Category	Description
Category XI — Military Electronics	*(a) Electronic equipment not included in Category XII of the U.S. Munitions List which is specifically designed, modified or configured for military application. This equipment includes but is not limited to:* *(3) Radar systems, with capabilities such as: *(i) Search, *(ii) Acquisition,*(iii) Tracking, *(iv) Moving target indication, *(v) Imaging radar systems, and (vi) Any ground air traffic control radar which is specifically designed or modified for military application.* **(5) Command, control and communications systems to include radios (transceivers), navigation, and identification equipment.* *(7) Any experimental or developmental electronic equipment specifically designed or modified for military application or specifically designed or modified for use with a military system.* **(b) Electronic systems or equipment specifically designed, modified, or configured for intelligence, security, or military purposes for use in search, reconnaissance, collection, monitoring, direction-finding, display, analysis and production of information from the electromagnetic spectrum and electronic systems or equipment designed or modified to counteract electronic surveillance or monitoring. A system meeting this definition is controlled under this subchapter even in instances where any individual pieces of equipment constituting the system may be subject to the controls of another U.S. Government agency. Such systems or equipment described above include, but are not limited to, those:* *(1) Designed or modified to use cryptographic techniques to generate the spreading code for spread spectrum or hopping code for frequency agility. This does not include fixed code techniques for spread spectrum.* *(2) Designed or modified using burst techniques (e.g., time compression techniques) for intelligence, security or military purposes.* *(3) Designed or modified for the purpose of information security to suppress the compromising emanations of information-bearing signals. This covers TEMPEST suppression technology and equipment meeting or designed to meet government TEMPEST standards. This definition is not intended to include equipment designed to meet Federal Communications Commission (FCC) commercial electro-magnetic interference standards or equipment designed for health and safety.* *(c) Components, parts, accessories, attachments, and associated equipment specifically designed or modified for use with the equipment in paragraphs (a) and (b) of this category, except for such items as are in normal commercial use.* *(d) Technical data (as defined in § 120.10) and defense services (as defined in § 120.9) directly related to the defense articles enumerated in paragraphs (a) through (c) of this category. (See § 125.4 for exemptions.) Technical data directly related to the manufacture or production of any defense articles enumerated elsewhere in this category that are designated as Significant Military Equipment (SME) shall itself be designated as SME.*

Category XII ***Optical equipment***	**(a) Fire control systems; gun and missile tracking and guidance systems; gun range, position, height finders, spotting instruments and laying equipment; aiming devices (electronic, optic, and acoustic); bomb sights, bombing computers, military television sighting and viewing units, and periscopes for the articles of this section.* **(b) Lasers specifically designed, modified or configured for military application including those used in military communication devices, target designators and range finders, target detection systems, and directed energy weapons.* **(c) Infrared focal plane array detectors specifically designed, modified, or configured for military use; image intensification and other night sighting equipment or systems specifically designed, modified or configured for military use; second generation and above military image intensification tubes (defined below) specifically designed, developed, modified, or configured for military use, and infrared, visible and ultraviolet devices specifically designed, developed, modified, or configured for military application. Military second and third generation image intensification tubes and military infrared focal plane arrays identified in this subparagraph are licensed by the Department of Commerce (ECCN 6A002A and 6A003A) [sic][1] when part of a commercial system (i.e., those systems originally designed for commercial use). This does not include any military system comprised of non-military specification components. Replacement tubes or focal plane arrays identified in this paragraph being exported for commercial systems are subject to the controls of the ITAR.* ***NOTE**: Special Definition. For purposes of this subparagraph, second and third generation image intensification 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 compound semiconductor photo cathode.*
Category XV — ***Spacecraft Systems and Associated Equipment***	**(a) Spacecraft, including communications satellites, remote sensing satellites, scientific satellites, research satellites, navigation satellites, experimental and multi-mission satellites.* ***NOTE TO PARAGRAPH (a)**: Commercial communications satellites, scientific satellites, research satellites and experimental satellites are designated as SME only when the equipment is intended for use by the armed forces of any foreign country.* *(b) Ground control stations for telemetry, tracking and control of spacecraft or satellites, or employing any of the cryptographic items controlled under category XIII of this subchapter.* *(c) Global Positioning System (GPS) receiving equipment specifically designed, modified or configured for military use; or GPS receiving equipment with any of the following characteristics:*

	(1) Designed for encryption or decryption (e.g., Y-Code) of GPS precise positioning service (PPS) signals; *(2) Designed for producing navigation results above 60,000 feet altitude and at 1,000 knots velocity or greater;* *(3) Specifically designed or modified for use with a null steering antenna or including a null steering antenna designed to reduce or avoid jamming signals;* *(4) Designed or modified for use with unmanned air vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km.* ***(NOTE**: GPS receivers designed or modified for use with military unmanned air vehicle systems with less capability are considered to be specifically designed, modified or configured for military use and therefore covered under this paragraph (d)(4).)* *Any GPS equipment not meeting this definition is subject to the jurisdiction of the Department of Commerce (DOC). Manufacturers or exporters of equipment under DOC jurisdiction are advised that the U.S. Government does not assure the availability of the GPS P-Code for civil navigation. It is the policy of the Department of Defense (DOD) that GPS receivers using P-Code without clarification as to whether or not those receivers were designed or modified to use Y-Code will be presumed to be Y-Code capable and covered under this paragraph. The DOD policy further requires that a notice be attached to all P-Code receivers presented for export. The notice must state the following: "ADVISORY NOTICE: This receiver uses the GPS P-Code signal, which by U.S. policy, may be switched off without notice."* *(d) Radiation-hardened microelectronic circuits that meet or exceed all five of the following characteristics:* *(1) A total dose of 5×10^5 Rads (Si);* *(2) A dose rate upset threshold of 5×10^8 Rads (Si)/sec;* *(3) A neutron dose of 1×10^{14} n/cm^2 (1 MeV equivalent);* *(4) A single event upset rate of 1×10^{-10} errors/bit-day or less, for the CREME96 geosynchronous orbit, Solar Minimum Environment;* *(5) Single event latch-up free and having a dose rate latch-up threshold of 5×10^8 Rads (Si).* *(e) All specifically designed or modified systems or subsystems, components, parts, accessories, attachments, and associated equipment for the articles in this category, including the articles identified in section 1516 of Public Law 105-261: satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and non-embedded solid propellant orbit transfer engines (see also Categories IV and V in this section).* *(f) Technical data (as defined in § 120.10 of this subchapter) and defense services (as defined in § 120.9 of this subchapter) directly related to the articles enumerated in paragraphs (a) through (e) of this category, as well as detailed design, development, manufacturing or production data for all spacecraft and specifically designed or modified components for all spacecraft systems. This paragraph includes all technical data, without exception, for all launch support activities (e.g., technical data provided to the launch provider*

	on form, fit, function, mass, electrical, mechanical, dynamic, environmental, telemetry, safety, facility, launch pad access, and launch parameters, as well as interfaces for mating and parameters for launch.) (See § 124.1 for the requirements for technical assistance agreements before defense services may be furnished even when all the information relied upon by the U.S. person in performing the defense service is in the public domain or is otherwise exempt from the licensing requirements of this subchapter.) Technical data directly related to the manufacture or production of any article enumerated elsewhere in this category that is designated as Significant Military Equipment (SME) shall itself be designated SME. Further, technical data directly related to the manufacture or production of all spacecraft, notwithstanding the nature of the intended end use (e.g., even where the hardware is not SME), is designated SME.
Proposed Category XI ***Military Electronics Radar and Tracking Systems***	*Other paragraphs – not applicable* *(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 l/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) Air surveillance radar with multiple elevation beams, phase or amplitude monopulse estimation, or 3D height-finding;* *(x) Air surveillance radar with a beam solid angle less than or equal to 16 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 l/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;(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 or IV;* *(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 a t 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 50dB;*

	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 (EP) or electronic counter countermeasures(ECCM) other than manual gain control, automatic gain control, radio frequency selection, constant false alarm rate, and pulse repetition interval jitter;* *(xix) Radar employing electronic attack (EA) mode(s) using the radar transmitter and antenna;* *(xx) Radar employing electronic support (ES) mode(s) (i.e., the ability to use a radar system for ES purposes in one or more of the following: as a high gain receiver, as a wide-bandwidth receiver, as a multi-beam receiver, or as part of a multi-point system);* *(xxi) Radar employing non-cooperative target recognition (NCTR)(i.e., the ability to recognize a specific platform type without cooperative action of the target platform);* *(xxii) Radar employing automatic target recognition (ATR) (i.e., recognition of target using structural features (e.g., tank versus car) of the target with system resolution better than(less than) 0.3 m;* *(xxiii) Radar that sends interceptor guidance commands or provides illumination keyed to an interceptor seeker;* *(xxiv) Radar employing wave form generation for LPI other than frequency modulated continuous wave (FMCW) with linear ramp modulation;* *(xxv) Radar that sends and receives communications;*

Type of control	Description
	Antenna
5A001Telecommunications equipment	d. "Electronically steerable phased array antennae" operating above 31.8 GHz;
Antenna in Category XV of the ITAR	*Antennas with a diameter >25 m* *Actively scanned antennas* *Adaptive beam forming antennas*
EAR	Optical Sensors, Cameras and Mirrors
6A002 Optical sensors or equipment and components	a.1 Space-qualified" solid-state detectors having all of the following: a.1.a.1. A peak response in the wavelength range exceeding 10 nm but not exceeding 300 nm; *and* a.1.a.2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm; a.1.b.1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; *and* a.1.b.2. A response "time constant" of 95 ns or less a.1.c. "Space-qualified" solid-state detectors having a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm; a.1.d. "Space-qualified" "focal plane arrays" having more than 2,048 elements per array and having a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm;
6A002 Optical sensors or equipment and components (cont'd)	a.2. Image intensifier tubes and specially designed components therefor, as follows: a.2.a. Image intensifier tubes having all of the following: a.2.a. 1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm; a.2.a.2. Electron image amplification using any of the following: a.2.a.2.a. A microchannel plate with a hole pitch (center-to-center spacing) of 12 _m or less; or a.2.a.2.b. An electron sensing device with a non-binned pixel pitch of 500 _m or less, specially designed or modified to achieve 'charge multiplication' other than by a microchannel plate; *and* a.2.a.3. Any of the following photocathodes: a.2.a.3.a. Multialkali photocathodes (e.g., S-20 and S-25) having a luminous sensitivity exceeding 350 _A/lm; a.2.a.3.b. GaAs or GaInAs photocathodes; or a.2.a.3.c. Other "III-V compound" semiconductor photocathodes having a maximum "radiant sensitivity" exceeding 10 mA/W; a.2.b. Image intensifier tubes having all of the following: a.2.b.1. A peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,800 nm; a.2.b.2. Electron image amplification using any of the following: a.2.b.2.a. A microchannel plate with a hole pitch (center-to-center spacing) of 12 _m or less; *or* a.2.b.2.b. An electron sensing device with a non-binned pixel pitch

	of 500 □m or 'charge multiplication' other than by a microchannel plate; *and* a.2.b.3. “III/V compound” semiconductor (e.g., GaAs or GaInAs) photocathodes and transferred electron photocathodes, having a maximum “radiant sensitivity” exceeding 15 mA/W; a.2.c. Specially designed components as follows: a.2.c.1. Microchannel plates having a hole pitch (center-to-center spacing) of 12 □m or less; a.2.c.2. An electron sensing device with a non-binned pixel pitch of 500 □m multiplication' other than by a microchannel plate; a.2.c.3. “III-V compound” semiconductor (*e.g.,* GaAs or GaInAs) photocathodes and transferred electron photocathodes; **Note:** 6A002.a.2.c.3 does not control compound semiconductor photocathodes designed to achieve a maximum “radiant sensitivity” of any of the following: a. 10 mA/W or less at the peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm; or b. 15 mA/W or less at the peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,800 nm.
6A002 Optical sensors or equipment and components (cont’d)	a.3. Non-“space-qualified” “focal plane arrays” as follows: a.3.a. Non-“space-qualified” “focal plane arrays” having all of the following: a.3.a.1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; *and* a.3.a.2. Any of the following: a.3.a.2.a. A response “time constant” of less than 0.5 ns; *or* a.3.a.2.b. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity” exceeding 10 mA/W. a.3.b. Non-“space-qualified” “focal plane arrays” having all of the following: a.3.b.1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; *and* a.3.b.2. Any of the following: a.3.b.2.a. A response “time constant” of 95 ns or less; *or* a.3.b.2.b. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity” exceeding 10 mA/W. a.3.c. Non-“space-qualified” non-linear (2-dimensional) “focal plane arrays” having individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm; a.3.d. Non-“space-qualified” linear (1-dimensional) “focal plane arrays” having all of the following: a.3.d.1. Individual elements with a peak response in the wavelength

	range exceeding 1,200 nm but not exceeding 3,000 nm; *and* a.3.d.2. Any of the following: a.3.d.2.a. A ratio of 'scan direction' dimension of the detector element to the 'cross-scan direction' dimension of the detector element of less than 3.8; *or* a.3.d.2.b. Signal Processing In The Element (SPRITE); a.3.e. Non-“space-qualified” linear (1-dimensional) “focal plane arrays” having individual elements with a peak response in the wavelength range exceeding 3,000 nm but not exceeding 30,000 nm; a.3.f. Non-“space-qualified” non-linear (2-dimensional) infrared “focal plane arrays” based on 'microbolometer' material having individual elements with an unfiltered response in the wavelength range equal to or exceeding 8,000 nm but not exceeding 14,000 nm; **Technical Note:** For the purposes of 6A002.a.3.f, 'microbolometer' is defined as a thermal imaging detector that, as a result of a temperature change in the detector caused by the absorption of infrared radiation, is used to generate any usable signal. a.3.g. Non-“space-qualified” “focal plane arrays” having all of the following: a.3.g.1. Individual detector elements with a peak response in the wavelength range exceeding 400 nm but not exceeding 900 nm; a.3.g.2. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity” exceeding 10 mA/W for wavelengths exceeding 760 nm; *and* a.3.g.3. Greater than 32 elements.
6A002 Optical sensors or equipment and components (cont’d)	b. “Monospectral imaging sensors” and “multispectral imaging sensors”, designed for remote sensing applications and having any of the following: b.1. An Instantaneous-Field-Of-View (IFOV) of less than 200 (microradians); *or* ra b.2. Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm and having all the following: b.2.a. Providing output imaging data in digital format; *and* b.2.b. Having any of the following characteristics: b.2.b.1. “Space-qualified”; *or* b.2.b.2. Designed for airborne having an IFOV of less than 2.5 mrad (milliradians); **Note:** 6A002.b.1 does not control “monospectral imaging sensors” with a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm and only incorporating any of the following non -“space-qualified” detectors or non -“space-qualified” “focal plane arrays”: a. Charge Coupled Devices (CCD) not designed or modified to

	achieve 'charge multiplication'; or b. Complementary Metal Oxide Semiconductor (CMOS) devices not designed or modified to achieve 'charge multiplication
6A002 Optical sensors or equipment and components (cont'd)	c. 'Direct view' imaging equipment incorporating any of the following: c.1. Image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b; c.2. "Focal plane arrays" having the characteristics listed in 6A002.a.3; *or* c.3. Solid state detectors specified by 6A002.a.1. **Technical Note**: 'Direct view' refers to imaging equipment that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means. **Note**: 6A002 c. 'Direct view' imaging equipment incorporating any of the following: c.1. Image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b; c.2. "Focal plane arrays" having the characteristics listed in 6A002.a.3; or c.3. Solid state detectors specified by 6A002.a.1. **Technical Note**: 'Direct view' refers to imaging equipment that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means. **Note**: 6A002.c does not control equipment as follows, when incorporating other than GaAs or GaInAs photocathodes: a. Industrial or civilian intrusion alarm, traffic or industrial movement control
6A002 Optical sensors or equipment and components (cont'd)	d. Special support components for optical sensors, as follows: d.1. "Space-qualified" cryocoolers; d.2. Non-"space-qualified" cryocoolers having a cooling source temperature below 218K (-55° C), as follows: d.2.a. Closed cycle type with a specified Mean-Time-To-Failure (MTTF) or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours; d.2.b. Joule-Thomson (JT) self-regulating minicoolers having bore (outside) diameters of less than 8 mm; d.3. Optical sensing fibers specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.

	Note: 6A002.d.3 does not apply to encapsulated optical sensing fibers specially designed for bore hole sensing applications.
6A003 Cameras	This entry is very long, just the headings are provided below. If your work involves use of cameras, read EAR 6A003. a. Instrumentation cameras and specially designed components therefor, b. Imaging cameras as follows: b.1. Video cameras incorporating solid state sensors, having a peak response in the wavelength range exceeding 10 nm, but not exceeding 30,000 nm and having all of the following: (See text in Category 6 to Part 774 of EAR) b.2. Scanning cameras and scanning camera systems, having all of the following: (see text in Category 6 to Part 774 of EAR b.3. Imaging cameras incorporating image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b; b.4. Imaging cameras incorporating "focal plane arrays" having any of the following: These cameras require a security plan if it is being used outside of the countries in Europe, Canada, Japan, Australia, New Zealand and South Korea (see detail at http://www.bis.doc.gov/policiesandregulations/ear/ccl6.pdf page 14) b.5. Imaging cameras incorporating solid-state detectors specified by 6A002.a.1.
6A004 Optical equipment and components	a. Optical mirrors (reflectors) as follows: a.1. "Deformable mirrors" having either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz; a.2. Lightweight monolithic mirrors having an average "equivalent density" of less than 30 kg/m and a total mass exceeding 10 kg; a.3. Lightweight "composite" or foam mirror structures having an average "equivalent density" of less than 30 kg/m 2 and a total mass exceeding 2 kg; a.4. Beam steering mirrors more than 100 mm in diameter or length of major axis, that maintain a flatness of λ/2 or better (λ is equal to 633 nm) having a control bandwidth exceeding 100 Hz;
6A004 Optical equipment and components (cont'd)	b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and having any of the following: b.1. Exceeding 100 cm in volume; or

	b.2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth);
6A004 Optical equipment and components (cont'd)	c. "Space-qualified" components for optical systems, as follows: c.1. Components light weighted to less than 20% "equivalent density" compared with a solid blank of the same aperture and thickness; c.2. Raw substrates, processed substrates having surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or having protective films; c.3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 m in diameter; c.4. Components manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than 5×10^{-6} in any coordinate direction;
6A004 Optical equipment and components (cont'd)	d. Optical control equipment as follows: d.1. Equipment specially designed to maintain the surface figure or orientation of the "space-qualified" components controlled by 6A004.c.1 or 6A004.c.3; d.2. Equipment having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 µrad (microradians) or less; d.3. Gimbals having all of the following: d.3.a. A maximum slew exceeding 5°; d.3.b. A bandwidth of 100 Hz or more; d.3.c. Angular pointing errors of 200 µrad (microradians) or less; and d.3.d. Having any of the following: d.3.d.1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 2 rad (radians)/s2; *or* d.3.d.2. Exceeding 1 m in diameter accelerations exceeding 0.5 rad (radians)/s2; d.4. "Specially designed" to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more;
6A004 Optical	e. 'Aspheric optical elements' having all of the following:

equipment and components (cont'd)	e.1. Largest dimension of the optical-aperture greater than 400 mm; e.2. Surface roughness less than 1 nm (rms) for sampling lengths equal to or greater than 1 mm; and e.3. Coefficient of linear thermal expansion's absolute magnitude less than 3 x 10^{-6}/K at 25°C. **Technical Note: 1.** [See Related Definitions section of this ECCN] 2. Manufacturers are not required to measure the surface roughness listed in 6A004.e.2 unless the optical element was designed or manufactured with the intent to meet, or exceed, the control parameter. **Note:** 6A004.e does not control 'aspheric optical elements' having any of the following: a. Largest optical-aperture dimension less than 1 m and focal length to aperture ratio equal to or greater than 4.5:1; b. Largest optical-aperture dimension equal to or greater than 1 m and focal length to aperture ratio equal to or greater than 7:1; c. Designed as Fresnel, flyeye, stripe, prism or diffractive optical elements; d. Fabricated from borosilicate glass having a coefficient of linear thermal expansion greater than 2.5 x 10-6 /K at 25° C; or **e. An x-ray optical element having inner mirror capabilities (e.g., tube-type mirrors*)***

B. TEST, INSPECTION AND PRODUCTION EQUIPMENT **6B004 Optical equipment as follows (see List of Items Controlled).**	a. Equipment for measuring absolute reflectance to an accuracy of ± 0.1% of the reflectance value; b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an “accuracy” of 2 nm or less (better) against the required profile.
Spacecraft and satellites- ITAR Category XV Proposed in ECR change	*Space-qualified optics (i.e., lens or mirror), including optical coating, having active properties (e.g., adaptive or deformable), or having a largest lateral dimension greater than 0.35 meters;* *(3) ``Space-qualified'' focal plane arrays (FPA) having a peak response in the wavelength range exceeding 900nm and readout integrated circuit (ROIC) specially designed therefor;*

EAR	Computers
4A003 Digital computers, Electronic assemblies and related equipment	Items: **Note 1**: 4A003 includes the following: **- 'Vector processors' (as defined in Note 7 of the "Technical Note on "Adjusted Peak Performance" ("APP")");** **- Array processors;** **- Digital signal processors;** **- Logic processors;** **- Equipment designed for "image enhancement";** **- Equipment designed for "signal processing".** **Note 2:** The control status of the "digital computers" and related equipment described in 4A003 is determined by the control status of other equipment or systems provided: a. The "digital computers" or related equipment are essential for the operation of the other equipment or systems; b. The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; and N.B. 1:The control status of "signal processing" or "image enhancement" equipment specially designed for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the "principal element" criterion. N.B. 2: For the control status of "digital computers" or related equipment for telecommunications equipment, see Category 5, Part 1 (Telecommunications). c. The "technology" for the "digital computers" and related equipment is determined by 4E. a. [RESERVED] **b. "Digital computers" having an "Adjusted Peak Performance" ("APP") exceeding 3.0 weighted TeraFLOPS (WT);** **c. "Electronic assemblies" specially designed or modified to be capable of enhancing performance by aggregation of processors so that the "APP" of the aggregation exceeds the limit in 4A003.b.;** **Note 1:** 4A003.c applies only to "electronic assemblies" and programmable interconnections not exceeding the limit in 4A003.b. when shipped as unintegrated "electronic assemblies". It does not apply to "electronic assemblies" inherently limited by nature of their design for use as related equipment controlled by 4A003.e. **Note 2**: 4A003.c does not control "electronic assemblies" specially designed for a product or family of products whose maximum

	configuration does not exceed the limit of 4A003.b. d. [RESERVED] **e. Equipment performing analog-to-digital conversions exceeding the limits in 3A001.a.5** f. [RESERVED] **g. Equipment specially designed for aggregating the performance of "digital computers" by providing external interconnections which allow communications at unidirectonal data rates exceeding 2.0 Gbyte/s per link.** **Note: 4A003.g does not control internal interconnection equipment (e.g., backplanes, buses) passive interconnection equipment, "network access controllers" or "communication channel controllers"**
3A001 Electronic Components	a. General purpose integrated circuits, as follows: **Note 1:** The control status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3A001.a. **Note 2**: Integrated circuits include the following types: - Monolithic integrated circuits - Hybrid integrated circuits - Multichip integrated circuits - Film type integrated circuits, including silicon-on-sapphire integrated circuits - Optical integrated circuits a.1. Integrated circuits designed or rated as radiation hardened to withstand any of the following: a.1.a. A total dose of 5 x 103 Gy (Si), or higher; a.1.b. A dose rate upset of 5 x 106 Gy (Si)/s, or higher; or a.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5 x 1013 n/cm² or higher on silicon, or its equivalent for other materials; **Note:** 3A001.a.1.c does not apply to Metal Insulator Semiconductors (MIS). a.2. "Microprocessor microcircuits", "microcomputer microcircuits", microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analog-to-digital converters, digital-to-analog converters, electro-optical or "optical integrated circuits" designed for "signal processing", field programmable logic devices, custom integrated circuits for which either the function is unknown or

	the control status of the equipment in which the integrated circuit will be used in unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following: a.2.a. Rated for operation at an ambient temperature above 398 K (+125°C); a.2.b. Rated for operation at an ambient temperature below 218 K (-55°C); or a.2.c. Rated for operation over the entire ambient temperature range from 218 K (-55°C) to 398 K (125°C); a.3. “Microprocessor microcircuits”, “microcomputer microcircuits” and microcontroller microcircuits, manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz; *Note: 3A001.a.3 includes digital signal processors, digital array processors and digital coprocessors.* a.4. [RESERVED] a.5. Analog-to-Digital Converter (ADC) and Digital-to-Analog Converter (DAC) integrated circuits, as follows: a.5.a. ADCs having any of the following: a.5.a.1. A resolution of 8 bit or more, but less than 10 bit, with an output rate greater than 500 million words per second; a.5.a.2. A resolution of 10 bit or more, but less than 12 bit, with an output rate greater than 300 million words per second; a.5.a.3. A resolution of 12 bit with an output rate greater than 200 million words per second; a.5.a.4. A resolution of more than 12 bit but equal to or less than 14 bit with an output rate greater than 125 million words per second; or a.5.a.5. A resolution of more than 14 bit with an output rate greater than 20 million words per second; **Technical Notes:** 1. A resolution of n bit corresponds to a quantization of 2n levels. 2. The number of bits in the output word is equal to the resolution of the ADC. 3. The output rate is the maximum output rate of the converter, regardless of architecture or oversampling. 4. For ‘multiple channel ADCs’, the outputs are not aggregated and the output rate is the maximum output rate of any single channel. 5. For ‘interleaved ADCs’ or for ‘multiple channel ADCs’ that are specified to have an interleaved mode of operation, the outputs are aggregated and the output rate is the maximum combined total output rate of all of the outputs. 6. Vendors may also refer to the output rate as sampling rate, conversion rate or throughput rate. It is often specified in megahertz (MHz) or mega samples per second (MSPS).

	7. For the purpose of measuring output rate, one output word per second is equivalent to one Hertz or one sample per second. 8. 'Multiple channel ADCs' are defined as devices which integrate more than one ADC, designed so that each ADC has a separate analog input. 9. 'Interleaved ADCs' are defined as devices which have multiple ADC units that sample the same analog input at different times such that when the outputs are aggregated, the analog input has been effectively sampled and converted at a higher sampling rate. a.5.b. Digital-to-Analog Converters (DAC) having any of the following: a.5.b.1. A resolution of 10 bit or more with an 'adjusted update rate' of 3,500 MSPS or greater; or a.5.b.2. A resolution of 12-bit or more with an 'adjusted update rate' of equal to or greater than 1,250 MSPS and having any of the following: (consult category 3 of Commerce Control List of EAR) a.6. Electro-optical and "optical integrated circuits", designed for "signal processing" and having all of the following: a.6.a. One or more than one internal "laser" diode; a.6.b. One or more than one internal light detecting element; *and* a.6.c. Optical waveguides; **Note:** 3A001. a.7 includes: -Simple Programmable Logic Devices (SPLDs) -Complex Programmable Logic Devices (CPLDs) -Field Programmable Gate Arrays (FPGAs) -Field Programmable Logic Arrays (FPLAs) -Field Programmable Interconnects (FPICs)
3A002 General purpose electronic equipment and accessories therefor	a. Recording equipment as follows and specially designed test tape therefor: a.1. Analog instrumentation magnetic tape recorders, including those permitting the recording of digital signals (*e.g.*, using a high density digital recording (HDDR) module), having any of the following: a.1.a. A bandwidth exceeding 4 MHz per electronic channel or track; a.1.b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; or a.1.c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ± 0.1 □s; **Note:** Analog magnetic tape recorders specially designed for civilian video purposes are not considered to be instrumentation tape recorders. a.2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s; **Note:** 3A002.a.2 does not control digital video magnetic tape

	recorders specially designed for television recording using a signal format,which may include a compressed signal format, standardized or recommended by the ITU, the IEC, the SMPTE, the EBU , the ETSI, or the IEEE for civil television applications. a.3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques and having any of the following: a.3.a. A maximum digital interface transfer rate exceeding 175 Mbit/s; *or* a.3.b. Being “space-qualified”; ***Note*: *3A002.a.3 does not control analog magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.*** a.4. Equipment having a maximum digital interface transfer rate exceeding 175 Mbit/s and designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders; a.5. Waveform digitizers and transient recorders, having all of the following: a.5.a. Digitizing rates equal to or more than 200 million samples per second and a resolution of 10 bits or more; *and* a.5.b. A ‘continuous throughput’ of 2 Gbit/s or more; **Technical Notes: 1.** For those instruments with a parallel bus architecture, the ‘continuous’ throughput rate is the highest word rate multiplied by the number of bits in a word. **2.** ‘Continuous throughput’ is the fastest data rate the instrument can output to mass storage without the loss of any information while sustaining the sampling rate and analog-to digital conversion. a.6. Digital instrumentation data recorders using magnetic disk storage technique and having all of the following: a.6.a. Digitizing rate equal to or more than 100 million samples per second and a resolution of 8 bits or more; *and* a.6.b. A ‘continuous throughput’ of 1 Gbit/s or more; b. [RESERVED] c. Radio-frequency “signal analyzers” as follows: c.1. “Signal analyzers” having a 3 dB resolution bandwidth (RBW) exceeding 10 MHz anywhere within the frequency range exceeding 31.8 GHz but not exceeding 37.5 GHz; c.2. “Signal analyzers” having Displayed Average Noise Level (DANL) less (better) than –150 dBm/Hz anywhere within the frequency range exceeding 43.5 GHz but not exceeding 75 GHz; c.3. “Signal analyzers”having a frequency exceeding 75 GHz; c.4. “Signal analyzers” having all of the following: c.4.a. “Real-time bandwidth” exceeding 85 MHz; *and*

	c.4.b. 100% probability of discovery with less than a 3 dB reduction from full amplitude due to gaps or windowing effects of signals having a duration of 15 µs or less; **Note:** 3A002.c.4 does not apply to those “signal analyzers” using only constant percentage bandwidth filters (also known as octave or fractional octave filters). **Technical Notes:** 1. Probability of discovery in 3A002.c.4.b is also referred to as probability of intercept or probability of capture. 2. For the purposes of 3A002.c.4.b, the duration for 100% probability of discovery is equivalent to the minimum signal duration necessary for the specified level measurement uncertainty. c.5. “Signal analyzers” having a “frequency mask trigger” function with 100% probability of trigger (capture) for signals having a duration of 15 µs or less; d. Frequency synthesized signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master reference oscillator, and having any of the following: d.1. Specified to generate pulses having all of the following**,** anywhere within the synthesized frequency range exceeding 31.8 GHz but not exceeding 75 GHz: d.1.a. ‘Pulse duration’ of less than 100 ns; *and* d.1.b. On/off ratio equal to or exceeding 65 dB; d.2. An output power exceeding 100 mW (20 dBm) anywhere within the synthesized frequency range exceeding 43.5 GHz but not exceeding 75 GHz; d.3. A “frequency switching time” as specified by any of the following: d.3.a. [RESERVED]; d.3.b. Less than 100 µs for any frequency change exceeding 1.6 GHz within the synthesized frequency range exceeding 4.8 GHz but not exceeding 10.6 GHz; d.3.c. Less than 250 µs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 10.6 GHz but not exceeding 31.8 GHz; d.3.d. Less than 500 µs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 31.8 GHz but not exceeding 43.5 GHz; d.3.e. Less than 1 ms for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 43.5 GHz but not

	exceeding 56 GHz; *or* d.3.f. Less than 1 ms for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 56 GHz but not exceeding 75 GHz; d.4. Single sideband (SSB) phase noise, in dBc/Hz, specified as being all of the following: d.4.a. Less (better) than - (126+20 log10 F-20 log10f) for anywhere within the range of 10 Hz <F<10 kHz anywhere within the synthesized frequency range exceeding 3.2 GHz but not exceeding 75 GHz; *and* d.4.b. Less (better) than - (114+20 log10 F-20 log10f) for anywhere within the range of 10 kHz <F< 500 kHz anywhere within the synthesized frequency range exceeding 3.2 GHz but not exceeding 75 GHz; *or* **Technical Note:** In 3A002.d.4, F is the offset from the operating frequency in Hz and f is the operating frequency in MHz. d.5. A maximum synthesized frequency exceeding 75 GHz; **Note 1**: For the purpose of 3A002.d, frequency synthesized signal generators include arbitrary waveform and function generators. **Note 2**: 3A002.d does not control equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result. **Technical Notes:** 1. The maximum synthesized frequency of an arbitrary waveform or function generator is calculated by dividing the sample rate, in samples/second, by a factor of 2.5. 2. For the purposes of 3A002.d.1.a, 'pulse duration' is defined as the time interval between the leading edge of the pulse achieving 90% of the peak and the trailing edge of the pulse achieving 10% of the peak. e. Network analyzers having any of the following: e.1. An output power exceeding 31.62 mW (15 dBm) anywhere within the operating frequency range exceeding 43.5 GHz but not exceeding 75 GHz; e.2. An output power exceeding 1 mW (0 dBm) anywhere within the operating frequency range exceeding 75 GHz but not exceeding 110 GHz; e.3. 'Nonlinear vector measurement functionality' at frequencies exceeding 50 GHz but not exceeding 110 GHz; *or*

	Technical Note: 'Nonlinear vector measurement functionality' is an instrument's ability to analyze the test results of devices driven into the large-signal domain or the non-linear distortion range. e.4. A maximum operating frequency exceeding 110 GHz; f. Microwave test receivers having all of the following: f.1. Maximum operating frequency exceeding 110 GHz; *and* f.2. Being capable of measuring amplitude and phase simultaneously; g. Atomic frequency standards being any of the following: g.1. "Space-qualified"; g.2. Non-rubidium and having a long-term stability less (better) than 1 x 10-11/month; *or* g.3. Non-"space-qualified" and having all of the following: g.3.a. Being a rubidium standard; g.3.b. Long-term stability less (better) than 1 x 10-11/month; *and* g.3.c. Total power consumption of less than 1 Watt.
3A999 Specific Processing Equipment	a. Frequency changers capable of operating in the frequency range from 300 up to 600 Hz, n.e.s; b. Mass spectrometers n.e.s; c. All flash x-ray machines, and "parts" or "components" of pulsed power systems designed thereof, including Marx generators, high power pulse shaping networks, high voltage capacitors, and triggers; d. Pulse amplifiers, n.e.s.; e. Electronic equipment for time delay generation or time interval measurement, as follows: e.1. Digital time delay generators with a resolution of 50 nanoseconds or less over time intervals of 1 microsecond or greater; *or* e.2. Multi-channel (three or more) or modular time interval meter and chronometry equipment with resolution of 50 nanoseconds or less over time intervals of 1 microsecond or greater; f. Chromatography and spectrometry analytical instruments.
9A004 Space launch vehicles and "spacecraft".	The international space station operated under the supervision of the U.S. National Aeronautics and Space Administration. Hardware specific to the international space station transferred to the Department of Commerce by commodity jurisdiction action is also included.

	c. Specific items as may be determined to be not subject to the ITAR through the commodity jurisdiction procedure administered by the Commerce Control List Department of State after March 15, 1999.
9A005 Liquid rocket propulsion systems **9A006 Systems and components, specially designed for liquid rocket propulsion systems.** **9A007 Solid rocket propulsion systems.** **9A008 Components specially designed for solid rocket propulsion systems.**	These items are subject to the export licensing authority of the U.S. Department of State, Directorate of Defense Trade Controls. See 22 CFR part 121.
9A012 Non-military "unmanned aerial vehicles," ("UAVs"), unmanned "airships", associated systems, equipment and components, as follows (see List of Items Controlled).	a. "UAVs" or unmanned "airships", having any of the following: a.1. An autonomous flight control and navigation capability (e.g., an autopilot with an Inertial Navigation System); or a.2. Capability of controlled flight out of the direct visual range involving a human operator (e.g., televisual remote control); b. Associated systems, equipment and components, as follows: b.1. Equipment specially designed for remotely controlling the "UAVs" or unmanned "airships", controlled by 9A012.a.; b.2. Systems for navigation, attitude, guidance or control, other than those controlled in Category 7, specially designed to provide autonomous flight control or navigation capability to "UAVs" or unmanned "airships", controlled by 9A012.a.; b.3. Equipment or components specially designed to convert a manned "aircraft" or a manned "airship" to a "UAV" or unmanned "airship", controlled by 9A012.a; b.4. Air breathing reciprocating or rotary internal combustion type engines, specially designed or modified to propel "UAVs" or unmanned "airships", at altitudes above 50,000 feet (15,240 meters

2E003	Other technology as follows Deposition methods as listed at the end of this table.
3A233 Mass spectrometers, other than those described in 0B002.g, capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, and ion sources therefor.	a. Inductively coupled plasma mass spectrometers (ICP/MS); b. Glow discharge mass spectrometers (GDMS); c. Thermal ionization mass spectrometers (TIMS); d. Electron bombardment mass spectrometers that have a source chamber constructed from, lined with or plated with materials resistant to UF6; e. Molecular beam mass spectrometers having either of the following characteristics: e.1. A source chamber constructed from, lined with or plated with stainless steel or molybdenum and equipped with a cold trap capable of cooling to 193 K (-80°C) or less; *or* e.2. A source chamber constructed from, lined with or plated with materials resistant to UF6; d. Mass spectrometers equipped with a microfluorination ion source designed for actinides or actinide fluorides
7A001 Accelerometers	a. Linear accelerometers having any of the following: a.1. Specified to function at linear acceleration levels less than or equal to 15 g and having any of the following: a.1.a. A “bias” “stability” of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year; or a.1.b. A “scale factor” “stability” of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year; a.2. Specified to function at linear acceleration levels exceeding 15 g but less than or equal to 100 g and having all of the following: a.2.a. A “bias” “repeatability” of less (better) than 1,250 micro g over a period of one year; and a.2.b. A “scale factor” “repeatability” of less (better) than 1,250 ppm over a period of one year; or a.3. Designed for use in inertial navigation or guidance systems and specified to function at linear acceleration levels exceeding 100 g; **Note**: 7A001.a.1 and 7A001.a.2 do not apply to accelerometers limited to measurement of only vibration or shock. b. Angular or rotational accelerometers, specified to function at linear acceleration

7A101 Accelerometers, other than those controlled by 7A001	a. Linear accelerometers designed for use in inertial navigation systems or in guidance missiles" having *all* of the following characteristics, and "specially designed" "parts" and "components" therefor: a.1. 'Scale factor' "repeatability" less (better) than 1250 ppm; and a.2. 'Bias' "repeatability" less (better) than 1250 micro g. **Note:** The measurement of 'bias' and 'scale factor' refers to one sigma standard deviation with respect to a fixed calibration over a period of one year. b. Accelerometers of any type, designed for use in inertial navigation systems or in guidance systems of all types, specified to function at acceleration levels greater than 100 g. **Note to paragraph (b)**: This paragraph (b) does not include accelerometers that are designed to measure vibration or shock.
7A002 Gyros or angular rate sensors	a. Specified to function at linear acceleration levels less than or equal to 100 g and having any of the following: a.1. A rate range of less than 500 degrees per second and having any of the following: a.1.a. A "bias" "stability" of less (better) than 0.5 degree per hour, when measured in a 1 g environment over a period of one month, and with respect to a fixed calibration value; *or* a.1.b. An "angle random walk" of less (better) than or equal to 0.0035 degree per square root hour; **Note**: 7A002.a.1.b does not control 'spinning mass gyros'. **Technical Note**: 'Spinning mass gyros' are gyros which use a continually rotating mass to sense angular motion. a.2. A rate range greater than or equal to 500 degrees per second and having any of the following: a.2.a. A "bias" "stability" of less (better) than 40 degrees per hour, when measured in a 1 g environment over a period of three minutes, and with respect to a fixed calibration value; *or* a.2.b. An "angle random walk" of less (better) than or equal to 0.2 degree per square root hour; *or* **Note**: 7A002.a.2.b does not apply to 'spinning mass gyros'. b. Specified to function at linear acceleration levels exceeding 100 g.

7A102 Gyros, other than those controlled by 7A002	a. All types of gyros, usable in rockets, missiles, or unmanned aerial vehicles capable of achieving a "range" equal to or greater than 300 km, with a rated "drift rate" 'stability' of less than 0.5 degrees (1 sigma or rms) per hour in a 1 g environment. b. Gyros of any type, designed for use in inertial navigation systems or in guidance systems of all types, specified to function at acceleration levels greater than 100 g. **Technical Note:** In this entry, the term 'stability' is defined as 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.) (IEEE STD 528-2001 paragraph 2.247)
7A003 Inertial systems and "specially designed" "components	a. Inertial Navigation Systems (INS) (gimbaled or strapdown) and inertial equipment, designed for "aircraft," land vehicles, vessels (surface or underwater) or "spacecraft," for navigation, attitude, guidance or control and having any of the following, and "specially designed" "components" therefor: a.1. Navigation error (free inertial) subsequent to normal alignment of 0.8 nautical mile per hour (nm/hr) "Circular Error Probable" ("CEP") or less (better); *or* a.2. Specified to function at linear acceleration levels exceeding 10 g; b. Hybrid Inertial Navigation Systems embedded with Global Navigation Satellite System(s) (GNSS) or with "Data-Based Referenced Navigation" ("DBRN") System(s) for navigation, attitude, guidance or control, subsequent to normal alignment and having an INS navigation position accuracy, after loss of GNSS or "DBRN" for a period of up to 4 minutes, of less (better) than 10 meters "Circular Error Probable" ("CEP"); c. Inertial measurement equipment for heading or True North determination and having any of the following, and "specially designed" "components" therefor: c.1. Designed to have heading or True North determination accuracy equal to, or less (better) than 0.07 deg sec(Lat) (equivalent to 6 arc minutes (rms) at 45 degrees latitude); *or* c.2. Designed to have a non-operating shock level of 900 g or greater at a duration of 1 msec, or greater; d. Inertial measurement equipment including Inertial Measurement Units (IMU) and Inertial Reference Systems (IRS), incorporating accelerometers or gyros controlled by 7A001 or 7A002. **Note 1:** The parameters of 7A003.a and 7A003.b are applicable with any of the following environmental conditions: a. Input random vibration with an overall magnitude of 7.7 g (rms) in the first 0.5 hour and a total test duration of 1.5 hour per axis in each of

	the 3 perpendicular axes, when the random vibration meets all of the following: 1. A constant Power Spectral Density(PSD) value of 0.04 g2/Hz over a frequency interval of 15 to 1,000 Hz; and 2. The PSD attenuates with frequency from 0.04 g2/Hz to 0.01 g2/Hz over a frequency interval from 1,000 to 2,000 Hz; b. An angular rate capability about one or more axes of equal to or more than +2.62 rad/s (150 deg/s); or c. According to national standards equivalent to a. or b. of this note. **Note 2:** 7A003 does not control inertial navigation systems which are certified for use on “civil aircraft” by civil authorities of a Wassenaar Arrangement Participating State, see Supplement No. 1 to Part 743 for a list of these countries. **Note 3:** 7A003.c.1 does not control theodolite systems incorporating inertial equipment “specially designed” for civil surveying purposes. **Technical Note:** 7A003.b refers to systems in which an INS and other independent navigation aids are built into a single unit (embedded) in order to achieve improved performance.
7A103 Instrumentation, navigation equipment and systems, other than those controlled by 7A003,	a. Inertial or other equipment using accelerometers or gyros controlled by 7A001, 7A002, 7A101 or 7A102 and systems incorporating such equipment, and “specially designed” “parts” and “components” therefor; **Note 1:** 7A103.a does not control equipment containing accelerometers “specially designed” and developed as MWD (Measurement While Drilling) sensors for use in down-hole well services operations. **Note 2**: 7A103.a does not control inertial or other equipment using accelerometers or gyros controlled by 7A001 or 7A002 that are only NS controlled. b. Integrated flight instrument systems, which include gyrostabilizers or automatic pilots, designed or modified for use in rockets, missiles, or unmanned aerial vehicles capable of achieving a “range” equal to or greater than 300 km, and “specially designed” “parts” and “components” therefor. c. Integrated Navigation Systems, designed or modified for use in rockets, missiles, or unmanned aerial vehicles capable of achieving a “range” equal to or greater than 300 km and capable of providing a navigational accuracy of 200m Circular Error Probable (CEP) or less. **Technical Note:** An ‘integrated navigation system’ typically incorporates the following “parts” and “components”: 1. An inertial measurement device (e.g., an attitude and heading reference system, inertial reference unit, or inertial navigation system);

	2. One or more external sensors used to update the position and/or velocity, either periodically or continuously throughout the flight (e.g., satellite navigation receiver, radar altimeter, and/or Doppler radar); and 3. Integration hardware and software.
7A004 'Star trackers' and "components" therefor	a. 'Star trackers' with a specified azimuth accuracy of equal to or less (better) than 20 seconds of arc throughout the specified lifetime of the equipment; b. "Components" "specially designed" for equipment specified in 7A004.a as follows: b.1. Optical heads or baffles; b.2. Data processing units. **Technical Note:** 'Star trackers' are also referred to as stellar attitude sensors or gyroastro compasses.
7A104 Gyro-astro compasses and other devices, other than those controlled by 7A004, which derive position or orientation by means of automatically tracking celestial bodies or satellites and "specially designed" "parts" and "components" therefor	The list of items controlled is contained in the ECCN heading.
7A005 Global Navigation Satellite Systems (GNSS) receiving equipment having any of the following (see List of Items Controlled) and "specially designed" "components" therefor.	a. Employing a decryption algorithm "specially designed" or modified for government use to access the ranging code for position and time; *or* b. Employing 'adaptive antenna systems'. **Note:** 7A005.b does not apply to GNSS receiving equipment that only uses "components" designed to filter, switch, or combine signals from multiple omni-directional antennas that do not implement adaptive antenna techniques. **Technical Note:** For the purposes of 7A005.b 'adaptive antenna systems' dynamically generate one or more spatial nulls in an antenna array pattern by signal processing in the time domain or frequency domain.

7A105 Receiving equipment for Global Navigation Satellite Systems (GNSS) (e.g. GPS, GLONASS, or Galileo)	1. Designed or modified for use in "missiles"; or 2. Designed or modified for airborne applications and having any of the following: 2.a. Capable of providing navigation information at speeds in excess of 600 m/s (1,165 nautical mph); 2.b. Employing decryption, designed or modified for military or governmental services, to gain access to GNSS secured signal/data; or 2.c. Being "specially designed" to employ anti-jam features (e.g. null steering antenna or electronically steerable antenna) to function in an environment of active or passive countermeasures . **Note to 7A105:** See also 7A005 and 7A994
7A006 Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive and having any of the following	a. "Power management"; *or* b. Using phase shift key modulation.
7A106 Altimeters, other than those controlled by 7A006, of radar or laser radar type, designed or modified for use in "missiles".	a. Internal tilt compensation in pitch (+/-90 degrees) and roll (+/-180 degrees) axes; b. Capable of providing azimuthal accuracy better (less) than 0.5 degrees rms at latitudes of +/- 80 degrees, referenced to local magnetic field; *and* c. Designed or modified to be integrated with flight control and navigation systems. **Note:** Flight control and navigation systems in 7A107 include gyrostabilizers, automatic pilots and inertial navigation systems.
7A008 Underwater sonar navigation systems using Doppler velocity or correlation velocity logs integrated with a heading source and having a positioning accuracy of equal to or less (better) than 3% of distance traveled "Circular	The list of items controlled is contained in the ECCN heading.

Error Probable" ("CEP") and "specially designed" "components	
7A115 Passive sensors for determining bearing to specific electromagnetic sources (direction finding equipment) or terrain characteristics, designed or modified for use in "missiles".	*(These items are "subject to the ITAR". See 22 CFR parts 120 through 130.)*
7A116 Flight control systems (hydraulic, mechanical, electro-optical, or electromechanical flight control systems (including fly-by-wire systems) and attitude control equipment) designed or modified for "missiles".	*(These items are "subject to the ITAR". See 22 CFR parts 120 through 130.)*
7A117 "Guidance sets" capable of achieving system accuracy of 3.33% or less of the range (e.g., a "CEP" of 10 km or less at a range of 300 km	*(These items are "subject to the ITAR". See 22 CFR parts 120 through 130.)*
7A994 Other navigation direction finding equipment, airborne communication equipment	The list of items controlled is contained in the ECCN heading. **Note** 1) See also 7A005 and 7A105. (2) QRS11 Micromachined Angular Rate Sensors are "subject to the ITAR" (see 22 CFR parts 120 through 130), unless the QRS11-00100-100/101 is integrated into and included as an integral "component" of a commercial primary or standby instrument system of the type described in ECCN 7A994, or aircraft of the type described in ECCN 9A991 that incorporates such systems, or is exported solely for integration into such a system; or the QRS11-00050-

	443/569 is integrated into an automatic flight control system of the type described in ECCN 7A994, or aircraft of the type described in ECCN 9A991 that incorporates such systems, or are exported solely for integration into such a system. (See Commodity Jurisdiction requirements in 22 CFR Parts 121; Category VIII(e), Note(1).) In the latter case, such items are subject to the EAR. Technology specific to the development and production of QRS11 sensors remains "subject to the ITAR" (see 22 CFR parts 120 through 130).

'Substrate' under column 2. For example, Chemical Vapor Deposition (CVD) 'coating process' technical data are controlled for the application of 'silicides' to 'Carbon-carbon, Ceramic and Metal "matrix" "composites" substrates, but are not controlled for the application of 'silicides' to 'Cemented tungsten carbide (16), Silicon carbide (18)' substrates. In the second case, the resultant coating is not listed in the paragraph under column 3 directly across from the paragraph under column 2 listing 'Cemented tungsten carbide (16), Silicon carbide (18)'.

Category 2E - Materials Processing Table; Deposition Techniques

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
A. Chemical Vapor Deposition (CVD)	"Superalloys"	Aluminides for internal passages
	Ceramics (19) and Low-expansion glasses(14)	Silicides Carbides Dielectric layers (15) Diamond Diamond-like carbon (17)
	Carbon-carbon, Ceramic, and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Aluminides Alloyed aluminides (2) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15) Diamond Diamond-like carbon (17)

[1] The numbers in parenthesis refer to the Notes following this Table.

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Sensor window materials (9)	Dielectric layers (15) Diamond Diamond-like carbon (17)
B. Thermal-Evaporation Physical Vapor		
1. Physical Vapor Deposition (PVD): Deposition (TE-PVD) Electron-Beam (EB-PVD)	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15)
	Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15) Borides Beryllium
	Sensor window materials (9)	Dielectric layers (15)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Titanium alloys (13)	Borides Nitrides
2. Ion assisted resistive heating Physical Vapor Deposition (PVD)(Ion Plating)	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16) Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric Layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric Layers (15) Diamond-like carbon (17)
3. Physical Vapor Deposition (PVD): "Laser" Vaporization	Ceramics (19) and Low-expansion glasses (14)	Silicides Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon,Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric Layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
4. Physical Vapor Deposition (PVD): Cathodic Arc Discharge.	"Superalloys"	Alloyed silicides Alloyed Aluminides (2) MCrA1X (5)
	Polymers (11) and Organic "matrix" "composites"	Borides Carbides Nitrides Diamond-like carbon (17)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
C. Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
	Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
	Refractory metals and alloys (8)	Silicides Oxides
D. Plasma spraying	"Superalloys"	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel-Graphite Abradable materials containing Ni-Cr-Al Abradable Al-Si-Polyester Alloyed aluminides (2)
	Aluminum alloys (6)	MCrAlX (5) Modified zirconia (12) Silicides Mixtures thereof (4)
	Refractory metals and alloys (8), Carbides, Corrosion resistant steel (7)	Aluminides Silicides MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
D. Plasma spraying (continued)	Titanium alloys (13)	Carbides Aluminides Silicides Alloyed aluminides (2)
	Abradable Nickel Graphite	Abradable materials containing Ni-Cr-Al Abradable Al-Si-Polyester
E. Slurry Deposition	Refractory metals and alloys (8)	Fused silicides Fused aluminides except for resistance heating elements
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
F. Sputter Deposition	"Superalloys"	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)
	Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectric layers (15) Diamond-like carbon (17)
	Titanium alloys (13)	Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
F. Sputter Deposition (continued)	Carbon-carbon, Ceramic and Metal "matrix" "Composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Borides Dielectric layers (15) Beryllium
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon (17)
	Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides
G. Ion Implantation	High temperature bearing steels	Additions of Chromium,Tantalum, or Niobium (Columbium)
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

Notes to Table on Deposition Techniques:

1. The term "coating process" includes coating repair and refurbishing as well as original coating.

2. The term "alloyed aluminide coating" includes single or multiple-step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include