethyl chloride hydrochloride (C.A.S. #4261-68-1)
- 11) N,N-Diisopropyl-beta-aminoethanol (C.A.S. #96-80-0)
- 12) N,N-Diisopropyl-beta-aminoethyl chloride (C.A.S. #96-79-7)
- 13) Dimethyl ethylphosphonate (C.A.S. #6163-75-3)
- 14) Dimethyl methylphosphonate (C.A.S. #756-79-6)
- 15) Ethyl phosphonous dichloride [Ethyl phosphinyl dichloride] (C.A.S. #1498-40-4)
- 16) Ethyl phosphonus difluoride [Ethyl phosphinyl difluoride] (C.A.S. #430-78-4)
- 17) Ethyl phosphoryl dichloride (C.A.S. #1066-50-8)
- 18) Pinacolyl alcohol (C.A.S. #464-07-3)
- 19) 3-Quinuclidinol (C.A.S. #1619-34-7)
- 20) Thiodiglycol (C.A.S. #111-48-8)
- 21) Diethyl phosphate (C.A.S. #762-04-9)
- 22) Dimethyl phosphate (dimethyl hydrogen phosphite) (C.A.S. #868-85-9)
- 23) Phosphorus oxychloride (C.A.S. #10025-87-3)
- 24) Phosphorus pentachloride (C.A.S. #10026-13-8)
- 25) Phosphorus trichloride (C.A.S. #7719-12-2)
- 26) Sulfur monochloride (C.A.S. #10025-67-9)

- 27) Sulfur dichloride (C.A.S. #10545-99-0)
- 28) Thionyl chloride (C.A.S. #7719-09-7)
- 29) Triethanolamine (C.A.S. #102-71-6)
- 30) Triethyl phosphate (C.A.S. #122-52-1)
- 31) Trimethyl phosphate (C.A.S. #121-45-9)
- 32) Ammonium hydrogen fluoride (C.A.S. #1341-49-7)
- 33) 2-Chloroethanol (C.A.S. #107-07-3)
- 34) N,N- Diethylaminoethanol (C.A.S. #100-37-8)
- 35) Di-isopropylamine (C.A.S. #108-18-9)
- 36) Dimethylamine (C.A.S. #124-40-3)
- 37) Dimethylamine hydrochloride (C.A.S. #506-59-2)
- 38) Hydrogen fluoride (C.A.S. #7664-39-3)
- 39) 3-Hydroxyl-1-methylpiperidine (C.A.S. #3554-74-3)
- 40) Methyl benzilate (C.A.S. #76-89-1)
- 41) Phosphorus pentasulfide (C.A.S. #1314-80-3)
- 42) Pinacolone (C.A.S. #75-97-8)
- 43) Potassium cyanide (C.A.S. #151-50-8)
- 44) Potassium fluoride (C.A.S. #7789-23-3)
- 45) Potassium bifluoride (C.A.S. #7789-29-9)
- 46) 3-Quinuclidone (C.A.S. #3731-38-2)
- 47) Sodium bifluoride (C.A.S. #1333-83-1)
- 48) Sodium cyanide (C.A.S. #143-33-9)
- 49) Sodium fluoride (C.A.S. #7681-49-4)
- 50) Sodium sulfide (C.A.S. #1313-82-2)
- 51) Triethanolamine hydrochloride (C.A.S. #637-39-8)

- 52) Tri-isopropyl phosphate(C.A.S. #116-17-6)
- 53) O,O-diethyl phosphorothioate (C.A.S. #2465-65-8)
- 54) O,O-diethyl phosphorodithioate (C.A.S. #298-06-6)
- 55) Sodium hexafluorosilicate (C.A.S. #16893-85-9)

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6. Chemical Agents That Can Be Used As Weapons

- 1) Any nerve agents
- 2) Amiton (i.e., O,O-Diethyl S-[2(diethylamino)ethyl] phosphorothiolate and corresponding alkylated or protonated salts (C.A.S. #78-53-5))
- 3) Vesicant agents (i.e., Sulfur mustards, Lewisites, Nitrogen mustards Ethyldichloroarsine (ED) Methyldichloroarsine (MD))
- 4) Incapacitating agents (e.g., 3-Quinuclidinyl benzilate (BZ) (C.A.S. #6581-06-2) Diphenylchloroarsine (DA) (C.A.S. #712-48-1) Diphenylcyanoarsine (DC))
- 5) PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene (C.A.S. #382-21-8)
- 6) FAMILY: Chemicals containing a phosphorus atom to which is bonded one methyl, ethyl, or propyl (normal or iso) group with no additional carbon atoms in the structure (except Fonofos: O-Ethyl S-phenyl ethylphosphonothiolothionate (C.A.S. #944-22-9))
- 7) FAMILY: N,N-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic dihalides
- 8) FAMILY: Dialkyl (Me, Et, n-Pr or i-Pr) N,N-dialkyl (Me, Et, n-Pr, or i-Pr)-phosphoramidates
- 9) FAMILY: N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethyl-2-chlorides and corresponding protonated salts
- 10) FAMILY: N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-ols and corresponding protonated salts (except N,N-Dimethylaminoethanol and corresponding protonated salts (C.A.S. #108-01-0) and N,N-Diethylaminoethanol and corresponding protonated salts (C.A.S. #100-37-8))

- 11) FAMILY: N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-thiols and corresponding protonated salts
- 12) Phosgene: Carbonyl dichloride (C.A.S. #75-44-5)
- 13) Cyanogen chloride (C.A.S. #506-77-4)
- 14) Hydrogen cyanide (C.A.S. #74-90-8)
- 15) Ethyldiethanolamine (C.A.S. #139-87-7)
- 16) Methyldiethanolamine (C.A.S. #105-59-9)
- 17) Chloropicrin (trichloronitromethane) (C.A.S. #76-06-2)
- 18) Chlorine trifluoride (ClF₃)

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7. Chemical Agent Binary Precursors and Key Precursors

- 1) Alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonyl difluorides, such as: DF: Methyl Phosphonyldifluoride (C.A.S. #676-99-3)
- 2) Methylphosphinyldifluoride
- 3) 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)phosphonite and corresponding alkylated and protonated salts, such as: QL: O-Ethyl-2-di-isopropylaminoethyl methylphosphonite (C.A.S. #57856-11-8)
- 4) Chlorosarin: O-Isopropyl methylphosphonochloridate (C.A.S. #1445-76-7)
- 5) Chlorosoman: O-Pinacolyl methylphosphonochloridate (C.A.S. #7040-57-5)
- 6) DC: Methylphosphonyl dichloride (C.A.S. #676-97-1)
- 7) Methylphosphinyldichloride

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8. Tear Gases and Riot Control Agents, such as:

- 1) Adamsite (Diphenylamine chloroarsine or DM) (C.A.S. #578-94-9)
- 2) CA (Bromobenzyl cyanide) (C.A.S. #5798-79-8)
- 3) CN (Phenylacetyl chloride or w-Chloroacetophenone) (C.A.S. #532-27-4)
- 4) CR (Dibenz-(b,f)-1,4-oxazepine) (C.A.S. #257-07-8)
- 5) CS (o-Chlorobenzylidenemalononitrile or o-Chlorobenzalmalononitrile) (C.A.S. #2698-41-1)
- 6) Dibromodimethyl ether (C.A.S. #4497-29-4)
- 7) Dichlorodimethyl ether (ClCi) (C.A.S. #542-88-1)
- 8) Ethyldibromoarsine (C.A.S. #683-43-2)
- 9) Bromo acetone
- 10) Bromo methylethylketone
- 11) Iodo acetone
- 12) Phenylcarbylamine chloride
- 13) Ethyl iodoacetate
- 14) Tear gas formulations
- 15) Smoke bombs
- 16) Non-irritant smoke flares
- 17) Canisters, grenades and charges
- 18) Any pyrotechnic articles having a military use

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9. **Defoliants**

- 1) Agent Orange (2,4,5-Trichlorophenoxyacetic acid mixed with 2,4-dichlorophenoxyacetic acid)
- 2) LNF (Butyl 2-chloro-4-fluorophenoxyacetate).

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10. **Any biological agents and biological derived substances specifically developed, configured, adapted or modified for the purpose of increasing their capability produce casualties in humans or livestock degrade equipment or damage crops.**

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11. **Any vaccines, immunotoxins, medical products, analytical kits, diagnostic kits, or food testing kits that contain any of the listed chemicals or biological organisms.**

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12. **Any software or technology (including technical data) specifically configured for the development, production, or disposal of any of the listed chemicals or biological organisms.**

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13. **Any item or device that can be used in the dissemination, dispersion, testing, detection, identification, warning, monitoring, collection, processing, protection against, decontamination or remediation of any of the listed chemicals or biological organisms, including (1) equipment of any sort (including gas masks, filter canisters and decontamination equipment, protective suits, gloves and shoes, toxic gas monitoring systems and equipment for destruction or production), (2) antibodies, polynucleoides, biopolymers or biocatalysts, (3) medical countermeasures; and/or (4) modeling or simulation tools.**

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III OTHER CHEMICALS, ELEMENTS AND SPECIAL EQUIPMENT

1. Seals, gaskets, sealants or fuel bladders specially designed for aircraft or aerospace use
2. Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers
3. Flexible piezoelectric ceramic materials
4. Composite structures of laminates or in the form of tubes
5. Platinized catalysts
6. Specialized packings made of phosphor bronzed mesh and designed to be used in vacuum distillation towers
7. Manufactures of non-fluorinated polymeric substances
8. Metal alloys, metal alloy powder, metal powder or alloyed materials and equipment for producing such items
9. Magnetic metals
10. Tools, dies, molds or fixtures for superplastic forming or diffusion bonding titanium or aluminum or their alloys
11. Devices and materials for reduced observables for applications usable in missiles and their subsystems
12. Resaturated pyrolyzed carbon-carbon components and materials
13. Equipment for the production of structural composites, fibers, prepegs, performs, propellants or propellant constituents and specially designed components therefor
14. Superconductive composite conductors
15. Uranium titanium alloys or tungsten alloys
16. Batch mixers and continuous mixers with provision for mixing
17. Fluid energy mills
18. Hydraulic fluids containing synthetic or silahydrocarbon oils or chlorofluorocarbons
19. Lubricating materials containing phenylene or alkyphenylene ethers or thio-ethers or fluorinated silicone fluids
20. Damping or flotation fluids with a purity exceeding 99.8%

21. Fluorocarbon electronic cooling fluids
22. Ceramic base materials, non-composite ceramic materials, ceramic-matrix composite materials and precursor materials
23. Non-fluorinated polymeric substances
24. Unprocessed fluorinated compounds
25. Fibrous or filamentary materials or prepegs (i) that may be used in organic matrix, metallic matrix or carbon matrix composite structures or laminates, (ii) made from carbon or aramid materials or glass or (iii) thermoset resin impregnated continuous yarns, rovings, tows, or tapes with a width no greater than 15 mm
26. Maraging steel capable of ultimate tensile strength of 2,050 MPa or more at 293 K
27. Metals in particle sizes of less than 60 μm whether manufactured from material consisting of 99% or more of zirconium, magnesium and alloys
28. Boron or boron carbide of 85% purity or higher and a particle size of 60 μm or less
29. Guanidine nitrate
30. Nitroguanidine (NQ) (C.A.S. #556-88-7)
31. Plutonium
32. Previously separated neptunium-237
33. Maraging steels (steels characterized by high nickel, low carbon content and the use of substitutional elements or precipitates to produce age-hardening)
34. Tungsten, molybdenum and alloys of these metals in the form of uniform, spherical or atomized particles of 500 micrometer diameter or less with a purity of 97% or greater for fabrication of rocket motor components
35. Tungsten, tungsten carbide and alloys containing more than 90% tungsten by weight
36. Boron enriched to greater than its natural isotopic abundance
37. Calcium having 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

38. 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
39. Bismuth having or purity of 99.88% or greater by weight and containing less than 10 parts per million by weight of silver
40. Beryllium metal, alloys containing more than 50% beryllium by weight, beryllium compounds, manufactures thereof, and waste of scrap of any of the foregoing
41. Hafnium metal, hafnium alloys and compounds containing more than 60% hafnium by weight, manufactures thereof, and waste or scrap thereof
42. Helium-3 mixtures containing helium-3, and products or devices containing any of the foregoing
43. Lithium enriched in the lithium-6 isotope to greater than its natural isotopic abundance and products or devices containing enriched lithium
44. Zirconium with hafnium content
45. Tritium, tritium compounds and mixtures containing tritium
46. Alpha-emitting radionuclides
47. Radium-226 and radium-226 alloys, compounds, mixtures, manufactures and products and devices containing such items
48. Nickel powder or porous nickel metal
49. Titanium-stabilized duplex stainless steel
50. Titanium alloys capable of ultimate tensile strength of 900 MPa or more at 293 K and in the form of tubes or cylindrical solid forms with an outside diameter of 75mm
51. Graphite and ceramic materials
52. Electrolytic cells for fluorine production
53. Industrial process control hardware/systems designed for power industries
54. Freon and chilled water cooling systems
55. Electromagnetic isotope separators
56. Materials specially designed for use as absorbers or electromagnetic waves or intrinsically conductive polymers

57. Ammonia synthesis converters or units
58. Hydrogen-cryogenic distillation columns
59. Water-hydrogen sulphide exchange tray columns and internal contactors
60. Pumps capable of circulating solutions of concentrated or dilute potassium amide catalyst in liquid ammonia
61. Tritium facilities or plants and equipment therefor
62. Turboexpanders or turboexpander-compressor sets
63. Lithium isotope separation facilities or plants and equipment therefor
64. Titanium-stabilized duplex stainless steel
65. Bearings and bearing systems
66. Crucibles made of materials resistant to liquid actinide metals
67. Valves that have a nominal size of 5 mm or greater, have a bellows seal and are wholly made of or lined with aluminum, aluminum alloy, nickel, or nickel alloy containing more than 60% nickel by weight
68. Piping, fittings and valves made of, or lined with, stainless steel, copper-nickel alloy or other alloy steel containing 10% or more nickel and/or chromium
69. Pumps designed to move molten metals by electromagnetic forces
70. Portable electric generators and specially designed parts
71. Bellows sealed valves
72. Machine tools and any combination thereof, for removing (or cutting) metals, ceramics or composites that can be equipped with electronic devices for numerical control
73. Numerically controlled or manual machine tools, and specially designed components, controllers and accessories therefor, specially designed for the shaving, finishing, grinding or honing of hardened ($R_c = 40$ or more) spur, helical and double-helical gears with a pitch diameter exceeding 1,250 mm and a face width of 15% of pitch diameter or larger finished to a quality of AGMA 14 or better (equivalent to ISO 1328 class 3)
74. Numerically controlled machine tools using a magnetorheological finishing process
75. Isostatic presses

76. Equipment specially designed for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications for non-electronic substrates and specially designed automated handling, positioning, manipulation and control components therefor
77. Dimensional inspection or measuring systems and equipment
78. Robots
79. Linear position feedback units
80. Rotary position feedback units
81. Compound rotary tables and tilting spindles
82. Spin-forming machines and flow-forming machines and specially designed components therefor
83. Chemical vapor deposition furnaces designed or modified for the densification of carbon-carbon composites
84. Vibration test systems, equipment and components therefor
85. Balancing machines and related equipment
86. Machine tools for removing or cutting metals, ceramics or composites that can be equipped with electronic devices for simultaneous contouring control in two or more axes
87. Dimensional inspection machines, instruments or systems
88. Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells
89. Furnaces capable of operation above 1,123 K (850o C) with induction coils 600 mm or less in diameter and designed for power inputs of 5 kW or more and power supplies specifically designed therefor
90. Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment and computer control and monitoring systems specially configured therefor
91. Rotor fabrication and assembly equipment, rotor straightening equipment, bellows-forming mandrels and dies
92. Pressure transducers capable of measuring absolute pressures at any point in the range 0 to 13 kPa

93. Vacuum pumps having input throat size equal to or greater than 380 mm, pumping speed equal to or greater than 15 m³/s and capable of producing an ultimate vacuum better than 13.3 MPa
94. 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
95. Turning machines or combination turning/milling machines that are capable of machining diameters greater than 2.5 meters
96. Motion simulators or rate tables
97. Positioning tables
98. Centrifuges capable of imparting accelerations above 100g and having slip rings capable of transmitting electrical power and signal formation
99. Reaction vessels or reactors, with or without agitators, with total internal (geometric) volume greater than 0.1 m³ (100 liters) and less than 20 m³ (20,000 liters)
100. Numerical control units for machine tools
101. Non-numerically controlled machine tools for generating optical quality surfaces and specially designed components therefor
102. Gearmaking and/or finishing machinery capable of producing gears to a quality level of better than AGMA 11
103. Dimensional inspection or measuring systems or equipment
104. Bellows manufacturing equipment, including hydraulic forming equipment and bellows forming dies
105. Laser welding machines
106. MIG and E-beam welders
107. Monel equipment, including valves, piping, tanks and vessels
108. 304 and 316 stainless steel valves, piping, tanks and vessels
109. Large boring equipment capable of drilling holes greater than two feet in diameter and large earth-moving equipment used in the mining industry
110. Electroplating equipment designed for coating parts with nickel or aluminum

111. Pumps designed for industrial service and for use with an electrical motor of 5 HP or greater
112. Vacuum valves, piping, flanges, gaskets and related equipment specially designed for use in high-vacuum service
113. Austenitic stainless steel plate, valves, piping, tanks and vessels
114. Carbon/carbon billets and preforms that are reinforced with continuous unidirectional tows, tapes, or woven cloths in three or more dimensional planes (i.e., 3D, 4D, etc.), structural materials including carbon/carbon and metal matrix composites, plate, forgings, castings, welding consumables and rolled and extruded shapes which have been specifically designed or modified for defense articles
115. Assemblies, units or inserts specially designed for any of the items listed above
116. Software and technology specially designed or modified for the development, production or use of any item listed above
117. Software or technology for the development of matrix laminates or composites
118. Technical data and procedures for the regulation of temperature, pressure or atmosphere in autoclaves or hydroclaves
119. Technology for the production of pyrolytically derived materials
120. Polytetrahydrofuran polyethylene glycol (TPEG)

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IV ELECTRONICS

1. Electronic equipment that is specifically designed, modified or configured for military application, such as:
 - a) Electronic combat equipment
 - b) Command, control and communications systems to include radios (transceivers), navigation, and identification equipment
 - c) Computers specifically designed or developed for military application and any computer specifically modified for use with any defense article

- d) Any experimental or developmental electronic equipment specifically designed or modified for military application or specifically designed or modified for use with a military system
2. Electronic systems or equipment specifically designed, modified, or configured for intelligence, security, or military purposes for use in search, reconnaissance, collection, monitoring, direction-finding, display, analysis and production of information from the electromagnetic spectrum and electronic systems or equipment designed or modified to counteract electronic surveillance or monitoring, such as:
 - a) Systems designed or modified to use cryptographic techniques to generate the spreading code for spread spectrum or hopping code for frequency agility
 - b) Systems designed or modified using burst techniques (e.g., time compression techniques) for intelligence, security or military purposes
 - c) Systems designed or modified for the purpose of information security to suppress the compromising emanations of information-bearing signals
 3. Integrated circuits designed or rated as radiation hardened
 4. Microprocessor microcircuits, microcomputer microcircuits, storage integrated circuits manufactured from a compound semiconductor, electro-optical or optical integrated circuits designed for signal processing, field programmable logic devices, 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 processors, electrical erasable programmable read-only memories (EEPROMS), flash memories, static random-access memories (SRAMS) if any of the foregoing a rated for an ambient temperature above 398K (125 C) or below 218K (-55 C) or over the entire range from 398K to 218K
 5. Microprocessor microcircuits, microcomputer microcircuits and microcontroller microcircuits manufactured from a compound semiconductor and operating at a clock frequency exceeding 40MHz or where more than one data or instruction bus or serial communication port that provides a direct external interconnection between parallel microprocessor microcircuits with a transfer rate exceeding 150 Mbytes
 6. Analog-to-digital and digital-to-analog converters or converter integrated circuits
 7. Electro-optical and optical integrated circuits designed for signal processing
 8. Field programmable logic devices
 9. Neural network integrated circuits

10. Custom integrated circuits for which the function is unknown or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer having any of the following: (i) more than 1,000 terminals, (ii) a typical basic gate propagation delay time of less than 0.1 ns or (iii) an operating frequency exceeding 3Ghz
11. Digital integrated circuits based upon any compound semiconductor
12. Microwave or millimeter wave components
13. Acoustic wave devices
14. Electronic devices and circuits containing components, manufactured from superconductive materials specially designed for operation at temperatures below the critical temperature of at least one of the superconductive constituents
15. High energy devices
16. Rotary input type shaft absolute position encoders
17. Analog instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module)
18. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s
19. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques
20. Equipment, having a maximum digital interface transfer rate exceeding 175 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders
21. Frequency synthesizer electronic assemblies having a frequency switching time from one selected frequency to another of less than 1 ms
22. Waveform digitizers and transient recorders
23. Signal analyzers capable of analyzing frequencies exceeding 31.8 GHz or exceeding 43.5 GHz
24. Dynamic signal analyzers having a real-time bandwidth exceeding 500 kHz
25. Frequency synthesized signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master frequency
26. Network analyzers with a maximum operating frequency exceeding 43.5 GHz

27. Microwave test receivers having a maximum operating frequency exceeding 43.5 GHz and being capable of measuring amplitude and phase simultaneously
28. Atomic frequency standards having long-term stability (aging) less (better) than 1×10^{-11} /month or being space qualified
29. Accelerators capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and systems containing those accelerators
30. Pulse discharge capacitors
31. Superconducting solenoidal electromagnets
32. Flash X-ray generators or pulsed electron accelerators
33. Frequency changers (also known as converters or inverters) or generators, having a multiphase output capable of providing a power of 40 W or more, capable of operating in the frequency range between 600 and 2000 Hz, a total harmonic distortion below 10% and frequency control better than 0.1%
34. High-power direct current power supplies capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 A or greater and current or voltage stability better than 0.1% over a time period of 8 hours
35. High-voltage direct current power supplies capable of continuously producing, over a time period of 8 hours, 20 kV or greater with current output of 1 A or greater and current or voltage stability better than 0.1% over a time period of 8 hours
36. Cold-cathode tubes, whether gas filled or not, operating similarly to a spark gap
37. Triggered spark-gaps having an anode delay time of 15 μ s or less and rated for a peak current of 500 A or more
38. Modules or assemblies with a fast switching function having anode peak voltage rating greater than 2 kV; anode peak current rating of 500 A or more and turn-on time of 1 μ s or less
39. Firing sets and equivalent high-current pulse generators (for detonators)
40. High-speed pulse generators having output voltage greater than 6 V into a resistive load of less than 55 ohms and pulse transition time less than 500 ps
41. Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction

42. Detonators and multipoint initiation systems
43. Mass spectrometers
44. Oscilloscopes and transient recorders and specially designed components therefor
45. Voice print identification and analysis equipment and parts
46. Polygraphs (except biomedical recorders designed for use in medical facilities for monitoring biological and neurophysical responses); fingerprint analyzers, cameras and equipment; automated fingerprint and identification retrieval systems; psychological stress analysis equipment; electronic monitoring restraint devices; and specially designed parts and accessories
47. Microprocessor microcircuits, microcomputer microcircuits, and microcontroller microcircuits having a composite theoretical performance (CTP) of 6,500 million theoretical operations per second (MTOPS) or more and an arithmetic logic unit with an access width of 32 bit or more; a clock frequency rate exceeding 25 MHz or more than one data or instruction bus or serial communication port that provides a direct external interconnection between parallel microprocessor microcircuits with a transfer rate of 2.5 Mbyte/s
48. Electrical erasable programmable read-only memories (EEPROMs) and static random access memories
49. Fast Fourier Transform (FFT) processors
50. Traveling wave tubes, pulsed or continuous wave
51. Flexible waveguides designed for use at frequencies exceeding 40 GHz
52. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., signal processing devices employing elastic waves in materials)
53. Primary cells and batteries having an energy density exceeding 350 Wh/kg and rated for operation in the temperature range from below 243 K (-30oC) to above 343 K (70oC)
54. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours when operating in the temperature range from below 253 K (-20oC) to above 333 K (600 C)
55. Superconductive electromagnets or solenoids specially designed to be fully charged or discharged in less than one minute
56. Circuits or systems for electromagnetic energy storage, containing components manufactured from superconductive materials specially designed for operation at

temperatures below the critical temperature of at least one of their superconductive constituents

57. Hydrogen/hydrogen-isotope thyratrons of ceramic-metal construction
58. Digital integrated circuits based on any compound semiconductor having an equivalent gate count of more than 300
59. Electronic test equipment
60. Digital instrumentation magnetic tape data recorders
61. Equipment with a maximum digital interface transfer rate exceeding 60 Mbit/s designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders
62. Frequency changers capable of operating in the frequency range from 300 up to 600 Hz
63. Flash x-ray machines, and components of pulsed power systems designed thereof, including Marx generators, high power pulse shaping networks, high voltage capacitors, and triggers
64. Pulse amplifiers
65. Electronic equipment for time delay generation
66. Chromatography and spectrometry analytical instruments
67. Spray cooling thermal management systems employing closed loop fluid handling and reconditioning equipment in a sealed enclosure where a dielectric fluid is sprayed onto electronic components using specially designed spray nozzles that are designed to maintain electronic components within their operating range, and specially designed components therefor
68. Equipment for the manufacturing of semiconductor devices or materials and specially designed components and accessories therefor
69. Stored program controlled test equipment, specially designed for testing finished or unfinished semiconductor devices
70. Equipment specially designed for the manufacture, inspection or testing of electron tubes, optical elements and specially designed components therefor
71. Equipment specially designed for the manufacture, inspection or testing of semiconductor devices, integrated circuits and electronic assemblies and systems incorporating or having the characteristics of such equipment

72. Hetero-epitaxial materials consisting of a substrate having stacked epitaxially grown multiple layers
73. Resist material and substrates coated with controlled resists
74. Organo-metallic compounds of aluminium, gallium or indium having a purity (metal basis) better than 99.999
75. Organo-arsenic, organo-antimony and organo-phosphorus compounds having a purity (inorganic element basis) better than 99.999%
76. Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in inert gases or hydrogen
77. Positive resists designed for semiconductor lithography
78. Vacuum microelectronic devices
79. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices
80. Superconductive electronic devices
81. Substrates of films of diamond for electronic components
82. Substrates of silicon-on-insulator (SOI) for integrated circuits in which the insulator is silicon dioxide
83. Substrates of silicon carbide for electronic components
84. Components, parts, accessories, attachments, and associated equipment specifically designed or modified for any item listed above
85. Software specially designed for the development, production or use of any item listed above
86. Computer Aided Design designed for the development of semiconductor devices or integrated circuits
87. Computer Aided Design designed to perform or use design rules or circuit verification rules; simulation of the physically laid out circuits; or lithographic processing simulators for design
88. Physics-based simulation software specially designed for the development of lithographic, etching or deposition processes for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor materials

89. Technology for the development or production of: vacuum microelectronic devices, hetero-structure semiconductor devices, superconductive electronic devices, substrates of films of diamond for electronic components, substrates of silicon-on-insulator for integrated circuits in which the insulator is silicon dioxide, substrates of silicon carbide for electronic components, electronic vacuum tubes operating at frequencies of 31.8 GHz or higher
90. Technology for the development, production or use of any item listed above
91. Technical data or defense services specifically designed for or directly related to any item listed above

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V SUPER COMPUTERS AND OTHER SPECIAL COMPUTERS

1. Electronic computers and related equipment and electronic assemblies and specially designed components therefor specially designed to be rated for operation at an ambient temperature below 228 K (-45EC) or above 358 K (85EC) or radiation hardened
2. Digital computers, electronic assemblies and related equipment therefor, and specially designed components therefor designed or modified for fault tolerance
3. Digital computers having a composite theoretical performance (CTP) equal to or greater than 6,000 million theoretical operations per second (MTOPS)
4. Electronic assemblies that are specially designed or modified to enhance performance by aggregation of computing elements: (i) that are designed to be capable of aggregation in configurations of 16 or more computing elements or (ii) having a sum of maximum data rates on all channels available for connection to associated processors exceeding 40 million Bytes
5. Hybrid computers and electronic assemblies and specially designed components therefor containing digital computers or analog-to-digital converters having 32 channels or more and a resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more
6. Electronic assemblies specially designed or modified to be capable of enhancing performance by aggregation of computing elements so that the CTP exceeds 28,000 MTOPS
7. Equipment performing analog-to-digital conversions

8. Equipment specially designed to provide external interconnection of digital computers or associated equipment that allows communications at data rates exceeding 1.25 Gbyte/s
9. Systolic array computers
10. Neural computers
11. Optical computers
12. Analog computers, digital computers or digital differential analyzers, designed or modified for use in missiles
13. Hybrid computers
14. Computers for fingerprint equipment
15. Electronic computers and related equipment, and electronic assemblies and specially designed components therefor, rated for operation at an ambient temperature above 343 K (70oC)
16. Magnetic, erasable optical or magneto-optical disk drives with a maximum bit transfer rate exceeding 25 million bit/s and input/output units designed for use with such equipment
17. Solid state storage equipment, other than main storage (also known as solid state disks or RAM disks), with a maximum bit transfer rate exceeding 36 million bit/s and input/output units designed for use with such equipment
18. Equipment for signal processing or image enhancement having a CTP exceeding 8.5 MTOPS
19. Graphics accelerators or graphics coprocessors that exceed a three dimensional vector rate of 400,000 or, if supported by 2-D vectors only, a two dimensional vector rate of 600,000
20. Color displays or monitors having more than 120 resolvable elements per cm in the direction of the maximum pixel density
21. Equipment containing terminal interface equipment
22. Equipment specially designed to provide external interconnection of digital computers or associated equipment that allows communications at data rates exceeding 80 Mbyte/s
23. Equipment for the development and production of magnetic and optical storage equipment

24. Materials specially formulated for and required for the fabrication of head/disk assemblies for controlled magnetic and magneto-optical hard disk drives
25. Software specially designed or modified for the development, production or use of equipment listed above
26. Operating system software, software development tools and compilers specially designed for multi-data-stream processing equipment, in source code
27. Operating systems specially designed for real time processing equipment that guarantees a global interrupt latency time of less than 20 μ s
28. Program proof and validation software, software allowing the automatic generation of source codes, and operating system software that are specially designed for real time processing equipment
29. Technology for the development, production or use of any of the above items
30. Technology for the development or production of graphics accelerators or equipment designed for multi-data-stream processing and technology required for the development or production of magnetic hard disk drives

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VI TELECOMMUNICATIONS AND INFORMATION SECURITY EQUIPMENT

1. Telecommunications systems, equipment, and components specially designed to withstand transitory electronic effects or electromagnetic pulse effects, specially hardened to withstand gamma neutron or ion radiation or specially designed to operate outside the temperature range from 218 K (-55oC) to 397 K (124oC)
2. Underwater communications systems and specially designed components and accessories therefor
3. Radio equipment operating in the 1.5 MHz to 87.5 MHz band or employing spread spectrum techniques, including frequency hopping techniques, and specially designed components and accessories therefor
4. Digitally controlled radio receivers and specially designed components and accessories therefor
5. Telecommunications transmission equipment and specially designed components and accessories therefor employing functions of digital signal processing to provide voice coding

6. Optical fibers specified by the manufacturer as being capable of withstanding a proof test tensile stress of 2×10^9 N/m² or more
7. Optical fiber cables and accessories designed for underwater use
8. Electronically steerable phased array antennae operating above 31 GHz
9. Telemetry and telecontrol equipment usable for missiles or designed or modified for unmanned aerial vehicles or rocket systems
10. Communications intercepting devices; and parts and accessories therefor
11. Any type of telecommunications equipment specially designed to operate outside the temperature range from 219 K (-540C) to 397 K (1240C)
12. Telecommunication transmission equipment and systems, and specially designed components and accessories therefor categorized as:
 - a) Radio equipment (e.g., transmitters, receivers and transceivers)
 - b) Line terminating equipment
 - c) Intermediate amplifier equipment
 - d) Repeater equipment
 - e) Regenerator equipment
 - f) Translation encoders (transcoders)
 - g) Multiplex equipment (statistical multiplex included)
 - h) Modulators/demodulators (modems)
 - i) Transmultiplex equipment
 - j) Stored program controlled digital cross connection equipment
 - k) Gateways and bridges
 - l) Media access units
13. Telecommunication transmission equipment and systems, and specially designed components and accessories therefor designed for use in single or multi-channel communication via any of the following:
 - a) Wire (line)
 - b) Coaxial cable

- c) Optical fiber cable
 - d) Electromagnetic radiation
 - e) Underwater acoustic wave propagation
14. Stored program controlled switching equipment and related signaling systems
 15. Optical fibers and optical fiber cables designed for single mode operation
 16. Centralized network control that receive data from the nodes and process these data in order to provide control of traffic not requiring operator decisions, and thereby performing dynamic adaptive routing
 17. Phased array antennae
 18. Mobile communications equipment and assemblies and components therefor
 19. Radio relay communications equipment designed for use at frequencies equal to or exceeding 19.7 GHz and assemblies and components therefor
 20. Equipment and specially designed components or accessories therefor, specially designed for the development of equipment employing digital techniques, including Asynchronous Transfer Mode (ATM), designed to operate at a total digital transfer rate exceeding 1.5 Gbit/s
 21. Equipment and specially designed components or accessories therefore, specially designed for the development of equipment employing digital techniques designed to operate at a total digital transfer rate exceeding 15 Gbit/s
 22. Equipment and specially designed components or accessories therefor specially designed for the development of equipment employing a laser
 23. Equipment employing optical switching
 24. Radio equipment employing quadrature-amplitude-modulation (QAM) techniques above level 256
 25. Equipment employing common channel signaling operating in either non-associated mode of operation or quasi-associated mode of operation
 26. Telecommunications test equipment
 27. Systems, equipment, application specific electronic assemblies, modules and integrated circuits for information security, and other specially designed components therefor and other equipment designed or modified to use cryptography, to perform cryptanalytic functions or to use cryptographic techniques

28. Systems, equipment, application specific electronic assemblies, modules and integrated circuits for information security, and other specially designed components therefor and other equipment specially designed or modified to reduce the compromising emanations of information-bearing signals beyond what is necessary for health, safety or electromagnetic interference standards
29. Systems, equipment, application specific electronic assemblies, modules and integrated circuits for information security, and other specially designed components therefor and other equipment designed or modified to provide certified or certifiable multilevel security or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent
30. Communications cable systems designed or modified to detect surreptitious intrusion
31. Telecommunications and other information security equipment containing encryption
32. Information security equipment (e.g., cryptographic, cryptanalytic, and cryptologic equipment) and components therefor
33. Military cryptographic (including key management) systems, equipment, assemblies, modules, integrated circuits, components or software with the capability of maintaining secrecy or confidentiality of information systems, including equipment and software for tracking, telemetry and control (TT&C) encryption and decryption
34. Military cryptographic (including key management) systems, equipment, assemblies, modules, integrated circuits and components of software which have the capability of generating spearing or hopping codes for spread spectrum systems or equipment
35. Military cryptanalytic systems, equipment, assemblies, modules, integrated circuits, components or software
36. Military systems, equipment, assemblies, modules, integrated circuits, components or software providing certified or certifiable multi-level security or user isolation exceeding class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) and software to certify such systems, equipment or software
37. Equipment and components specially designed for the development, production or use of any item listed above
38. Measuring equipment specially designed to evaluate and validate the information security functions listed above

39. Software specially designed or modified for the development, production or use of, or to support, or having the characteristics of, or performing or simulating the functions of, the equipment contained on this list and software that is specially designed or modified for the development, production or use of or to support or to certify such software
40. Software designed or modified to protect against malicious computer damage and software specially designed for the development, production or use of such software
41. Software, other than in machine-executable form, specially designed for dynamic adaptive routing
42. Technology for the development or production of telecommunications equipment specially designed to be used on board satellites
43. Technology specially designed or modified for the development, production or use of, or to support, or having the characteristics of, or performing or simulating the functions of, the equipment listed above and technology that is specially designed or modified for the development, production or use of or to support or to certify such technology
44. Technology for the development or use of laser communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media
45. Technology for the development of digital cellular radio systems
46. Technology for the development of spread spectrum techniques, including frequency hopping techniques
47. Technical data directly related to any of the items listed above

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VII LASERS, SENSORS AND RELATED EQUIPMENT

1. Marine acoustic systems, equipment and specially designed components therefor
2. Hydrophones
3. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m
4. Space-qualified solid-state detectors

5. Image intensifier tubes and specially designed components therefor
6. Focal plane arrays
7. Monospectral imaging sensors and multispectral imaging sensors designed for remote sensing applications
8. Direct view imaging equipment operating in the visible or infrared spectrum
9. Preforms of glass or of any other material optimized for the manufacture of optical fibers
10. High speed cameras, mechanical or streak cameras, electronic cameras and specially designed components therefor
11. Video cameras incorporating solid state sensors
12. Scanning and imaging cameras and scanning camera systems
13. Deformable mirrors having either continuous or multi-element surfaces, and specially designed components therefor
14. Lightweight monolithic mirrors having an average equivalent density of less than 30 kg/m² and a total mass exceeding 10 kg
15. Lightweight composite or foam mirror structures having an average equivalent density of less than 30 kg/m² and a total mass exceeding 2 kg
16. Beam steering mirrors more than 100 mm in diameter or length of major axis
17. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS)
18. Space-qualified components for optical systems
19. Optical control equipment specially designed to maintain the surface figure or orientation of space-qualified components listed above
20. Optical control equipment having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 μ r (microradians) or less
21. Optical control gimbals
22. Aspheric optical elements with the following: the largest dimension of the optical aperture is greater than 400 mm; the surface roughness is less than 1 nm(rms) for sampling lengths equal to or greater than 1 mm and the coefficient of linear thermal expansion's absolute magnitude is less than $3 \times 10^{-6}/K$ at 25°C
23. Gas lasers

24. Semiconductor lasers
25. Solid state lasers
26. Dye and other liquid lasers
27. Argon ion lasers
28. Pulsed carbon dioxide lasers
29. Pulse-excited, Q-switched neodymium-doped (other than glass) lasers
30. Carbon dioxide lasers
31. Semiconductor lasers
32. Solid state, non-tunable lasers
33. Free electron lasers
34. Lasers specifically designed, modified or configured for military application including those used in military communication devices, target designators and range finders, target detection systems, and directed energy weapons
35. Laser welding machines
36. Linear position feedback units
37. Rotary position feedback units
38. Mirrors cooled either by active cooling or by heat pipe cooling that are laser components
39. Optical mirrors or transmissive or partially transmissive optical or electro-optical components specially designed for use with controlled lasers
40. Dynamic wavefront (phase) measuring equipment
41. Laser diagnostic equipment capable of measuring SHPL system angular beam steering errors of equal to or less than 10 μ rad
42. Optical equipment and components specially designed for a phased-array SHPL system for coherent beam combination
43. Projection telescopes specially designed for use with SHPL systems
44. Magnetometers, magnetic gradiometers, intrinsic magnetic gradiometers and compensation systems, and specially designed components therefor

45. Radar systems, equipment and assemblies
46. Magnetic, pressure, and acoustic underwater detection devices specially designed for military purposes and controls and components therefor
47. Radiation hardened detectors, for use in protecting against nuclear effects and usable for missiles
48. Gravity meters (gravimeters), gravity gradiometers, and specially designed components therefor
49. Radar and laser radar systems designed or modified for use in missiles
50. Precision tracking systems, usable for missiles
51. Photomultiplier tubes
52. Mechanical rotating mirror cameras
53. Electronic streak cameras, electronic framing cameras, tubes and devices
54. Tunable pulsed single-mode dye laser oscillators
55. Tunable pulsed dye laser amplifiers and oscillators
56. Para-hydrogen Raman shifters
57. Velocity interferometers for measuring velocities exceeding 1 km/s during time intervals of less than 10 microseconds
58. Manganin gauges for pressures greater than 100 kilobars
59. Quartz pressure transducers for pressures greater than 100 kilobars
60. Marine or terrestrial acoustic equipment
61. Image intensifier tubes and specially designed components therefor
62. Optical filters
63. Fluoride fiber cable, or optical fibers therefor, having an attenuation of less than 4 dB/km in the wavelength range exceeding 1,000 nm but not exceeding 3,000 nm
64. Magnetometers having a noise level (sensitivity) lower (better) than 1.0 nT rms per square root Hz
65. Airborne radar equipment and specially designed components therefor

66. Space-qualified laser radar or Light Detection and Ranging (LIDAR) equipment specially designed for surveying or for meteorological observation
67. Seismic detection equipment
68. Equipment for measuring absolute reflectance to an accuracy of $\pm 0.1\%$ of the reflectance value
69. Equipment having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an accuracy of 2 nm or less (better) against the required profile
70. Equipment to produce, align and calibrate land-based gravity meters with a static accuracy of better than 0.1 mgal
71. Pulse radar cross-section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefor
72. Systems specially designed for radar cross section measurement
73. Specially designed or modified equipment, including tools, dies, fixtures or gauges, and other specially designed components and accessories therefore, for (i) the manufacture or inspection of free electron laser magnet wigglers or free electron laser photo injectors or (ii) the adjustment, to required tolerances, of the longitudinal magnetic field of free electron lasers
74. Elemental tellurium (Te) of purity levels of 99.9995% or more
75. Single crystals (including epitaxial wafers) of cadmium zinc telluride (CdZnTe), cadmium telluride (CdTe) or mercury cadmium telluride (HgCdTe)
76. Zinc selenide (ZnSe) and zinc sulphide (ZnS) substrate blanks produced by the chemical vapor deposition process
77. Boules of potassium titanyl arsenate (KTA); silver gallium selenide (AgGaSe₂) or thallium arsenic selenide (Tl₃AsSe₃, also known as TAS)
78. Non-linear optical materials, having third order susceptibility (χ^3) of 10^{-6} m²/V² or more and a response time of less than 1 ms
79. Substrate blanks of silicon carbide or beryllium beryllium (Be/Be) deposited materials
80. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF₄) and hafnium fluoride (HfF₄), having a hydroxyl ion (OH⁻) concentration of less than 5 ppm; integrated metallic purity levels of less than 1 ppm and high homogeneity (index of refraction variance) less than 5×10^{-6}

81. Synthetically produced diamond material with an absorption of less than 10^{-5} cm⁻¹ for wavelengths exceeding 200 nm but not exceeding 14,000 nm
82. Synthetic crystalline laser host material in unfinished form: titanium doped sapphire and alexandrite
83. Optical sensing fibers that are modified structurally to have a beat length of less than 500 mm (high birefringence) or optical sensor materials and having a zinc content of equal to or more than 6% by mole fraction
84. Bulk fluoride compounds containing ingredients with a purity of 99.999% or better or comprised of zirconium or aluminum and variants
85. Bulk fluoride glass
86. Optical fiber preforms made from bulk fluoride compounds
87. Software specially designed for the development, production or use of the items listed above
88. Acoustic software
89. Software specially designed for magnetic compensation systems for magnetic sensors designed to operate on mobile platforms
90. Software specially designed for magnetic anomaly detection on mobile platforms
91. Air Traffic Control software application programs
92. Software for the design or production of radomes
93. Software that processes post-flight, recorded data enabling determination of vehicle position throughout its flight path
94. Technology for the development, production or use of the items listed above
95. Optical surface coating and treatment technology
96. Optical fabrication technology
97. Technology required for the development, production or use of specially designed diagnostic instruments or targets in test facilities for SHPL testing or testing or evaluation of materials irradiated by SHPL beams
98. Technology required for the development or production of fluxgate magnetometers or fluxgate magnetometer systems
99. Optical fabrication technologies for serially producing optical components at a rate exceeding 10 m² of surface area per year on any single spindle

100. Technology for optical filters with a bandwidth equal to or less than 10 nm, a field of view (FOV) exceeding 40° and a resolution exceeding 0.75 line pairs per milliradian

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VIII NAVIGATION AND AVIONICS EQUIPMENT

1. Spacecraft, including communications satellites, remote sensing satellites, scientific satellites, research satellites, navigation satellites, experimental and multi-mission satellites
2. Ground control stations for telemetry, tracking and control of spacecraft or satellites
3. Radiation-hardened microelectronic circuits
4. Any space-qualified items, such as traveling wave tubes or photovoltaic arrays, data recorders, or telecommunications systems
5. Rockets (including meteorological and other sounding rockets), launchers, launch vehicles, missile and anti-missile systems
6. Ablative materials fabricated or semi-fabricated from advanced composites
7. Any navigation direction finding equipment, airborne communication equipment, aircraft inertial navigation systems such as:
8. Linear Accelerometers
9. Gyros, angular or rotational accelerometers, or gyro-astro compasses, and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites
10. Global navigation satellite systems (i.e., GPS or GLONASS) or receiving equipment
11. Airborne altimeters of any sort
12. Direction-finding equipment
13. Passive sensors for determining bearing to specific electromagnetic source or terrain characteristics
14. Flight control systems (hydraulic, mechanical, electro-optical, or electro-mechanical flight control systems (including fly-by-wire systems) and attitude control equipment

15. Guidance sets
16. Equipment specially designed to characterize mirrors for ring laser gyros
17. Aero, marine gas, turbojet, or turbofan engines, and any related equipment
18. Liquid or solid rocket propulsion systems
19. Vibration test equipment
20. Unmanned air vehicle systems (UAVs) and remotely piloted vehicles (RPVs)
21. Parts or components designed for or related to any of the items described above
22. Production equipment, and other test, calibration, and alignment equipment, designed or modified to be used with equipment described above
23. Software specially designed or modified for the development, production or use of the items described above
24. Source code for the use of any inertial navigation equipment or Attitude and Heading Reference Systems
25. Technology for the design, development, production, repair or use of the items described above
26. Technology for the protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards, from external sources

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IX MARINE SYSTEMS EQUIPMENT

1. Submersible vehicles and surface vessels and systems and equipment and systems specially designed for such vehicles and systems
2. Fiber optic hull penetrators or connectors
3. Underwater vision systems
4. Photographic still cameras specially designed or modified for underwater use
5. Electronic imaging systems specially designed or modified for underwater use
6. 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

7. Argon arc light systems
8. Robots specially designed for underwater use and systems that control such Robots
9. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles
10. Air independent power systems specially designed for underwater use
11. Skirts, seals and fingers designed for cushion pressure of 3,830 Pa or more
12. Lift fans rated at more than 400kW specially designed for surface effect vehicles
13. Fully submerged subcavitating or supercavitating hydrofoils specially designed for underwater or surface vessels
14. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels listed above
15. Propellers, power transmission systems, power generation systems and noise reduction systems
16. 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
17. Closed and semi-closed circuit (rebreathing) apparatus for diving and underwater swimming, and specially designed components therefor
18. Engines and motors specially designed for submarines or military purposes
19. Self-contained diving and underwater breathing apparatus
20. Marine boilers designed to have heat release rate (at maximum rating) equal to or in excess of 190,000 BTU per hour per cubic foot of furnace volume or ratio of steam generated in pounds per hour (at maximum rating) to the dry weight of the boiler in pounds equal to or in excess of 0.83
21. Submarine and torpedo nets
22. Underwater vision systems
23. Photographic still cameras specially designed or modified for underwater use
24. Stroboscopic light systems, specially designed or modified for underwater use
25. Other underwater camera equipment

26. Other submersible systems
27. Boats including inflatable boats, and specially designed components therefor
28. Marine engines (both inboard and outboard) and submarine engines and specially designed parts therefor
29. Other self-contained underwater breathing apparatus (scuba gear) and related equipment
30. Life jackets, inflation cartridges, compasses, wetsuits, masks, fins, weight belts, and dive computers
31. Underwater lights and propulsion equipment
32. Air compressors and filtration systems specially designed for filling air cylinders
33. 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
34. Syntactic foam designed for underwater use
35. Components, parts, accessories and attachments for any of the above
36. Software specially designed or modified for the development, production or use of any of the items listed above
37. Software specially designed or modified for the development production, repair, overhaul or refurbishing re-machining) of propellers specially designed for underwater noise reduction
38. Technology for the development, production or use of any of the items listed above

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X PROPULSION SYSTEMS, SPACE VEHICLES AND RELATED EQUIPMENT

1. Space launch vehicles and spacecraft
2. Rocket propulsion systems and components specially designed therefor
3. Ramjet, scramjet or combined cycle engines and specially designed components therefor
4. Military trainer aircraft

5. Pressure refuelers, pressure refueling equipment, and equipment specially designed to facilitate operations in confined areas; and ground equipment, developed specially for military aircraft and helicopters, and specially designed parts and accessories
6. Pressurized breathing equipment specially designed for use in aircraft and helicopters
7. Military parachutes and complete canopies, harnesses, and platforms and electronic release mechanisms therefor, except such types as are in normal sporting use
8. Military instrument flight trainers, except for combat simulation; and components, parts, attachments and accessories specially designed for such equipment
9. Sounding rockets
10. Liquid propellant rocket engines
11. Ablative liners for thrust or combustion chambers
12. Rocket nozzles
13. Thrust vector control sub-systems
14. Liquid and slurry propellant (including oxidizers) control systems, and specially designed components therefor
15. Solid propellant rocket engines, usable in rockets
16. Solid rocket propulsion components usable in rockets
17. Hybrid rocket motors, usable in rockets and specially designed components therefor
18. Composite structures, laminates and manufactures thereof, specially designed for use in missiles or the subsystems listed above
19. Apparatus, devices and vehicles, designed or modified for the transport, handling, control, activation and launching of rockets, missiles and unmanned aerial vehicles
20. Reentry vehicles, usable in missiles, and equipment designed or modified therefor
21. Staging mechanisms, separation mechanisms, and interstages therefor, usable in missiles
22. Devices to regulate combustion, usable in engines which are usable in rockets

23. Individual rocket stages
24. Nonmilitary mobile crime science laboratories; and parts and accessories
25. Diesel engines and tractors and specially designed parts therefor
26. Aircraft and parts and components
27. Complete canopies, harnesses, and platforms and electronic release mechanisms therefor, except such types as are in normal sporting use
28. Directional solidification or single crystal casting equipment
29. Ceramic cores or shells
30. 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
31. Equipment specially designed for the production or test of gas turbine brush seals
32. Tools, dies or fixtures for the solid state joining of superalloy, titanium or intermetallic airfoil-to-disk combinations for gas turbines
33. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with wind tunnels or devices
34. Acoustic vibration test equipment capable of producing sound pressure levels and specially designed quartz heaters therefor
35. 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
36. Transducers specially designed for the direct measurement of wall skin friction of test flow
37. Tooling specially designed for producing turbine engine powder metallurgy rotor components
38. Wind tunnels
39. Environmental chambers and anechoic chambers
40. Specially designed production equipment and facilities for the systems, sub-systems and components listed above

41. Test benches and test stands for solid or liquid propellant rockets or rocket motors
42. Vibration test equipment and specially designed parts and components therefor
43. Specially designed equipment, tooling or fixtures for manufacturing or measuring gas turbine blades, vanes or tip shroud castings
44. Resin impregnated fiber prepregs and metal coated fiber preforms therefor, for composite structures, laminates and manufactures
45. Rotor blade tip clearance control systems employing active compensating casing technology limited to a design and development data
46. Gas bearing for turbine engine rotor assemblies
47. Software specially designed for the development, production or use of any of the items listed above
48. Technology for the development, production or use of any of the items listed above

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XI FIREARMS, AMMUNITION AND ORDNANCE

1. Nonautomatic and semiautomatic and fully automatic firearms
2. Firearms or other weapons having special military applications
3. Combat shotguns
4. Military and police helmets and shields
5. Silences, mufflers, sound and flash suppressors for any of the above items
6. Riflescopes manufactured to military specifications
7. Barrels, cylinders, receives or complete breech mechanisms for any item listed above
8. Discharge type arms (e.g., stun guns, shock batons, electric cattle prods, immobilization guns and projectiles)
9. Optical sighting devices for firearms
10. Guns over caliber 0.50, such as howitzers, mortars, cannons and recoilless rifles and engines specifically designed for such items

11. Flame throwers specifically designed or modified for military application
12. Kinetic energy weapons systems specifically designed or modified for destruction or rendering mission-abort of a target
13. Signature control materials, techniques and equipment specifically designed, developed, configured, adapted or modified to alter or reduce the signature of any item listed above
14. Engines specifically designed or modified for self-propelled guns
15. Ammunition/ordnance and related handling equipment specifically designed or modified for the items listed above and guidance and control components for such ammunition and ordnance
16. Equipment specially designed for manufacturing shotgun shells
17. Specially designed components and parts for ammunition, except cartridge cases, powder bags, bullets, jackets, cores, shells, projectiles, boosters, fuses and components, primers, and other detonating devices and ammunition belting and linking machines
18. Apparatus and devices for launching or delivering ordnance
19. Safing, arming and fuzing components for the ammunition and ordnance listed above
20. Equipment, tooling and test, evaluation and test models specifically designed or modified for the production of any item listed above
21. Components, parts, accessories and attachments for the items listed above
22. Technical data related to any of items listed above

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XII EXPLOSIVES, ENERGETIC MATERIALS AND INCENDIARY AGENTS

1. Explosives, and mixtures thereof:
 - a) ADNBF (aminodinitrobenzofuroxan or 7-Amino 4,6-dinitrobenzofurazanr-1-oxide) (C.A.S. #97096-78-1)
 - b) BNCP (cis-bis (5-nitrotetrazolato) tetra amine-cobalt (III) perchlorate)
 - c) CL-14 (diamino dinitrobenzofuroxan or 5,7-diamino-4,6-dinitrobenzofurazane-1-oxide) (C.A.S. #117907-74-1)

- d) CL-20 (HNIW or Hexanitrohexaazaisowurtzitane); (C.A.S. #135285-90-4); clathrates of CL-20
- e) CP (2-(5-cyanotetrozolato) penta aminocobalt (III) perchlorate); (C.A.S. #70247-32-4)
- f) DADE (1,1-diamino-2,2-dinitroethylene, FOX7)
- g) DFP (1,4-dinitrodifurazanopiperazine)
- h) DDPO (2,6-diamino-3,5-dinitropyrazine-1-oxide, PZO); (C.A.S. #194486-77-6)
- i) DIPAM (3,3'-Diamino-2,2',4,4',6,6'-hexanitrobiphenyl or dipicrimide) (C.A.S. #17215-44-0)
- j) DNGU (DINGU or dinitroglycoluril) (C.A.S. #55510-04-8)
- k) Furazans
- l) HMX and derivatives
- m) HNAD (hexanitroadamantane) (C.A.S. #143850-71-9)
- n) HNS (hexanitrostilbene) (C.A.S. #20062-22-0)
- o) Imidazoles
- p) NTNMH (1-(2-nitrotriazolo)-2-dinitromethylene hydrazine)
- q) NTO (ONTA or 3-nitro-1,2,4-triazol-5-one) (C.A.S. #932-64-9)
- r) Polynitrocubanes with more than four nitro groups
- s) PYX (2,6-Bis(picrylamino)-3,5-dinitropyridine) (C.A.S. #38082-89-2)
- t) RDX and derivatives
- u) TAGN (Triaminoguanidinenitrate) (C.A.S. #4000-16-2)
- v) TATB (Triaminotrinitrobenzene) (C.A.S. #3058-38-6)
- w) TEDDZ (3,3,7,7-tetrabis(difluoroamine) octahydro-1,5-dinitro-1,5-diazocine)
- x) Tetrazoles
- y) Tetryl (trinitrophenylmethylnitramine) (C.A.S. #479-45-8)

- z) TNAD (1,4,5,8-tetranitro-1,4,5,8-tetraazadecalin) (C.A.S. #135877-16-6)
- aa) TNAZ (1,1,3-trinitroazetidine) (C.A.S. #97645-24-4)
- bb) TNGU (SORGUYL or tetranitroglycoluril) (C.A.S. #55510-03-7)
- cc) TNP (1,4,5,8-tetranitropyridazine) (C.A.S. #229176-04-9)
- dd) Triazines
- ee) Triazoles
- ff) Other explosives with a detonation velocity exceeding 8,700m/s at maximum density or a detonation pressure exceeding 34 Gpa (340 kbar)
- gg) Other organic explosives yielding detonation pressures of 25 Gpa (250 kbar) or more that will remain stable at temperatures of 523K (250° C) or higher for periods of 5 minutes or longer
- hh) Diaminotrinitrobenzene (DATB)
- ii) Any other explosive specifically designed, modified, adapted, or configured (e.g., formulated) for military application

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2. Propellants and constituent chemicals for propellants
3. Production equipment for propellants
4. Commercial charges and devices containing energetic materials
5. Pyrotechnics, fuels and related substances, and mixtures thereof:
 - a) Alane (aluminum hydride)(C.A.S. #7784-21-6)
 - b) Carboranes; decaborane (C.A.S. #17702-41-9); pentaborane and derivatives thereof
 - c) Hydrazine and derivatives
 - d) Liquid fuels specifically formulated for use by launch vehicles, guided missiles, ballistic missiles, rockets, torpedoes, bombs, and mines, vessels of war and special naval equipment and aircraft and associated equipment

- e) Spherical aluminum powder (C.A.S. #7429-90-5) in particle sizes of 60 micrometers or less manufactured from material with an aluminum content of 99% or more
- f) Metal fuels in particle form manufactured from material consisting of 99% or more of metals, alloys and mixtures thereof or explosives and fuels containing metals or alloys
- g) Pyrotechnics and pyrophoric materials specifically formulated for military purposes to enhance or control the production of radiated energy in any part of the IR spectrum
- h) Titanium subhydride (TiH_n) of stoichiometry equivalent to $n = 0.65-1.68$
- i) Military materials containing thickeners for hydrocarbon fuels specially formulated for use in flame throwers or incendiary munitions; metal stearates or palmates (also known as octol); and M1, M2 and M3 thickeners
- j) Any other pyrotechnic, fuel or related substance and mixtures thereof specifically designed, modified, adapted, or configured (e.g., formulated) for military application
- k) Specially designed nozzles for producing pyrolytically derived materials

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6. Oxidizers:

- a) ADN (ammonium dinitramide or SR-12) (C.A.S. #140456-78-6)
- b) AP (ammonium perchlorate) (C.A.S. #7790-98-9)
- c) BDNPN (bis,2,2-dinitropropyl nitrate) (C.A.S. #28464-24-6)
- d) DNAD (1,3-dinitro-1,3-diazetidine) (C.A.S. #78246-06-7)
- e) HAN (Hydroxylammonium nitrate) (C.A.S. #13465-08-2)
- f) HAP (hydroxylammonium perchlorate) (C.A.S. #15588-62-2); HNF (Hydrazinium nitroformate) (C.A.S. #20773-28-8)
- g) Hydrazine nitrate (C.A.S. #37836-27-4)
- h) Hydrazine perchlorate (C.A.S. #27978-54-7)

- i) Liquid oxidizers comprised of or containing inhibited red fuming nitric acid (IRFNA) (C.A.S. #8007-58-7) or oxygen difluoride
- j) Perchlorates, chlorates, and chromates composited with powdered metal or other high energy fuel components
- k) Any other oxidizer specifically designed, modified, adapted, or configured (e.g., formulated) for military application

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7. Binders, and mixtures thereof:

- a) AMMO (azidomethylmethyloxetane and its polymers) (C.A.S. #90683-29-7)
- b) BAMO (bisazidomethyloxetane and its polymers) (C.A.S. #17607-204)
- c) BTTN (butanetrioltrinitrate) (C.A.S. #6659-60-5)
- d) FAMAO (3-difluoroaminomethyl-3-azidomethyl oxetane) and its polymers
- e) FEFO (bis-(2-fluoro-2,2-dinitroethyl)formal) (C.A.S. #17003-79-1)
- f) GAP (glycidylazide polymer) (C.A.S. #143178-24-9) and its derivatives
- g) HTPB (hydroxyl terminated polybutadiene) with a hydroxyl functionality equal to or greater than 2.2 and less than or equal to 2.4, a hydroxyl value of less than 0.77 meq/g, and a viscosity at 30[deg] C of less than 47 poise (C.A.S. #69102-90-5)
- h) NENAS (nitroethylnitramine compounds) (C.A.S. #17096-47-8, 85068-73-1 and 82486-82-6)
- i) Poly-NIMMO (nitratomethylmethyloxetane (poly [3-nitratomethyl, 3-methyl oxetane] or (NMMO)) (C.A.S. #84051-81-0)
- j) Energetic monomers, plasticizers and polymers containing nitro, azido nitrate, nitraza or difluoromaino groups specially formulated for military use
- k) TVOPA 1,2,3-Tris [1,2-bis(difluoroamino) ethoxy]propane; tris vinoxyl propane adduct

- l) Polynitrorthocarbonates
- m) FPF-1 poly-2,2,3,3,4,4-hexafluoro pentane-1,5-diolformal
- n) FPF-3 poly-2,4,4,5,5,6,6-heptafluoro-2-trifluoromethyl-3-oxaheptane-1,7-dioformal
- o) PGN (Polyglycidylnitrate or poly(nitratomethyl oxirane); poly-GLYN)
- p) N-methyl-p-nitroaniline
- q) Low (less than 10,000) molecular weight, alcohol-functionalized, oly(epichlorohydrin); poly(epichlorohydrindiol) and triol
- r) Bis(2,2-dinitropropyl) formal and acetal
- s) Any other binder and mixture specifically designed, modified, adapted, or configured (e.g., formulated) for military application

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8. Additives:

- a) Basic copper salicylate (C.A.S. #62320-94-9)
- b) BHEGA (Bis-(2-hydroxyethyl)glycolamide) (C.A.S. #17409-41-5)
- c) Ferrocene Derivatives
- d) Lead beta-resorcylate (C.A.S. #20936-32-7)
- e) Lead citrate (C.A.S. #14450-60-3)
- f) Lead-copper chelates of beta-resorcylate or salicylates (C.A.S. #68411-07-4)
- g) Lead maleate (C.A.S. #19136-34-6)
- h) Lead salicylate (C.A.S. #15748-73-9)
- i) Lead stannate (C.A.S. #12036-31-6)
- j) MAPO (tris-1-(2-methyl)aziridinyl phosphine oxide) (C.A.S. #57-39-6); BOBBA-8 (bis(2-methyl aziridinyl) 2-(2-hydroxypropanoxy) propylamino phosphine oxide); and other MAPO derivatives

- k) Methyl BAPO (Bis(2-methyl aziridiny) methylamino phosphine oxide) (C.A.S. #85068-72-0)
- l) 3-Nitraz-1,5 pentane diisocyanate (C.A.S. #7406-61-9)
- m) Organo-metallic coupling agents
- n) Polyfunctional aziridine amides with isophthalic, trimesic (BITA or butylene imine trimesamide), isoyanuric, or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring and its polymers
- o) Superfine iron oxide (Fe₂O₃ hematite) with a specific surface area more than 250 m²/g and an average particle size of 0.003 [μ]m or less (C.A.S. #1309-37-1)
- p) TEPAN (tetraethylenepentaamineacrylonitrile) (C.A.S. #68412-45-3); cyanoethylated polyamines and their salts
- q) TEPANOL (Tetra ethylene pentamine acrylo nitrile glycidol) (C.A.S. #110445-33-5); cyanoethylated polyamines adducted with glycidol and their salts
- r) TPB (triphenyl bismuth) (C.A.S. #603-33-8)
- s) PCDE (Poly[chyph]cyano di fluoro aminoethyl ene oxide)
- t) BNO (Butadienenitrileoxide)
- u) Any other additive specifically designed, modified, adapted, or configured (e.g., formulated) for military application

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9. Precursors:

- a) BCMO (bischloromethyloxetane) (C.A.S. #142173-26-0)
- b) Dinitroazetidine-t-butyl salt (C.A.S. #125735-38-8)
- c) HBIW (hexabenzylhexaazaisowurtzitane) (C.A.S. #124782-15-6)
- d) TAIW (tetraacetyldibenzylhexa-azaisowurtzitane)

- e) TAT (1,3,5,7-tetraacetyl-1,3,5,7-tetraaza-cyclooctane) (C.A.S. #41378-98-7)
- f) Tetraazadecalin (C.A.S. #5409-42-7)
- g) 1,3,5-trichlorobenzene (C.A.S. #108-70-3)
- h) 1,2,4-trihydroxybutane (1,2,4-butanetriol) (C.A.S. #3068-00-6)

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- 10. Explosives or detonator detection systems and equipment
- 11. Software or technology for the development, production or use of any of the items listed above
- 12. Technical data and defense services related to any of the above items

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XIII SPECIAL NAVAL EQUIPMENT, TANKS, MILITARY VEHICLES, MILITARY AIRCRAFT, SUBMERSIBLE VESSELS AND OCEANOGRAPHIC AND ASSOCIATED EQUIPMENT

- 1. Military type armed or armored vehicles, military railway trains, and vehicles specifically designed or modified to accommodate mountings for arms or other specialized military equipment or fitted with such items and engines specially designed for such vehicles
- 2. Military tanks, combat engineer vehicles, bridge launching vehicles, half-tracks and gun carriers and engines specially designed for such vehicles
- 3. Military trucks, trailers hoists and skids specifically designed, modified or equipped to mount or carry or handle firearms, ammunition, guns and armament, launch vehicles, guided missiles, ballistic missiles, rockets, torpedoes, bombs and mines and engines specially designed for such vehicles
- 4. Military recovery vehicles
- 5. Amphibious vehicles
- 6. Submersible vessels, manned or unmanned, tethered or untethered, designed or modified for military purposes, or powered by nuclear propulsion plants

7. Swimmer delivery vehicles designed or modified for military purposes
8. Warships, amphibious warfare vessels, landing craft, mine warfare vessels, patrol vessels and any vessels specifically designed or modified for military purposes
9. Patrol craft without armor, armament or mounting surfaces for weapon systems more significant than .50 caliber machine guns or equivalent and auxiliary vessels
10. Turrets and gun mounts, arresting gear, special weapons systems, protective systems, submarine storage batteries, catapults, mine sweeping equipment (including mine countermeasures equipment deployed by aircraft) and other significant naval systems specifically designed or modified for combatant vessels
11. Harbor entrance detection devices (magnetic, pressure, and acoustic) and controls therefor
12. Aircraft, including but not limited to helicopters, non-expansive balloons, drones, and lighter-than-air aircraft, which are specifically designed, modified, or equipped for military purposes, such as for gunnery, bombing, rocket or missile launching, electronic and other surveillance, reconnaissance, refueling, aerial mapping, military liaison, cargo carrying or dropping, personnel dropping, airborne warning and control, and military training
13. Ground transport vehicles and parts and components therefor designed or modified for non-combat military use and unarmed all-wheel drive vehicles capable of off-road use which have been manufactured or fitted with materials to provide ballistic protection to level III or better
14. Engines specifically designed or modified for military aircraft
15. Cartridge-actuated devices utilized in emergency escape of personnel and airborne equipment (including but not limited to airborne refueling equipment) specifically designed or modified for use with the aircraft and engines listed above
16. Inertial navigation systems, aided or hybrid inertial navigation systems, Inertial Measurement Units (IMUs), and Attitude and Heading Reference Systems (AHRS) specifically designed, modified, or configured for military use and all specifically designed components, parts and accessories
17. Developmental aircraft, engines, and components thereof specifically designed, modified, or equipped for military uses or purposes, or developed principally with U.S. Department of Defense funding
18. Ground effect machines (GEMS) specifically designed or modified for military use, including but not limited to surface effect machines and other air cushion vehicles, and all components, parts, and accessories, attachments, and associated equipment specifically designed or modified for use with such machines

19. Military trainer aircraft bearing “T” designations
20. Pressure refuelers, pressure refueling equipment, and equipment specially designed to facilitate operations in confined areas; and ground equipment, developed specially for military aircraft and helicopters, and specially designed parts and accessories
21. Pressurized breathing equipment specially designed for use in military aircraft and helicopters
22. Military parachutes and complete canopies, harnesses, and platforms and electronic release mechanisms therefor
23. Military instrument flight trainers, except for combat simulation; and components, parts, attachments and accessories specially designed for such equipment
24. Construction equipment built to military specifications, specially designed for airborne transport; and specially designed parts and accessories therefor
25. Specially designed components and parts for ammunition
26. Components, parts, accessories, attachments and associated equipment specifically designed or modified for the items listed above
27. Software required for the development, production or use of equipment or technology listed above
28. Technology for the development, production or use of equipment or software listed above
29. Technical data and defense services directly related to the manufacture or production of any of the above items

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XIV OTHER MILITARY EQUIPMENT

1. Military training equipment including but not limited to attack trainers, radar target trainers, radar target generators, gunnery training devices, antisubmarine warfare trainers, target equipment, armament training units, pilot-less aircraft trainers, navigation trainers, human-rated centrifuges, operational flight trainers, air combat training systems, radar trainers, and simulation devices related to defense articles
2. Cameras and specialized processing equipment therefor, photointerpretation, stereoscopic plotting, and photogrammetry equipment which are specifically

designed or modified for military purposes, and components specifically designed or modified therefor

3. Military Information Security Assurance System and equipment
4. Self-contained diving and underwater breathing apparatus
5. Concealment and deception equipment, including but not limited to special paints, decoys, and simulators and components, parts and accessories specifically designed or modified therefor
6. Energy conversion devices for producing electrical energy from nuclear, thermal, or solar energy, or from chemical reaction which are specifically designed or modified for military application
7. Chemiluminescent compounds and solid state devices specifically designed or modified for military application
8. Devices embodying particle beam and electromagnetic pulse technology and associated components and subassemblies that are specifically designed or modified for directed energy weapon applications
9. Metal embrittling agents
10. Hardware and equipment, which has been specifically designed or modified for military applications, that is associated with the measurement or modification of system signatures for detection of defense articles, including signature measurement equipment; prediction techniques and codes; signature materials and treatments; and signature control design methodology
11. Body armor; military helmets equipped with communications hardware, optical sights, slewing devices or mechanisms to protect against thermal flash or lasers, excluding standard military helmets
12. Partial pressure suits and liquid oxygen converters used in aircraft
13. Protective apparel and equipment specifically designed or modified for use with toxicological agents and equipment and Radiological equipment
14. Conventional military steel helmets
15. Restraint devices, including thumbcuffs, leg irons, shackles, and handcuffs, straight jackets, plastic handcuffs and parts and accessories thereof
16. Specially designed implements of torture and thumbscrews and parts and accessories thereof

17. Specialized machinery, equipment, gear, and specially designed parts and accessories therefor, that are specially designed for the examination, manufacture, testing, and checking of arms, appliances, machines, and implements of war
18. Components, parts, accessories, attachments, and associated equipment specifically designed or modified for use with the items listed above
19. Technical data and defense services directly related to the items listed above

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XV FIRE CONTROL, RANGE FINDER, OPTICAL AND GUIDANCE AND CONTROL EQUIPMENT

1. Fire control systems
2. Gun and missile tracking and guidance systems
3. Gun range, position, height finders, spotting instruments and laying equipment; aiming devices (electronic, optic, and acoustic)
4. Bomb sights, bombing computers, military television sighting and viewing units, and periscopes for fire control, range finder, optical and guidance and control equipment
5. Infrared focal plane array detectors specifically designed, modified or configured for military use
6. Image intensification and other night sighting equipment or systems specifically designed, modified, or configured for military use
7. Second generation and above military image intensification tubes specifically designed, developed, modified or configured for military use, and infrared, visible and ultraviolet devices specifically designed, developed, modified, or configured for military application
8. Inertial platforms and sensors for weapons or weapon systems
9. Guidance, control and stabilization systems
10. Astro-compasses and star trackers and military accelerometers and gyros
11. Components, parts, accessories, attachments and associated equipment specifically designed or modified for the items listed above
12. Technical data and defense services directly related to the items listed above

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XVI DIRECTED ENERGY WEAPONS

1. Directed energy weapon systems specifically designed or modified for military applications and equipment specifically designed or modified for the detection or identification of, or defense against, such articles, such as:
 - a) Laser systems, including continuous wave or pulsed laser systems, specifically designed or modified to cause blindness
 - b) Lasers of sufficient continuous wave or pulsed power to effect destruction similar to the manner of conventional ammunition
 - c) Particle beam systems
 - d) Particle accelerators
 - e) High power radio-frequency (RF) systems
 - f) High pulsed power or high average power radio frequency beam transmitters
 - g) Prime power generation, energy storage, switching, power conditioning, thermal management or fuel handling equipment
 - h) Target acquisition or tracking systems
 - i) Systems capable of assessing target damage, destruction or mission-abort
 - j) Beam-handling propagation or pointing equipment
 - k) Equipment with rapid beam slew capability for rapid multiple target operations
 - l) Negative ion beam funneling equipment
 - m) Equipment for controlling and slewing a high-energy ion beam
2. Tooling or equipment specifically designed or modified for the items listed above
3. Test and evaluation equipment and test models specifically designed or modified for the items listed above
4. Components, parts, accessories, attachments and associated equipment specifically designed or modified for the items listed above

5. Technical data and defense services directly related to the items listed above

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* Last updated on October 8, 2007