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Title 22 – Foreign Relations

Chapter I – Department of State

Subchapter M – International Traffic in Arms Regulations

Part 121 the United States Munitions List

Enumeration of Articles

§ 121.0 United States Munitions List description and definitions.

§ 121.1 The United States Munitions List.

§§ 121.2-121.16 [Reserved]

PART 121—THE UNITED STATES MUNITIONS LIST

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ENUMERATION OF ARTICLES

§ 121.0 United States Munitions List description and definitions.

- (a) For a description of the U.S. Munitions List and its designations, including the use of asterisks and the parenthetical “(MT)”, see § 120.10 of this subchapter.
- (b) As used in this part, *EAR* means Export Administration Regulations in 15 CFR parts 730 through 774.

[87 FR 16422, Mar. 23, 2022]

§ 121.1 The United States Munitions List.

Link to an amendment published at 86 FR 48022, Aug. 27, 2021.

(a)–(b) [Reserved]

Category I—Firearms and Related Articles

* (a) Firearms using caseless ammunition.

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

* (c) Firearms specially designed to integrate fire control, automatic tracking, or automatic firing (e.g., Precision Guided Firearms).

Note 1 to paragraph (c): Integration does not include only attaching to the firearm or rail.

* (d) Fully automatic shotguns regardless of gauge.

* (e) Silencers, mufflers, and sound suppressors.

(f) [Reserved]

(g) Barrels, receivers (frames), bolts, bolt carriers, slides, or sears specially designed for the articles in paragraphs (a), (b), and (d) of this category.

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

(1) Drum and other magazines for firearms to .50 caliber (12.7 mm) inclusive with a capacity greater than 50 rounds, regardless of jurisdiction of the firearm, and specially designed parts and components therefor;

(2) Parts and components specially designed for conversion of a semi-automatic firearm to a fully automatic firearm;

(3) Parts and components specially designed for defense articles described in paragraphs (c) and (e) of this category; or

(4) Accessories or attachments specially designed to automatically stabilize aim (other than gun rests) or for automatic targeting, and specially designed parts and components therefor.

(i) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles described in this category and classified technical data directly related to items controlled in ECCNs 0A501, 0B501, 0D501, and 0E501 and defense services using the classified technical data. (See § 125.4 of this subchapter for exemptions.)

(j)–(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Note 1 to Category I: The following interpretations explain and amplify the terms used in this category:

(1) A firearm is a weapon not over .50 caliber (12.7 mm) which is designed to expel a projectile by the deflagration of propellant;

(2) A fully automatic firearm or shotgun is any firearm or shotgun that shoots, is designed to shoot, or can readily be restored to shoot, automatically more than one shot, without manual reloading, by a single function of the trigger; and

(3) Caseless ammunition is firearm ammunition without a cartridge case that holds the primer, propellant, and projectile together as a unit.

Category II—Guns and Armament

(a) Guns and armament greater than .50 caliber (12.7 mm), as follows:

* (1) Guns, howitzers, artillery, and cannons;

* (2) Mortars;

* (3) Recoilless rifles;

* (4) Grenade launchers; or

(5) Developmental guns and armament greater than .50 caliber (12.7 mm) funded by the Department of Defense and specially designed parts and components therefor.

Note 1 to paragraph (a)(5): This paragraph does not control guns and armament greater than .50 caliber (12.7 mm):

(a) in production;

(b) determined to be subject to the EAR via a commodity jurisdiction determination; or

(c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (a)(5): Note 1 to paragraph (a)(5) does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (a)(5): This provision is applicable to those contracts or other funding authorizations that are dated January 23, 2021, or later.

Note 1 to paragraph (a): This paragraph does not include: Non-automatic and non-semi-automatic rifles, carbines, and pistols between .50 (12.7 mm) and .72 caliber (18.288 mm)

that are controlled on the CCL under ECCN 0A501; shotguns controlled on the CCL under ECCN 0A502; black powder guns and armaments manufactured between 1890 and 1919 controlled on the CCL under ECCN 0A602; or black powder guns and armaments manufactured earlier than 1890.

Note 2 to paragraph (a): Guns and armament when integrated into their carrier (e.g., surface vessels, ground vehicles, or aircraft) are controlled in the category associated with the carrier. Self-propelled guns and armament are controlled in USML Category VII. Towed guns and armament and stand-alone guns and armament are controlled under this category.

(b) Flamethrowers with an effective range greater than or equal to 20 meters.

(c) [Reserved]

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

Note 1 to paragraph (d): Kinetic energy weapons systems include but are not limited to launch systems and subsystems capable of accelerating masses larger than 0.1g to velocities in excess of 1.6 km/s, in single or rapid fire modes, using methods such as: Electromagnetic, electrothermal, plasma, light gas, or chemical. This does not include launch systems and subsystems used for research and testing facilities subject to the EAR, which are controlled on the CCL under ECCN 2B232.

(e) Signature reduction devices specially designed for the guns and armament controlled in paragraphs (a), (b), and (d) of this category (e.g., muzzle flash suppression devices).

(f)–(i) [Reserved]

(j) Parts, components, accessories, and attachments, as follows:

(1) Gun barrels, rails, tubes, and receivers specially designed for the weapons controlled in paragraphs (a) and (d) of this category;

(2) Sights specially designed to orient indirect fire weapons;

(3) Breech blocks for the weapons controlled in paragraphs (a) and (d) of this category;

(4) Firing mechanisms for the weapons controlled in paragraphs (a) and (d) of this category and specially designed parts and components therefor;

(5) Systems for firing superposed or stacked ammunition and specially designed parts and components therefor;

- (6) Servo-electronic and hydraulic elevation adjustment mechanisms;
- (7) Muzzle brakes;
- (8) Bore evacuators;
- (9) Independent ammunition handling systems for the guns and armament controlled in paragraphs (a), (b), and (d) of this category;
- (10) Components for independently powered ammunition handling systems and platform interface, as follows:
 - (i) Mounts;
 - (ii) Carriages;
 - (iii) Gun pallets;
 - (iv) Hydro-pneumatic equilibration cylinders; or
 - (v) Hydro-pneumatic systems capable of scavenging recoil energy to power howitzer functions;

Note 1 to paragraph (j)(10): For weapons mounts specially designed for surface vessels and special naval equipment, see Category VI. For weapons mounts specially designed for ground vehicles, see Category VII.

- (11) Ammunition containers/drums, ammunition chutes, ammunition conveyor elements, ammunition feeder systems, and ammunition container/drum entrance and exit units, specially designed for the guns and armament controlled in paragraphs (a), (b), and (d) of this category;
- (12) Systems and equipment for the guns and armament controlled in paragraphs (a) and (d) of this category for use in programming ammunition, and specially designed parts and components therefor;
- (13) Aircraft/gun interface units to support gun systems with a designed rate of fire greater than 100 rounds per minute and specially designed parts and components therefor;
- (14) Recoil systems specially designed to mitigate the shock associated with the firing process of guns integrated into air platforms and specially designed parts and components therefor;
- (15) Prime power generation, energy storage, thermal management, conditioning, switching, and fuel-handling equipment, and the electrical interfaces between the gun power supply and other turret electric drive components specially designed for kinetic weapons controlled in paragraph (d) of this category;
- (16) Kinetic energy weapon target acquisition, tracking fire control, and damage assessment systems and specially designed parts and components therefor; or
- * (17) Any part, component, accessory, attachment, equipment, or system that:

- (i) Is classified;
- (ii) Contains classified software; or
- (iii) Is being developed using classified information.
- (k) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles described in paragraphs (a), (b), (d), (e), and (j) of this category and classified technical data directly related to items controlled in ECCNs 0A602, 0B602, 0D602, and 0E602 and defense services using the classified technical data. (See § 125.4 of this subchapter for exemptions.)
- (l)–(w) [Reserved]
- (x) Commodities, software, and technology subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Category III—Ammunition and Ordnance

(a) Ammunition, as follows:

- * (1) Ammunition that incorporates a projectile controlled in paragraph (d)(1) or (3) of this category;
- * (2) Ammunition preassembled into links or belts;
- * (3) Shotgun ammunition that incorporates a projectile controlled in paragraph (d)(2) of this category;
- * (4) Caseless ammunition manufactured with smokeless powder;

Note 1 to paragraph (a)(4): Caseless ammunition is ammunition without a cartridge case that holds the primer, propellant, and projectile together as a unit.

- * (5) Ammunition, except shotgun ammunition, based on non-metallic cases, or non-metallic cases that have only a metallic base, which result in a total cartridge mass 80% or less than the mass of a brass- or steel-cased cartridge that provides comparable ballistic performance;
- * (6) Ammunition employing pyrotechnic material in the projectile base or any ammunition employing a projectile that incorporates tracer materials of any type having peak radiance above 710 nm and designed to be observed primarily with night vision optical systems;
- * (7) Ammunition for fully automatic firearms that fire superposed or stacked projectiles or for guns that fire superposed or stacked projectiles;

- * (8) Electromagnetic armament projectiles or billets for weapons with a design muzzle energy exceeding 5 MJ;
- * (9) Ammunition, not specified above, for the guns and armaments controlled in Category II; or
- (10) Developmental ammunition funded by the Department of Defense and specially designed parts and components therefor.

Note 1 to paragraph (a)(10): This paragraph does not control ammunition:
(a) in production;

(b) determined to be subject to the EAR via a commodity jurisdiction determination; or

(c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (a)(10): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (a)(10): This provision is applicable to those contracts or other funding authorizations that are dated January 23, 2021, or later.

(b) Ammunition/ordnance handling equipment specially designed for the articles controlled in this category, as follows:

(1) Belting, linking, and de-linking equipment; or

(2) Fuze setting devices.

(c) [Reserved]

(d) Parts and components for the articles in this category, as follows:

(1) Projectiles that use pyrotechnic tracer materials that incorporate any material having peak radiance above 710 nm or are incendiary or explosive;

(2) Shotgun projectiles that are flechettes, incendiary, tracer, or explosive;

Note 1 to paragraph (d)(2): This paragraph does not include explosive projectiles specially designed to produce noise for scaring birds or other pests (e.g., bird bombs, whistlers, crackers).

(3) Projectiles of any caliber produced from depleted uranium;

(4) Projectiles not specified above, guided or unguided, for the items controlled in USML Category II, and specially designed parts and components therefor (e.g., fuzes, rotating bands, cases, liners, fins, boosters);

(5) Canisters or sub-munitions (e.g., bomblets or minelets), and specially designed parts and components therefor, for the guns or armament controlled in USML Category II;

(6) Projectiles that employ tips (e.g., M855A1 Enhanced Performance Round (EPR)) or cores regardless of caliber, produced from one or a combination of the following: Tungsten, steel, or beryllium copper alloy;

(7) Cartridge cases, powder bags, or combustible cases specially designed for the items controlled in USML Category II;

(8) Non-metallic cases, including cases that have only a metallic base, for the ammunition controlled in paragraph (a)(5) of this category;

(9) Cartridge links and belts for fully automatic firearms and guns controlled in USML Categories I or II;

(10) Primers other than Boxer, Berdan, or shotshell types;

Note 1 to paragraph (d)(10): This paragraph does not control caps or primers of any type in use prior to 1890.

(11) Safing, arming, and fuzing components (to include target detection and proximity sensing devices) for the ammunition in this category and specially designed parts therefor;

(12) Guidance and control components for the ammunition in this category and specially designed parts therefor;

(13) Terminal seeker assemblies for the ammunition in this category and specially designed parts and components therefor;

(14) Illuminating flares or target practice projectiles for the ammunition controlled in paragraph (a)(9) of this category; or

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

(i) Is classified;

(ii) Contains classified software; or

(iii) Is being developed using classified information.

(e) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles enumerated in paragraphs (a), (b), and (d) of this category and classified technical data directly related to items controlled in ECCNs 0A505, 0B505, 0D505, and 0E505 and defense services using the classified technical data. (See § 125.4 of this subchapter for exemptions.)

(f)–(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Note 1 to Category III: This category does not control ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.

Note 2 to Category III: 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.

Note 3 to Category III: Grenades containing non-lethal or less lethal projectiles are under the jurisdiction of the Department of Commerce.

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.

Note 1 to paragraph (a): "Range" is the maximum distance that the specified rocket system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining range. The range for rocket systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links, or other external constraints. For rocket systems, the range will be determined using the trajectory that maximizes range, assuming International Civil Aviation Organization (ICAO) standard atmosphere with zero wind.

Note 2 to paragraph (a): "Payload" is the total mass that can be carried or delivered by the specified rocket, SLV, or missile that is not used to maintain flight.

Note 3 to paragraph (a): This paragraph does not control model and high power rockets (as defined in National Fire Protection Association Code 1122) and kits thereof made of paper, wood, fiberglass, or plastic containing no substantial metal parts and designed to be flown with hobby rocket motors that are certified for consumer use. Such rockets must not contain active controls (e.g., RF, GPS).

Note 4 to paragraph (a): "Mine" means a munition placed under, on, or near the ground or other surface area and designed to be exploded by the presence, proximity, or contact of a person or vehicle.

* (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).

Note 1 to paragraph (b): For controls on non-SLV launcher mechanisms for use on aircraft, see USML Category VIII(h).

Note 2 to paragraph (b): For controls on launcher mechanisms that are integrated onto a vessel or ground vehicle, see USML Categories VI and VII, respectively.

Note 3 to paragraph (b): This paragraph does not control parts and accessories (e.g., igniters, launch stands) specially designed for consumer use with model and high power rockets (as defined in National Fire Protection Association Code 1122) and kits thereof made of paper, wood, fiberglass, or plastic containing no substantial metal parts and designed to be flown with hobby rocket motors that are certified for consumer use.

(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).

Note 1 to paragraph (c): This paragraph includes specialized handling equipment (transporters, cranes, and lifts) specially designed to handle articles enumerated in paragraphs (a) and (b) of this category for preparation and launch from fixed and mobile sites. The equipment in this paragraph also includes specially designed robots, robot controllers, and robot end-effectors, and liquid propellant tanks specially designed for the storage or handling of the propellants controlled in USML Category V, CCL ECCNs 1C011, 1C111, and 1C608, or other liquid propellants used in the systems enumerated in paragraphs (a)(1), (a)(2), or (a)(5) of this category.

Note 2 to paragraph (c): Aircraft Missile Protection Systems (AMPS) are controlled in USML Category XI.

* (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.

Note 1 to paragraph (d): This paragraph does not control model and high power rocket motors, containing no more than 5 pounds of propellant, that are certified for U.S. consumer use as described in National Fire Protection Association Code 1125.

Note 2 to paragraph (d): This paragraph does not control thrusters for spacecraft.

(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);

Note to paragraph (h)(1): A guidance set integrates the process of measuring and computing a vehicle's position and velocity (*i.e.*, navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.

(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);

Note to paragraph (h)(17): This paragraph does not control spacecraft. For controls on spacecraft, see USML Category XV and, if not described therein, then CCL ECCN 9A515.

- (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

Note to paragraph (h)(29): This paragraph also includes electrical connectors installed between the systems specified in paragraph (a)(1) or (a)(2) of this category and their payload.

* (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.

(i) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 0A604, 0B604, 0D604, 9A604, 9B604, or 9D604 and defense services using the classified technical data. Defense services include the furnishing of assistance (including training) to a foreign person 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) to a foreign person in the launch failure analysis of a launch vehicle, regardless of the jurisdiction, ownership, or origin of the launch vehicle, 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 spacecraft and spacecraft launches.) (MT for technical data and defense services related to articles designated as such.)

(j)–(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

Note to Category IV: If a Missile Technology Control Regime Category I item is included in a system, that system will also be considered as a Category I item, except when the incorporated item cannot be separated, removed, or duplicated.

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]- (9Cl); or Furazanamine, 4-[(nitrofurany)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-diazahehexane (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;
- Note to paragraph (c)(3)(ii): JP-4, JP-8, fossil refined fuels or biofuels, or fuels for engines certified for use in civil aviation are not included.
- (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 (TiH_n) 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-diazetidene) (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) FAMA0 (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 (nitrateethylnitramine compounds), as follows:

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

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

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

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

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

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

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

(12) TVOPA 1,2,3-Tris [1,2-bis(difluoroamino)ethoxy]propane; tris vinoxyl 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-Nitroaza-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;

Note to paragraph (f)(16)(ii): Included are (1) 1,1H-Isophthaloyl-bis(2-methylaziridine) (HX-752) (CAS 7652-64-4); (2) 2,4,6-tris(2-ethyl-1-aziridinyl)-1,3,5-triazine (HX-874) (CAS 18924-91-9); and (3) 1,1'-trimethyladipoylbis(2-ethylaziridine) (HX-877) (CAS 71463-62-2).

(17) Superfine iron oxide (Fe_2O_3 , hematite) with a specific surface area more than $250 \text{ m}^2/\text{g}$ 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) (tetraethylenepentaamineacrylonitrileglycidol) (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.

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

Note 1 to paragraph (i): This paragraph does not control explosives, propellants, pyrotechnics, fuels, oxidizers, binders, additives, or precursors therefor (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (i): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (i): This paragraph is applicable only to those contracts and funding authorizations that are dated January 5, 2015, or later.

(j) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles described in paragraphs (a) through (i) of this category (see also § 120.5(c) of this subchapter for nuclear related controls) (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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

Note 1 to USML Category V: To assist the exporter, an item has been categorized by the most common use. Also, where appropriate, references have been provided to the related controlled precursors.

Note 2 to USML Category V: Chemical Abstract Service (CAS) registry numbers do not cover all the substances and mixtures controlled by this category. The numbers are provided as examples to assist government agencies in the license review process and exporters when completing their license application and export documentation.

Note 3 to USML Category V: Items controlled in this Category, except for materials described in paragraph (c)(6), (h), or (i), are licensed by the Department of Commerce when incorporated into an item subject to the EAR and classified under ECCN 1C608.

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.

Note to paragraph (b)(4): "Mission systems" are defined as "systems" (see § 120.40(h) of this subchapter) that are defense articles that perform specific military functions such as by providing military communication, electronic warfare, target designation, surveillance, target detection, or sensor capabilities.

Note to paragraphs (a) and (b): Vessels specially designed for military use that are not identified in paragraph (a) or (b) of this category are subject to the EAR under ECCN 8A609, including any demilitarized vessels, regardless of origin or designation, manufactured prior to 1950 and unmodified since 1949. Vessels with modifications made to incorporate safety features required by law, are cosmetic (e.g., different paint), or that add parts or components otherwise available prior to 1950 are considered "unmodified" for the purposes of this paragraph.

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

Note 1 to paragraph (c): This paragraph does not control vessels, and specially designed parts, components, accessories, and attachments therefor, (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (c): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (c): This provision is applicable to those contracts and funding authorizations that are dated July 8, 2014, or later.

(d) [Reserved]

* (e) Naval nuclear propulsion plants and prototypes, and special facilities for construction, support, and maintenance therefor(see also § 120.5(c) of this subchapter for nuclear related controls).

(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 also § 120.5(c) of this subchapter for nuclear related controls);

(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);

Note to paragraph (f)(6): "Range" is the maximum distance that the specified rocket system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining range. The range for rocket systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links,

or other external constraints. For rocket systems, the range will be determined using the trajectory that maximizes range, assuming International Civil Aviation Organization (ICAO) standard atmosphere with zero wind.

(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.

Note 1 to paragraph (f): Parts, components, accessories, attachments, associated equipment, and systems specially designed for vessels described in this category but not listed in paragraph (f) are subject to the EAR under ECCN 8A609.

Note 2 to paragraph (f): For controls related to ship signature management, see USML Category XIII.

(g) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

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).

Note to paragraph (c): “Mission systems” are defined as “systems” (see § 120.40(h) of this subchapter) that are defense articles that perform specific military functions, such as by providing military communication, target designation, surveillance, target detection, or sensor capabilities.

Note to paragraphs (b) and (c): “Payload” is the total mass that can be carried or delivered by the specified rocket, space launch vehicle, missile, drone, or unmanned aerial vehicle that is not used to maintain flight. For definition of “range” as it pertains to aircraft systems, see note to paragraph (a) USML Category VIII. For definition of “range” as it pertains to rocket systems, see note to paragraph (f)(6) of USML Category VI.

(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;

Note to paragraphs (g)(3)–(6): See USML Category XIII(m)(1)–(4) for interpretations which explain and amplify terms used in these paragraphs.

(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 processors, 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.

Note to paragraph (g): Parts, components, accessories, attachments, associated equipment, and systems specially designed for vehicles in this category but not listed in paragraph (g) are subject to the EAR under ECCN 0A606.

(h) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

Note 1 to Category VII: Ground vehicles specially designed for military applications that are not identified in this category are subject to the EAR under ECCN 0A606, including any unarmed ground vehicles, regardless of origin or designation, manufactured prior to 1956 and unmodified since 1955. Ground vehicles with modifications made to incorporate safety features required by law, are cosmetic (e.g., different paint, repositioning of bolt holes), or that add parts or components otherwise available prior to 1956 are considered “unmodified” for the purposes of this paragraph. ECCN 0A606 also includes unarmed vehicles derived from otherwise EAR99 civilian vehicles that have been modified or otherwise fitted with materials to provide ballistic protection, including protection to level III (National Institute of Justice Standard 0108.01, September 1985) or better and that do not have reactive or electromagnetic armor.

Note 2 to Category VII: Armored ground vehicles are (i) ground vehicles that have integrated,

fully armored hulls or cabs, or (ii) ground vehicles on which add-on armor has been installed to provide ballistic protection to level III (National Institute of Justice Standard 0108.01, September 1985) or better. Armored support vehicles do not include those that are merely capable of being equipped with add-on armor.

Note 3 to Category VII: Ground vehicles include any vehicle meeting the definitions or control parameters regardless of the surface (e.g., highway, off-road, rail) upon which the vehicle is designed to operate.

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);

Note 1 to paragraph (a): Aircraft specially designed for military applications that are not identified in paragraph (a) of this section are subject to the EAR and classified as ECCN 9A610, including any model of unarmed military aircraft manufactured prior to 1956, regardless of origin or designation, and unmodified since manufacture. Aircraft with modifications made to incorporate safety of flight features or other FAA or NTSB modifications such as transponders and air data recorders are considered “unmodified” for the purposes of this paragraph.

Note 2 to paragraph (a): “Range” is the maximum distance that the specified aircraft system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining range. The range for aircraft systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links, or other external constraints. For aircraft systems, the range will be determined for a one-way distance using the most fuel-efficient flight profile (e.g., cruise speed and altitude), assuming International Civil Aviation Organization (ICAO) standard atmosphere with zero wind, but with no fuel reserve.

(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).

Note to paragraph (d): For the definition of “range,” see note to paragraph (a) of this category.

(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.

Note 1 to paragraph (f): This paragraph does not control aircraft and specially designed parts, components, accessories, and attachments therefor (a) in production; (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (f): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (f): This paragraph is applicable only to those contracts, other funding authorizations, or modifications initiating development of a new defense article that are dated April 16, 2014, or later.

(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;

Note to paragraph (h)(1): This paragraph does not control parts, components, accessories, and attachments that are common to aircraft described in paragraph (a) of this category but not identified in paragraph (h)(1), and those identified in paragraph (h)(1). For example, when applying § 120.41(b)(3), a part common to only the F-16 and F-35 is not specially designed for purposes of this paragraph. A part common to only the F-22 and F-35—two aircraft models identified in paragraph (h)(1)—is specially designed for purposes of this paragraph, unless one of the other paragraphs is applicable under § 120.41(b) of this subchapter.

(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;

Note to paragraph (h)(2): Loss of lubrication means a situation where oil/lubrication is mostly or completely lost from a transmission/gearbox such that only a residual coating remains due to the lubrication system failure.

- (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 that operate autonomously (without human input) to interact with each other to avoid collisions, fly in formations, and are capable of adapting in real-time to changes in operational/threat environment, 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 processors 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, 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-m³ 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/cm² 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 § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles controlled in this category.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles controlled in this category where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Note: Parts, components, accessories, and attachments in paragraphs (h)(3)–(5), (7), (14), (17), or (19) are licensed by the Department of Commerce when incorporated in an aircraft subject to the EAR and classified under ECCN 9A610. Replacement systems, parts,

components, accessories and attachments are subject to the controls of the ITAR.

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;

Note to paragraph (a)(1): Target drones are controlled in USML Category VIII(a).

(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;

Note to paragraph (a)(6): This paragraph includes stimulators that are built-in or add-on devices that cause the actual equipment to act as a trainer.

(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.

Note to paragraph (a): Training equipment does not include combat games without item signatures or tactics, techniques, and procedures covered by this subchapter.

(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 § 120.33 of this subchapter) and defense services (see § 120.32 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 § 120.32(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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

Note to USML Category IX: Parts, components, accessories, or attachments of a simulator in this category that are common to the simulated system or simulated end-item are controlled under the same USML category or CCL ECCN as the parts, components, accessories, and attachments of the simulated system or simulated end-item.

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;

Note 1 to paragraph (a)(1): For body armor providing a level of protection of Type I, Type II, Type IIA, Type IIIA, or Type III, see ECCNs 1A005 and 1A613.

Note 2 to paragraph (a)(1): See USML Category XIII(e) for controls on related materials.

(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;

Note to paragraph (a)(2): See USML Category XIII(j) for controls on related materials.

(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

Note 1 to paragraph (a)(7): See paragraphs (d)(2) and (3) of this category for controls on related parts, components, and materials.

Note 2 to paragraph (a)(7): See USML Category XII for sensor protection equipment.

- (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.

Note 1 to paragraph (a)(8): This paragraph does not control personal protective equipment and specially designed parts, components, accessories, and attachments (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (a)(8): Note 1 does not apply to defense articles enumerated on the USML, whether in production or development.

Note 3 to paragraph (a)(8): This paragraph is applicable only to those contracts and funding authorizations that are dated January 5, 2015, or later.

(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.

Note to paragraphs (a) and (d): See National Institute of Justice Classification, NIJ Standard-0101.06, or national equivalents, for a description of level of protection for armor.

(e) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

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;

Note to paragraph(a)(1)(ii): The term tonals implies discrete frequencies in the broadband and narrowband spectra, emanating from man-made objects.

(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);

Note to paragraph (a)(1)(iv): Adaptive compensation is the capability of an underwater modem to assess the water conditions to select the best algorithm to receive and transmit data.

(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;

Note to paragraph (a)(3)(i): This paragraph does not control radars that: (1) Are incapable of free space detection of 1 square meter Radar Cross Section (RCS) target beyond 8 nautical miles (nmi); (2) contain a radar update rate of not more than 1Hz; and (3) employ a design determined to be subject to the EAR via a commodity jurisdiction determination.

(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 Wm²;

(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 ¹/₄ 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) [Reserved]

(x) Air surveillance radar with a beam solid angle less than or equal to 16 degrees² 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 ¹/₃ 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;

Note to paragraph (a)(3)(xii): This paragraph does not control radars not otherwise controlled in this subchapter, operating with a peak transmit power less than or equal to 550 watts, and employing a design determined to be subject to the EAR via a commodity jurisdiction determination.

(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;

Note to paragraph (a)(3)(xvii): Normalized clutter attenuation is defined as the reduction in the power level of received distributed clutter when normalized to the thermal noise level.

(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);

Note to paragraph (a)(3)(xxi): The definition of "type" in this paragraph is that provided in 14 CFR § 1.1.

(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);

Note 1 to paragraph (a)(3)(xxix): Laser radar systems embody specialized transmission, scanning, receiving, and signal processing techniques for utilization of lasers for echo ranging, direction finding, and discrimination of targets by location, radial speed, and body reflection characteristics.

Note 2 to paragraph (a)(3)(xxix): For definition of "range" as it pertains to rocket systems, see note 1 to paragraph (a) of USML Category IV. "Payload" is the total mass that can be carried or delivered by the specified rocket, SLV, or missile that is not used to maintain flight.

Note to paragraph (a)(3): This paragraph does not control: (a) Systems or equipment that require aircraft transponders in order to meet control parameters; (b) precision approach radar (PAR) equipment conforming to ICAO standards and employing electronically steerable linear (1- dimensional) arrays or mechanically positioned passive antennas; and (c) radio altimeter equipment conforming to FAA TSO C87.

* (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;

Note to paragraph (a)(4)(i): ES provides tactical situational awareness, automatic cueing, targeting, electronic order of battle planning, electronic intelligence (ELINT), communication intelligence (COMINT), or signals intelligence (SIGINT).

(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, SINGARS, 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;

Note 1 to paragraph (a)(7): This paragraph does not control electronic systems or equipment (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (a)(7): Note 1 does not apply to defense articles enumerated on the USML, whether in production or development.

Note 3 to paragraph (a)(7): This paragraph is applicable only to those contracts and funding authorizations that are dated July 1, 2015, or later.

- (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. See note 2 to paragraph (a)(3)(xxix) of this category).

Note 1 to paragraph (a): The term Low Probability of Intercept used in this paragraph and elsewhere in this category is defined as a class of measures that disguise, delay, or prevent the interception of acoustic or electromagnetic signals. LPI techniques can involve permutations of power management, energy management, frequency variability, out-of-receiver-frequency band, low-side lobe antenna, complex waveforms, and complex scanning. LPI is also referred to as Low Probability of Intercept, Low Probability of Detection, and Low Probability of Identification.

Note 2 to paragraph (a): Paragraphs (a)(3)(xxix) and (a)(12) include terrain contour mapping equipment, scene mapping and correlation (both digital and analogue) equipment, Doppler navigation radar equipment, passive interferometer equipment, and imaging sensor equipment (both active and passive).

*(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;

Note 1 to paragraph (c)(1): An ASIC is an integrated circuit developed and produced for a specific application or function regardless of number of customers.

Note 2 to paragraph (c)(1): ASICs and PLDs programmed for 600 series items are controlled in ECCN 3A611.f.

Note 3 to paragraph (c)(1): Unprogrammed PLDs are not controlled by this paragraph.

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

Note to paragraph (c)(2): PCBs and populated circuit card assemblies for which the layout is specially designed for 600 series items are controlled in ECCN 3A611.g.

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

Note to paragraph (c)(3): Multichip modules for which the pattern or layout is specially designed for 600 series items are controlled in ECCN 3A611.h.

(4) Transmit/receive modules, transmit/receive monolithic microwave integrated circuits (MMICs), transmit modules, and transmit MMICs having all of the following:

(i) A peak saturated power output (in watts), P_{sat} , greater than 505.62 divided by the maximum operating frequency (in GHz) squared [$P_{sat} > 505.62 \text{ W} * \text{GHz}^2 / \text{fGHz}^2$] for any channel;

(ii) A fractional bandwidth of 5% or greater for any channel;

(iii) Any planar side with length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [$d \leq 15 \text{ cm} * \text{GHz} / \text{fGHz}$]; and

(iv) At least one electronically variable phase shifter per channel.

Note 1 to paragraph (c)(4): A MMIC: (a) Is formed by means of diffusion processes, implantation processes, or deposition processes in or on a single semiconducting piece of material; (b) can be considered as indivisibly associated; (c) performs the function(s) of a circuit; and (d) operates at microwave frequencies (*i.e.*, 300 MHz to 300 GHz).

Note 2 to paragraph (c)(4): A transmit/receive module is a multifunction electronic assembly that provides bi-directional amplitude and phase control for transmission and reception of signals.

Note 3 to paragraph (c)(4): A transmit module is an electronic assembly that provides amplitude and phase control for transmission of signals.

Note 4 to paragraph (c)(4): A transmit/receive MMIC is a multifunction MMIC that provides bi-directional amplitude and phase control for transmission and reception of signals.

Note 5 to paragraph (c)(4): A transmit MMIC is a MMIC that provides amplitude and phase control for transmission of signals.

Note 6 to paragraph (c)(4): USML Category XI(c)(4) applies to transmit/receive modules and to transmit modules, with or without a heat sink. The value of length d in USML Category XI(c)(4)(iii) does not include any portion of the transmit/receive module or transmit module that functions as a heat sink.

Note 7 to paragraph (c)(4): Transmit/receive modules, transmit modules, transmit/receive MMICs, and transmit MMICs may or may not have N integrated radiating antenna elements, where N is the number of transmit or transmit/receive channels.

Note 8 to paragraph (c)(4): Fractional bandwidth is the bandwidth over which output power remains constant within 3 dB (without the adjustment of other operating parameters), divided by the center frequency, and multiplied by 100. Fractional bandwidth is expressed as a percentage.

(5) High-energy storage capacitors that:

(i) Are capable of operating at greater than one hundred twenty-five volts (125 V);

(ii) Have a repetition rate greater than or equal to six (6) discharges per minute;

(iii) Have a full energy life greater than or equal to 10,000 discharges at greater than 0.2 Amps per Joule peak current; and

(iv) Have any of the following:

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

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

Note to paragraph (c)(5): *Volumetric energy density* is Energy per unit Volume. *Mass energy density* is Energy per unit Mass, sometimes referred to as *Gravimetric energy density* or *Specific energy*. *Energy* ($E = \frac{1}{2}CV^2$, where C is Capacitance and V is the Voltage rating) in these calculations must not be confused with useful energy or extractable energy.

- (6) Radio frequency circulators of any dimension equal to or less than one quarter ($1/4$) 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);
- Note to paragraph (c)(10): This category does not control Traffic Collision Avoidance Systems (TCAS) equipment conforming to FAA TSO C-119c.
- (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. See note 2 to paragraph (a)(3)(xxix) of this category);

(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/m² 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). See note 2 to paragraph (a)(3)(xxix) of this category);

(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) (see Note 2 to paragraph (a)(3)(xxix) of this category);

(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. See note 2 to paragraph (a)(3)(xxix) of this category);

(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.

Note to paragraph (c)(19)(ii): Parts and components controlled by this paragraph are limited to those that store, process, or transmit classified software (see § 120.40(g) of this subchapter).

(d) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Note to Category XI: Category XI does not control transmit/receive modules, transmit/receive MMICs, transmit modules, or transmit MMICs that incorporate or are MMICs fabricated

exclusively with homojunction CMOS silicon-based circuits on silicon substrates, or radars and radar antennas specially designed to use only such modules or MMICs.

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);

Note to paragraph (a)(3): For controls on LIDAR, see paragraph (b)(6) of this category.

* (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.

Note 1 to paragraph (b)(7): This paragraph does not control lasers or laser systems: (a) In production, (b) determined to be subject to the EAR via a Commodity Jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (b)(7): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (b)(7): This provision is applicable to those contracts or other funding authorizations that are dated October 12, 2017 or later.

* (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 $\mu\text{A}/\text{lm}$, 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);

Note to paragraph (c)(6)(i): Target is defined as a NATO standard tank target having a frontal cross-section of 2.3 x 2.3 meters, and a side cross-section of 2.3 x 6.4 meters.

(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 km² 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.

Note 1 to paragraph (c)(10): This paragraph does not control electro-optical, infrared, or terahertz imaging systems: (a) In production, (b) determined to be subject to the EAR via a Commodity Jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (c)(10): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (c)(10): This provision is applicable to those contracts or other funding authorizations that are dated October 12, 2017 or later.

(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);

Note 1 to paragraph (d)(1): For rocket, SLV, or missile flight control and guidance systems (including guidance sets), see Category IV(h).

Note 2 to paragraph (d)(1): Inertial measurement units are described in paragraph (e) of this category.

(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);

Note to paragraph (d)(2)(iv): "Payload" is the total mass that can be carried or delivered by the specified rocket, missile, SLV, drone, or unmanned aerial vehicle that is not used to maintain flight. For definition of "range" as it pertains to rocket systems, see Note 1 to paragraph (a) of USML Category IV. For definition of "range" as it pertains to aircraft systems, see Note 2 to paragraph (a) of USML Category VIII.

(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);

Note to paragraph (d)(5): "Eotvos" is a unit of acceleration divided by distance that was used in conjunction with the older centimeter-gram-second system of units. The Eotvos is defined as $1/1,000,000,000$ Galileo (Gal) per centimeter.

(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).

Note 1 to paragraph (d)(6): This paragraph does not control guidance or navigation systems: (a) in production, (b) determined to be subject to the EAR via a Commodity Jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (d)(6): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (d)(6): This provision is applicable to those contracts or other funding authorizations that are dated October 12, 2017 or later.

Note 4 to paragraph (d)(6): For definition of "range" as it pertains to rocket systems, see Note 1 to paragraph (a) of USML Category IV. For definition of "range" as it pertains to aircraft systems, see Note 2 to paragraph (a) of USML Category VIII.

(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;

Note to paragraph (e)(4): The articles controlled by this paragraph have sufficient electronics to enable at a minimum the output of an analog or digital signal once power is applied.

(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;

Note to paragraph (e)(7): Second and third generation image intensifier tubes are defined as having a peak response within the 0.4 to 1.05 micron wavelength range and incorporating a microchannel plate for electron image amplification having a hole pitch (center-to-center spacing) of less than 25 microns and having either: (a) an S-20, S-25, or multialkali photo cathode; or (b) a GaAs, GaInAs, or other III-V compound semiconductor photocathode.

(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);

Note 1 to paragraph (e)(11): For weapon fuze accelerometers, see Category III(d) or IV(h).

Note 2 to paragraph (e)(11): MT designation does not include accelerometers that are designed to measure vibration or shock.

(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);

Note to paragraphs (e)(11) and (e)(12): "Repeatability" is the closeness of agreement among repeated measurements of the same variable under the same operating conditions when changes in conditions or non-operating periods occur between measurements.

"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;

Note to paragraph (e)(18): For the purposes of this paragraph, treatments and coatings may be analyzed as a part, component, accessory, or attachment under paragraph (b) of § 120.41 to determine if they are specially designed.

(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).

Note 1 to paragraph (e)(24): This paragraph does not control items: (a) In production, (b) determined to be subject to the EAR via a Commodity Jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as

being developed for both civil and military applications.

Note 2 to paragraph (e)(24): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (e)(24): This provision is applicable to those contracts or other funding authorizations that are dated October 12, 2017 or later.

(f) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 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 used in or with defense articles controlled in this category.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles controlled in this category where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

Note to Category XII: For purposes of paragraphs (b)(6), (c)(1)(iii), (c)(3), (c)(4)(ii), (c)(5), (c)(6)(viii)(b), and (c)(7)(ii) of this category, a “military end user” means the national armed services (army, navy, marine, air force, or coast guard), national guard, national police, government intelligence or reconnaissance organizations, or any person or entity whose actions or functions are intended to support military end uses. A system or end item is not specially designed for a military end user if the item was developed with knowledge that it is or would be for use by both military end users and non-military end users, or if the item was or is being developed with no knowledge of use by a particular end user. For the purpose of conducting a self-determination of jurisdiction, documents contemporaneous with the development must establish such knowledge. For the purpose of a Commodity Jurisdiction determination, the government may base a determination on post-development information that evidences such knowledge or is otherwise consistent with §§ 120.4 and 120.12 of this subchapter.

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).

Note to paragraph (d): “Range” is the maximum distance that the specified rocket system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining range. The range for rocket systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links, or other external constraints. For rocket systems, the range will be determined using the trajectory that maximizes range, assuming International Civil Aviation Organization (ICAO) standard atmosphere with zero wind.

Note to paragraph (d)(2): This paragraph does not control carbon/carbon billets and preforms where reinforcement in the third dimension is limited to interlocking of adjacent layers only.

(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 $\frac{1}{4}$ inch-thick and larger than 8 inches \times 8 inches, excluding glass, for transparent armor;

(4) Non-transparent ceramic plate or blanks, greater than $\frac{1}{4}$ inches thick and larger than 8 inches \times 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.

Note 1 to paragraph (e)(7): This paragraph does not control armor (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (e)(7): Note 1 does not apply to defense articles enumerated on the USML, whether in production or development.

Note 3 to paragraph (e)(7): This provision is applicable to those contracts and funding authorizations that are dated July 8, 2014, or later.

* (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.

* (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. See note to paragraph (d) of this category):

(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. See note to paragraph (d) of this category); or

Note to paragraph (h)(3): Thermal batteries are single use batteries that contain a solid non-conducting inorganic salt as the electrolyte. These batteries incorporate a pyrolytic material that, when ignited, melts the electrolyte and activates the battery.

(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 (see note to paragraph (d) of this category) 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 § 120.43(c) 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. See note to paragraph (d) of this category).
- * (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 § 120.33 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 § 120.32 of this subchapter) directly related to the defense articles described in this category (see also § 120.5(c) of this subchapter for nuclear related controls). (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:

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

Where:

ρ_{RHA} = density of RHA, (7.85 g/cm³)

P_o = Baseline Penetration of RHA, (mm)

P_r = 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

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-chlorovinyl dichloroarsine (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;

Note 1 to paragraph (a)(3)(iii): Pharmaceutical formulations containing nitrogen mustards or certain reference standards for these formulations are not considered to be chemical agents and are subject to the EAR when: (1) The pharmaceutical is in the form of a final medical product; or (2) the reference standard contains salts of HN2 [bis(2-chloroethyl) methylamine], the quantity to be shipped is 150 milligrams or less, and individual shipments do not exceed twelve per calendar year per end user.

Note 2 to paragraph (a)(3)(iii): A "final medical product," as used in this paragraph, is a pharmaceutical formulation that is (1) designed for testing and administration in the treatment of human medical conditions, (2) prepackaged for distribution as a clinical or medical product, and (3) approved for marketing by the Food and Drug Administration or has a valid investigational new drug application (IND) in effect, in accordance with 21 CFR part 312.

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

(v) Methyl dichloroarsine (MD) (CAS 593-89-5);

(4) Incapacitating agents, such as:

(i) 3-Quinuclidinyl 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.)

Note to paragraph (a)(5): "Adapted for use in war" means any modification or selection (such as altering purity, shelf life, dissemination characteristics, or resistance to ultraviolet radiation) designed to increase the effectiveness in producing casualties in humans or animals, degrading equipment, or damaging crops or the environment.

Note 1 to paragraph (a): Paragraph (a) of this category does not include the following: Cyanogen chloride, Hydrocyanic acid, Chlorine, Carbonyl chloride (Phosgene), Ethyl bromoacetate, Xylyl bromide, Benzyl bromide, Benzyl iodide, Chloro acetone, Chloropicrin (trichloronitromethane), Fluorine, and Liquid pepper.

Note 2 to paragraph (a): Regarding U.S. obligations under the Chemical Weapons Convention (CWC), refer to Chemical Weapons Convention Regulations (CWCR) (15 CFR parts 710 through 721). As appropriate, the CWC schedule is provided to assist the exporter.

* (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.

Note 1 to paragraph (b): Non-naturally occurring means that the modification has not already been observed in nature, was not discovered from samples obtained from nature, and was developed with human intervention.

Note 2 to paragraph (b): This paragraph does not control biological agents or biologically

derived substances when these agents or substances have been demonstrated to be attenuated relative to natural pathogenic isolates and are incapable of causing disease or intoxication of ordinarily affected and relevant species (e.g., humans, livestock, crop plants) due to the attenuation of virulence or pathogenic factors. This paragraph also does not control genetic elements, nucleic acids, or nucleic acid sequences (whether recombinant or synthetic) that are unable to produce or direct the biosynthesis of infectious or functional forms of the biological agents or biologically derived substances that are capable of causing disease or intoxication of ordinarily affected and relevant species.

Note 3 to paragraph (b): Biological agents or biologically derived substances that meet both paragraphs (b)(1) and (b)(2) of this category are controlled in paragraph (b)(1).

* (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 C₁₀, including cycloalkyl) O-2-dialkyl (methyl, ethyl, n-Propyl or isopropyl) aminoethyl alkyl (methyl, ethyl, N-propyl or isopropyl) phosphonite and corresponding alkylated and protonated salts, such as QL: O-Ethyl-2-di-isopropylaminoethyl methylphosphonite (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.

Note 1 to paragraph (f)(2): This paragraph does not control articles that are (a) determined to be subject to the EAR via a commodity jurisdiction determination, or (b) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (f)(2): Note 1 does not apply to defense articles enumerated on the USML.

(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.

Note to paragraph (h): See ECCN 1A607.k for military medical countermeasures such as autoinjectors, combopens, and creams.

(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 (see § 120.33 of this subchapter) and defense services (see § 120.32 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;

Note 1 to paragraph (n): This paragraph does not control countermeasures or sorbents that are (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (n): Note 1 does not apply to defense articles enumerated on the USML, whether in production or development.

Note 3 to paragraph (n): This paragraph is applicable only to those contracts and funding authorizations that are dated July 28, 2017, or later.

(o)–(w) [Reserved]

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

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles controlled in this category where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

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 $\Delta\lambda$ less than or equal to 20nm full width at half maximum (FWHM) or having a wide spectral bandwidth with $\Delta\lambda$ 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 $\Delta\lambda$ less than or equal to 50nm FWHM or having a wide spectral bandwidth with $\Delta\lambda$ greater than 50nm FWHM and a GSD less than 500 meters;

Note 1 to paragraph (a)(7): Ground Sample Distance (GSD) is measured from a spacecraft's nadir (*i.e.*, local vertical) position.

Note 2 to paragraph (a)(7): Optical remote sensing spacecraft or satellite spectral bandwidth is the smallest difference in wavelength (*i.e.*, $\Delta\lambda$) that can be distinguished at full width at half maximum (FWHM) of wavelength λ .

Note 3 to paragraph (a)(7): An optical satellite or spacecraft is not Significant Military Equipment if non-earth pointing.

* (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;

Note to paragraph (a)(9): This paragraph does not control a satellite or spacecraft that provides only a differential correction broadcast for the purposes of positioning, navigation, or timing.

(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

Note to paragraph (a)(12): This paragraph does not control spacecraft that dock exclusively via the NASA Docking System (NDS), which are controlled by ECCN 9A515.a.4.

* (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).

Note 1 to paragraph (a): Spacecraft not identified in this paragraph are subject to the EAR (see ECCNs 9A004 and 9A515). Spacecraft described in ECCNs 9A004 and 9A515 remain subject to the EAR even if defense articles described on the USML are incorporated therein, except when such incorporation results in a spacecraft described in this paragraph.

Note 2 to paragraph (a): This paragraph does not control (a) the International Space Station

(ISS) and its specially designed (as defined in the EAR) parts and components, which are subject to the EAR, or (b) those articles for the ISS that are determined to be subject to the EAR via a commodity jurisdiction determination. Use of a defense article on the ISS that was not specially designed (as defined in the EAR) for the ISS does not cause the item to become subject to the EAR.

Note 3 to paragraph (a): This paragraph does not control the James Webb Space Telescope, which is subject to the EAR.

(b) Ground control systems or training simulators, specially designed for telemetry, tracking, and control (TT&C) of spacecraft in paragraph (a) of this category.

Note to paragraph (b): Parts, components, accessories, attachments, equipment, or systems that are common to ground control systems or training simulators controlled in this paragraph and those that are used for spacecraft not controlled in paragraph (a) of this category are subject to the EAR.

(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), P_{sat} , greater than 200 divided by the maximum operating frequency (in GHz) squared [$P_{sat} > 200 \text{ W} * \text{GHz}^2 / \text{fGHz}^2$]; 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 $-120 \text{ dBc/Hz} + (20 \log_{10}(\text{RF}))$ (in GHz) measured at $2 \text{ KHz} * \text{RF}$ (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;

Note 1 to paragraph (e)(17): *Primary payload* is that complement of equipment designed from the outset to accomplish the prime mission function of the spacecraft payload mission set. The primary payload may operate independently from the secondary payload(s). *Secondary payload* is that complement of equipment designed from the outset to be fully integrated into the spacecraft payload mission set. The secondary payload may operate separately from the primary payload. *Hosted payload* is a complement of equipment or sensors that uses the available or excess capacity (mass, volume, power, etc.) of a spacecraft to accommodate an additional, independent mission. The hosted payload may share the spacecraft bus support infrastructure. The hosted payload performs an additional, independent mission which does not dictate control or operation of the spacecraft. A hosted payload is not capable of operating as an independent spacecraft. *Spacecraft bus* (distinct from the spacecraft payload), provides the support infrastructure of the spacecraft (e.g., command and data handling, communications and antenna(s), electrical power, propulsion, thermal control, attitude and orbit control, guidance, navigation and control, structure and truss, life support (for crewed mission)) and location (e.g., attachment, interface) for the spacecraft payload. *Spacecraft payload* is that complement of equipment attached to the spacecraft bus that performs a particular mission in space (e.g., communications, observation, science).

Note 2 to paragraph (e)(17): An ECCN 9A004 or ECCN 9A515.a spacecraft remains a spacecraft subject to the EAR even when incorporating a hosted payload performing a function described in paragraph (a) of this category. All spacecraft that incorporate primary or secondary payloads that perform a function described in paragraph (a) of this category are controlled by that paragraph. This paragraph does not control primary or secondary payloads of the James Webb Space Telescope, which are subject to the EAR.

* (18) Secondary or hosted payload, and specially designed parts and components therefor, developed with Department of Defense-funding;

Note 1 to paragraph (e)(18): This paragraph does not control payloads that are (a) determined to be subject to the EAR via a commodity jurisdiction determination, or (b) identified in the relevant Department of Defense contract or other funding authorization or agreement as being developed for both military and either civil or commercial applications.

Note 2 to paragraph (e)(18): This paragraph is applicable only to those contracts or funding authorizations or agreements that are dated May 13, 2015, or later.

(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);

Note to paragraph (e)(19): "Payload" is the total mass that can be carried or delivered by the specified rocket, SLV, missile, drone, or UAV that is not used to maintain flight. For definition of "range" as it pertains to aircraft systems, see note to paragraph (a) of USML Category VIII. For definition of "range" as it pertains to rocket systems, see note 1 to paragraph (a) of USML Category IV.

(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.

Note 1 to paragraph (e): Parts, components, accessories, attachments, equipment, or systems specially designed for spacecraft or other articles enumerated in this category but not listed in paragraph (e) are subject to the EAR.

Note 2 to paragraph (e): The articles described in this paragraph are subject to the EAR when, prior to export, reexport, retransfer, or temporary import, they are integrated into and included as an integral part of an item subject to the EAR (see note 2 to paragraph (e)(17) of this

category). Articles do not become subject to the EAR until integrated into the item subject to the EAR. Export, reexport, retransfer, or temporary import of, and technical data and defense services directly related to defense articles intended to be integrated remain subject to the ITAR.

Note 3 to paragraph (e): For the purposes of this paragraph, an article is space-qualified if it is designed, manufactured, or qualified through successful testing, for operation at altitudes greater than 100 km above the surface of the Earth. The use of an altitude of 100 km above the surface of the Earth in this paragraph does not represent a legal demarcation between national air space and outer space under United States or international law.

Note 4 to paragraph (e): (1) A determination that a specific article (or commodity) (e.g., by product serial number) is space-qualified by virtue of testing alone does not mean that other articles in the same production run or model series are space-qualified if not individually tested. (2) "Article" is synonymous with "commodity," as defined in EAR § 772.1. (3) A specific article not designed or manufactured for use at altitudes greater than 100 km above the surface of the Earth is not space-qualified before it is successfully tested. (4) The terms "designed" and "manufactured" in this definition are synonymous with "specially designed."

(f) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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) to a foreign person 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) to a foreign person in the launch failure analysis of a satellite or spacecraft, regardless of the jurisdiction, ownership, or origin of the satellite or 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.)

Note 1 to paragraph (f): The technical data control of this paragraph does not apply to certain technical data directly related to articles described in paragraphs (c) or (e) of this category when such articles are integrated into and included as an integral part of a satellite subject to the EAR. For controls in these circumstances, see ECCN 9E515. This only applies to that level of technical data (including marketing data) necessary and reasonable for a purchaser to have assurance that a U.S. built item intended to operate in space has been designed, manufactured, and tested in conformance with specified contract requirements (e.g., operational performance, reliability, lifetime, product quality, or delivery expectations) as well

as data necessary for normal orbit satellite operations, to evaluate in-orbit anomalies, and to operate and maintain associated ground station equipment (except encryption hardware).

Note 2 to paragraph (f): Activities and technology/technical data directly related to or required for the spaceflight (e.g., sub-orbital, orbital, lunar, interplanetary, or otherwise beyond Earth orbit) passenger or participant experience, regardless of whether the passenger or participant experience is for space tourism, scientific or commercial research, commercial manufacturing/production activities, educational, media, or commercial transportation purposes, are not subject to the ITAR or the EAR. Such activities and technology/technical data include those directly related to or required for: (a) Spacecraft access, ingress, and egress, including the operation of all spacecraft doors, hatches, and airlocks; (b) physiological training (e.g., human-rated centrifuge training or parabolic flights, pressure suit or spacesuit training/operation); (c) medical evaluation or assessment of the spaceflight passenger or participant; (d) training for and operation by the passenger or participant of health and safety related hardware (e.g., seating, environmental control and life support, hygiene facilities, food preparation, exercise equipment, fire suppression, communications equipment, safety-related clothing or headgear) or emergency procedures; (e) viewing of the interior and exterior of the spacecraft or terrestrial mock-ups; (f) observing spacecraft operations (e.g., pre-flight checks, landing, in-flight status); (g) training in spacecraft or terrestrial mock-ups for connecting to or operating passenger or participant equipment used for purposes other than operating the spacecraft; or (h) donning, wearing, or utilizing the passenger's or participant's flight suit, pressure suit, or spacesuit, and personal equipment.

Note 3 to paragraph (f): Paragraph (f) and ECCNs 9E001, 9E002 and 9E515 do not control the data transmitted to or from a satellite or spacecraft, whether real or simulated, when limited to information about the health, operational status, or measurements or function of, or raw sensor output from, the spacecraft, spacecraft payload(s), or its associated subsystems or components. Such information is not within the scope of information captured within the definition of technology in the EAR for purposes of Category 9 Product Group E. Examples of such information, which are commonly referred to as "housekeeping data," include (i) system, hardware, component configuration, and operation status information pertaining to temperatures, pressures, power, currents, voltages, and battery charges; (ii) spacecraft or payload orientation or position information, such as state vector or ephemeris information; (iii) payload raw mission or science output, such as images, spectra, particle measurements, or field measurements; (iv) command responses; (v) accurate timing information; and (vi) link budget data. The act of processing such telemetry data—*i.e.*, converting raw data into engineering units or readable products—or encrypting it does not, in and of itself, cause the telemetry data to become subject to the ITAR or to ECCN 9E515 for purposes of 9A515, or to

ECCNs 9E001 or 9E002 for purposes of 9A004. All classified technical data directly related to items controlled in USML Category XV or ECCNs 9A515, and defense services using the classified technical data, remains subject to the ITAR. This note does not affect controls in USML XV(f), ECCN 9D515, or ECCN 9E515 on software source code or commands that control a spacecraft, payload, or associated subsystems for purposes of 9A515. This note also does not affect controls in ECCNs 9D001, 9D002, 9E001, or 9E002 on software source code or commands that control a spacecraft, payload, or associated subsystems for purposes of 9A004.

(g)–(w) [Reserved]

(x) Commodities, software, and technology subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation also includes commodities, software, or technology subject to the EAR (see § 123.21(b) of this subchapter).

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 § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles described in paragraph (b) of this category (see also § 120.5(c) of this subchapter for nuclear related controls).

(f)–(w) [Reserved]

(x) Commodities, software, and technical data subject to the EAR used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

Category XVII—Classified Articles, Technical Data, and Defense Services Not Otherwise Enumerated

* (a) All articles, and technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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

* (a) Directed energy weapons as follows:

(1) Systems or equipment that, other than as a result of incidental, accidental, or collateral effect:

(i) Degrade, destroy or cause mission-abort of a target;

(ii) Disturb, disable, or damage electronic circuitry, sensors or explosive devices remotely;

(iii) Deny area access;

(iv) Cause lethal effects; or

(v) Cause ocular disruption or blindness; and

(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;

Note 1 to paragraph (f): This paragraph does not control directed energy weapons (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination, or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (f): Note 1 does not apply to defense articles enumerated on the USML,

whether in production or development.

Note 3 to paragraph (f): This paragraph is applicable only to those contracts and funding authorizations that are dated July 28, 2017, or later.

(g) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles controlled in this category.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles controlled in this category where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

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.

Note to paragraph (d): Engines subject to the control of this paragraph are licensed by the Department of Commerce when incorporated in an aircraft subject to the EAR and controlled under ECCN 9A610. Such engines are subject to the controls of the ITAR in all other circumstances.

* (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).

Note to paragraph (e): Digital electronic control systems autonomously control the engine throughout its whole operating range from demanded engine start until demanded engine shut-down, in both normal and fault conditions.

(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;

Note to paragraph (f)(1): This paragraph does not control parts, components, accessories, and attachments that are common to engines enumerated in paragraph (a) through (d) of this category but not identified in paragraph (f)(1), and those identified in paragraph (f)(1). For example, a part common to only the F110 and F136 is not specially designed for purposes of this paragraph. A part common to only the F119 and F135—two engine models identified in paragraph (f)(1)—is specially designed for purposes of this paragraph, unless one of the other paragraphs is applicable under § 120.41(b).

* (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 § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles controlled in this category.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles controlled in this category where the purchase documentation includes commodities, software, or technology subject to the EAR (see § 123.1(b) of this subchapter).

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

Note to paragraph (a)(7): “Mission system” is defined as a “system” (see § 120.40(h) of this subchapter) that are defense articles that perform specific military functions such as by providing military communication, electronic warfare, target designation, surveillance, target detection, or sensor capabilities.

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

Note 1 to paragraph (a)(8): This paragraph does not control vessels, and specially designed parts, components, accessories, attachments, and associated equipment therefor, (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.

Note 2 to paragraph (a)(8): Note 1 does not apply to defense articles enumerated on the U.S. Munitions List, whether in production or development.

Note 3 to paragraph (a)(8): This provision is applicable to those contracts and funding authorizations that are dated July 8, 2014, or later.

* (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 also § 120.5(c) of this subchapter for nuclear related controls);

(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).

Note to paragraph (c): "Range" is the maximum distance that the specified rocket system is capable of traveling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining range. The range for rocket systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links, or other external constraints. For rocket systems, the range will be determined using the trajectory that maximizes range, assuming International Civil Aviation Organization (ICAO) standard atmosphere with zero wind.

(d) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 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 used in or with defense articles.

Note to paragraph (x): Use of this paragraph is limited to license applications for defense articles where the purchase documentation includes commodities, software, or technical data subject to the EAR (see § 123.1(b) of this subchapter).

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, shall be made by the Director, Office of Defense Trade Controls Policy.

(b) Technical data (see § 120.33 of this subchapter) and defense services (see § 120.32 of this subchapter) directly related to the defense articles covered in paragraph (a) of this category.

[58 FR 39287, July 22, 1993]

Editorial Notes: 1. For FEDERAL REGISTER citations affecting § 121.1, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.govinfo.gov.
2. At 79 FR 61228, Oct. 10, 2014, § 121.1 was amended by removing the word “enumerated” and adding in its place the word “described” in one place in Note 1 to paragraph (i) of Category VI; however, the amendment could not be incorporated because of inaccurate amendatory instruction.

§§ 121.2-121.16 [Reserved]