The United States Munitions List.

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(a) *U.S. Munitions List.* In this part, articles, services, and related technical data are designated as defense articles or defense services pursuant to sections 38 and 47(7) of the Arms Export Control Act and constitute the U.S. Munitions List (USML). Changes in designations are published in the FEDERAL REGISTER. Paragraphs (a)(1) through (3) of this section describe or explain the elements of a USML category:

(1) *Composition of U.S. Munitions List categories.* USML categories are organized by paragraphs and subparagraphs identified alphanumerically. They usually start by enumerating or otherwise

describing end-items, followed by major systems and equipment; parts, components, accessories, and attachments; and technical data and defense services directly related to the defense articles of that USML category.

(2) *Significant Military Equipment.* All items described within a USML paragraph or subparagraph that is preceded by an asterisk (*) are designated "Significant Military Equipment" (*see* §120.7 of this subchapter). Note that technical data directly related to the manufacture or production of a defense article designated as Significant Military Equipment (SME) is also designated as SME.

(3) *Missile Technology Control Regime (MTCR) designation.* Annotation with the parenthetical "(MT)" at the end of a USML entry, or inclusion in §121.16, indicates those defense articles that are on the MTCR Annex. *See* §120.29 of this subchapter.

(b) *Order of review.* Articles are controlled on the U.S. Munitions List because they are either:

(1) Enumerated in a category; or

(2) Described in a "catch-all" paragraph that incorporates "specially designed" (see §120.41 of this subchapter) as a control parameter. In order to classify an item on the USML, begin with a review of the general characteristics of the item. This should guide you to the appropriate category, whereupon you should attempt to match the particular characteristics and functions of the article to a specific entry within that category. If the entry includes the term "specially designed," refer to §120.41 to determine if the article qualifies for one or more of the exclusions articulated in §120.41(b). An item described in multiple entries should be categorized according to an enumerated entry rather than a specially designed catch-all paragraph. In all cases, articles not controlled on the USML may be subject to another U.S. government regulatory agency (*see* §120.5 of this subchapter, and Supplement No. 4 to part 774 of the Export Administration Regulations for guidance on classifying an item subject to the EAR).

Category I—Firearms, Close Assault Weapons and Combat Shotguns

*(a) Nonautomatic and semi-automatic firearms to caliber .50 inclusive (12.7 mm).

*(b) Fully automatic firearms to .50 caliber inclusive (12.7 mm).

*(c) Firearms or other weapons (e.g. insurgency-counterinsurgency, close assault weapons systems) having a special military application regardless of caliber.

*(d) Combat shotguns. This includes any shotgun with a barrel length less than 18 inches.

*(e) Silencers, mufflers, sound and flash suppressors for the articles in (a) through (d) of this category and their specifically designed, modified or adapted components and parts.

(f) Riflescopes manufactured to military specifications (See category XII(c) for controls on night sighting devices.)

*(g) Barrels, cylinders, receivers (frames) or complete breech mechanisms for the articles in paragraphs (a) through (d) of this category.

(h) Components, parts, accessories and attachments for the articles in paragraphs (a) through (g) of this category.

(i) Technical data (as defined in §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (h) of this category. Technical data directly related to the manufacture or production of any defense articles described elsewhere in this category that are designated as Significant Military Equipment (SME) shall itself be designated SME.

(j) The following interpretations explain and amplify the terms used in this category and throughout this subchapter:

(1) A firearm is a weapon not over .50 caliber (12.7 mm) which is designed to expel a projectile by the action of an explosive or which may be readily converted to do so.

(2) A rifle is a shoulder firearm which can discharge a bullet through a rifled barrel 16 inches or longer.

(3) A carbine is a lightweight shoulder firearm with a barrel under 16 inches in length.

(4) A pistol is a hand-operated firearm having a chamber integral with or permanently aligned with the bore.

(5) A revolver is a hand-operated firearm with a revolving cylinder containing chambers for individual cartridges.

(6) A submachine gun, “machine pistol” or “machine gun” is a firearm originally designed to fire, or capable of being fired, fully automatically by a single pull of the trigger.

Category II—Guns and Armament

*(a) Guns over caliber .50 (*i.e.,* 12.7 mm), whether towed, airborne, self-propelled, or fixed, including but not limited to, howitzers, mortars, cannons, recoilless rifles, and grenade launchers.

(b) Flame throwers specifically designed or modified for military application.

(c) Apparatus and devices for launching or delivering ordnance, other than those articles controlled in Category IV.

*(d) Kinetic energy weapon systems specifically designed or modified for destruction or rendering mission-abort of a target.

(e) Signature control materials (e.g., parasitic, structural, coatings, screening) techniques, and equipment specifically designed, developed, configured, adapted or modified to alter or reduce the signature (e.g., muzzle flash suppression, radar, infrared, visual, laser/electro-optical, acoustic) of defense articles controlled by this category.

*(f) Engines specifically designed or modified for the self-propelled guns and howitzers in paragraph (a) of this category.

(g) Tooling and equipment specifically designed or modified for the production of defense articles controlled by this category.

(h) Test and evaluation equipment and test models specifically designed or modified for the articles controlled by this category. This includes but is not limited to diagnostic instrumentation and physical test models.

(i) Autoloading systems for electronic programming of projectile function for the defense articles controlled in this Category.

(j) All other components, parts, accessories, attachments and associated equipment specifically designed or modified for the articles in paragraphs (a) through (i) of this category. This includes but is not limited to mounts and carriages for the articles controlled in this category.

(k) Technical data (as defined in §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (j) of this category. Technical data directly related to the manufacture or production of any defense articles described elsewhere in this category that are designated as Significant Military Equipment (SME) shall itself be designated SME.

(l) The following interpretations explain and amplify the terms used in this category and elsewhere in this subchapter:

(1) The kinetic energy weapons systems in paragraph (d) of this category include but are not limited to:

(i) Launch systems and subsystems capable of accelerating masses larger than 0.1g to velocities in excess of 1.6km/s, in single or rapid fire modes, using methods such as: electromagnetic, electrothermal, plasma, light gas, or chemical;

(ii) Prime power generation, electric armor, energy storage, thermal management; conditioning, switching or fuel-handling equipment; and the electrical interfaces between power supply gun and other turret electric drive function;

(iii) Target acquisition, tracking fire control or damage assessment systems; and

(iv) Homing seeker, guidance or divert propulsion (lateral acceleration) systems for projectiles.

(2) The articles in this category include any end item, component, accessory, attachment part, firmware, software or system that has been designed or manufactured using technical data and defense services controlled by this category.

(3) The articles specifically designed or modified for military application controlled in this category include any article specifically developed, configured, or adapted for military application.

Category III—Ammunition/Ordnance

*(a) Ammunition/ordnance for the articles in Categories I and II of this section.

(b) Ammunition/ordnance handling equipment specifically designed or modified for the articles controlled in this category, such as, belting, linking, and de-linking equipment.

(c) Equipment and tooling specifically designed or modified for the production of defense articles controlled by this category.

(d) Components, parts, accessories, attachments and associated equipment specifically designed or modified for the articles in this category:

*(1) Guidance and control components for the articles in paragraph (a) of this category;

*(2) Safing, arming and fuzing components (including target detection and localization devices) for the articles in paragraph (a) of this category; and

(3) All other components, parts, accessories, attachments and associated equipment for the articles in paragraphs (a) through (c) of this category.

(e) Technical data (as defined in §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (d) of this category. Technical data directly related to the manufacture or production of any defense articles described elsewhere in this category that are designated as Significant Military Equipment (SME) shall itself be designated SME.

(f) The following explains and amplifies the terms used in this category and elsewhere in this subchapter:

(1) The components, parts, accessories and attachments controlled in this category include, but are not limited to cartridge cases, powder bags (or other propellant charges), bullets, jackets, cores, shells (excluding shotgun shells), projectiles (including canister rounds and submunitions therefor), boosters, firing components therefor, primers, and other detonating devices for the defense articles controlled in this category.

(2) This category does not control cartridge and shell casings that, prior to export, have been rendered useless beyond the possibility of restoration for use as a cartridge or shell casing by means of heating, flame treatment, mangling, crushing, cutting or popping.

(3) Equipment and tooling in paragraph (c) of this category does not include equipment for hand-loading ammunition.

(4) The articles in this category include any end item, component, accessory, attachment, part, firmware, software, or system that has been designed or manufactured using technical data and defense services controlled by this category.

(5) The articles specifically designed or modified for military application controlled in this category include any article specifically developed, configured, or adapted for military application

Category IV—Launch Vehicles, Guided Missiles, Ballistic Missiles, Rockets, Torpedoes, Bombs, and Mines

*(a) Rockets, space launch vehicles (SLVs), missiles, bombs, torpedoes, depth charges, mines, and grenades, as follows:

(1) Rockets, SLVs, and missiles capable of delivering at least a 500-kg payload to a range of at least 300 km (MT);

(2) Rockets, SLVs, and missiles capable of delivering less than a 500-kg payload to a range of at least 300 km (MT);

(3) Man-portable air defense systems (MANPADS);

(4) Anti-tank missiles and rockets;

(5) Rockets, SLVs, and missiles not meeting the criteria of paragraphs (a)(1) through (a)(4) of this category;

(6) Bombs;

(7) Torpedoes;

(8) Depth charges;

(9) Anti-personnel, anti-vehicle, or anti-armor land mines (e.g., area denial devices);

(10) Anti-helicopter mines;

(11) Naval mines; or

(12) Fragmentation and high explosive hand grenades.

*(b) Launchers for rockets, SLVs, and missiles, as follows:

(1) Fixed launch sites and mobile launcher mechanisms for any system enumerated in paragraphs (a)(1) and (a)(2) of this category (MT); or

(2) Fixed launch sites and mobile launcher mechanisms for any system enumerated in paragraphs (a)(3) through (a)(5) of this category (e.g., launch tables, TOW missile, MANPADS).

(c) Apparatus and devices specially designed for the handling, control, activation, monitoring, detection, protection, discharge, or detonation of the articles enumerated in paragraphs (a) and (b) of this category (MT for those systems enumerated in paragraphs (a)(1), (a)(2), and (b)(1) of this category).

*(d) Rocket, SLV, and missile power plants, as follows:

(1) Except as enumerated in paragraph (d)(2) or (d)(3) of this category, individual rocket stages for the articles enumerated in paragraph (a)(1), (a)(2), or (a)(5) of this category (MT for those stages usable in systems enumerated in paragraphs (a)(1) and (a)(2) of this category);

(2) Solid propellant rocket motors, hybrid or gel rocket motors, or liquid propellant rocket engines having a total impulse capacity equal to or greater than 1.1×10^6 N·s (MT);

(3) Solid propellant rocket motors, hybrid or gel rocket motors, or liquid propellant rocket engines having a total impulse capacity equal to or greater than 8.41×10^5 N·s, but less than 1.1×10^6 N·s (MT);

(4) Combined cycle, pulsejet, ramjet, or scramjet engines (MT);

(5) Air-breathing engines that operate above Mach 4 not enumerated in paragraph (d)(4) of this category;

(6) Pressure gain combustion-based propulsion systems not enumerated in paragraphs (d)(4) and (d)(5) of this category; or

(7) Rocket, SLV, and missile engines and motors, not otherwise enumerated in paragraphs (d)(1) through (d)(6) of this category or USML Category XIX.

(e)-(f) [Reserved]

*(g) Non-nuclear warheads for rockets, bombs, and missiles (e.g., explosive, kinetic, EMP, thermobaric, shape charge, and fuel air explosive (FAE)).

(h) Systems, subsystems, parts, components, accessories, attachments, or associated equipment, as follows:

(1) Flight control and guidance systems (including guidance sets) specially designed for articles enumerated in paragraph (a) of this category (MT for those articles enumerated in paragraphs (a)(1) and (a)(2) of this category);

(2) Seeker systems specially designed for articles enumerated in paragraph (a) of this category (e.g., radiofrequency, infrared) (MT for articles enumerated in paragraphs (a)(1) and (a)(2) of this category);

(3) Kinetic kill vehicles and specially designed parts and components therefor;

(4) Missile or rocket thrust vector control systems (MT for those thrust vector control systems usable in articles enumerated in paragraph (a)(1) of this category);

(5) MANPADS grip stocks and specially designed parts and components therefor;

(6) Rocket or missile nozzles and nozzle throats, and specially designed parts and components therefor (MT for those nozzles and nozzle throats usable in systems enumerated in paragraphs (a)(1) and (a)(2) of this category);

(7) Rocket or missile nose tips, nose fairings, or aerospikes, and specially designed parts and components therefor (MT for those articles enumerated in paragraphs (a)(1) and (a)(2) of this category);

(8) Re-entry vehicle or warhead heat shields (MT for those re-entry vehicles and heat shields usable in systems enumerated in paragraph (a)(1) of this category);

(9) Missile and rocket safing, arming, fuzing, and firing (SAFF) components (to include target detection and proximity sensing devices), and specially designed parts therefor (MT for those SAFF components usable in systems enumerated in paragraph (a)(1) of this category);

(10) Self-destruct systems specially designed for articles enumerated in paragraph (a) of this category (MT for those articles enumerated in paragraphs (a)(1) and (a)(2) of this category);

(11) Separation mechanisms, staging mechanisms, and interstages useable for articles enumerated in paragraph (a) of this category, and specially designed parts and components therefor (MT for those separation mechanisms, staging mechanisms, and interstages usable in systems enumerated in paragraph (a)(1) of this category);

(12) Post-boost vehicles (PBV) (MT);

(13) Engine or motor mounts specially designed for articles enumerated in paragraphs (a) and (b) of this category (MT for those articles enumerated in paragraphs (a)(1), (a)(2), and (b)(1) of this category);

(14) Combustion chambers specially designed for articles enumerated in paragraphs (a) and (d) of this category and specially designed parts and components therefor (MT for those articles enumerated in paragraphs (a)(1), (a)(2), (b)(1), and (d)(1) through (d)(5) of this category);

(15) Injectors specially designed for articles controlled in this category (MT for those injectors specially designed which are usable in systems enumerated in paragraph (a)(1) of this category);

(16) Solid rocket motor or liquid engine igniters;

(17) Re-entry vehicles and specially designed parts and components therefor not elsewhere specified in this category (MT);

(18) Specially designed parts and components for articles controlled in paragraph (g) not elsewhere specified in this category;

(19) Penetration aids and specially designed parts and components therefor (e.g., physical or electronic countermeasure suites, re-entry vehicle replicas or decoys, or submunitions);

(20) Rocket motor cases and specially designed parts and components therefor (e.g., flanges, flange seals, end domes) (MT for those rocket motor cases usable in systems enumerated in paragraphs (a)(1) and (a)(2) of this category and for specially designed parts and components for hybrid rocket motors enumerated in paragraphs (d)(2) and (d)(3) of this category);

(21) Solid rocket motor liners and rocket motor insulation (MT for those solid rocket motor liners usable in systems enumerated in paragraph (a)(1) of this category or specially designed for systems enumerated in paragraph (a)(2) of this category; and rocket motor insulation usable in systems enumerated in paragraphs (a)(1) and (a)(2) of this category);

(22) Radomes, sensor windows, and antenna windows specially designed for articles enumerated in paragraph (a) of this category (MT for those radomes usable in systems enumerated in paragraph (a)(1) of this category and for

any radomes, sensor windows, or antenna windows manufactured as composite structures or laminates specially designed for use in the systems and components enumerated in paragraph (a)(1), (a)(2), (d)(1), (h)(8), (h)(9), (h)(17), or (h)(25) of this category);

(23) Rocket or missile payload fairings;

(24) Rocket or missile launch canisters (MT for those rocket or missile launch canisters designed or modified for systems enumerated in paragraphs (a)(1) and (a)(2) of this category);

(25) Fuzes specially designed for articles enumerated in paragraph (a) of this category (e.g., proximity, contact, electronic, dispenser proximity, airburst, variable time delay, or multi-option) (MT for those fuzes usable in systems enumerated in paragraph (a)(1) of this category);

(26) Rocket or missile liquid propellant tanks (MT for those rocket or missile liquid propellant tanks usable in systems enumerated in paragraph (a)(1) of this category);

(27) Rocket or missile altimeters specially designed for use in articles enumerated in paragraph (a)(1) of this category (MT);

(28) Pneumatic, hydraulic, mechanical, electro-optical, or electromechanical flight control systems (including fly-by-wire systems) and attitude control equipment specially designed for use in the rockets or missiles enumerated in paragraph (a)(1) of this category (MT for these systems which have been designed or modified for those enumerated in paragraph (a)(1) of this category);

(29) Umbilical and interstage electrical connectors specially designed for use in the rockets or missiles enumerated in paragraph (a)(1) or (a)(2) of this category (MT); or

*(30) Any part, component, accessory, attachment, equipment, or system that (MT for those articles designated as such):

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

(j)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category V—Explosives and Energetic Materials, Propellants, Incendiary Agents, and Their Constituents

*(a) Explosives, and mixtures thereof, as follows:

(1) ADNBF (aminodinitrobenzofuroxan or 7-Amino 4,6-dinitrobenzofurazane-1-oxide) (CAS 97096-78-1);

(2) BNCP (cis-bis(5-nitrotetrazolato) tetra amine-cobalt (III) perchlorate) (CAS 117412-28-9);

(3) CL-14 (diaminodinitrobenzofuroxan or 5,7-diamino-4,6-dinitrobenzofurazane-1-oxide) (CAS 117907-74-1);

(4) CL-20 (HNIW or Hexanitrohexaazaisowurtzitane) (CAS 135285-90-4); clathrates of CL-20 (MT for CL-20);

(5) CP (2-(5-cyanotetrazolato) penta aminecobalt (III) perchlorate) (CAS 70247-32-4);

(6) DADE (1,1-diamino-2,2-dinitroethylene, FOX-7) (CAS 145250-81-3);

(7) DATB (Diaminotrinitrobenzene) (CAS 1630-08-6);

(8) DDFP (1,4-dinitrodifurazanopiperazine);

(9) DDPO (2,6-diamino-3,5-dinitropyrazine-1-oxide, PZO) (CAS 194486-77-6);

(10) DIPAM (3,3′-Diamino-2,2′,4,4′,6,6′-hexanitrobiphenyl or dipicramide) (CAS 17215-44-0);

(11) DNAN (2,4-Dinitroanisole) (CAS 119-27-7);

(12) DNGU (DINGU or dinitroglycoluril) (CAS 55510-04-8);

(13) Furazans, as follows:

(i) DAAOF (DAAF, DAAFox, or diaminoazoxyfurazan);

(ii) DAAzF (diaminoazofurazan) (CAS 78644-90-3);

(iii) ANF (Furazanamine, 4-nitro- or 3-Amino-4-nitrofurazan; or 4-Nitro-1,2,5-oxadiazol-3-amine; or 4-Nitro-3-furazanamine; CAS 66328-69-6); or

(iv) ANAzF (Aminonitroazofurazan or 1,2,5-Oxadiazol-3-amine, 4-[2-(4-nitro-1,2,5-oxadiazol-3-yl) diazenyl]; or 1,2,5-Oxadiazol-3-amine, 4-[(4-nitro-1,2,5-oxadiazol-3-yl)azo]- (9CI); or Furazanamine, 4-[(nitrofurananyl)azo]-; or 4-[(4-Nitro-1,2,5-oxadiazol-3-yl)azo]-1,2,5-oxadiazol-3-amine) (CAS 155438-11-2);

(14) GUDN (Guanylurea dinitramide) FOX-12 (CAS 217464-38-5);

(15) HMX and derivatives, as follows:

(i) HMX (Cyclotetramethylenetetranitramine; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine; 1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane; octogen, octogene) (CAS 2691-41-0) (MT);

(ii) Difluoroaminated analogs of HMX; or

(iii) K-55 (2,4,6,8-tetranitro-2,4,6,8-tetraazabicyclo [3,3,0]-octanone-3, tetranitrosemiglycouril, or keto-bicyclic HMX) (CAS 130256-72-3);

(16) HNAD (hexanitroadamantane) (CAS 143850-71-9);

(17) HNS (hexanitrostilbene) (CAS 20062-22-0);

(18) Imidazoles, as follows:

(i) BNNII (Octohydro-2,5-bis(nitroimino) imidazo [4,5-d]imidazole);

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

(iii) FDIA (1-fluoro-2,4-dinitroimidazole);

(iv) NTDNIA (N-(2-nitrotriazolo)-2,4-dinitro-imidazole); or

(v) PTIA (1-picryl-2,4,5-trinitroimidazole);

(19) NTNMH (1-(2-nitrotriazolo)-2-dinitromethylene hydrazine);

(20) NTO (ONTA or 3-nitro-1,2,4-triazol-5-one) (CAS 932-64-9);

(21) Polynitrocubanes with more than four nitro groups;

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

(23) RDX and derivatives, as follows:

(i) RDX (cyclotrimethylenetrinitramine), cyclonite, T4, hexahydro-1,3,5-trinitro-1,3,5-triazine, 1,3,5-trinitro-1,3,5-triaza-cyclohexane, hexogen, or hexogene) (CAS 121-82-4) (MT);

(ii) Keto-RDX (K-6 or 2,4,6-trinitro-2,4,6-triazacyclohexanone) (CAS 115029-35-1); or

(iii) Difluoraminated derivative of RDX; 1,3-Dinitro-5,5-bis(difluoramino)1,3-diazahexane (CAS No. 193021-34-0);

(24) TAGN (Triaminoguanidinenitrate) (CAS 4000-16-2);

(25) TATB (Triaminotrinitrobenzene) (CAS 3058-38-6);

(26) TEDDZ (3,3,7,7-tetrakis(difluoroamine) octahydro-1,5-dinitro-1,5-diazocine;

(27) Tetrazines, as follows:

(i) BTAT (Bis(2,2,2-trinitroethyl)-3,6-diaminotetrazine); or

(ii) LAX-112 (3,6-diamino-1,2,4,5-tetrazine-1,4-dioxide);

(28) Tetrazoles, as follows:

(i) NTAT (nitrotriazolaminotetrazole); or

(ii) NTNT (1-N-(2-nitrotriazolo)-4-nitrotetrazole);

(29) Tetryl (trinitrophenylmethylnitramine) (CAS 479-45-8);

(30) TEX (4,10-Dinitro-2,6,8,12-tetraoxa-4,10-diazaisowurtzitane);

(31) TNAD (1,4,5,8-tetranitro-1,4,5,8-tetraazadecalin) (CAS 135877-16-6);

(32) TNAZ (1,3,3-trinitroazetidine) (CAS 97645-24-4);

(33) TNGU (SORGUYL or tetranitroglycoluril) (CAS 55510-03-7);

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

(35) Triazines, as follows:

(i) DNAM (2-oxy-4,6-dinitroamino-s-triazine) (CAS 19899-80-0); or

(ii) NNHT (2-nitroimino-5-nitro-hexahydro-1,3,5 triazine) (CAS 130400-13-4);

(36) Triazoles, as follows:

(i) 5-azido-2-nitrotriazole;

(ii) ADHTDN (4-amino-3,5-dihydrazino-1,2,4-triazole dinitramide) (CAS 1614-08-0);

(iii) ADNT (1-amino-3,5-dinitro-1,2,4-triazole);

(iv) BDNTA (Bis(dinitrotriazole)amine);

(v) DBT (3,3′-dinitro-5,5-bi-1,2,4-triazole) (CAS 30003-46-4);

(vi) DNBT (dinitrobistriazole) (CAS 70890-46-9);

(vii) NTDNT (1-N-(2-nitrotriazolo) 3,5-dinitro-triazole);

(viii) PDNT (1-picryl-3,5-dinitrotriazole); or

(ix) TACOT (tetranitrobenzotriazolobenzotriazole) (CAS 25243-36-1);

(37) Energetic ionic materials melting between 343 K (70 °C) and 373 K (100 °C) and with detonation velocity exceeding 6800 m/s or detonation pressure exceeding 18 GPa (180 kbar); or

(38) Explosives, not otherwise enumerated in this paragraph or on the CCL in ECCN 1C608, with a detonation velocity exceeding 8700 m/s at maximum density or a detonation pressure exceeding 34 Gpa (340 kbar).

*(b) Propellants, as follows (MT for composite and composite modified double-base propellants):

(1) Any solid propellant with a theoretical specific impulse (*see* paragraph (k)(4) of this category) greater than:

(i) 240 seconds for non-metallized, non-halogenated propellant;

(ii) 250 seconds for non-metallized, halogenated propellant; or

(iii) 260 seconds for metallized propellant;

(2) Propellants having a force constant of more than 1,200 kJ/Kg;

(3) Propellants that can sustain a steady-state burning rate more than 38 mm/s under standard conditions (as measured in the form of an inhibited single strand) of 6.89 Mpa (68.9 bar) pressure and 294K (21 °C);

(4) Elastomer-modified cast double-based propellants with extensibility at maximum stress greater than 5% at 233 K (−40 °C); or

(5) Other composite and composite modified double-base propellants.

(c) Pyrotechnics, fuels and related substances, and mixtures thereof, as follows:

(1) Alane (aluminum hydride) (CAS 7784-21-6);

(2) Carboranes; decaborane (CAS 17702-41-9); pentaborane and derivatives thereof (MT);

(3) Liquid high energy density fuels, as follows (MT):

(i) Mixed fuels that incorporate both solid and liquid fuels, such as boron slurry, having a mass-based energy density of 40 MJ/kg or greater; or

(ii) Other high energy density fuels and fuel additives (e.g., cubane, ionic solutions, JP-7, JP-10) having a volume-based energy density of 37.5 GJ per cubic meter or greater, measured at 20 °C and one atmosphere (101.325 kPa) pressure;

(4) Metal fuels, and fuel or pyrotechnic mixtures in particle form whether spherical, atomized, spheroidal, flaked, or ground, manufactured from material consisting of 99% or more of any of the following:

(i) Metals, and mixtures thereof, as follows:

(A) Beryllium (CAS 7440-41-7) in particle sizes of less than 60 micrometers (MT); or

(B) Iron powder (CAS 7439-89-6) with particle size of 3 micrometers or less produced by reduction of iron oxide with hydrogen;

(ii) Fuel mixtures or pyrotechnic mixtures, which contain any of the following:

(A) Boron (CAS 7440-42-8) or boron carbide (CAS 12069-32-8) fuels of 85% purity or higher and particle sizes of less than 60 micrometers; or

(B) Zirconium (CAS 7440-67-7), magnesium (CAS 7439-95-4), or alloys of these in particle sizes of less than 60 micrometers;

(iii) Explosives and fuels containing the metals or alloys listed in paragraphs (c)(4)(i) and (c)(4)(ii) of this category whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium, or beryllium;

(5) Fuel, pyrotechnic, or energetic mixtures having any nanosized aluminum, beryllium, boron, zirconium, magnesium, or titanium, as follows:

(i) Having particle size less than 200 nm in any direction; and

(ii) Having 60% or higher purity;

(6) Pyrotechnic and pyrophoric materials, as follows:

(i) Pyrotechnic or pyrophoric materials specifically formulated to enhance or control the production of radiated energy in any part of the IR spectrum; or

(ii) Mixtures of magnesium, polytetrafluoroethylene and the copolymer vinylidene difluoride and hexafluoropropylene (MT);

(7) Titanium subhydride (TiHn) of stoichiometry equivalent to n = 0.65-1.68; or

(8) Hydrocarbon fuels specially formulated for use in flame throwers or incendiary munitions containing metal stearates (e.g., octal) or palmitates, and M1, M2, and M3 thickeners.

(d) Oxidizers, as follows:

(1) ADN (ammonium dinitramide or SR-12) (CAS 140456-78-6) (MT);

(2) AP (ammonium perchlorate) (CAS 7790-98-9) (MT);

(3) BDNPN (bis(2,2-dinitropropyl)nitrate) (CAS 28464-24-6);

(4) DNAD (1,3-dinitro-1,3-diazetidine) (CAS 78246-06-7);

(5) HAN (Hydroxylammonium nitrate) (CAS 13465-08-2);

(6) HAP (hydroxylammonium perchlorate) (CAS 15588-62-2);

(7) HNF (Hydrazinium nitroformate) (CAS 20773-28-8) (MT);

(8) Hydrazine nitrate (CAS 37836-27-4) (MT);

(9) Hydrazine perchlorate (CAS 27978-54-7) (MT);

(10) Inhibited red fuming nitric acid (IRFNA) (CAS 8007-58-7) and liquid oxidizers comprised of or containing IRFNA or oxygen difluoride (MT for liquid oxidizers comprised of IRFNA); or

(11) Perchlorates, chlorates, and chromates composited with powdered metal or other high energy fuel components controlled under this category (MT).

*(e) Binders, and mixtures thereof, as follows:

(1) AMMO (azidomethylmethyloxetane and its polymers) (CAS 90683-29-7);

(2) BAMO-3-3 (bis(azidomethyl)oxetane and its polymers) (CAS 17607-20-4);

(3) BTTN (butanetriol trinitrate) (CAS 6659-60-5) (MT);

(4) FAMAO (3-difluoroaminomethyl-3-azidomethyloxetane) and its polymers;

(5) FEFO (bis(2-fluoro-2,2-dinitroethyl)formal) (CAS 17003-79-1);

(6) GAP (glycidyl azide polymer) (CAS 143178-24-9) and its derivatives (MT for GAP);

(7) 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 °C of less than 47 poise (CAS 69102-90-5) (MT);

(8) 4,5 diazidomethyl-2-methyl-1,2,3-triazole (iso-DAMTR) (MT);

(9) NENAS (nitratoethylnitramine compounds), as follows:

(i) N-Methyl 2-nitratoethylnitramine (Methyl-NENA) (CAS 17096-47-8) (MT);

(ii) N-Ethyl 2-nitratoethylnitramine (Ethyl-NENA) (CAS 85068-73-1) (MT);

(iii) N-Propyl 2-nitratoethylnitramine (CAS 82486-83-7);

(iv) N-Butyl-2-nitratoethylnitramine (BuNENA) (CAS 82486-82-6); or

(v) N-Pentyl 2-nitratoethylnitramine (CAS 85954-06-9);

(10) Poly-NIMMO (poly nitratomethylmethyoxetane, poly-NMMO, (poly[3-nitratomethyl-3-methyl oxetane]) (CAS 84051-81-0);

(11) PNO (Poly(3-nitratooxetane));

(12) TVOPA 1,2,3-Tris [1,2-bis(difluoroamino)ethoxy]propane; tris vinoxy propane adduct (CAS 53159-39-0);

(13) Polynitrorthocarbonates;

(14) FPF-1 (poly-2,2,3,3,4,4-hexafluoro pentane-1,5-diolformal) (CAS 376-90-9);

(15) FPF-3 (poly-2,4,4,5,5,6,6-heptafluoro-2-trifluoromethyl-3-oxaheptane-1,7-diolformal);

(16) PGN (Polyglycidyl nitrate or poly(nitratomethyloxirane); poly-GLYN); (CAS 27814-48-8);

(17) N-methyl-p-nitroaniline (MT);

(18) Low (less than 10,000) molecular weight, alcohol-functionalized, poly(epichlorohydrin); poly(epichlorohydrindiol); and triol; or

(19) Dinitropropyl based plasticizers, as follows (MT):

(i) BDNPA (bis (2,2-dinitropropyl) acetal) (CAS 5108-69-0); or

(ii) BDNPF (bis (2,2-dinitropropyl) formal) (CAS 5917-61-3).

(f) Additives, as follows:

(1) Basic copper salicylate (CAS 62320-94-9);

(2) BHEGA (Bis-(2-hydroxyethyl)glycolamide) (CAS 17409-41-5);

(3) BNO (Butadienenitrile oxide);

(4) Ferrocene derivatives, as follows (MT):

(i) Butacene (CAS 125856-62-4);

(ii) Catocene (2,2-Bis-ethylferrocenylpropane) (CAS 37206-42-1);

(iii) Ferrocene carboxylic acids and ferrocene carboxylic acid esters;

(iv) n-butylferrocene (CAS 31904-29-7);

(v) Ethylferrocene (CAS 1273-89-8);

(vi) Propylferrocene;

(vii) Pentylferrocene (CAS 1274-00-6);

(viii) Dicyclopentylferrocene;

(ix) Dicyclohexylferrocene;

(x) Diethylferrocene (CAS 173-97-8);

(xi) Dipropylferrocene;

(xii) Dibutylferrocene (CAS 1274-08-4);

(xiii) Dihexylferrocene (CAS 93894-59-8);

(xiv) Acetylferrocene (CAS 1271-55-2)/1,1′-diacetyl ferrocene (CAS 1273-94-5); or

(xv) Other ferrocene derivatives that do not contain a six carbon aromatic functional group attached to the ferrocene molecule (MT if usable as rocket propellant burning rate modifier);

(5) Lead beta-resorcylate (CAS 20936-32-7);

(6) Lead citrate (CAS 14450-60-3);

(7) Lead-copper chelates of beta-resorcylate or salicylates (CAS 68411-07-4);

(8) Lead maleate (CAS 19136-34-6);

(9) Lead salicylate (CAS 15748-73-9);

(10) Lead stannate (CAS 12036-31-6);

(11) MAPO (tris-1-(2-methyl) aziridinylphosphine oxide) (CAS 57-39-6); BOBBA-8 (bis(2-methyl aziridinyl)-2-(2-hydroxypropanoxy) propylamino phosphine oxide); and other MAPO derivatives (MT for MAPO);

(12) Methyl BAPO (Bis(2-methyl aziridinyl)methylaminophosphine oxide) (CAS 85068-72-0);

(13) 3-Nitraza-1,5-pentane diisocyanate (CAS 7406-61-9);

(14) Organo-metallic coupling agents, as follows:

(i) Neopentyl[diallyl]oxy, tri [dioctyl] phosphatotitanate (CAS 103850-22-2); also known as titanium IV, 2,2[bis 2-propenolato-methyl, butanolato, tris (dioctyl) phosphato] (CAS 110438-25-0), or LICA 12 (CAS 103850-22-2);

(ii) Titanium IV, [(2-propenolato-1) methyl, n-propanolatomethyl] butanolato-1, tris(dioctyl)pyrophosphate, or KR3538; or

(iii) Titanium IV, [(2-propenolato-1)methyl, propanolatomethyl] butanolato-1, tris(dioctyl) phosphate;

(15) PCDE (Polycyanodifluoroaminoethylene oxide);

(16) Certain bonding agents, as follows (MT):

(i) 1,1R,1S-trimesoyl-tris(2-ethylaziridine) (HX-868, BITA) (CAS 7722-73-8); or

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

(17) Superfine iron oxide (Fe_2O_3, hematite) with a specific surface area more than 250 m^2/g and an average particle size of 0.003 micrometers or less (CAS 1309-37-1);

(18) TEPAN (HX-879) (tetraethylenepentaamineacrylonitrile) (CAS 68412-45-3); cyanoethylated polyamines and their salts (MT for TEPAN (HX-879));

(19) TEPANOL (HX-878) (tetraethy-lenepentaamineacrylonitrileglycidol) (CAS 68412-46-4); cyanoethylated polyamines adducted with glycidol and their salts (MT for TEPANOL (HX-878));

(20) TPB (triphenyl bismuth) (CAS 603-33-8) (MT); or

(21) Tris (ethoxyphenyl) bismuth (TEPB) (CAS 90591-48-3).

(g) Precursors, as follows:

(1) BCMO (3,3-bis(chloromethyl)oxetane) (CAS 78-71-7);

(2) DADN (1,5-diacetyl-3,7-dinitro-1, 3, 5, 7-tetraazacyclooctane);

(3) Dinitroazetidine-t-butyl salt (CAS 125735-38-8);

(4) CL-20 precursors (any molecule containing hexaazaisowurtzitane) (e.g., HBIW (hexabenzylhexaazaisowurtzitane), TAIW (tetraacetyldibenzylhexa-azaisowurtzitane));

(5) TAT (1, 3, 5, 7-tetraacetyl-1, 3, 5, 7-tetraazacyclooctane) (CAS 41378-98-7);

(6) Tetraazadecalin (CAS 5409-42-7);

(7) 1,3,5-trichlorobenzene (CAS 108-70-3); or

(8) 1,2,4-trihydroxybutane (1,2,4-butanetriol) (CAS 3068-00-6).

*(h) Any explosive, propellant, pyrotechnic, fuel, oxidizer, binder, additive, or precursor that (MT for articles designated as such):

(1) Is classified; or

(2) Is being developed using classified information (*see* §120.10(a)(2) of this subchapter).

(i) Developmental explosives, propellants, pyrotechnics, fuels, oxidizers, binders, additives, or precursors therefor funded by the Department of Defense via contract or other funding authorization.

(j) Technical data (as defined in §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (i) of this category (*see* also §123.20 of this subchapter) (MT for articles designated as such).

(k) The following interpretations explain and amplify the terms used in this category and elsewhere in this subchapter:

(1) USML Category V contains explosives, energetic materials, propellants, and pyrotechnics and specially formulated fuels for aircraft, missile, and naval applications. Explosives are solid, liquid, or gaseous substances or

mixtures of substances, which, in their primary, booster, or main charges in warheads, demolition, or other military applications, are required to detonate.

(2) The resulting product of the combination or conversion of any substance controlled by this category into an item not controlled will no longer be controlled by this category provided the controlled item cannot easily be recovered through dissolution, melting, sieving, etc. As an example, beryllium converted to a near net shape using hot isostatic processes will result in an uncontrolled part. A cured thermoset containing beryllium powder is not controlled unless meeting an explosive or propellant control. The mixture of beryllium powder in a cured thermoset shape is not controlled by this category. The mixture of controlled beryllium powder mixed with a typical propellant binder will remain controlled by this category. The addition of dry silica powder to dry beryllium powder will remain controlled.

(3) Paragraph (c)(4)(ii)(A) of this category does not apply to boron and boron carbide enriched with boron-10 (20% or more of total boron-10 content).

(4) Theoretical specific impulse (Isp) is calculated using standard conditions (1000 psi chamber pressure expanded to 14.7 psi) and measured in units of pound-force-seconds per pound-mass (lbf-s/lbm) or simplified to seconds (s). Calculations will be based on shifting equilibrium.

(5) Particle size is the mean particle diameter on a weight basis. Best industrial practices will be used in determining particle size and the controls may not be undermined by addition of larger or smaller sized material to shift the mean diameter.

(l)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category VI—Surface Vessels of War and Special Naval Equipment

*(a) Warships and other combatant vessels (*i.e.,* battleships, aircraft carriers, destroyers, frigates, cruisers, corvettes, littoral combat ships, mine sweepers, mine hunters, mine countermeasure ships, dock landing ships, amphibious assault ships), Coast Guard Cutters (with or equivalent to those with U.S. designations WHEC, WMEC, WMSL, or WPB for the purpose of this subchapter), or foreign-origin vessels specially designed to provide functions equivalent to those of the vessels listed above;

(b) Other vessels not controlled in paragraph (a) of this category, as follows:

(1) High-speed air cushion vessels for transporting cargo and personnel, ship-to-shore and across a beach, with a payload over 25 tons;

(2) Surface vessels integrated with nuclear propulsion plants or specially designed to support naval nuclear propulsion plants;

(3) Vessels armed or specially designed to be used as a platform to deliver munitions or otherwise destroy or incapacitate targets (e.g., firing lasers, launching torpedoes, rockets, or missiles, or firing munitions greater than .50 caliber); or

(4) Vessels incorporating any mission systems controlled under this subchapter.

(c) Developmental vessels, and specially designed parts, components, accessories, and attachments therefor, funded by the Department of Defense via contract or other funding authorization.

(d) [Reserved]

*(e) Naval nuclear propulsion plants and prototypes, and special facilities for construction, support, and maintenance therefor (*see* §123.20 of this subchapter).

(f) Vessel and naval equipment, parts, components, accessories, attachments, associated equipment, and systems, as follows:

(1) Hulls or superstructures, including support structures therefor, that:

(i) Are specially designed for any vessels controlled in paragraph (a) of this category;

(ii) Have armor, active protection systems, or developmental armor systems; or

(iii) Are specially designed to survive 12.5% or greater damage across the length as measured between perpendiculars;

(2) Systems that manage, store, create, distribute, conserve, and transfer energy, and specially designed parts and components therefor, that have:

(i) Storage exceeding 30MJ;

(ii) A discharge rate less than 3 seconds; and

(iii) A cycle time under 45 seconds;

(3) Shipborne auxiliary systems for chemical, biological, radiological, and nuclear (CBRN) compartmentalization, over-pressurization and filtration systems, and specially designed parts and components therefor;

*(4) Control and monitoring systems for autonomous unmanned vessels capable of on-board, autonomous perception and decision-making necessary for the vessel to navigate while avoiding fixed and moving hazards, and obeying rules-of-the road without human intervention;

*(5) Any machinery, device, component, or equipment, including production, testing and inspection equipment, and tooling, specially designed for plants or facilities controlled in paragraph (e) of this section (*see* §123.20 of this subchapter);

(6) Parts, components, accessories, attachments, and equipment specially designed for integration of articles controlled by USML Categories II, IV, or XVIII or catapults for launching aircraft or arresting gear for recovering aircraft (MT for launcher mechanisms specially designed for rockets, space launch vehicles, or missiles capable of achieving a range greater than or equal to 300 km);

(7) Shipborne active protection systems (*i.e.,* defensive systems that actively detect and track incoming threats and launch a ballistic, explosive, energy, or electromagnetic countermeasure(s) to neutralize the threat prior to contact with a vessel) and specially designed parts and components therefor;

(8) Minesweeping and mine hunting equipment (including mine countermeasures equipment deployed by aircraft), and specially designed parts and components therefor; or

*(9) Any part, component, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information. “Classified” means classified pursuant to Executive Order 13526, or predecessor order, and a security classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization.

(g) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (f) of this category and classified technical data directly related to items controlled in ECCNs 8A609, 8B609, 8C609, and 8D609 and defense services using the classified technical data. (MT for technical data and defense services related to articles designated as such.)

(*See* §125.4 of this subchapter for exemptions.)

(h)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category VII—Ground Vehicles

*(a) Armored combat ground vehicles as follows:

(1) Tanks; or

(2) Infantry fighting vehicles.

*(b) Ground vehicles (not enumerated in paragraph (a) of this category) and trailers that are armed or are specially designed to be used as a firing or launch platform to deliver munitions or otherwise destroy or incapacitate targets (e.g., firing lasers, launching rockets, firing missiles, firing mortars, firing artillery rounds, or firing other ammunition greater than .50 caliber) (MT if specially designed for rockets, space launch vehicles, missiles, drones, or unmanned aerial vehicles capable of delivering a payload of at least 500 kg to a range of at least 300 km).

(c) Ground vehicles and trailers equipped with any mission systems controlled under this subchapter (MT if specially designed for rockets, space launch vehicles, missiles, drones, or unmanned aerial vehicles capable of delivering a payload of at least 500 kg to a range of at least 300 km).

(d) [Reserved]

*(e) Armored support vehicles capable of off-road or amphibious use specially designed to transport or deploy personnel or materiel, or to move with other vehicles over land in close support of combat vehicles or troops (e.g., personnel carriers, resupply vehicles, combat engineer vehicles, recovery vehicles, reconnaissance vehicles, bridge launching vehicles, ambulances, and command and control vehicles).

(f) [Reserved]

(g) Ground vehicle parts, components, accessories, attachments, associated equipment, and systems as follows:

(1) Armored hulls, armored turrets, and turret rings;

(2) Active protection systems (*i.e.,* defensive systems that actively detect and track incoming threats and launch a ballistic, explosive, energy, or electromagnetic countermeasure(s) to neutralize the threat prior to contact with a vehicle) and specially designed parts and components therefor;

(3) Composite armor parts and components specially designed for the vehicles in this category;

(4) Spaced armor components and parts, including slat armor parts and components specially designed for the vehicles in this category;

(5) Reactive armor parts and components;

(6) Electromagnetic armor parts and components, including pulsed power specially designed parts and components therefor;

(7) Built in test equipment (BITE) to evaluate the condition of weapons or other mission systems for vehicles identified in this category, excluding equipment that provides diagnostics solely for a subsystem or component involved in the basic operation of the vehicle;

(8) Gun mount, stabilization, turret drive, and automatic elevating systems, and specially designed parts and components therefor;

(9) Self-launching bridge components rated class 60 or above for deployment by vehicles in this category;

(10) Suspension components as follows:

(i) Rotary shock absorbers specially designed for the vehicles weighing more than 30 tons in this category; or

(ii) Torsion bars specially designed for the vehicles weighing more than 50 tons in this category;

(11) Kits specially designed to convert a vehicle in this category into either an unmanned or a driver-optional vehicle. For a kit to be controlled by this paragraph, it must, at a minimum, include equipment for:

(i) Remote or autonomous steering;

(ii) Acceleration and braking; and

(iii) A control system;

(12) Fire control computers, mission computers, vehicle management computers, integrated core processers, stores management systems, armaments control processors, vehicle-weapon interface units and computers;

(13) Test or calibration equipment for the mission systems of the vehicles in this category, except those enumerated elsewhere; or

*(14) Any part, component, accessory, attachment, equipment, or system that (MT for those articles designated as such):

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

“Classified” means classified pursuant to Executive Order 13526, or predecessor order, and a security classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization.

(h) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (g) of this category and classified technical data directly related to items controlled in ECCNs 0A606, 0B606, 0C606, and 0D606 and defense services using the classified technical data. (*See* §125.4 of this subchapter for exemptions.) (MT for technical data and defense services related to articles designated as such.)

(i)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category VIII—Aircraft and Related Articles

(a) Aircraft, whether manned, unmanned, remotely piloted, or optionally piloted, as follows (MT if the aircraft, excluding manned aircraft, has a range equal to or greater than 300 km):

*(1) Bombers;

*(2) Fighters, fighter bombers, and fixed-wing attack aircraft;

*(3) Turbofan- or turbojet-powered trainers used to train pilots for fighter, attack, or bomber aircraft;

*(4) Attack helicopters;

*(5) Unmanned aerial vehicles (UAVs) specially designed to incorporate a defense article;

*(6) [Reserved]

*(7) Aircraft specially designed to incorporate a defense article for the purpose of performing an intelligence, surveillance, and reconnaissance function;

*(8) Aircraft specially designed to incorporate a defense article for the purpose of performing an electronic warfare function; airborne warning and control aircraft; or aircraft specially designed to incorporate a defense article for the purpose of performing a command, control, and communications function;

(9) Aircraft specially designed to incorporate a defense article for the purpose of performing an air refueling function;

(10) Target drones;

(11) [Reserved]

(12) Aircraft capable of being refueled in-flight including hover-in-flight refueling (HIFR);

(13) [Reserved]

(14) Aircraft with a roll-on/roll-off ramp, capable of airlifting payloads over 35,000 lbs. to ranges over 2,000 nm without being refueled in-flight, and landing onto short or unimproved airfields, other than L-100 and LM-100J aircraft;

*(15) Aircraft not enumerated in paragraphs (a)(1) through (a)(14) as follows:

(i) U.S.-origin aircraft that bear an original military designation of A, B, E, F, K, M, P, R, or S; or

(ii) Foreign-origin aircraft specially designed to provide functions equivalent to those of the aircraft listed in paragraph (a)(15)(i) of this category; or

(16) Aircraft that are armed or are specially designed to be used as a platform to deliver munitions or otherwise destroy targets (e.g., firing lasers, launching rockets, firing missiles, dropping bombs, or strafing);

(b)-(c) [Reserved]

(d) Launching and recovery equipment specially designed to allow an aircraft described in paragraph (a) of this category to take off or land on a vessel described in Category VI paragraphs (a) through (c) (MT if the launching and recovery equipment is for an aircraft, excluding manned aircraft, that has a range equal to or greater than 300 km).

(e) [Reserved]

(f) Developmental aircraft funded by the Department of Defense via contract or other funding authorization, and specially designed parts, components, accessories, and attachments therefor.

(g) [Reserved]

(h) Parts, components, accessories, attachments, associated equipment and systems, as follows:

(1) Parts, components, accessories, and attachments specially designed for the following U.S.-origin aircraft: The B-1B, B-2, B-21, F-15SE, F/A-18 E/F, EA-18G, F-22, F-35, and future variants thereof; or the F-117 or U.S. Government technology demonstrators. Parts, components, accessories, and attachments of the F-15SE and F/A-18 E/F that are common to earlier models of these aircraft, unless listed in paragraph (h) of this category, are subject to the EAR;

(2) Rotorcraft gearboxes with internal pitch line velocities exceeding 20,000 feet per minute and able to operate 30 minutes with loss of lubrication without an emergency or auxiliary lubrication system, and specially designed parts and components therefor;

(3) Tail boom folding systems, stabilator folding systems or automatic rotor blade folding systems, and specially designed parts and components therefor;

(4) Wing folding systems, and specially designed parts and components therefor, for:

(i) Aircraft powered by power plants controlled under USML Category IV(d); or

(ii) Aircraft with any of the following characteristics and powered by gas turbine engines:

(A) The portion of the wing outboard of the wing fold is required for sustained flight;

(B) Fuel can be stored outboard of the wing fold;

(C) Control surfaces are outboard of the wing fold;

(D) Hard points are outboard of the wing fold;

(E) Hard points inboard of the wing fold allow for in-flight ejection; or

(F) The aircraft is designed to withstand maximum vertical maneuvering accelerations greater than +3.5g/−1.5g.

(5) On-aircraft arresting gear (e.g., tail hooks and drag chutes) and specially designed parts and components therefor;

(6) Bomb racks, missile or rocket launchers, missile rails, weapon pylons, pylon-to-launcher adapters, unmanned aerial vehicle (UAV) airborne launching systems, external stores support systems for ordnance or weapons, and specially designed parts and components therefor (MT if the bomb rack, missile launcher, missile rail, weapon pylon, pylon-to-launcher adapter, UAV airborne launching system, or external stores support system is for an aircraft, excluding manned aircraft, or missile that has a “range” equal to or greater than 300 km);

(7) Damage or failure-adaptive flight control systems, that do not consist solely of redundant internal circuitry, specially designed for aircraft controlled in this category;

(8) Threat-adaptive autonomous flight control systems, where a “threat-adaptive autonomous flight control system” is a flight control system that, without input from the operator or pilot, adjusts the aircraft control or flight path to minimize risk caused by hostile threats;

(9) Non-surface-based flight control systems and effectors (e.g., thrust vectoring from gas ports other than main engine thrust vector);

(10) Radar altimeters with output power management LPI (low probability of intercept) or signal modulation (*i.e.,* frequency hopping, chirping, direct sequence-spectrum spreading) LPI capabilities (MT if for an aircraft, excluding manned aircraft, or missile that has a “range” equal to or greater than 300 km);

(11) Air-to-air refueling systems and hover-in-flight refueling (HIFR) systems, and specially designed parts and components therefor;

(12) Unmanned aerial vehicle (UAV) flight control systems and vehicle management systems with swarming capability (*i.e.,* UAVs interact with each other to avoid collisions and stay together, or, if weaponized, coordinate targeting) (MT if for an aircraft, excluding manned aircraft, or missile that has a “range” equal to or greater than 300 km);

(13) [Reserved]

(14) Lift fans, clutches, and roll posts for short take-off, vertical landing (STOVL) aircraft and specially designed parts and components for such lift fans and roll posts;

(15) Integrated helmets incorporating optical sights or slewing devices, which include the ability to aim, launch, track, or manage munitions (e.g., Helmet Mounted Cueing Systems, Joint Helmet Mounted Cueing Systems (JHMCS), Helmet Mounted Displays, Display and Sight Helmets (DASH)), and specially designed parts, components, accessories, and attachments therefor;

(16) Fire control computers, stores management systems, armaments control processors, and aircraft-weapon interface units and computers (e.g., AGM-88 HARM Aircraft Launcher Interface Computer (ALIC));

(17) Mission computers, vehicle management computers, and integrated core processers specially designed for aircraft controlled in this category;

(18) Drive systems, flight control systems, and parts and components therefor, specially designed to function after impact of a 7.62mm or larger projectile;

(19) Thrust reversers specially designed to be deployed in flight for aircraft controlled in this category;

*(20) Any part, component, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

(21)-(26) [Reserved]

(27) Variable speed gearboxes, where a “variable speed gearbox” has the ability to vary the gearbox output speed by mechanical means within the gearbox while the gearbox input speed from the engine or other source is constant, and is capable of varying output speed by 20% or greater and providing power to rotors, proprotors, propellers, propfans, or liftfans; and specially designed parts and components therefor;

(28) Electrical power or thermal management systems specially designed for an engine controlled in Category XIX and having any of the following:

(i) Electrical power generators that provide greater than 300kW of electrical power (per generator) with gravimetric power densities exceeding 2kW/pound (excluding the mass of the controller for the purpose of calculating the gravimetric power density);

(ii) Heat exchangers that exchange 60 kW/K-m^3 or 1 kW/K of heat or greater into the gas turbine engine flow path; or

(iii) Direct-cooling thermal electronic package heat exchangers that transfer 20kW of heat or greater at 100W/cm^2 or greater.

(29) Any of the following equipment if specially designed for a defense article described in paragraph (h)(1):

(i) Scale test models;

(ii) Full scale iron bird ground rigs used to test major aircraft systems; or

(iii) Jigs, locating fixtures, templates, gauges, molds, dies, or caul plates.

(i) Technical data (see §120.10 of this subchapter) and defense services (see §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (h) of this category and classified technical data directly related to items controlled in ECCNs 9A610, 9B610, 9C610, and 9D610 and defense services using classified technical data. (See §125.4 of this subchapter for exemptions.) (MT for technical data and defense services related to articles designated as such.)

(j)-(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR (see §120.42 of this subchapter) used in or with defense articles controlled in this category.

Category IX—Military Training Equipment and Training

(a) Training equipment, as follows:

(1) Ground, surface, submersible, space, or towed airborne targets that:

(i) Have an infrared, radar, acoustic, magnetic, or thermal signature that mimic a specific defense article, specific other item, or specific person; or

(ii) Are instrumented to provide hit/miss performance information for defense articles controlled in this subchapter;

(2) Devices that are mockups of articles enumerated in this subchapter used for maintenance training or disposal training for ordnance enumerated in this subchapter, that reveal technical data or contain parts, components, accessories, or attachments controlled in this subchapter;

(3) Air combat maneuvering instrumentation and ground stations therefor;

(4) Physiological flight trainers for fighter aircraft or attack helicopters;

(5) Radar trainers specially designed for training on radar controlled by USML Category XI;

(6) Training devices specially designed to be attached to a crew station, mission system, or weapon of an article controlled in this subchapter;

(7) Anti-submarine warfare trainers;

(8) Missile launch trainers;

(9) Radar target generators;

(10) Infrared scene generators; or

*(11) Any training device that:

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

(b) Simulators, as follows:

(1) System specific simulators that replicate the operation of an individual crew station, a mission system, or a weapon of an end-item that is controlled in this subchapter;

(2)-(3) [Reserved]

(4) Software and associated databases not elsewhere enumerated in this subchapter that can be used to model or simulate the following:

(i) Trainers enumerated in paragraph (a) of this category;

(ii) Battle management;

(iii) Military test scenarios/models; or

(iv) Effects of weapons enumerated in this subchapter; or

*(5) Simulators that:

(i) Are classified;

(ii) Contain classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Are being developed using classified information.

(c)-(d) [Reserved]

(e) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter):

(1) Directly related to the defense articles enumerated in paragraphs (a) and (b) of this category;

(2) Directly related to the software and associated databases enumerated in paragraph (b)(4) of this category even if no defense articles are used or transferred; or

(3) Military training (*see,* §120.9(a)(3) of this subchapter) not directly related to defense articles or technical data enumerated in this subchapter.

(f)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category X—Personal Protective Equipment

(a) Personal protective equipment, as follows:

(1) Body armor providing a protection level equal to or greater than NIJ Type IV;

(2) Personal protective clothing, equipment, or face paints specially designed to protect against or reduce detection by radar, IR, or other sensors at wavelengths greater than 900 nanometers;

(3)-(4) [Reserved]

(5) Integrated helmets, not specified in USML Category VIII(h)(15) or USML Category XII, incorporating optical sights or slewing devices, which include the ability to aim, launch, track, or manage munitions;

(6) Helmets and helmet shells providing a protection level equal to or greater than NIJ Type IV;

(7) Goggles, spectacles, visors, vision blocks, canopies, or filters for optical sights or viewers, employing other than common broadband absorptive dyes or UV inhibitors as a means of protection (e.g., narrow band filters/dyes or broadband limiters/coatings with high visible transparency), having an optical density greater than 3, and that protect against:

(i) Multiple visible (in-band) laser wavelengths;

(ii) Thermal flashes associated with nuclear detonations; or

(iii) Near infrared or ultraviolet (out-of-band) laser wavelengths; or

(8) Developmental personal protective equipment and specially designed parts, components, accessories, and attachments therefor, developed for the U.S. Department of Defense via contract or other funding authorization.

(b)-(c) [Reserved]

(d) Parts, components, assemblies, accessories, attachments, and associated equipment for the personal protective equipment controlled in this category, as follows:

(1) Ceramic or composite plates that provide protection equal to or greater than NIJ Type IV;

(2) Lenses, substrates, or filters “specially designed” for the articles covered in paragraph (a)(7) of this category;

(3) Materials and coatings specially designed for the articles covered in paragraph (a)(7) of this category with optical density greater than 3, as follows:

(i) Narrowband absorbing dyes;

(ii) Broadband optical switches or limiters (*i.e.,* nonlinear material, tunable or switchable agile filters, optical power limiters, near infrared interference based filters); or

(iii) Narrowband interference based notch filters (*i.e.,* multi-layer dielectric coatings, rugate, holograms or hybrid (*i.e.,*interference with dye)) protecting against multiple laser wavelength and having high visible band transparency; or

*(4) Any component, part, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

(e) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (d) of this category.

(f)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XI—Military Electronics

(a) Electronic equipment and systems not included in Category XII of the U.S. Munitions List, as follows:

*(1) Underwater hardware, equipment, or systems, as follows:

(i) Active or passive acoustic array sensing systems or acoustic array equipment capable of real-time processing that survey or detect, and also track, localize (*i.e.,* determine range and bearing), classify, or identify, surface vessels, submarines, other undersea vehicles, torpedoes, or mines, having any of the following:

(A) Multi-static capability;

(B) Operating frequency less than 20 kHz; or

(C) Operating bandwidth greater than 10 kHz;

(ii) Underwater single acoustic sensor system that distinguishes non-biologic tonals and locates the origin of the sound;

(iii) Non-acoustic systems that survey or detect, and also track, localize (*i.e.,* determine range and bearing), classify, or identify, surface vessels, submarines, other undersea vehicles, torpedoes, or mines;

(iv) Acoustic modems, networks, and communications equipment with real-time adaptive compensation or employing Low Probability of Intercept (LPI);

(v) Low Frequency/Very Low Frequency (LF/VLF) electronic modems, routers, interfaces, and communications equipment, specially designed for submarine communications; or

(vi) Autonomous systems and equipment that enable cooperative sensing and engagement by fixed (bottom mounted/seabed) or mobile Autonomous Underwater Vehicles (AUVs);

*(2) Underwater acoustic countermeasures or counter-countermeasures systems or equipment;

*(3) Radar systems and equipment, as follows:

(i) Airborne radar that maintains positional state of an object or objects of interest, other than weather phenomena, in a received radar signal through time;

(ii) Synthetic Aperture Radar (SAR) incorporating image resolution less than (better than) 0.3 m, or incorporating Coherent Change Detection (CCD) with geo-registration accuracy less than (better than) 0.3 m, not including concealed object detection equipment operating in the frequency range from 30 GHz to 3,000 GHz and having a spatial resolution of 0.1 milliradians up to and including 1 milliradians at a standoff distance of 100 m;

(iii) Inverse Synthetic Aperture Radar (ISAR);

(iv) Radar that geodetically-locates (*i.e.,* geodetic latitude, geodetic longitude, and geodetic height) with a target location error 50 (TLE50) less than or equal to 10 m at ranges greater than 1 km;

(v) Any Ocean Surveillance Radar with an average-power-aperture product of greater than 50 Wm^2;

(vi) Any ocean surveillance radar that transmits a waveform with an instantaneous bandwidth greater than 100 MHz and has an antenna rotation rate greater than 60 revolutions per minute (RPM);

(vii) Air surveillance radar with free space detection of 1 square meter RCS target at 85 nmi or greater range, scaled to RCS values as RCS to the ¼ power;

(viii) Air surveillance radar with free space detection of 1 square meter RCS target at an altitude of 65,000 feet and an elevation angle greater than 20 degrees (*i.e.,* counter-battery);

(ix) Air surveillance radar with multiple elevation beams, phase or amplitude monopulse estimation, or 3D height-finding;

(x) Air surveillance radar with a beam solid angle less than or equal to 16 $degrees^2$ that performs free space tracking of 1 square meter RCS target at a range greater or equal to 25 nmi with revisit rate greater or equal to ⅓ Hz;

(xi) Instrumentation radar for anechoic test facility or outdoor range that maintains positional state of an object of interest in a received radar signal through time or provides measurement of RCS of a static target less than or equal to minus 10dBsm, or RCS of a dynamic target;

(xii) Radar incorporating pulsed operation with electronics steering of transmit beam in elevation and azimuth;

(xiii) Radar with mode(s) for ballistic tracking or ballistic extrapolation to source of launch or impact point of articles controlled in USML Categories III, IV, or XV;

(xiv) Active protection radar and missile warning radar with mode(s) implemented for detection of incoming munitions;

(xv) Over the horizon high frequency sky-wave (ionosphere) radar;

(xvi) Radar that detects a moving object through a physical obstruction at distance greater than 0.2 m from the obstruction;

(xvii) Radar having moving target indicator (MTI) or pulse-Doppler processing where any single Doppler filter provides a normalized clutter attenuation of greater than 60dB;

(xviii) Radar having electronic protection or electronic counter-countermeasures (ECCM) other than manual gain control, automatic gain control, radio frequency selection, constant false alarm rate, and pulse repetition interval jitter;

(xix) Radar employing electronic attack (EA) mode(s) using the radar transmitter and antenna;

(xx) Radar employing electronic support (ES) mode(s) (*i.e.,* the ability to use a radar system for ES purposes in one or more of the following: as a high-gain receiver, as a wide-bandwidth receiver, as a multi-beam receiver, or as part of a multi-point system);

(xxi) Radar employing non-cooperative target recognition (NCTR) (*i.e.,* the ability to recognize a specific platform type without cooperative action of the target platform);

(xxii) Radar employing automatic target recognition (ATR) (*i.e.,* recognition of target using structural features (e.g., tank versus car) of the target with system resolution better than (less than) 0.3 m);

(xxiii) Radar that sends interceptor guidance commands or provides illumination keyed to an interceptor seeker;

(xxiv) Radar employing waveform generation for LPI other than frequency modulated continuous wave (FMCW) with linear ramp modulation;

(xxv) Radar that sends and receives communications;

(xxvi) Radar that tracks or discriminates ballistic missile warhead from debris or countermeasures;

(xxvii) Bi-static/multi-static radar that exploits greater than 125 kHz bandwidth and is lower than 2 GHz center frequency to passively detect or track using radio frequency (RF) transmissions (e.g., commercial radio, television stations);

(xxviii) Radar target generators, projectors, or simulators, specially designed for radars controlled by this category; or

(xxix) Radar and laser radar systems specially designed for defense articles in paragraph (a)(1) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if specially designed for rockets, space launch vehicles, missiles, drones, or unmanned aerial vehicles capable of delivering a payload of at least 500 kg to a range of at least 300 km);

*(4) Electronic Combat (*i.e.,* Electronic Warfare) systems and equipment, as follows:

(i) ES systems and equipment that search for, intercept and identify, or locate sources of intentional or unintentional electromagnetic energy specially designed to provide immediate threat detection, recognition, targeting, planning, or conduct of future operations;

(ii) Systems and equipment that detect and automatically discriminate acoustic energy emanating from weapons fire (e.g., gunfire, artillery, rocket propelled grenades, or other projectiles), determining location or direction of weapons fire in less than two seconds from receipt of event signal, and able to operate on-the-move (e.g., operating on personnel, land vehicles, sea vessels, or aircraft while in motion); or

(iii) Systems and equipment specially designed to introduce extraneous or erroneous signals into radar, infrared based seekers, electro-optic based seekers, radio communication receivers, navigation receivers, or that otherwise hinder the reception, operation, or effectiveness of adversary electronics (e.g., active or passive electronic attack, electronic countermeasure, electronic counter-countermeasure equipment, jamming, and counter jamming equipment);

*(5) Command, control, and communications (C3); command, control, communications, and computers (C4); command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); and identification systems or equipment, that:

(i) Are specially designed to integrate, incorporate, network, or employ defense articles that are controlled in paragraphs or subparagraphs of the categories of §121.1 of this part that do not use the term specially designed;

(ii) Incorporate U.S. government identification friend or foe (IFF) Modes 4 or 5;

(iii) Implement active or passive ECCM used to counter acts of communication disruption (e.g., radios that incorporate HAVE QUICK I/II, SINCGARS, SATURN);

(iv) Specially designed, rated, certified, or otherwise specified or described to be in compliance with U.S. government NSTISSAM TEMPEST 1-92 standards or CNSSAM TEMPEST 01-02, to implement techniques to suppress compromising emanations of information bearing signals; or

(v) Transmit voice or data signals specially designed to elude electromagnetic detection;

(6) [Reserved]

(7) Developmental electronic equipment or systems funded by the Department of Defense via contract or other funding authorization;

(8) Unattended ground sensor (UGS) systems or equipment having all of the following:

(i) Automatic target detection;

(ii) Automatic target tracking, classification, recognition, or identification;

(iii) Self-forming or self-healing networks; and

(iv) Self-localization for geo-locating targets;

(9) Electronic sensor systems or equipment for non-acoustic antisubmarine warfare (ASW) or mine warfare (e.g., magnetic anomaly detectors (MAD), electric-field, electromagnetic induction);

(10) Electronic sensor systems or equipment for detection of concealed weapons, having a standoff detection range of greater than 45 m for personnel or detection of vehicle-carried weapons, not including concealed object detection equipment operating in the frequency range from 30 GHz to 3,000 GHz and having a spatial resolution of 0.1 milliradians up to and including 1 milliradians at a standoff distance of 100 m;

(11) Test sets specially designed for testing defense articles controlled in paragraphs (a)(3), (a)(4), (a)(5), or (b); or

(12) Direction finding equipment for determining bearings to specific electromagnetic sources or terrain characteristics specially designed for defense articles in paragraph (a)(1) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if specially designed for rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km*(b) Electronic systems, equipment or software, not elsewhere enumerated in this subchapter, specially designed for intelligence purposes that collect, survey, monitor, or exploit, or analyze and produce information from, the electromagnetic spectrum (regardless of transmission medium), or for counteracting such activities.

(c) Parts, components, accessories, attachments, and associated equipment, as follows:

(1) Application Specific Integrated Circuits (ASICs) and Programmable Logic Devices (PLD) programmed for defense articles in this subchapter;

(2) Printed Circuit Boards (PCBs) and populated circuit card assemblies for which the layout is specially designed for defense articles in this subchapter;

(3) Multichip modules for which the pattern or layout is specially designed for defense articles in this subchapter;

(4) Transmit/receive modules or transmit modules that have any two perpendicular sides, with either length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [d≤15cm*GHz/fGHz], with an electronically variable phase shifter or phasers that are a Monolithic Microwave Integrated Circuit (MMIC), or incorporate a MMIC or discrete RF power transistor;

(5) High-energy storage capacitors with a repetition rate of 6 discharges or more per minute and full energy life greater than or equal to 10,000 discharges, at greater than 0.2 Amps per Joule peak current, that have any of the following:

(i) Volumetric energy density greater than or equal to 1.5 J/cc; or

(ii) Mass energy density greater than or equal to 1.3 kJ/kg;

(6) Radio frequency circulators of any dimension equal to or less than one quarter (¼) wavelength of the highest operating frequency and isolation greater than 30 dB;

(7) Polarimeter that detects and measures polarization of radio frequency signals within a single pulse;

(8) Digital radio frequency memory (DRFM) with RF instantaneous input bandwidth greater than 400 MHz, and 4 bit or higher resolution whose output signal is a translation of the input signal (e.g., changes in magnitude, time, frequency) and specially designed parts and components therefor;

(9) Vacuum electronic devices, as follows:

(i) Multiple electron beam or sheet electron beam devices rated for operation at frequencies of 16 GHz or above, and with a saturated power output greater than 10,000 W (70 dBm) or a maximum average power output greater than 3,000 W (65 dBm); or

(ii) Cross-field amplifiers with a gain of 15 dB to 17 dB or a duty factor greater than 5%;

(10) Antenna, and specially designed parts and components therefor, that:

(i) Employ four or more elements, electronically steer angular beams, independently steer angular nulls, create angular nulls with a null depth greater than 20 dB, and achieve a beam switching speed faster than 50 milliseconds;

(ii) Form adaptive null attenuation greater than 35 dB with convergence time less than one second;

(iii) Detect signals across multiple RF bands with matched left hand and right hand spiral antenna elements for determination of signal polarization; or

(iv) Determine signal angle of arrival less than two degrees (e.g., interferometer antenna);

(11) Radomes or electromagnetic antenna windows that:

(i) Incorporate radio frequency selective surfaces;

(ii) Operate in multiple non-adjacent frequency bands for radar applications;

(iii) Incorporate a structure that is specially designed to provide ballistic protection from bullets, shrapnel, or blast;

(iv) Have a melting point greater than 1,300 °C and maintain a dielectric constant less than 6 at temperatures greater than 500 °C;

(v) Are manufactured from ceramic materials with a dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz (MT if usable in rockets, SLVs, or missiles capable of achieving a range greater than or equal to 300 km; or if usable in drones or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km. (vi) Maintain structural integrity at stagnation pressures greater than 6,000 pounds per square foot; or

(vii) Withstand combined thermal shock greater than 4.184×10^6 J/m^2 accompanied by a peak overpressure of greater than 50 kPa (MT if usable in rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km and usable in protecting against nuclear effects (e.g., Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects). (12) Underwater sensors (acoustic vector sensors, hydrophones, or transducers) or projectors, specially designed for systems controlled by paragraphs (a)(1) and (a)(2) of this category, having any of the following:

(i) A transmitting frequency below 10 kHz for sonar systems;

(ii) Sound pressure level exceeding 224 dB (reference 1 mPa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

(iii) Sound pressure level exceeding 235 dB (reference 1 mPa at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

(iv) Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

(v) Designed to operate with an unambiguous display range exceeding 5,120 m; or

(vi) Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers with any of the following:

(A) Dynamic compensation for pressure; or

(B) Incorporating other than lead zirconate titanate as the transduction element;

(13) Parts or components containing piezoelectric materials which are specially designed for underwater hardware, equipment, or systems controlled by paragraph (c)(12) of this category;

(14) Tuners specially designed for systems and equipment in paragraphs (a)(4) and (b) of this category;

(15) Electronic assemblies and components, capable of operation at temperatures in excess of 125 °C and specially designed for UAVs or drones controlled by USML Category VIII, rockets, space launch vehicles (SLV), or

missiles controlled by USML Category IV capable of achieving a range greater than or equal to 300 km (MT) (16) Hybrid (combined analogue/digital) computers specially designed for modeling, simulation, or design integration of systems enumerated in paragraphs (a)(1), (d)(1), (d)(2), (h)(1), (h)(2), (h)(4), (h)(8), and (h)(9) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if for rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km or their subsystems. (17) Chaff and flare rounds specially designed for the systems and equipment described in paragraph (a)(4)(iii) of this category, and parts and components therefor containing materials controlled in USML Category V;

(18) Parts, components, or accessories specially designed for an information assurance/information security system or radio controlled in this subchapter that modify its published properties (e.g., frequency range, algorithms, waveforms, CODECs, or modulation/demodulation schemes); or

*(19) Any part, component, accessory, attachment, equipment, or system that (MT for those articles designated as such):

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information (*see* §120.10(a)(2) of this subchapter).

(d) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (c) of this category and classified technical data directly related to items controlled in CCL ECCNs 3A611, 3B611, 3C611, and 3D611 and defense services using the classified technical data. (*See* §125.4 of this subchapter for exemptions.) (MT for technical data and defense services related to articles designated as such.)

(e)-(w) [Reserved];

(x) Commodities, software, and technology subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XII—Fire Control, Laser, Imaging, and Guidance Equipment

(a) Fire control, aiming, detection, guidance, and tracking systems, as follows:

*(1) Fire control systems;

*(2) Electronic or optical weapon positioning, laying, or spotting systems;

*(3) Laser spot trackers or laser spot detection, location, or imaging systems, with an operational wavelength shorter than 400 nm or longer than 710 nm and that are for laser target designators or coded target markers controlled in paragraph (b)(1);

*(4) Bomb sights or bombing computers;

*(5) Electro-optical systems that automatically detect and locate ordnance launch, blast, or fire;

*(6) Electro-optical ordnance guidance systems;

*(7) Missile or ordnance electro-optical tracking systems;

*(8) Remote wind-sensing systems specially designed for ballistic-corrected aiming; or

(9) Helmet mounted display (HMD) systems or end items (e.g., Combat Vehicle Crew HMD, Mounted Warrior HMD, Integrated Helmet Assembly Subsystem, Drivers Head Tracked Vision System), other than such items controlled in Category VIII, that:

(i) Incorporate or interface (either via wired or wireless connection) with optical sights or slewing devices that aim, launch, track, or manage munitions; or

(ii) Control infrared imaging systems or end items described in paragraphs (a) through (d) of this category.

*(b) Laser systems and end items, as follows:

(1) Laser target designators or coded target markers, that mediate the delivery of ordnance to a target;

(2) Target illumination systems having a variable beam divergence and a laser output wavelength exceeding 710 nm, to artificially light an area to search, locate, or track a target;

(3) Laser rangefinders having any of the following:

(i) Output wavelength of 1064 nm and any Q-switched pulse output; or

(ii) Output wavelength exceeding 1064 nm and any of the following:

(A) Single or multiple shot(s) within one second ranging capability of 3 km or greater against a standard 2.3 m x 2.3 m NATO target having 10% reflectivity and 23 km atmospheric visibility; or

(B) Multiple shot ranging capability at 3 Hz or greater of 1 km or greater against a standard 2.3 m x 2.3 m NATO target having 10% reflectivity and 23 km atmospheric visibility;

(4) Targeting systems and target location systems, incorporating or specially designed to incorporate both of the following:

(i) A laser rangefinder; and

(ii) A defense article controlled in paragraph (d) of this category (MT if designed or modified for rockets, missiles, space launch vehicles (SLVs), drones, or unmanned aerial vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km);

(5) Systems specially designed to use laser energy with an output wavelength exceeding 710 nm for exploiting differential target-background retroreflectance in order to detect optical/electro-optical equipment (e.g., optical augmentation systems);

(6) Light detection and ranging (LIDAR), laser detection and ranging (LADAR), or range-gated systems, specially designed for a military end user

(MT if designed or modified for rockets, missiles, SLVs, drones, or unmanned aerial vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km); or

(7) Developmental lasers or laser systems funded by the Department of Defense via contract or other funding authorization.

*(c) Imaging systems or end items, as follows:

(1) Binoculars, bioculars, monoculars, goggles, or head or helmet-mounted imaging systems (including video-based articles having a separate near-to-eye display), as follows:

(i) Employing an autogated third generation image intensifier tube or a higher generation image intensifier tube;

(ii) Fusing output of an image intensifier tube and an infrared focal plane array having a peak response wavelength greater than 1,000 nm; or

(iii) Having an infrared focal plane array or infrared imaging camera, and specially designed for a military end user;

(2) Weapon sights (*i.e.,* with a reticle) or aiming or imaging systems (e.g., clip-on), specially designed to mount to a weapon or to withstand weapon shock or recoil, with or without an integrated viewer or display, and also incorporating or specially designed to incorporate any of the following:

(i) An infrared focal plane array having a peak response wavelength exceeding 1,000 nm;

(ii) Second generation with luminous sensitivity greater than 350 μA/lm, third generation, or higher generation, image intensifier tubes;

(iii) Ballistic computing electronics for adjusting the aim point display; or

(iv) Infrared laser having a wavelength exceeding 710 nm;

(3) Electro-optical reconnaissance, surveillance, target detection, or target acquisition systems, specially designed for articles in this subchapter or specially designed for a military end user (MT if for determining bearings to specific electromagnetic sources (direction finding equipment) or terrain characteristics and designed or modified for rockets, missiles, SLVs, drones, or unmanned aerial vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km);

(4) Infrared search and track (IRST) systems having one of the following:

(i) Airborne or naval systems, that:

(A) Have range performance of 3 km or greater;

(B) Incorporate or are specially designed to incorporate an infrared focal plane array or imaging camera, having a peak response wavelength exceeding 3 microns or greater; and

(C) Maintain positional or angular state of a target through time; or

(ii) Specially designed for a military end user;

(5) Distributed aperture systems having a peak response wavelength exceeding 710 nm specially designed for articles in this subchapter or specially designed for a military end user;

(6) Infrared imaging systems, as follows:

(i) Mobile reconnaissance, scout, or surveillance systems providing real-time target recognition at ranges greater than 3 km (e.g., LRAS, CIV, HTI, SeeSpot, MMS);

(ii) Airborne stabilized systems specially designed for military reconnaissance (e.g., DB-110, C-B4);

(iii) Multispectral imaging systems that provide automated classification or identification of military or intelligence targets or characteristics;

(iv) Automated missile detection or warning systems;

(v) Systems hardened to withstand electromagnetic pulse (EMP), directed energy, chemical, biological, or radiological threats;

(vi) Systems incorporating mechanism(s) to reduce the optical chain signature for optical augmentation;

(vii) Persistent surveillance systems with a ground sample distance (GSD) of 0.5 m or better (smaller) at 10,000 ft or higher above ground level and a simultaneous coverage area of 3 km^2 or greater;

(viii) Gimbaled infrared systems, as follows:

(A) Having a stabilization better (less) than 30 microradians RMS and a turret with a ball diameter of 15 inches or greater; or

(B) Specially designed for articles in this subchapter or specially designed for a military end user;

(7) Terahertz imaging systems as follows:

(i) Concealed object detection systems operating in the frequency range from 30 GHz to 3000 GHz, and having a resolution less (better) than 0.1 milliradians at a standoff range of 100 m; or

(ii) Specially designed for a military end user;

(8) Systems or equipment, incorporating an ultraviolet or infrared (IR) beacon or emitter, specially designed for Combat Identification;

(9) Systems that project radiometrically calibrated scenes at a frame rate greater than 30 Hz directly into the entrance aperture of an electro-optical or infrared (EO/IR) sensor controlled in this subchapter within either the spectral band exceeding 10 nm but not exceeding 400 nm, or the spectral band exceeding 900 nm but not exceeding 30,000 nm;

(10) Developmental electro-optical, infrared, or terahertz systems funded by the Department of Defense.

(d) Guidance and navigation systems or end items, as follows:

(1) Guidance or navigation systems (e.g., inertial navigation systems, inertial reference units, attitude and heading reference systems) having any of the following:

(i) A circular error probability at fifty percent (CEP50) of position error rate less (better) than 0.28 nautical miles per hour, without the use of positional aiding references;

(ii) A heading error or true north determination of less (better) than 0.28 mrad secant (latitude) (0.016043 degrees secant (latitude)), without the use of positional aiding references;

(iii) A CEP50 of position error rate less than 0.2 nautical miles in an 8 hour period, without the use of positional aiding references; or

(iv) Meeting or exceeding specified performance at linear acceleration levels exceeding 25g (MT if designed or modified for rockets, missiles, SLVs, drones, or unmanned aerial vehicle systems capable of a range greater than or equal to 300 km or incorporating accelerometers specified in paragraph (e)(11) or gyroscopes or angular rate sensors specified in paragraph (e)(12) of this category that are designated MT);

(2) Global Navigation Satellite System (GNSS) receiving equipment, as follows:

(i) GNSS receiving equipment specially designed for military applications (MT if designed or modified for airborne applications and capable of providing navigation information at speeds in excess of 600 m/s);

(ii) Global Positioning System (GPS) receiving equipment specially designed for encryption or decryption (e.g., Y-Code, M-Code) of GPS precise positioning service (PPS) signals (MT if designed or modified for airborne applications);

(iii) GNSS receiving equipment specially designed for use with an antenna described in Category XI(c)(10) (MT if designed or modified for airborne applications); or

(iv) GNSS receiving equipment specially designed for use with rockets, missiles, SLVs, drones, or unmanned air vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km (MT);

(3) GNSS anti-jam systems specially designed for use with an antenna described in Category XI(c)(10);

(4) Mobile relative gravimeters having automatic motion compensation with an in-service accuracy of less (better) than 0.4 mGal (MT if designed or modified for airborne or marine use and having a time to steady-state registration of two minutes or less);

(5) Mobile gravity gradiometers having an accuracy of less (better) than 10 Eotvos squared per radian per second for any component of the gravity gradient tensor, and having a spatial gravity wavelength resolution of 50 m or less (MT if designed or modified for airborne or marine use);

(6) Developmental guidance or navigation systems funded by the Department of Defense (MT if designed or modified for rockets, missiles, SLVs, drones, or unmanned aerial vehicle systems capable of a range equal to or greater than 300 km).

(e) Parts, components, accessories, or attachments, as follows:

(1) Parts and components specially designed for articles described in paragraph (a)(1) or (a)(5) of this category;

(2) Lasers specially designed for articles in this subchapter;

(3) Laser stacked arrays specially designed for articles in this subchapter;

(4) Night vision or infrared cameras (e.g., camera core) specially designed for articles in this subchapter;

(5) Infrared focal plane arrays specially designed for articles in this subchapter;

(6) Charge multiplication focal plane arrays exceeding 50 mA/W for any wavelength exceeding 760 nm and specially designed for articles described in this subchapter;

(7) Second generation and greater image intensifier tubes specially designed for articles in this subchapter, and specially designed parts and components therefor;

(8) Parts and components specially designed for articles described in paragraph (c)(3), (c)(4), (c)(5) or (c)(6)(vi)-(vii) of this category;

(9) Inertial measurement units specially designed for articles in this subchapter (MT for systems incorporating accelerometers specified in paragraph (e)(11) or gyroscopes or angular rate sensors specified in paragraph (e)(12) that are designated MT);

(10) GNSS security devices (e.g., Selective Availability Anti-Spoofing Modules (SAASM), Security Modules (SM), and Auxiliary Output Chips (AOC));

(11) Accelerometers having a bias repeatability of less (better) than 10 µg and a scale factor repeatability of less (better) than 10 parts per million, or capable of measuring greater than 100,000 g (MT);

(12) Gyroscopes or angular rate sensors as follows:

(i) Having an angle random walk of less (better) than 0.001 degrees per square root hour; or

(ii) Mechanical gyroscopes or rate sensors having a bias repeatability less (better) than 0.0015 degrees per hour (MT if having a rated drift stability of less than 0.5 degrees (1 sigma or rms) per hour in a 1 g environment or specified to function at acceleration levels greater than 100 g);

"Bias" is the accelerometer output when no acceleration is applied.

"Scale factor" is the ratio of change in output to a change in the input.

The measurements of "bias" and "scale factor" refer to one sigma standard deviation with respect to a fixed calibration over a period of one year.

"Drift Rate" is the component of gyro output that is functionally independent of input rotation and is expressed as an angular rate.

"Stability" is a measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition. (This definition does not refer to dynamic or servo stability.)

(13) Optical sensors having a spectral filter specially designed for systems or equipment controlled in USML Category XI(a)(4), or optical sensor assemblies that provide threat warning or tracking for systems or equipment controlled in Category XI(a)(4);

(14) Infrared focal plane array read-out integrated circuits (ROICs) specially designed for articles in this subchapter;

(15) Integrated dewar cooler assemblies specially designed for articles in this subchapter, with or without an infrared focal plane array, and specially designed parts and components therefor;;

(16) Gimbals specially designed for articles in this category;

(17) Infrared focal plane array Joule-Thomson (JT) self-regulating cryostats specially designed for articles controlled in this subchapter;

(18) Infrared lenses, mirrors, beam splitters or combiners, filters, and treatments and coatings, specially designed for articles controlled in this category;

(19) Drive, control, signal, or image processing electronics, specially designed for articles controlled in this category;

(20) Near-to-eye displays (e.g., micro-displays) specially designed for articles controlled in this category;

(21) Resonators, receivers, transmitters, modulators, gain media, drive electronics, and frequency converters, specially designed for laser systems controlled in this category;

(22) Two-dimensional infrared scene projector emitter arrays (*i.e.,* resistive arrays) specially designed for infrared scene generators controlled in USML Category IX(a)(10);

*(23) Any part, component, accessory, attachment, or associated equipment, that:

(i) Is classified;

(ii) Contains classified software;

(iii) Is manufactured using classified production data; or

(iv) Is being developed using classified information.

(24) Developmental image intensifier tubes, focal plane arrays, read-out-integrated circuits, accelerometers, gyroscopes, angular rate sensors, and inertial measurement units funded by the Department of Defense (MT if designed or modified for rockets, missiles, SLVs, drones, or unmanned aerial vehicle systems capable of a range equal to or greater than 300 km).

(f) Technical data (see §120.10) and defense services (see §120.9) directly related to the defense articles described in paragraphs (a) through (e) of this category and classified technical data directly related to items controlled in ECCNs 7A611, 7B611, and 7D611. (See §125.4 for exemptions.) (MT for technical data and defense services related to articles designated as such.)

(g)-(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR (see §120.42 of this subchapter) used in or with defense articles controlled in this category.

Category XIII— Materials and Miscellaneous Articles

(a) [Reserved]

(b) Information security or information assurance systems and equipment, cryptographic devices, software, and components, as follows:

(1) Military or intelligence cryptographic (including key management) systems, equipment, assemblies, modules, integrated circuits, components, and software (including their cryptographic interfaces) capable of maintaining secrecy or confidentiality of information or information systems, including equipment or software for tracking, telemetry, and control (TT&C) encryption and decryption;

(2) Military or intelligence cryptographic (including key management) systems, equipment, assemblies, modules, integrated circuits, components, and software (including their cryptographic interfaces) capable of generating spreading or hopping codes for spread spectrum systems or equipment;

(3) Military or intelligence cryptanalytic systems, equipment, assemblies, modules, integrated circuits, components and software;

(4) Military or intelligence systems, equipment, assemblies, modules, integrated circuits, components, or software (including all previous or derived versions) authorized to control access to or transfer data between different security domains as listed on the Unified Cross Domain Management Office (UCDMO) Control List (UCL); or

(5) Ancillary equipment specially designed for the articles in paragraphs (b)(1)-(b)(4) of this category.

(c) [Reserved]

(d) Materials, as follows:

*(1) Ablative materials fabricated or semi-fabricated from advanced composites (e.g., silica, graphite, carbon, carbon/carbon, and boron filaments) specially designed for the articles in USML Category IV or XV (MT if usable for nozzles, re-entry vehicles, nose tips, or nozzle flaps usable in rockets, space launch vehicles (SLVs), or missiles capable of achieving a range greater than or equal to 300 km); or

(2) Carbon/carbon billets and preforms that are reinforced with continuous unidirectional fibers, tows, tapes, or woven cloths in three or more dimensional planes (MT if designed for rocket, SLV, or missile systems and usable in rockets, SLVs, or missiles capable of achieving a range greater than or equal to 300 km).

(e) Armor (e.g., organic, ceramic, metallic) and armor materials, as follows:

(1) Spaced armor with E_m greater than 1.4 and meeting NIJ Level III or better;

(2) Transparent armor having E_m greater than or equal to 1.3 or having E_m less than 1.3 and meeting and exceeding NIJ Level III standards with areal density less than or equal to 40 pounds per square foot;

(3) Transparent ceramic plate greater than ¼ inch-thick and larger than 8 inches × 8 inches, excluding glass, for transparent armor;

(4) Non-transparent ceramic plate or blanks, greater than ¼ inches thick and larger than 8 inches × 8 inches for transparent armor. This includes spinel and aluminum oxynitride (ALON);

(5) Composite armor with E_m greater than 1.4 and meeting or exceeding NIJ Level III;

(6) Metal laminate armor with E_m greater than 1.4 and meeting or exceeding NIJ Level III; or

(7) Developmental armor funded by the Department of Defense via contract or other funding authorization.

*(f) Any article enumerated in this category that (MT for those articles designated as such):

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

“Classified” means classified pursuant to Executive Order 13526, or predecessor order, and a security classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization.

*(g) Concealment and deception equipment, as follows (MT for applications usable for rockets, SLVs, missiles, drones, or unmanned aerial vehicles (UAVs) capable of achieving a range greater than or equal to 300 km and their subsystems. (1) Polymers loaded with carbonyl iron powder, ferrites, iron whiskers, fibers, flakes, or other magnetic additives having a surface resistivity of less than 5000 ohms/square and greater than 10 ohms/square with electrical isotropy of less than 5%;

(2) Multi-layer camouflage systems specially designed to reduce detection of platforms or equipment in the infrared or ultraviolet frequency spectrums;

(3) High temperature (greater than 300 °F operation) ceramic or magnetic radar absorbing material (RAM) specially designed for use on defense articles or military items subject to the EAR; or

(4) Broadband (greater than 30% bandwidth) lightweight (less than 2 lbs/sq ft) magnetic radar absorbing material (RAM) specially designed for use on defense articles or military items subject to the EAR.

(h) Energy conversion devices not otherwise enumerated in this subchapter, as follows:

(1) Fuel cells specially designed for platforms or soldier systems specified in this subchapter;

(2) Thermal engines specially designed for platforms or soldier systems specified in this subchapter;

(3) Thermal batteries (MT if designed or modified for rockets, SLVs, missiles, drones, or UAVs capable of achieving a range equal to or greater than 300 km.

(4) Thermionic generators specially designed for platforms or soldier systems enumerated in this subchapter.

*(i) Signature reduction software, and technical data as follows (MT for software specially designed for reduced observables, for applications usable for rockets, SLVs, missiles, drones, or UAVs capable of achieving a range greater than or equal to 300 km, and their subsystems, including software specially designed for analysis of signature reduction; MT for technical data for the development, production, or use of equipment, materials, or software designated as such, including databases specially designed for analysis of signature reduction):

(1) Software associated with the measurement or modification of system signatures for defense articles to reduce detectability or observability;

(2) Software for design of low-observable platforms;

(3) Software for design, analysis, prediction, or optimization of signature management solutions for defense articles;

(4) Infrared signature measurement or prediction software for defense articles or radar cross section measurement or prediction software;

(5) Signature management technical data, including codes and algorithms for defense articles to reduce detectability or observability;

(6) Signature control design methodology (*see* §125.4(c)(4) of this subchapter) for defense articles to reduce detectability or observability;

(7) Technical data for use of micro-encapsulation or micro-spheres to reduce infrared, radar, or visual detection of platforms or equipment;

(8) Multi-layer camouflage system technical data for reducing detection of platforms or equipment;

(9) Multi-spectral surface treatment technical data for modifying infrared, visual or radio frequency signatures of platforms or equipment;

(10) Technical data for modifying visual, electro-optical, radiofrequency, electric, magnetic, electromagnetic, or wake signatures (e.g., low probability of intercept (LPI) techniques, methods or applications) of defense platforms or equipment through shaping, active, or passive techniques; or

(11) Technical data for modifying acoustic signatures of defense platforms or equipment through shaping, active, or passive techniques.

(j) Equipment, materials, coatings, and treatments not elsewhere specified, as follows:

(1) Specially treated or formulated dyes, coatings, and fabrics used in the design, manufacture, or production of personnel protective clothing, equipment, or face paints designed to protect against or reduce detection by radar, infrared, or other sensors at wavelengths greater than 900 nanometers (*see* USML Category X(a)(2)); or

*(2) Equipment, materials, coatings, and treatments that are specially designed to modify the electro-optical, radiofrequency, infrared, electric, laser, magnetic, electromagnetic, acoustic, electro-static, or wake signatures of defense articles or 600 series items subject to the EAR through control of absorption, reflection, or emission to reduce detectability or observability (MT for applications usable for rockets, SLVs, missiles, drones, or UAVs capable of achieving a range greater than or equal to 300 km, and their subsystems

*(k) Tooling and equipment, as follows:

(1) Tooling and equipment specially designed for production of low observable (LO) components; or

(2) Portable platform signature field repair validation equipment (e.g., portable optical interrogator that validates integrity of a repair to a signature reduction structure).

(l) Technical data (*see* §120.10 of this subchapter) directly related to the defense articles described in paragraphs (a) through (h), (j), and (k) of this category and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in this category. (*See* also §123.20 of this subchapter.) (MT for technical data and defense services related to articles designated as such.)

(m) The following interpretations explain and amplify terms used in this category and elsewhere in this subchapter:

(1) Composite armor is defined as having more than one layer of different materials or a matrix.

(2) Spaced armors are metallic or non-metallic armors that incorporate an air space or obliquity or discontinuous material path effects as part of the defeat mechanism.

(3) Reactive armor employs explosives, propellants, or other materials between plates for the purpose of enhancing plate motion during a ballistic event or otherwise defeating the penetrator.

(4) Electromagnetic armor (EMA) employs electricity to defeat threats such as shaped charges.

(5) Materials used in composite armor could include layers of metals, plastics, elastomers, fibers, glass, ceramics, ceramic-glass reinforced plastic laminates, encapsulated ceramics in a metallic or non-metallic matrix, functionally gradient ceramic-metal materials, or ceramic balls in a cast metal matrix.

(6) For this category, a material is considered transparent if it allows 75% or greater transmission of light, corrected for index of refraction, in the visible spectrum through a 1 mm thick nominal sample.

(7) The material controlled in paragraph (e)(4) of this category has not been treated to reach the 75% transmission level referenced in (m)(6) of this category.

(8) Metal laminate armors are two or more layers of metallic materials which are mechanically or adhesively bonded together to form an armor system.

(9) E_m is the line-of-sight target mass effectiveness ratio and provides a measure of the tested armor's performance to that of rolled homogenous armor, where E_m is defined as follows:

$$Em = \frac{\rho_{RHA}(P_o - P_r)}{AD_{Target}}$$

Where:

ρ_{RHA} = density of RHA, (7.85 g/cm^3)

Po = Baseline Penetration of RHA, (mm)

Pr = Residual Line of Sight Penetration, either positive or negative (mm RHA equivalent)

AD_{TARGET} = Line-of-Sight Areal Density of Target (kg/m^2)

If witness plate is penetrated, P_r is the distance from the projectile to the front edge of the witness plate. If not penetrated, P_r is negative and is the distance from the back edge of the target to the projectile.

(10) NIJ is the National Institute of Justice and Level III refers to the requirements specified in NIJ standard 0108.01 Ballistic Resistant Protective Materials.

(n)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XIV—Toxicological Agents, Including Chemical Agents, Biological Agents, and Associated Equipment

*(a) Chemical agents, as follows:

(1) Nerve agents, as follows:

(i) O-Alkyl (equal to or less than C_{10}, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonofluoridates, such as: Sarin (GB): O-Isopropyl methylphosphonofluoridate (CAS 107-44-8) (CWC Schedule 1A); and Soman (GD): O-Pinacolyl methylphosphonofluoridate (CAS 96-64-0) (CWC Schedule 1A);

(ii) O-Alkyl (equal to or less than C_{10}, including cycloalkyl) N,N-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphoramidocyanidates, such as: Tabun (GA): O-Ethyl N, N-dimethylphosphoramidocyanidate (CAS 77-81-6) (CWC Schedule 1A); or

(iii) O-Alkyl (H or equal to or less than C_{10}, including cycloalkyl) S-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonothiolates and corresponding alkylated and protonated salts, such as VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (CAS 50782-69-9) (CWC Schedule 1A);

(2) Amiton: O,O-Diethyl S-[2(diethylamino)ethyl] phosphorothiolate and corresponding alkylated or protonated salts (CAS 78-53-5) (CWC Schedule 2A);

(3) Vesicant agents, as follows:

(i) Sulfur mustards, such as: 2-Chloroethylchloromethylsulfide (CAS 2625-76-5) (CWC Schedule 1A); Bis(2-chloroethyl)sulfide (HD) (CAS 505-60-2) (CWC Schedule 1A); Bis(2-chloroethylthio)methane (CAS 63839-13-6) (CWC Schedule 1A); 1,2-bis (2-chloroethylthio)ethane (CAS 3563-36-8) (CWC Schedule 1A); 1,3-bis (2-chloroethylthio)-n-propane (CAS 63905-10-2) (CWC Schedule 1A); 1,4-bis (2-chloroethylthio)-n-butane (CWC Schedule 1A); 1,5-bis (2-chloroethylthio)-n-pentane (CWC Schedule 1A); Bis (2-chloroethylthiomethyl)ether (CWC Schedule 1A); Bis (2-chloroethylthioethyl)ether (CAS 63918-89-8) (CWC Schedule 1A);

(ii) Lewisites, such as: 2-chlorovinyldichloroarsine (CAS 541-25-3) (CWC Schedule 1A); Tris (2-chlorovinyl) arsine (CAS 40334-70-1) (CWC Schedule 1A); Bis (2-chlorovinyl) chloroarsine (CAS 40334-69-8) (CWC Schedule 1A);

(iii) Nitrogen mustards, or their protonated salts, as follows:

(A) HN1: Bis (2-chloroethyl) ethylamine (CAS 538-07-8) (CWC Schedule 1A);

(B) HN2: Bis (2-chloroethyl) methylamine (CAS 51-75-2) (CWC Schedule 1A);

(C) HN3: Tris (2-chloroethyl) amine (CAS 555-77-1) (CWC Schedule 1A); or

(D) Other nitrogen mustards, or their salts, having a propyl, isopropyl, butyl, isobutyl, or tertiary butyl group on the bis(2-chloroethyl) amine base;

(iv) Ethyldichloroarsine (ED) (CAS 598-14-1); or

(v) Methyldichloroarsine (MD) (CAS 593-89-5);

(4) Incapacitating agents, such as:

(i) 3-Quinuclindinyl benzilate (BZ) (CAS 6581-06-2) (CWC Schedule 2A);

(ii) Diphenylchloroarsine (DA) (CAS 712-48-1); or

(iii) Diphenylcyanoarsine (DC) (CAS 23525-22-6);

(5) Chemical warfare agents not enumerated above adapted for use in war to produce casualties in humans or animals, degrade equipment, or damage crops or the environment. (*See* the CCL at ECCNs 1C350, 1C355, and 1C395 for control of certain chemicals not adapted for use in war.)

*(b) Biological agents and biologically derived substances and genetic elements thereof as follows:

(1) Genetically modified biological agents:

(i) Having non-naturally occurring genetic modifications that are known to or are reasonably expected to result in an increase in any of the following:

(A) Persistence in a field environment (*i.e.,* resistance to oxygen, UV damage, temperature extremes, arid conditions, or decontamination processes); or

(B) The ability to defeat or overcome standard detection methods, personnel protection, natural or acquired host immunity, host immune response, or response to standard medical countermeasures; and

(ii) Being any micro-organisms/toxins or their non-naturally occurring genetic elements as listed below:

(A) Bacillus anthracis;

(B) Botulinum neurotoxin producing species of Clostridium;

(C) Burkholderia mallei;

(D) Burkholderia pseudomallei;

(E) Ebola virus;

(F) Foot-and-mouth disease virus;

(G) Francisella tularensis;

(H) Marburg virus;

(I) Variola major virus (Smallpox virus);

(J) Variola minor virus (Alastrim);

(K) Yersinia pestis; or

(L) Rinderpest virus.

(2) Biological agent or biologically derived substances controlled in ECCNs 1C351, 1C353, or 1C354:

(i) Physically modified, formulated, or produced as any of the following:

(A) 1-10 micron particle size;

(B) Particle-absorbed or combined with nano-particles;

(C) Having coatings/surfactants, or

(D) By microencapsulation; and

(ii) Meeting the criteria of paragraph (b)(2)(i) of this category in a manner that is known to or is reasonably expected to result in an increase in any of the following:

(A) Persistence in a field environment (*i.e.,* resistant to oxygen, UV damage, temperature extremes, arid conditions, or decontamination processes);

(B) Dispersal characteristics (e.g., reduced susceptibility to shear forces, optimized electrostatic charges); or

(C) The ability to defeat or overcome: standard detection methods, personnel protection, natural or acquired host immunity, or response to standard medical countermeasures.

*(c) Chemical agent binary precursors and key precursors, as follows:

(1) Alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonyl difluorides, such as: DF: Methyl Phosphonyldifluoride (CAS 676-99-3) (CWC Schedule 1B); Methylphosphinyldifluoride (CAS 753-59-3) (CWC Schedule 2B);

(2) O-Alkyl (H or equal to or less than C_{10}, 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 (CAS 57856-11-8) (CWC Schedule 1B);

(3) Chlorosarin: O-Isopropyl methylphosphonochloridate (CAS 1445-76-7) (CWC Schedule 1B);

(4) Chlorosoman: O-Pinacolyl methylphosphonochloridate (CAS 7040-57-5) (CWC Schedule 1B); or

(5) Methylphosphonyl dichloride (CAS 676-97-1) (CWC Schedule 2B); Methylphosphinyldichloride (CAS 676-83-5) (CWC Schedule 2B).

(d) [Reserved]

(e) Defoliants, as follows:

(1) 2,4,5-trichlorophenoxyacetic acid (CAS 93-76-5) mixed with 2,4-dichlorophenoxyacetic acid (CAS 94-75-7) (Agent Orange (CAS 39277-47-9)); or

(2) Butyl 2-chloro-4-fluorophenoxyacetate (LNF).

*(f) Parts, components, accessories, attachments, associated equipment, materials, and systems, as follows:

(1) Any equipment for the dissemination, dispersion, or testing of articles controlled in paragraphs (a), (b), (c), or (e) of this category, as follows:

(i) Any equipment “specially designed” for the dissemination and dispersion of articles controlled in paragraphs (a), (b), (c), or (e) of this category; or

(ii) Any equipment “specially designed” for testing the articles controlled in paragraphs (a), (b), (c), (e), or (f)(4) of this category and developed under a Department of Defense contract or other funding authorization.

(2) Any equipment, containing reagents, algorithms, coefficients, software, libraries, spectral databases, or alarm set point levels developed under a Department of Defense contract or other funding authorization, for the detection, identification, warning, or monitoring of:

(i) Articles controlled in paragraphs (a) or (b) of this category; or

(ii) Chemical agents or biological agents specified in the Department of Defense contract or other funding authorization.

(3) [Reserved]

(4) For individual protection or collective protection against the articles controlled in paragraphs (a) and (b) of this category, as follows:

(i) M53 Chemical Biological Protective Mask or M50 Joint Service General Purpose Mask (JSGPM);

(ii) Filter cartridges containing sorbents controlled in paragraph (f)(4)(iii) or (n) of this category;

(iii) Carbon meeting MIL-DTL-32101 specifications (e.g., ASZM-TEDA carbon); or

(iv) Ensembles, garments, suits, jackets, pants, boots, or socks for individual protection, and liners for collective protection that allow no more than 1% breakthrough of GD or no more than 2% breakthrough of any other chemical controlled in paragraph (a) of this category, when evaluated by executing the applicable standard method(s) of testing described in the current version of Test Operating Protocols (TOPs) 08-2-201 or 08-2-501 and using the defined Department of Defense-specific requirements;

(5)-(6) [Reserved]

(7) Chemical Agent Resistant Coatings that have been qualified to military specifications (MIL-PRF-32348, MIL-DTL-64159, MIL-C-46168, or MIL-DTL-53039); or

(8) Any part, component, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Is manufactured using classified production data; or

(iii) Is being developed using classified information.

(g) Antibodies, recombinant protective antigens, polynucleotides, biopolymers, or biocatalysts (including their expression vectors, viruses, plasmids, or cultures of specific cells modified to produce them) as follows:

(1) When exclusively funded by a Department of Defense contract for detection of the biological agents at paragraph (b)(1)(ii) of this category even if naturally occurring;

(2) Joint Biological Agent Identification and Diagnostic System (JBAIDS) Freeze Dried reagents listed by JRPD-ASY-No and Description respectively as follows:

(i) JRPD-ASY-0016 Q-Fever IVD Kit;

(ii) JRPD-ASY-0100 Vaccinia (Orthopox);

(iii) JRPD-ASY-0106 Brucella melitensis (Brucellosis);

(iv) JRPD-ASY-0108 Rickettsia prowazekii (Rickettsia);

(v) JRPD-ASY-0109 Burkholderia ssp. (Burkholderia);

(vi) JRPD-ASY-0112 Eastern equine encephalitis (EEE);

(vii) JRPD-ASY-0113 Western equine encephalitis (WEE);

(viii) JRPD-ASY-0114 Venezuelan equine encephalitis (VEE);

(ix) JRPD-ASY-0122 Coxiella burnetii (Coxiella);

(x) JRPD-ASY-0136 Influenza A/H5 IVD Detection Kit;

(xi) JRPD-ASY-0137 Influenza A/B IVD Detection Kit; or

(xii) JRPD-ASY-0138 Influenza A Subtype IVD Detection Kit;

(3) Critical Reagent Polymerase (CRP) Chain Reactions (PCR) assay kits with Catalog-ID and Catalog-ID Product respectively as follows:

(i) PCR-BRU-1FB-B-K Brucella Target 1 FastBlock Master Mix Biotinylated;

(ii) PCR-BRU-1FB-K Brucella Target 1 FastBlock Master Mix;

(iii) PCR-BRU-1R-K Brucella Target 1 LightCycler/RAPID Master Mix;

(iv) PCR-BURK-2FB-B-K Burkholderia Target 2 FastBlock Master Mix Biotinylated;

(v) PCR-BURK-2FB-K Burkholderia Target 2 FastBlock Master Mix;

(vi) PCR-BURK-2R-K Burkholderia Target 2 LightCycler/RAPID Master Mix;

(vii) PCR-BURK-3FB-B-K Burkholderia Target 3 FastBlock Master Mix Biotinylated;

(viii) PCR-BURK-3FB-K Burkholderia Target 3 FastBlock Master Mix;

(ix) PCR-BURK-3R-K Burkholderia Target 3 LightCycler/RAPID Master Mix;

(x) PCR-COX-1FB-B-K Coxiella burnetii Target 1 FastBlock Master Mix Biotinylated;

(xi) PCR-COX-1R-K Coxiella burnetii Target 1 LightCycler/RAPID Master Mix;

(xii) PCR-COX-2R-K Coxiella burnetii Target 2 LightCycler/RAPID Master Mix;

(xiii) PCR-OP-1FB-B-K Orthopox Target 1 FastBlock Master Mix Biotinylated;

(xiv) PCR-OP-1FB-K Orthopox Target 1 FastBlock Master Mix;

(xv) PCR-OP-1R-K Orthopox Target 1 LightCycler/RAPID Master Mix;

(xvi) PCR-OP-2FB-B-K Orthopox Target 2 FastBlock Master Mix Biotinylated;

(xvii) PCR-OP-3R-K Orthopox Target 3 LightCycler/RAPID Master Mix;

(xviii) PCR-RAZOR-BT-X PCR-RAZOR-BT-X RAZOR CRP BioThreat-X Screening Pouch;

(xix) PCR-RIC-1FB-K Ricin Target 1 FastBlock Master Mix;

(xx) PCR-RIC-1R-K Ricin Target 1 LightCycler/RAPID Master Mix;

(xxi) PCR-RIC-2R-K Ricin Target 2 LightCycler/RAPID Master Mix; or

(xxii) PCR-VEE-1R-K Venezuelan equine encephalitis Target 1 LightCycler/RAPID Master Mix; or

(4) Critical Reagent Program Antibodies with Catalog ID and Product respectively as follows:

(i) AB-AG-RIC Aff. Goat anti-Ricin;

(ii) AB-ALVG-MAB Anti-Alphavirus Generic Mab;

(iii) AB-AR-SEB Aff. Rabbit anti-SEB;

(iv) AB-BRU-M-MAB1 Anti-Brucella melitensis Mab 1;

(v) AB-BRU-M-MAB2 Anti-Brucella melitensis Mab 2;

(vi) AB-BRU-M-MAB3 Anti-Brucella melitensis Mab 3;

(vii) AB-BRU-M-MAB4 Anti-Brucella melitensis Mab 4;

(viii) AB-CHOL-0139-MAB Anti-V.cholerae 0139 Mab;

(ix) AB-CHOL-01-MAB Anti-V. cholerae 01 Mab;

(x) AB-COX-MAB Anti-Coxiella Mab;

(xi) AB-EEE-MAB Anti-EEE Mab;

(xii) AB-G-BRU-A Goat anti-Brucella abortus;

(xiii) AB-G-BRU-M Goat anti-Brucella melitensis;

(xiv) AB-G-BRU-S Goat anti-Brucella suis;

(xv) AB-G-CHOL-01 Goat anti-V.cholerae 0:1;

(xvi) AB-G-COL-139 Goat anti-V.cholerae 0:139;

(xvii) AB-G-DENG Goat anti-Dengue;

(xviii) AB-G-RIC Goat anti-Ricin;

(xix) AB-G-SAL-T Goat anti-S. typhi;

(xx) AB-G-SEA Goat anti-SEA;

(xxi) AB-G-SEB Goat anti-SEB;

(xxii) AB-G-SEC Goat anti-SEC;

(xxiii) AB-G-SED Goat anti-SED;

(xxiv) AB-G-SEE Goat anti-SEE;

(xxv) AB-G-SHIG-D Goat anti-Shigella dysenteriae;

(xxvi) AB-R-BA-PA Rabbit anti-Protective Antigen;

(xxvii) AB-R-COX Rabbit anti-C. burnetii;

(xxviii) AB-RIC-MAB1 Anti-Ricin Mab 1;

(xxix) AB-RIC-MAB2 Anti-Ricin Mab 2;

(xxx) AB-RIC-MAB3 Anti-Ricin Mab3;

(xxxi) AB-R-SEB Rabbit anti-SEB;

(xxxii) AB-R-VACC Rabbit anti-Vaccinia;

(xxxiii) AB-SEB-MAB Anti-SEB Mab;

(xxxiv) AB-SLT2-MAB Anti-Shigella-like t x2 Mab;

(xxxv) AB-T2T-MAB1 Anti-T2 Mab 1;

(xxxvi) AB-T2T-MAB2 Anti-T2 Toxin 2;

(xxxvii) AB-VACC-MAB1 Anti-Vaccinia Mab 1;

(xxxviii) AB-VACC-MAB2 Anti-Vaccinia Mab 2;

(xxxix) AB-VACC-MAB3 Anti-Vaccinia Mab 3;

(xl) AB-VACC-MAB4 Anti-Vaccinia Mab 4;

(xli) AB-VACC-MAB5 Anti-Vaccinia Mab 5;

(xlii) AB-VACC-MAB6 Anti-Vaccinia Mab 6;

(xliii) AB-VEE-MAB1 Anti-VEE Mab 1;

(xliv) AB-VEE-MAB2 Anti-VEE Mab 2;

(xlv) AB-VEE-MAB3 Anti-VEE Mab 3;

(xlvi) AB-VEE-MAB4 Anti-VEE Mab 4;

(xlvii) AB-VEE-MAB5 Anti-VEE Mab 5;

(xlviii) AB-VEE-MAB6 Anti-VEE Mab 6; or

(xlix) AB-WEE-MAB Anti-WEE Complex Mab.

(h) Vaccines exclusively funded by a Department of Defense contract, as follows:

(1) Recombinant Botulinum ToxinA/B Vaccine;

(2) Recombinant Plague Vaccine;

(3) Trivalent Filovirus Vaccine; or

(4) Vaccines specially designed for the sole purpose of protecting against biological agents and biologically derived substances identified in paragraph (b) of this category.

(i) Modeling or simulation tools, including software controlled in paragraph (m) of this category, for chemical or biological weapons design, development, or employment developed or produced under a Department of Defense contract or other funding authorization (e.g., the Department of Defense's HPAC, SCIPUFF, and the Joint Effects Model (JEM)).

(j)-(l) [Reserved]

(m) Technical data (as defined in §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles enumerated in paragraphs (a) through (l) and (n) of this category. (*See* §125.4 of this subchapter for exemptions.)

(n) Developmental countermeasures or sorbents funded by the Department of Defense via contract or other funding authorization;

(o)-(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR (see §120.42 of this subchapter) used in or with defense articles controlled in this category.

Category XV— Spacecraft and Related Articles

(a) Spacecraft, including satellites and space vehicles, whether designated developmental, experimental, research, or scientific, or having a commercial, civil, or military end-use, that:

*(1) Are specially designed to mitigate effects (e.g., scintillation) of or for detection of a nuclear detonation;

*(2) Autonomously detect and track moving ground, airborne, missile, or space objects other than celestial bodies, in real-time using imaging, infrared, radar, or laser systems;

*(3) Conduct signals intelligence (SIGINT) or measurement and signatures intelligence (MASINT);

*(4) Are specially designed to be used in a constellation or formation that when operated together, in essence or effect, form a virtual satellite (e.g., functioning as if one satellite) with the characteristics or functions of other items in paragraph (a);

*(5) Are anti-satellite or anti-spacecraft (e.g., kinetic, RF, laser, charged particle);

*(6) Have space-to-ground weapons systems (e.g., kinetic or directed energy);

*(7) Have any of the following electro-optical remote sensing capabilities or characteristics:

(i) Electro-optical visible and near infrared (VNIR) (*i.e.,* 400nm to 1,000nm) or infrared (*i.e.,* greater than 1,000nm to 30,000nm) with less than 40 spectral bands and having a clear aperture greater than 0.50m;

(ii) Electro-optical hyperspectral with 40 spectral bands or more in the VNIR, short-wavelength infrared (SWIR) (*i.e.,* greater than 1,000nm to 2,500nm) or any combination of the aforementioned and having a Ground Sample Distance (GSD) less than 30 meters;

(iii) Electro-optical hyperspectral with 40 spectral bands or more in the mid-wavelength infrared (MWIR) (*i.e.,* greater than 2,500nm to 5,500nm) having a narrow spectral bandwidth of Δλ less than or equal to 20nm full width at half maximum (FWHM) or having a wide spectral bandwidth with Δλ greater than 20nm FWHM and a GSD less than 200 meters; or

(iv) Electro-optical hyperspectral with 40 spectral bands or more in the long-wavelength infrared (LWIR) (*i.e.,* greater than 5,500nm to 30,000nm) having a narrow spectral bandwidth of Δλ less than or equal to 50nm FWHM or having a wide spectral bandwidth with Δλ greater than 50nm FWHM and a GSD less than 500 meters;

*(8) Have radar remote sensing capabilities or characteristics (e.g., active electronically scanned array (AESA), synthetic aperture radar (SAR), inverse synthetic aperture radar (ISAR), ultra-wideband SAR), except those having a center frequency equal to or greater than 1 GHz but less than or equal to 10 GHz and having a bandwidth less than 300 MHz;

(9) Provide Positioning, Navigation, and Timing (PNT) signals;

(10) Autonomously perform collision avoidance;

(11) Are sub-orbital, incorporate propulsion systems described in paragraph (e) of this category or Category IV(d)(1)-(6) of this section, and are specially designed for atmospheric entry or re-entry;

(12) Are specially designed to provide inspection or surveillance of another spacecraft, or service another spacecraft via grappling or docking; or

*(13) Are classified, contain classified software or hardware, are manufactured using classified production data, or are being developed using classified information (e.g., having classified requirements, specifications, functions, or operational characteristics or include classified cryptographic items controlled under USML Category XIII of this subchapter). “Classified” means classified pursuant to Executive Order 13526, or predecessor order, and a security

classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization.

(b) Ground control systems or training simulators, specially designed for telemetry, tracking, and control (TT&C) of spacecraft in paragraph (a) of this category.

(c)-(d) [Reserved]

(e) Spacecraft parts, components, accessories, attachments, equipment, or systems, as follows:

(1) Antenna systems specially designed for spacecraft that:

(i) Have a dimension greater than 25 meters in diameter or length of the major axis;

(ii) Employ active electronic scanning;

(iii) Are adaptive beam forming; or

(iv) Are for interferometric radar;

(2) Space-qualified optics (*i.e.,* lens, mirror or membrane) having one of the following:

(i) Active properties (e.g., adaptive, deformable) with a largest lateral clear aperture dimension greater than 0.35m; or

(ii) A largest lateral clear aperture dimension greater than 0.50m;

(3) Space-qualified focal plane arrays (FPA) having a peak response in the wavelength range exceeding 900nm and readout integrated circuit (ROIC), whether separate or integrated, specially designed therefor;

(4) Space-qualified mechanical (*i.e.,* active) cryocooler or active cold finger systems, and associated control electronics specially designed therefor;

(5) Space-qualified active vibration suppression systems, including active isolation and active dampening systems, and associated control electronics specially designed therefor;

(6) Optical bench assemblies specially designed to enable spacecraft to meet or exceed the parameters described in paragraph (a) of this category;

(7) Space-qualified kinetic or directed-energy systems (e.g., RF, laser, charged particle) specially designed for spacecraft in paragraph (a)(5) or (a)(6) of this category, and specially designed parts and components therefor (e.g., power conditioning and beam-handling/switching, propagation, tracking, and pointing equipment);

(8) [Reserved]

(9) Space-qualified cesium, rubidium, hydrogen maser, or quantum (e.g., based upon Al, Hg, Yb, Sr, Be Ions) atomic clocks, and specially designed parts and components therefor;

(10) Attitude determination and control systems, and specially designed parts and components therefor, that provide a spacecraft's geolocation accuracy, without using Ground Location Points, better than or equal to:

(i) 5 meters (CE90) from low earth orbit (LEO);

(ii) 30 meters (CE90) from medium earth orbit (MEO);

(iii) 150 meters (CE90) from geosynchronous orbit (GEO); or

(iv) 225 meters (CE90) from high earth orbit (HEO);

(11) Space-based systems, and specially designed parts and components therefor, as follows:

(i) Nuclear reactors and associated power conversion systems (e.g., liquid metal or gas-cooled fast reactors);

(ii) Radioisotope-based power systems (e.g., radioisotope thermoelectric generators);

(iii) Nuclear thermal propulsion systems (e.g., solid core, liquid core, gas core fission); or

(iv) Electric (Plasma/Ion) propulsion systems that provide a thrust greater than 300 milli-Newtons and a specific impulse greater than 1,500 sec; or that operate at an input power of more than 15kW;

(12) Thrusters (e.g., spacecraft or rocket engines) using bi-propellants or mono-propellant that provide greater than 150 lbf (*i.e.,*667.23 N) vacuum thrust (MT for rocket motors or engines having a total impulse capacity equal to or greater than 8.41 × 10^5 newton seconds);

(13) Control moment gyroscope (CMG) specially designed for spacecraft;

(14) Space-qualified monolithic microwave integrated circuits (MMIC) that combine transmit and receive (T/R) functions on a single die as follows:

(i) Having a power amplifier with maximum saturated peak output power (in watts), Psat, greater than 200 divided by the maximum operating frequency (in GHz) squared [Psat >200 W*GHz2/fGHz2]; or

(ii) Having a common path (e.g., phase shifter-digital attenuator) circuit with greater than 3 bits phase shifting at operating frequencies 10 GHz or below, or greater than 4 bits phase shifting at operating frequencies above 10 GHz;

(15) Space-qualified oscillator for radar in paragraph (a) of this category with phase noise less than −120 dBc/Hz + (20 log10(RF) (in GHz)) measured at 2 KHz*RF (in GHz) from carrier;

(16) Space-qualified star tracker or star sensor with angular accuracy less than or equal to 1 arcsec (1-Sigma) per star coordinate, and a tracking rate equal to or greater than 3.0 deg/sec, and specially designed parts and components therefor (MT);

*(17) Primary, secondary, or hosted payload that performs any of the functions described in paragraph (a) of this category;

*(18) Secondary or hosted payload, and specially designed parts and components therefor, developed with Department of Defense-funding;

(19) Spacecraft heat shields or heat sinks specially designed for atmospheric entry or re-entry, and specially designed parts and components therefor (MT if usable in rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km);

(20) Equipment modules, stages, or compartments that incorporate propulsion systems described in paragraph (e) of this category or Category IV(d)(1)-(6) of this section, and can be separated or jettisoned from another spacecraft; or

*(21) Any part, component, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Contains classified software; or

(iii) Is being developed using classified information.

(f) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (e) of this category and classified technical data directly related to items controlled in ECCNs 9A515, 9B515, or 9D515 and defense services using the classified technical data. Defense services include the furnishing of assistance (including training) in the integration of a satellite or spacecraft to a launch vehicle, including both planning and onsite support, regardless of the jurisdiction, ownership, or origin of the satellite or spacecraft, or whether technical data is used. It also includes the furnishing of assistance (including training) in the launch failure analysis of a satellite or spacecraft, regardless of the jurisdiction, ownership, or origin of the satellite of spacecraft, or whether technical data is used. (*See* §125.4 of this subchapter for exemptions, and §124.15 of this subchapter for special export controls for satellites and satellite launches.) (MT for technical data and defense services related to articles designated as such.)

(g)-(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XVI—Nuclear Weapons Related Articles

(a) [Reserved]

*(b) Modeling or simulation tools that model or simulate the environments generated by nuclear detonations or the effects of these environments on systems, subsystems, components, structures, or humans.

(c) [Reserved]

(d) Parts, components, accessories, attachments, associated equipment, and production, testing, and inspection equipment and tooling, specially designed for the articles in paragraph (b) of this category.

(e) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraph (b) of this category. (*See* §123.20 of this subchapter for nuclear related controls.)

(f)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XVII—Classified Articles, Technical Data, and Defense Services Not Otherwise Enumerated

*(a) All articles, and technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) relating thereto, that are classified in the interests of national security and that are not otherwise enumerated on the U.S. Munitions List.

Category XVIII—Directed Energy Weapons or EMP Weapons

*(a) Directed energy weapons as follows or EMP that uses the following components:

(1) 1.3 uF 100kV ultra low inductance capacitors and similar large capacitors

(i) Parabolic reflector or similar devices for directing energy

(ii)Rail gap switch or similar fast power release switches

(iii) 100 kV or higher power supply units

(iv) Low resistance antenna

(2) Use any non-acoustic technique such as lasers (including continuous wave or pulsed lasers), particle beams, particle accelerators that project a charged or neutral particle beam, high power radio-frequency (RF), or high pulsed power or high average power radio frequency beam transmitters.

*(b) Systems or equipment specially designed to detect, identify, or provide defense against articles specified in paragraph (a) of this category.

(c)-(d) [Reserved]

(e) Components, parts, accessories, attachments, systems or associated equipment specially designed for any of the articles in paragraphs (a) or (b) of this category.

(f) Developmental directed energy weapons funded by the Department of Defense via contract or other funding authorization, and specially designed parts and components therefor;

(g) Technical data (see §120.10 of this subchapter) and defense services (as defined in §120.9 of this subchapter) directly related to the defense articles enumerated in paragraphs (a) through (e) of this category;

(x) Commodities, software, and technology subject to the EAR (see §120.42 of this subchapter) used in or with defense articles controlled in this category.

Category XIX—Gas Turbine Engines and Associated Equipment

*(a) Turbofan and Turbojet engines (including those that are technology demonstrators, developmental engines, or variable cycle engines) capable of 15,000 lbf (66.7 kN) of thrust or greater that have any of the following:

(1) With or specially designed for thrust augmentation (afterburner);

(2) Thrust or exhaust nozzle vectoring;

(3) Parts or components controlled in paragraph (f)(6) of this category;

(4) Specially designed for sustained 30 second inverted flight or negative g maneuver; or

(5) Specially designed for high power extraction (greater than 50 percent of engine thrust at altitude) at altitudes greater than 50,000 feet.

*(b) Turboshaft and Turboprop engines (including those that are technology demonstrators or developmental engines) that have any of the following:

(1) Capable of 2000 mechanical shp (1491 kW) or greater and specially designed with oil sump sealing when the engine is in the vertical position; or

(2) Capable of a specific power of 225 shp/(lbm/sec) or greater and specially designed for armament gas ingestion and non-civil transient maneuvers, where specific power is defined as maximum takeoff shaft horsepower (shp) divided by compressor inlet flow (lbm/sec).

*(c) Gas turbine engines (including technology demonstrators, developmental engines, and variable cycle engines) specially designed for unmanned aerial vehicle systems controlled in this subchapter, cruise missiles, or target drones (MT if for an engine used in an aircraft, excluding manned aircraft, or missile that has a “range” equal to or greater than 300 km).

*(d) GE38, AGT1500, CTS800, MT7, T55, HPW3000, GE3000, T408, and T700 engines.

*(e) Digital engine control systems (e.g., Full Authority Digital Engine Controls (FADEC) and Digital Electronic Engine Controls (DEEC)) specially designed for gas turbine engines controlled in this category (MT if the digital engine control system is for an aircraft, excluding manned aircraft, or missile that has a range equal to or greater than 300 km).

(f) Parts, components, accessories, attachments, associated equipment, and systems as follows:

(1) Parts, components, accessories, and attachments specially designed for the following U.S.-origin engines (and military variants thereof): F101, F107, F112, F118, F119, F120, F135, F136, F414, F415, and J402;

*(2) Hot section components (*i.e.,* combustion chambers and liners; high pressure turbine blades, vanes, disks and related cooled structure; cooled intermediate pressure turbine blades, vanes, disks and related cooled structures; cooled low pressure turbine blades, vanes, disks and related cooled structures; cooled shaft-driving power turbine blades, vanes, disks and related cooled structures; cooled augmenters; and cooled nozzles) specially designed for gas turbine engines controlled in this category;

(3) Uncooled turbine blades, vanes, disks, and tip shrouds specially designed for gas turbine engines controlled in this category;

(4) Combustor cowls, diffusers, domes, and shells specially designed for gas turbine engines controlled in this category;

(5) Engine monitoring systems (*i.e.,* prognostics, diagnostics, and health) specially designed for gas turbine engines and components controlled in this category;

*(6) Any part, component, accessory, attachment, equipment, or system that:

(i) Is classified;

(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR; or

(iii) Is being developed using classified information.

(7) Investment casting cores, core dies, or wax pattern dies for parts or components enumerated in paragraphs (f)(1), (f)(2), or (f)(3) of this category;

(8) Pressure gain combustors specially designed for engines controlled in this category, and specially designed parts and components therefor;

(9) Three-stream fan systems, specially designed for gas turbine engines controlled in this Category, that allow the movement of airflow between the streams to control fan pressure ratio or bypass ratio (by means other than use of fan corrected speed or the primary nozzle area to change the fan pressure ratio or bypass ratio), and specially designed parts, components, accessories, and attachments therefor;

(10) High pressure compressors, specially designed for gas turbine engines controlled in this Category, with core-driven bypass streams that have a pressure ratio greater than one, occurring across any section of the bypass duct, and specially designed parts, components, accessories, and attachments therefor;

(11) Intermediate compressors of a three-spool compression system, specially designed for gas turbine engines controlled in this Category, with an intermediate spool-driven bypass stream that has a pressure ratio greater than one, occurring across any section of the bypass duct, and specially designed parts, components, accessories, and attachments therefor; or

(12) Any of the following equipment if specially designed for a defense article described in paragraph (f)(1): Jigs, locating fixtures, templates, gauges, molds, dies, caul plates, or bellmouths.

(g) Technical data (see §120.10 of this subchapter) and defense services (see §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (f) of this category and classified technical data directly related to items controlled in ECCNs 9A619, 9B619, 9C619, and 9D619 and defense services using the classified technical data. (See §125.4 of this subchapter for exemptions.) (MT for technical data and defense services related to articles designated as such.)

(h)-(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR (see §120.42 of this subchapter) used in or with defense articles controlled in this category.

Category XX—Submersible Vessels and Related Articles

(a) Submersible and semi-submersible vessels that are:

*(1) Submarines specially designed for military use;

(2) Mine countermeasure vehicles;

(3) Anti-submarine warfare vehicles;

(4) Armed or are specially designed to be used as a platform to deliver munitions or otherwise destroy or incapacitate targets (e.g., firing torpedoes, launching rockets, firing missiles, deploying mines, deploying countermeasures) or deploy military payloads;

(5) Swimmer delivery vehicles specially designed for the deployment, recovery, or support of swimmers or divers from submarines;

(6) Integrated with nuclear propulsion systems;

(7) Equipped with any mission systems controlled under this subchapter; or

(8) Developmental vessels funded by the Department of Defense via contract or other funding authorization.

*(b) Engines, electric motors, and propulsion plants as follows:

(1) Naval nuclear propulsion plants and prototypes, and special facilities for construction, support, and maintenance therefor (*see* §123.20 of this subchapter);

(2) Electric motors specially designed for submarines that have the following:

(i) Power output of more than 0.75 MW (1,000 hp);

(ii) Quick reversing;

(iii) Liquid cooled; and

(iv) Totally enclosed.

(c) Parts, components, accessories, attachments, and associated equipment, including production, testing, and inspection equipment and tooling, specially designed for any of the articles in paragraphs (a) and (b) of this category (MT for launcher mechanisms specially designed for rockets, space launch vehicles, or missiles capable of achieving a range greater than or equal to 300 km).

(d) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles described in paragraphs (a) through (c) of this category. (MT for technical data and defense services related to articles designated as such.) (*See* §125.4 of this subchapter for exemptions.)

(e)-(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR (*see* §120.42 of this subchapter) used in or with defense articles.

Category XXI—Articles, Technical Data, and Defense Services Not Otherwise Enumerated

*(a) Any article not enumerated on the U.S. Munitions List may be included in this category until such time as the appropriate U.S. Munitions List category is amended. The decision on whether any article may be included in this category, and the designation of the defense article as not Significant Military Equipment (*see* §120.7 of this subchapter), shall be made by the Director, Office of Defense Trade Controls Policy.

(b) Technical data (*see* §120.10 of this subchapter) and defense services (*see* §120.9 of this subchapter) directly related to the defense articles covered in paragraph (a) of this category.