DEPARTMENT OF COMMERCE

Bureau of Industry and Security

15 CFR Parts 734, 740, 742, 772, and 774

[Docket No. 230929–0236]

RIN 0694–AI95

Implementation of 2022 Wassenaar Arrangement Decisions and Request for Comments on License Exception Eligibility for Certain Supersonic Aero Gas Turbine Engine Component Technology

AGENCY: Bureau of Industry and Security, Commerce.

ACTION: Interim final rule, with request for comment.

SUMMARY: The Bureau of Industry and Security (BIS) maintains, as part of its Export Administration Regulations (EAR), the Commerce Control List (CCL), which identifies certain items subject to Department of Commerce jurisdiction. During the December 2022 Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (WA) Plenary meeting, Participating States of the WA (Participating States) made certain decisions affecting the WA dual-use and munitions control lists, which BIS is now implementing via amendments to the CCL. BIS seeks comments on restricting STA eligibility for countries in EAR Country Group A:5 of certain technology for the development of supersonic aero gas turbine engine components controlled under ECCN 9E003.k, formerly controlled under ECCN 9E001 as part of its ongoing assessment of current export control licensing policy.

DATES: This rule is effective October 18, 2023. Comments specific to ECCN 9E003.k must be received by BIS no later than December 4, 2023.

ADDRESSES: Comments on this rule may be submitted to the Federal rulemaking portal (*www.regulations.gov*). The *regulations.gov* ID for this rule is: BIS–2023–0025. Please refer to RIN 0694–AI95 in all comments.

All filers using the portal should use the name of the person or entity submitting the comments as the name of their files, in accordance with the instructions below. Anyone submitting business confidential information should clearly identify the business confidential portion at the time of submission, file a statement justifying nondisclosure and referring to the specific legal authority claimed, and provide a non-confidential version of the submission.

For comments submitted electronically containing business confidential information, the file name of the business confidential version should begin with the characters ''BC.'' Any page containing business confidential information must be clearly marked ''BUSINESS CONFIDENTIAL'' on the top of that page. The corresponding non-confidential version of those comments must be clearly marked ''PUBLIC.'' The file name of the non-confidential version should begin with the character ''P.'' Any submissions with file names that do not begin with either a ''BC'' or a ''P'' will be assumed to be public and will be made publicly available through *https://www.regulations.gov.* Commenters submitting business confidential information are encouraged to scan a hard copy of the non-confidential version to create an image of the file, rather than submitting a digital copy with redactions applied, to avoid inadvertent redaction errors which could enable the public to read business confidential information.

FOR FURTHER INFORMATION CONTACT: For general questions, contact Sharron Cook, Office of Exporter Services, Bureau of Industry and Security, U.S. Department of Commerce at 202–482–2440 or by email: *Sharron.Cook@bis.doc.gov.*

For Technical Questions Contact

Categories 0, 1 & 2: Sean Ghannadian at 202–482–3429 or *Sean.Ghannadian@bis.doc.gov*

Category 3: Carlos Monroy at 202–482–3246 or *Carlos.Monroy@bis.doc.gov*

Categories 4 & 5: Aaron Amundson or *Aaron.Amundson@bis.doc.gov*

Categories 6: John Varesi at 202–482–1114 or *John.Varesi@bis.doc.gov*

Categories 7: David Rosenberg at 202–482–5987, John Varesi at 202–482–1114 or *David.Rosenberg@bis.doc.gov* or *John.Varesi@bis.doc.gov*

Category 9: David Rosenberg at 202–482–5987, Jason Chauvin at 202–482–6462 or *David.Rosenberg@bis.doc.gov* or *Jason.Chauvin@bis.doc.gov*

''*600 Series*'' *(munitions items):* Jeffrey Leitz at 202–482–7417 or *Jeffrey.Leitz@bis.doc.gov*

SUPPLEMENTARY INFORMATION:

Background

The WA (*http://www.wassenaar.org/*) is a group of 42 like-minded states committed to promoting responsibility and transparency in the global arms trade and preventing destabilizing accumulations of conventional weapons. As a Participating State of the WA (Participating State), the United States has committed to controlling for export all items on the WA's List of Dual-Use Goods and Technologies (WA Dual-Use List) and on the WA Munitions List (together, WA control lists). The WA control lists were first established in 1996 and have been revised annually thereafter. Participating States implement changes to the WA control lists as soon as possible after the WA Plenary. By doing so in a timely manner, the United States demonstrates its decisive support for the goals of the WA, namely, that transfers do not contribute to the development or enhancement of military capabilities or are not diverted to support such capabilities. Timely implementation also ensures that U.S. companies have a level playing field with their competitors in other Participating States.

Revisions to the Commerce Control List Related to WA 2022 Plenary Meeting Decisions

Revisions (14) ECCNs: 1B001, 4D001,4E001, 6A005, 6B007, 7A003, 7E004, 8A001, 8A002, 9A001, 9A003, 9E001, 9E002, and 9E003.

Editorial Revision to Technical Notes in (55) ECCNS: This rule adds the phrase 'For the purposes of' in various Technical Notes in singular and plural form in ECCNs 1A004, 1A006, 1A007, 1A008, 1B001, 1C001, 1C002, 1C005, 1C008, 1C010, 1C011, 2A001, 2B004, 2B006, 2B008, 2B009, 2E003, 3A001, 3A002, 3B001, 3D003, 3D006, 3E001, 3E002, 4A004, 4D001, 4E001, 5A001, 5A002, 5A004, 6A001, 6A002, 6A003, 6A004, 6A005, 6A006, 6A007, 6A008, 6B007, 6C002, 6C005, 6D003, 6E003,7A004, 7A005, 7A006, 7B001, 7D002, 7E004, 8A002, 8C001, 8E002, 9A004, 9B005, and 9E003. The intention of this revision is to ensure consistency among ECCNs.

1C010 ''Fibrous or Filamentary Materials''

This rule makes an editorial revision by adding a reference to 1C010.e.1.b to technical note 1 because both paragraphs e.1.b.1 and e.1.b.2 use terms referenced in this technical note.

4D001 ''Software'' and 4E001 ''Technology''

In paragraphs 4D001.b.1 and 4E001.b.1, this rule changes the parameters of Weighted TeraFLOPS (WT) from 15 to 24. This change is made because processors with built-in hardware memory-coherent interconnects allow groupings of up to 8 processors without any additional

technical know-how, and it is widely believed that a single processor will reach Adjusted Peak Performance (APP) levels of up to 2 WT in the next year, and up to 2.5 WT by the 2025 timeframe. Thus, companies will soon be able to build computers that exceed the current APP levels without any additional technology. The corresponding technology and software levels in License Exception APP (Section 740.7 of the EAR) were adjusted in a final rule that implemented certain changes agreed to at the December 2021 WA Plenary. *See* 88 FR 12108 (February 24, 2023). Thus, BIS is not making any additional adjustments to those thresholds at this time.

6A005 ''Lasers'', ''Components'' and Optical Equipment

This rule raises the ''average output power'' parameter from ''50 W'' to ''80 W'' in 6A005.b.3.a.2. For the industrial applications that use green lasers, the power level is a key factor in manufacturing productivity. These applications require certain pulse energies for the resultant processes. To enhance manufacturing productivity, the repetition frequency for a given pulse energy must be increased, thereby requiring an increase in the average output power. Today, the average output power requirements for industrial green lasers exceed the WA threshold of 50 W, and are expected to continue an upward trend to more than 80 W. Companies outside of Participating States compete in the industrial green laser market, for example, several Chinese companies manufacture green lasers with average output power in the 50–80 W range.

To accommodate increased demand for single-mode semiconductor laser diodes, a decision was made during the WA 2022 Plenary to increase the technical parameters for semiconductor lasers. Specifically, adjusting the wavelength from 1,510 nm to 1,570 nm in 6A005.d.1.a.1 and d.1.a.2 groups these lasers with other semiconductor lasers with lower sensitivity applications. As a result, the necessary output power accommodation for automotive Light Detection and Ranging (LIDAR) applications is achieved with a modest output power increase from 1.5 W to 2.0 W in 6A005.d.1.a.1. Semiconductor lasers that fall within these parameters, while very useful for automotive LIDAR, have limited utility in military applications.

6A007 Gravity Meters (Gravimeters) and Gravity Gradiometers

A technical note to define 'time-to-steady-state registration' is added after paragraph 6A007.b.2, to harmonize this entry with the entry on the WA Dual-Use List.

6B007 Equipment To Produce, Align and Calibrate Land-Based Gravity Meters

This rule adds the word ''less'' to the heading of ECCN 6B007 to clarify that an ''accuracy'' better than 0.1 mGal is less than 0.1 mGal.

7A003 'Inertial Measurement Equipment or Systems'

This rule moves the definition of 'inertial measurement equipment or systems' from *Note 1* to a technical note, so that this entry is consistent with other CCL entries in which definitions are set forth in technical notes.

8A001 Submersible Vehicles and Surface Vessels

In paragraph 8A001.c.1.c, this rule adds the term 'wireless' before the term 'optical data' to clarify that the reference is to communications through water and to distinguish Remotely Operated Vehicles (ROVs) having this capability from those designed to only use a fiber optic data link.

8A002 Marine Systems, Equipment, ''Parts'' and ''Components''

In paragraphs 8A002.o.2.b and 8A002.o.2.c, this rule replaces the term 'engines' with 'motors' before the term 'propulsion.' While the terms ''engines'' and ''motors'' are largely interchangeable, it was determined that ''motor'' is more commonly used in the context of 8A002 items. In paragraph 8A002.o.4, this rule adds a new control for permanent magnet propulsion systems (PM propulsion systems) to adequately cover propulsion systems using permanent magnet motors, including Rim Driven Propulsion systems (RDPs).

9A001 Aero Gas Turbine Engines, and Technology Therefor in 9E001 and 9E002

This rule revises 9A001, 9A003, 9E001, 9E002, and 9E003 to permit the same civil certification release from 9A001 to 9A991 for supersonic aero gas turbine engines that is available for subsonic aero gas turbine engines.

The rule conforms with the decisions made at WA with regard to 9A001, specifically to combine 9A001.a and 9A001.b to allow for the same exclusion when the engine is certified by type with a civil certified supersonic aircraft. This rule revises the reference to 9A001.a in Notes 1 and 2 to read as 9A001, as 9A001.a is now the only subparagraph in 9A001. Note 1 now excludes from 9A001 aero gas turbine engines that power an ''aircraft'' to Mach 1 or higher for more than 30 minutes if the engines have been certified by an appropriate civil aviation authority, and are intended to power an ''aircraft'' for which a type certificate (or equivalent document) has been issued, as these engines are now controlled under ECCN 9A991 for AT reasons. As a conforming revision, the reference to 9A001.b is removed from the headings of ECCNs 9E001 and 9E002, as well as from the license requirements tables of these ECCNs. In addition, consistent with the removal of 9A001.b from the CCL, as described above, this rule also removes paragraphs (E) and (F) from § 740.20(b)(2)(viii), which had identified technology associated with 9A001.b that was ineligible for export, reexport, and transfer (in-country) under License Exception STA. Former paragraph (G) is redesignated as paragraph (E).

9A003 ''Specially Designed'' Assemblies or ''Components,'' Incorporating Any of the ''Technologies'' Controlled by 9E003.a, 9E003.h, 9E003.i, or 9E003.k, for Any of the Following Aero Gas Turbine Engines

This rule adds paragraph 9E003.k to the heading of ECCN 9A003, which expands the scope of control of assemblies and components under this ECCN.

9E003 Other ''Technology'' as Specified

This rule makes a simple editorial change to remove the first comma in 9E003.c after ''cooling holes'' that otherwise might bring confusion to the control text. This rule also redesignates 9E003.k as 9E003.l and adds a new paragraph 9E003.k to control specific technologies, formerly controlled by 9E001, that are peculiarly responsible for the development of an aero gas turbine engine that can enable an aircraft to cruise at supersonic speeds (Mach 1 or greater) for more than 30 minutes. This technology addition to 9E003 addresses the ''development'' of systems and components that enable the engine and aircraft to operate a supersonic speed. Because 9E003.k references engine capability (which does not change with certification) this important ''development'' technology will remain controlled even after the engine enters civil operation. The license requirement table is amended to reflect the redesignation of 9E003.k to

9E003.l to the SI control paragraph. Related revisions as a result of this redesignation are made to §§ 734.4(a)(4), 740.20(b)(2)(viii), 742.14(a), and the introductory text of 742.14(b).

The new 9E003.k technology for supersonic engines controls development technology only. The associated production technology has shifted from ECCN 9E002 to ECCN 9E991 and is designated as ''No License Required'' (NLR) to all destinations or countries listed in Country Group A:5 and A:6 (*see* supplement no. 1 to part 740 of the EAR).

The STA restrictions under 9E003 are revised by adding an ''or'' after 9E003.h and adding Country Group A:5 to harmonize with 740.20(b)(2) for 9E003. In addition, this rule adds a new STA restriction paragraph for 9E003.k for Country Group A:6 in order to maintain the STA restriction previously on ECCN 9E001 for ECCN paragraph 9A001.b. As required by the Export Control Reform Act (ECRA) (50 U.S.C. 4801–4852), BIS continually evaluates the control status of a range of technologies, including those related to supersonic engines, to effectively protect U.S. national security and foreign policy interests. In light of the amendments to 9E001 and 9E003 implementing the WA revisions, which identify technologies required for the development of specific components or systems specially designed for supersonic engines, BIS is seeking comment on whether to retain License Exception STA eligibility for destinations specified in Country Group A:5 of supplement no. 1 to part 740 of the EAR for the technology specified in 9E003.k. We invite the public to comment on this issue before the comment period closes. Information about how to comment is provided in the **ADDRESS** section of this rule.

Part 772—Definitions of Terms

This rule revises the definition for ''intrusion software'' by adding double quotes around the term ''program'' in paragraph (2) to indicate it is a defined term in § 772.1.

This rule notes the two occurrences of the term ''program'' that did not have double quotation marks indicating it is a defined term in § 772.1 and corrects this omission in technical note 1 below paragraph .g in ECCN 1B001 and in paragraph (2) in the definition of ''intrusion software'' in § 772.1. This rule also amends the term ''program'' in § 772.1 to add category 1 and 7 and remove category 2 from the categories where the term is used.

Supplement No. 6 to Part 774 Sensitive List

Paragraph 4 of supplement no. 6 to part 774 Sensitive List (SL) is amended by removing paragraphs (ii) 4D001 and (iii) 4E001. This change is being made as a consequence of the raising of the APP thresholds in 4D001 and 4E001. This rule implements the WA 2022 Plenary determination that high performance computer technology and software do not merit the same level of sensitivity as other items on the SL.

Savings Clause

Shipments of items removed from license exception eligibility or eligibility for export, reexport or transfer (in-country) without a license as a result of this regulatory action that were on dock for loading, on lighter, laden aboard an exporting carrier, or en route aboard a carrier to a port of export, on October 18, 2023, pursuant to actual orders for exports, reexports and transfers (in-country) to a foreign destination, may proceed to that destination under the previous license exception eligibility or without a license so long as they have been exported, reexported or transferred (in-country) before December 18, 2023. Any such items not actually exported, reexported or transferred (in-country) before midnight, on December 18, 2023, require a license in accordance with this interim final rule.

Export Control Reform Act of 2018

On August 13, 2018, the President signed into law the John S. McCain National Defense Authorization Act for Fiscal Year 2019, which included the Export Control Reform Act (ECRA), 50 U.S.C. 4801–4852. ECRA, as amended, provides the legal basis for BIS's principal authorities and serves as the authority under which BIS issues this rule.

Rulemaking Requirements

1. Executive Orders 12866, 13563, and 14094 direct agencies to assess all costs and benefits of available regulatory alternatives and, if regulation is necessary, to select regulatory approaches that maximize net benefits (including potential economic, environmental, public health and safety effects and distributive impacts and equity). Executive Order 13563 emphasizes the importance of quantifying both costs and benefits and of reducing costs, harmonizing rules, and promoting flexibility.

This interim final rule has been designated a ''significant regulatory action'' under section 3(f) of Executive Order 12866, as amended by Executive Order 14094. This rule does not contain policies with Federalism implications as that term is defined under Executive Order 13132.

2. Notwithstanding any other provision of law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*) (PRA), unless that collection of information displays a currently valid Office of Management and Budget (OMB) Control Number. Although this rule makes important changes to the EAR for items controlled for national security reasons, BIS believes that the overall increases in burdens and costs associated with the following information collections due to this rule will be minimal.

- 0694–0088, ''Simplified Network Application Processing System,'' which carries a burden- hour estimate of 29.6 minutes for a manual or electronic submission;
- 0694–0137 ''License Exceptions and Exclusions,'' which carries a burden-hour estimate average of 1.5 hours per submission (Note: submissions for License Exceptions are rarely required);
- 0694–0096 ''Five Year Records Retention Period,'' which carries a burden-hour estimate of less than 1 minute; and
- 0607–0152 ''Automated Export System (AES) Program,'' which carries a burden-hour estimate of 3 minutes per electronic submission.

Additional information regarding these collections of information—including all background materials—can be found at *https://www.reginfo.gov/public/do/PRAMain* and using the search function to enter either the title of the collection or the OMB Control Number.

3. Pursuant to Section 1762 of ECRA (50 U.S.C. 4821), this action is exempt from the Administrative Procedure Act (APA) (5 U.S.C. 553) requirements for notice of proposed rulemaking, opportunity for public participation and delay in effective date.

List of Subjects

15 CFR Part 734

Administrative practice and procedure, Exports, Inventions and patents, Research, Science and technology.

15 CFR Part 740

Administrative practice and procedure, Exports, Reporting and recordkeeping.

15 CFR Part 742

Exports, Terrorism.

15 CFR Part 772

Exports.

15 CFR Part 774

Exports, Reporting and recordkeeping requirements, Terrorism.

Accordingly, parts 734, 740, 742, 772 and 774 of the Export Administration Regulations (15 CFR parts 730–774) are amended as follows:

PART 734—SCOPE OF THE EXPORT ADMINISTRATION REGULATIONS

■ 1. The authority citation for part 734 continues to read as follows:

Authority: 50 U.S.C. 4801–4852; 50 U.S.C. 4601 *et seq.;* 50 U.S.C. 1701 *et seq.;* E.O. 12938, 59 FR 59099, 3 CFR, 1994 Comp., p. 950; E.O. 13020, 61 FR 54079, 3 CFR, 1996 Comp., p. 219; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783; E.O. 13637, 78 FR 16129, 3 CFR, 2014 Comp., p. 223; Notice of November 8, 2022, 87 FR 68015 (November 10, 2022).

■ 2. Section 734.4 is amended to revise paragraph (a)(4) to read as follows:

§ 734.4 *De Minimis* U.S. content.

(a) * * *

(4) There is no de minimis level for U.S.-origin technology controlled by ECCN 9E003.a.1 through a.6, a.8, .h, .i, and .l, when redrawn, used, consulted, or otherwise commingled abroad.

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PART 740—LICENSE EXCEPTIONS

■ 3. The authority citation for part 740 continues to read as follows:

Authority: 50 U.S.C. 4801–4852; 50 U.S.C. 4601 *et seq.;* 50 U.S.C. 1701 *et seq.;* 22 U.S.C. 7201 *et seq.;* E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

■ 4. Section 740.20 is amended by revising paragraph (b)(2)(viii) to read as follows:

§ 740.20 License Exception Strategic Trade Authorization (STA).

* * * * *

(b) * * *

(2) * * *

(viii) Commerce Control List Category 9 limitations on use of License Exception STA.

(A) License Exception STA may not be used for 9B001 when destined to a country in Country Group A:6.

(B) License Exception STA may not be used for 9D001 or 9D002 ''software'' that is ''specially designed'' or modified for the ''development'' or ''production'' of:

(1) Components of engines controlled by ECCN 9A001 if such components incorporate any of the ''technologies'' controlled by 9E003.a.1, 9E003.a.2, 9E003.a.3, 9E003.a.4, 9E003.a.5, 9E003.c, 9E003.h, or 9E003.i (other than technology for fan or power turbines); or

(2) Equipment controlled by 9B001.

(C) License Exception STA may not be used for 9D001 ''software'' that is ''specially designed'' or modified for the ''development'' of ''technology'' controlled by 9E003.a.1, 9E003.a.2, 9E003.a.3, 9E003.a.4, 9E003.a.5, 9E003.c, 9E003.h, or 9E003.i (other than technology for fan or power turbines).

(D) License Exception STA may not be used for 9D004.f or 9D004.g ''software''.

(E) License Exception STA may not be used for ''technology'' in 9E003.a.1, 9E003.a.2, 9E003.a.3, 9E003.a.4, 9E003.a.5, 9E003.c, 9E003.h, or 9E003.i (other than technology for fan or power turbines).

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PART 742—CONTROL POLICY—CCL BASED CONTROLS

■ 5. The authority citation for part 742 continues to read as follows:

Authority: 50 U.S.C. 4801–4852; 50 U.S.C. 4601 *et seq.;* 50 U.S.C. 1701 *et seq.;* 22 U.S.C. 3201 *et seq.;* 42 U.S.C. 2139a; 22 U.S.C. 7201 *et seq.;* 22 U.S.C. 7210; Sec. 1503, Pub. L. 108–11, 117 Stat. 559; E.O. 12058, 43 FR 20947, 3 CFR, 1978 Comp., p. 179; E.O. 12851, 58 FR 33181, 3 CFR, 1993 Comp., p. 608; E.O. 12938, 59 FR 59099, 3 CFR, 1994 Comp., p. 950; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783; Presidential Determination 2003–23, 68 FR 26459, 3 CFR, 2004 Comp., p. 320; Notice of November 8, 2022, 87 FR 68015 (November 10, 2022).

■ 6. Section 742.14 is amended by revising paragraphs (a) and (b) introductory text to read as follows:

§ 742.14 Significant items: hot section technology for the development, production or overhaul of commercial aircraft engines, components, and systems.

(a) *License requirement.* Licenses are required for all destinations, except Canada, for ECCNs having an ''SI'' under the ''Reason for Control'' paragraph. These items include hot section technology for the development, production or overhaul of commercial aircraft engines controlled under ECCN 9E003.a.1 through a.6, a.8, .h, .i, and .l, and related controls.

(b) *Licensing policy.* Pursuant to section 6 of the Export Administration Act of 1979, as amended, foreign policy controls apply to technology required for the development, production or overhaul of commercial aircraft engines controlled by ECCN 9E003a.1 through a.6, a.8, .h, .i, and .l, and related controls. These controls supplement the national security controls that apply to these items. Applications for export and reexport to all destinations will be reviewed on a case-by-case basis to determine whether the export or reexport is consistent with U.S. national security and foreign policy interests. The following factors are among those that will be considered to determine what action will be taken on license applications:

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PART 772—DEFINITIONS OF TERMS

■ 7. The authority citation for part 772 continues to read as follows:

Authority: 50 U.S.C. 4801–4852; 50 U.S.C. 4601 *et seq.;* 50 U.S.C. 1701 *et seq.;* E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

■ 8. Section 772.1 is amended by revising the definitions for ''Intrusion software'' and ''Program'' to read as follows:

§ 772.1 Definitions of terms as used in the Export Administration Regulations (EAR).

* * * * *

Intrusion software. (5P2) ''Software'' specially designed or modified to avoid detection by 'monitoring tools', or to defeat 'protective countermeasures', of a computer or network-capable device, and performing any of the following:

(1) The extraction of data or information, from a computer or network-capable device, or the modification of system or user data; or

(2) The modification of the standard execution path of a ''program'' or process in order to allow the execution of externally provided instructions.

Note 1 to "Intrusion Software" Definition: *''Intrusion software'' does not include any of the following: Hypervisors, debuggers or Software Reverse Engineering (SRE) tools; Digital Rights Management (DRM) ''software''; or ''Software'' designed to be installed by manufacturers, administrators or users, for the purposes of asset tracking or recovery.*

Note 2 to "Intrusion Software" Definition: *Network-capable devices include mobile devices and smart meters.*

Technical note 1 to "Intrusion Software" Definition: *'Monitoring tools': ''software'' or hardware devices, that monitor system behaviors or processes running on a device. This includes antivirus (AV) products, end point security products, Personal Security Products (PSP), Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS) or firewalls.*

Technical note 2 to "Intrusion Software" Definition: *'Protective countermeasures': techniques designed to ensure the safe execution of code, such as Data Execution Prevention (DEP), Address Space Layout Randomization (ASLR) or sandboxing.*

* * * * *

Program. (Cat 1, 4, 6, and 7)—A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

PART 774—THE COMMERCE CONTROL LIST

■ 9. The authority citation for part 774 continues to read as follows:

Authority: 50 U.S.C. 4801–4852; 50 U.S.C. 4601 *et seq.;* 50 U.S.C. 1701 *et seq.;* 10 U.S.C. 8720; 10 U.S.C. 8730(e); 22 U.S.C. 287c, 22 U.S.C. 3201 *et seq.;* 22 U.S.C. 6004; 42 U.S.C. 2139a; 15 U.S.C. 1824; 50 U.S.C. 4305; 22 U.S.C. 7201 *et seq.;* 22 U.S.C. 7210; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

■ 10. In supplement no. 1 to part 774, ECCNs 1A004, 1A006, 1A007, 1A008, 1B001, 1C001, 1C002, 1C003, 1C005, 1C008, 1C010, 1C011, 2A001, 2B004, 2B006, 2B008, 2B009, 2E003, 3A001, 3A002, 3B001, 3D003, 3D006, 3E001, 3E002, 4A004, 4D001, 4E001, 5A001, 5A002, 5A004, 6A001, 6A002, 6A003, 6A004, 6A005, 6A006, 6A007, 6A008, 6B007, 6C002, 6C005, 6D003, 6E003, 7A003, 7A004, 7A005, 7A006, 7B001, 7D002, 7E004, 8A001, 8A002, 8C001, 8E002, 9A001, 9A003, 9A004, 9A005, 9B005, 9E001, 9E002, and 9E003 are revised to read as follows:

Supplement No. 1 to Part 774—The Commerce Control List

* * * * *

1A004 Protective and detection equipment and ''components'', not ''specially designed'' for military use, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, CB, RS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
CB applies to chemical detection systems and dedicated detectors therefor, in 1A004.c, that also have the technical characteristic.	CB Column 2
RS apply to 1A004.d	RS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A

GBS: Yes for 1A004.a, .b, and .c.2.

List of Items Controlled

Related Controls: (1) See ECCNs 1A995, 2B351, and 2B352. (2) See ECCN 1D003 for ''software'' ''specially designed'' or modified to enable equipment to perform the functions of equipment controlled under section 1A004.c (Nuclear, biological, and chemical (NBC) detection systems). (3) See ECCN 1E002.g for control libraries (parametric technical databases) ''specially designed'' or modified to enable equipment to perform the functions of equipment controlled under 1A004.c (Nuclear, biological, and chemical (NBC) detection systems). (4) Chemical and biological protective and detection equipment specifically designed, developed, modified, configured, or adapted for military applications is ''subject to the ITAR'' (see 22 CFR parts 120 through 130, including USML Category XIV(f)), as is commercial equipment that incorporates ''parts'' or ''components'' controlled under that category except for domestic preparedness devices for individual protection that integrate ''components'' and ''parts'' identified in USML Category XIV(f)(4) when such ''parts'' or ''components'' are: Integral to the device; inseparable from the device; and incapable of replacement without compromising the effectiveness of the device, in which case the equipment is subject to the export licensing jurisdiction of the Department of Commerce under ECCN 1A004. (5) This entry does not control radionuclides incorporated in equipment listed in this entry—such materials are subject to the licensing jurisdiction of the Nuclear Regulatory Commission (See 10 CFR part 110).

Related Definitions: (1) 'Biological agents' means: pathogens or toxins, selected or modified (such as altering purity, shelf life, virulence, dissemination characteristics, or resistance to UV radiation) to produce casualties in humans or animals, degrade equipment or damage crops or the environment. (2) 'Riot control agents' are substances which, under the expected conditions of use for riot control purposes, produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure. (Tear gases are a subset of 'riot control agents.')

Items:

a. Full face masks, filter canisters and decontamination equipment therefor, designed or modified for defense against any of the following, and ''specially designed'' ''components'' therefor:

Note: *1A004.a includes Powered Air Purifying Respirators (PAPR) that are designed or modified for defense against agents or materials, listed in 1A004.a.*

Technical Notes: *For the purposes of 1A004.a:*

1. Full face masks are also known as gas masks.

2. Filter canisters include filter cartridges.

a.1. 'Biological agents';

a.2. 'Radioactive materials';

a.3. Chemical warfare (CW) agents; *or*

a.4. 'Riot control agents', as follows:

a.4.a. α-Bromobenzeneacetonitrile, (Bromobenzyl cyanide) (CA) (CAS 5798–79–8);

a.4.b. [(2-chlorophenyl) methylene] propanedinitrile, (o-Chlorobenzylidenemalononitrile) (CS) (CAS 2698–41–1);

a.4.c. 2-Chloro-1-phenylethanone, Phenylacyl chloride (ω-chloroacetophenone) (CN) (CAS 532–27–4);

a.4.d. Dibenz-(b,f)-1,4-oxazephine, (CR) (CAS 257–07–8);

a.4.e. 10-Chloro-5, 10-dihydrophenarsazine, (Phenarsazine chloride), (Adamsite), (DM) (CAS 578–94–9);

a.4.f. N-Nonanoylmorpholine, (MPA) (CAS 5299–64–9);

b. Protective suits, gloves and shoes, ''specially designed'' or modified for defense against any of the following:

b.1. 'Biological agents';

b.2. 'Radioactive materials'; *or*

b.3. Chemical warfare (CW) agents;

c. Detection systems, ''specially designed'' or modified for detection or identification of any of the following, and ''specially designed'' ''components'' therefor:

c.1. 'Biological agents';

c.2. 'Radioactive materials'; *or*

c.3. Chemical warfare (CW) agents;

d. Electronic equipment designed for automatically detecting or identifying the presence of ''explosives'' (as listed in the annex at the end of Category 1) residues and utilizing 'trace detection' techniques (*e.g.,* surface acoustic wave, ion mobility spectrometry, differential mobility spectrometry, mass spectrometry).

Technical Note: *For the purposes of 1A004.d, 'trace detection' is defined as the capability to detect less than 1 ppm vapor, or 1 mg solid or liquid.*

Note 1: *1A004.d does not apply to equipment ''specially designed'' for laboratory use.*

Note 2: *1A004.d does not apply to non-contact walk-through security portals.*

Note: *1A004 does not control:*

a. Personal radiation monitoring dosimeters;

b. Occupational health or safety equipment limited by design or function to protect against hazards specific to residential safety or civil industries, including:

1. Mining;

2. Quarrying;

3. Agriculture;

4. Pharmaceutical;

5. Medical;

6. Veterinary;

7. Environmental;

8. Waste management;

9. Food industry.

Technical Notes:

1. *1A004 includes equipment, ''components'' that have been 'identified,' successfully tested to national standards or otherwise proven effective, for the detection of or defense against 'radioactive materials' 'biological agents,' chemical warfare agents, 'simulants' or ''riot control agents,'' even if such equipment or ''components'' are used in civil industries such as mining, quarrying,*

agriculture, pharmaceuticals, medical, veterinary, environmental, waste management, or the food industry.

2. *'Simulant': A substance or material that is used in place of toxic agent (chemical or biological) in training, research, testing or evaluation.*

3. *For the purposes of 1A004, 'radioactive materials' are those selected or modified to increase their effectiveness in producing casualties in humans or animals, degrading equipment or damaging crops or the environment.*

* * * * *

1A006 Equipment, ''specially designed'' or modified for the disposal of Improvised Explosive Devices (IEDs), as follows (see List of Items Controlled), and ''specially designed'' ''components'' and ''accessories'' therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

License Requirement Note: *1A006 does not apply to equipment when accompanying its operator.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: Equipment ''specially designed'' for military use for the disposal of IEDs is ''subject to the ITAR'' (see 22 CFR parts 120 through 130, including USML Category IV).
Related Definitions: N/A
Items:

a. Remotely operated vehicles;
b. 'Disruptors'.

Technical Note: *For the purposes of 1A006.b 'disruptors' are devices ''specially designed'' for the purpose of preventing the operation of an explosive device by projecting a liquid, solid or frangible projectile.*

Note: *1A006 does not apply to equipment when accompanying its operator.*

1A007 Equipment and devices, ''specially designed'' to initiate charges and devices containing ''energetic materials,'' by electrical means, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
NP applies to 1A007.b, as well as 1A007.a when the detonator firing set meets or exceeds the parameters of 3A229.	NP Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: High explosives and related equipment ''specially designed'' for military use are ''subject to the ITAR'' (see 22 CFR parts 120 through 130). This entry does not control detonators using only primary explosives, such as lead azide. See also ECCNs 0A604, 3A229, and 3A232. See 1E001 for ''development'' and ''production'' technology controls, and 1E201 for ''use'' technology controls.
Related Definitions: N/A
Items:

a. Explosive detonator firing sets designed to drive explosive detonators specified by 1A007.b;

b. Electrically driven explosive detonators as follows:

b.1. Exploding bridge (EB);
b.2. Exploding bridge wire (EBW);
b.3. Slapper;
b.4. Exploding foil initiators (EFI).

Technical Notes:

1. The word initiator or igniter is sometimes used in place of the word detonator.

2. For the purposes of 1A007.b, the detonators of concern all utilize a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporizes when a fast, high-current electrical pulse is passed through it. In non slapper types, the exploding conductor starts a chemical detonation in a contacting high explosive material such as PETN (pentaerythritoltetranitrate). In slapper detonators, the explosive vaporization of the electrical conductor drives a flyer or slapper across a gap, and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator.

1A008 Charges, devices and ''components'', as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, UN, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1
UN applies to entire entry.	See § 746.1(b) for UN controls.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3,000 for .a through .c; $6,000 for .d.
GBS: N/A

List of Items Controlled

Related Controls: (1) All of the following are ''subject to the ITAR'' (see 22 CFR parts 120 through 130):

a. High explosives and related equipment ''specially designed'' for military use;

b. Explosive devices or charges in this entry that utilize USML controlled energetic materials (See 22 CFR 121.1 Category V), if they have been specifically designed, developed, configured, adapted, or modified for a military application;

c. Shaped charges that have all of the following a uniform shaped conical liner with an included angle of 90 degrees or less, more than 2.0 kg of controlled materials, and a diameter exceeding 4.5 inches;

d. Detonating cord containing greater than 0.1 kg per meter (470 grains per foot) of controlled materials;

e. Cutters and severing tools containing greater than 10 kg of controlled materials;

f. With the exception of cutters and severing tools, devices or charges controlled by this entry where the USML controlled materials can be easily extracted without destroying the device or charge; *and*

g. Individual USML controlled energetic materials in this entry, even when compounded with other materials, when not incorporated into explosive devices or charges controlled by this entry or 1C992.

(2) See also ECCNs 1C011, 1C018, 1C111, 1C239, *and* 1C608 for additional controlled energetic materials. See ECCN *1E001* for the ''development'' or ''production'' ''technology'' for the commodities controlled by ECCN 1A008, but not for explosives or commodities that are ''subject to the ITAR'' (see 22 CFR parts 120 through 130).
Related Definitions: N/A
Items:

a. 'Shaped charges' having all of the following:

a.1. Net Explosive Quantity (NEQ) greater than 90 g; *and*

a.2. Outer casing diameter equal to or greater than 75 mm;

b. Linear shaped cutting charges having all of the following, and ''specially designed'' ''components'' therefor:

b.1. An explosive load greater than 40 g/m; *and*

b.2. A width of 10 mm or more;

c. Detonating cord with explosive core load greater than 64 g/m;

d. Cutters, not specified by 1A008.b, and severing tools, having a NEQ greater than 3.5 kg.

Technical Note: *For the purposes of 1A008.a, 'shaped charges' are explosive*

charges shaped to focus the effects of the explosive blast.

Note: *The only charges and devices specified in 1A008 are those containing ''explosives'' (see list of explosives in the Annex at the end of Category 1) and mixtures thereof.*

* * * * *

1B001 Equipment for the production or inspection of ''composite'' structures or laminates controlled by 1A002 or ''fibrous or filamentary materials'' controlled by 1C010, as follows (see List of Items Controlled), and ''specially designed'' ''components'' and ''accessories'' therefor.

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to entire entry, except 1B001.d.4, e and f. **Note:** *MT applies to equipment in 1B001.d that meet or exceed the parameters of 1B101.*	MT Column 1
NP applies to filament winding machines described in 1B001.a that are capable of winding cylindrical rotors having a diameter between 75 mm (3 in) and 400 mm (16 in) and lengths of 600 mm (24 in) or greater; AND coordinating and programming controls and precision mandrels for these filament winding machines.	NP Column 1.
AT applies to entire entry.	AT Column 1.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A for MT and for 1B001.a; $5000 for all other items
GBS: N/A

List of Items Controlled

Related Controls: (1) See ECCN 1D001 for software for items controlled by this entry and see ECCNs 1E001 (''development'' and ''production'') and 1E101 (''use'') for technology for items controlled by this entry. (2) Also see ECCNs 1B101 and 1B201.
Related Definitions: N/A
Items:

a. Filament winding machines, of which the motions for positioning, wrapping and winding fibers are coordinated and programmed in three or more 'primary servo positioning' axes, ''specially designed'' for the manufacture of ''composite'' structures or laminates, from ''fibrous or filamentary materials'';

b. 'Tape laying machines', of which the motions for positioning and laying tape are coordinated and programmed in five or more 'primary servo positioning' axes, ''specially designed'' for the manufacture of ''composite'' airframe or missile structures;

Technical Note: *For the purposes of 1B001.b, 'tape-laying machines' have the ability to lay one or more 'filament bands' limited to widths greater than 25.4 mm and less than or equal to 304.8 mm, and to cut and restart individual 'filament band' courses during the laying process.*

c. Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, ''specially designed'' or modified for weaving, interlacing or braiding fibers for ''composite'' structures;

Technical Note: *For the purposes of 1B001.c the technique of interlacing includes knitting.*

d. Equipment ''specially designed'' or adapted for the production of reinforcement fibers, as follows:

d.1. Equipment for converting polymeric fibers (such as polyacrylonitrile, rayon, pitch or polycarbosilane) into carbon fibers or silicon carbide fibers, including special equipment to strain the fiber during heating;

d.2. Equipment for the chemical vapor deposition of elements or compounds, on heated filamentary substrates, to manufacture silicon carbide fibers;

d.3. Equipment for the wet-spinning of refractory ceramics (such as aluminum oxide);

d.4. Equipment for converting aluminum containing precursor fibers into alumina fibers by heat treatment;

e. Equipment for producing prepregs controlled by 1C010.e by the hot melt method;

f. Non-destructive inspection equipment ''specially designed'' for ''composite'' materials, as follows:

f.1. X-ray tomography systems for three dimensional defect inspection;

f.2. Numerically controlled ultrasonic testing machines of which the motions for positioning transmitters or receivers are simultaneously coordinated and programmed in four or more axes to follow the three dimensional contours of the ''part'' or ''component'' under inspection;

g. Tow-placement machines, of which the motions for positioning and laying tows are coordinated and programmed in two or more 'primary servo positioning' axes, ''specially designed'' for the manufacture of ''composite'' airframe or missile structures.

Technical Note to 1B001.g: *For the purposes of 1B001.g, 'tow-placement machines' have the ability to place one or more 'filament bands' having widths less than or equal to 25.4 mm, and to cut and restart individual 'filament band' courses during the placement process.*

Technical Notes for 1B001:

1. *For the purposes of 1B001, 'primary servo positioning' axes control, under computer ''program'' direction, the position of the end effector (i.e., head) in space relative to the work piece at the correct orientation and direction to achieve the desired process.*

2. *For the purposes of 1B001, a 'filament band' is a single continuous width of fully or partially resin-impregnated tape, tow or fiber. Fully or partially resin-impregnated 'filament bands' include those coated with dry powder that tacks upon heating.*

* * * * *

1C001 Materials ''specially designed'' for absorbing electromagnetic radiation, or intrinsically conductive polymers, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to items that meet or exceed the parameters of ECCN 1C101.	MT Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any item in this entry to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See also 1C101.
Related Definitions: N/A
Items:

a. Materials for absorbing frequencies exceeding 2×10^8 Hz but less than 3×10^{12} Hz.

Note 1: *1C001.a does not control:*

a. Hair type absorbers, constructed of natural or synthetic fibers, with non-magnetic loading to provide absorption;

b. Absorbers having no magnetic loss and whose incident surface is non-planar in shape, including pyramids, cones, wedges and convoluted surfaces;

c. Planar absorbers, having all of the following:

1. Made from any of the following:

a. Plastic foam materials (flexible or non-flexible) with carbon-loading, or organic materials, including binders, providing more than 5% echo compared with metal over a bandwidth exceeding ±15% of the center frequency of the incident energy, and not capable of withstanding temperatures exceeding 450 K (177 °C); or

b. Ceramic materials providing more than 20% echo compared with metal over a bandwidth exceeding ±15% of the center frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527°C);

Technical Note: *For the purposes of 1C001.a Note 1.c.1, absorption test samples should be a square at least 5 wavelengths of the center frequency on a side and positioned in the far field of the radiating element.*

2. Tensile strength less than 7×10^6 N/m²; and

3. Compressive strength less than 14×10^6 N/m²;

d. Planar absorbers made of sintered ferrite, having all of the following:

1. A specific gravity exceeding 4.4; and

2. A maximum operating temperature of 548 K (275 °C) or less;

e. Planar absorbers having no magnetic loss and fabricated from 'open-cell foams' plastic material with a density of 0.15 grams/cm³ or less.

Technical Note: *For the purposes of 1C001.a Note e., 'open-cell foams' are flexible and porous materials, having an inner structure open to the atmosphere. 'Open-cell foams' are also known as reticulated foams.*

Note 2: *Nothing in Note 1 releases magnetic materials to provide absorption when contained in paint.*

b. Materials not transparent to visible light and ''specially designed'' for absorbing near-infrared radiation having a wavelength exceeding 810 nm but less than 2,000 nm (frequencies exceeding 150 THz but less than 370 THz);

Note: *1C001.b does not apply to materials, ''specially designed'' or formulated for any of the following applications:*

a. ''Laser'' marking of polymers; or

b. ''Laser'' welding of polymers.

c. Intrinsically conductive polymeric materials with a 'bulk electrical conductivity' exceeding 10,000 S/m (Siemens per meter) or a 'sheet (surface) resistivity' of less than 100 ohms/square, based on any of the following polymers:

c.1. Polyaniline;

c.2. Polypyrrole;

c.3. Polythiophene;

c.4. Poly phenylene-vinylene; *or*

c.5. Poly thienylene-vinylene.

Note: *1C001.c does not apply to materials in a liquid form.*

Technical Note: *For the purposes of 1C001.c, 'bulk electrical conductivity' and 'sheet (surface) resistivity' should be determined using ASTM D–257 or national equivalents.*

1C002 Metal alloys, metal alloy powder and alloyed materials, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
NP applies to 1C002.b.3 or b.4 if they exceed the parameters stated in 1C202.	NP Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000; N/A for NP

GBS: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 1E001 (''development'' and ''production'') and 1E201 (''use'') for technology for items controlled by this entry. (2) Also see ECCN 1C202. (3) Aluminum alloys and titanium alloys in physical forms and finished products ''especially designed'' or prepared for use in separating uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

Related Definition: N/A

Items:

Note: *1C002 does not control metal alloys, metal alloy powder and alloyed materials, specially formulated for coating purposes.*

Technical Note: *For the purposes of 1C002, metal alloys are those containing a higher percentage by weight of the stated metal than of any other element.*

a. Aluminides, as follows:

a.1. Nickel aluminides containing a minimum of 15% by weight aluminum, a maximum of 38% by weight aluminum and at least one additional alloying element;

a.2. Titanium aluminides containing 10% by weight or more aluminum and at least one additional alloying element;

b. Metal alloys, as follows, made from the powder or particulate material controlled by 1C002.c:

b.1. Nickel alloys having any of the following:

b.1.a. A 'stress-rupture life' of 10,000 hours or longer at 923 K (650 °C) at a stress of 676 MPa; *or*

b.1.b. A 'low cycle fatigue life' of 10,000 cycles or more at 823 K (550 °C) at a maximum stress of 1,095 MPa;

b.2. Niobium alloys having any of the following:

b.2.a. A 'stress-rupture life' of 10,000 hours or longer at 1,073 K (800 °C) at a stress of 400 MPa; *or*

b.2.b. A 'low cycle fatigue life' of 10,000 cycles or more at 973 K (700 °C) at a maximum stress of 700 MPa;

b.3. Titanium alloys having any of the following:

b.3.a. A 'stress-rupture life' of 10,000 hours or longer at 723 K (450 °C) at a stress of 200 MPa; *or*

b.3.b. A 'low cycle fatigue life' of 10,000 cycles or more at 723 K (450 °C) at a maximum stress of 400 MPa;

b.4 Aluminum alloys having any of the following:

b.4.a. A tensile strength of 240 MPa or more at 473 K (200 °C); *or*

b.4.b. A tensile strength of 415 MPa or more at 298 K (25 °C);

b.5. Magnesium alloys having all the following:

b.5.a. A tensile strength of 345 MPa or more; and

b.5.b. A corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G–31 or national equivalents;

Technical Notes: *For the purposes of 1C002.b:*

1. 'Stress-rupture life' should be measured in accordance with ASTM standard E–139 or national equivalents.

2. 'Low cycle fatigue life' should be measured in accordance with ASTM Standard E–606 'Recommended Practice for Constant-Amplitude Low-Cycle Fatigue Testing' or national equivalents. Testing should be axial with an average stress ratio equal to 1 and a stress-concentration factor (K_t) equal to 1. The average stress ratio is defined as maximum stress minus minimum stress divided by maximum stress.

c. Metal alloy powder or particulate material, having all of the following:

c.1. Made from any of the following composition systems:

Technical Note: *For the purposes of 1C002.c.1, X equals one or more alloying elements.*

c.1.a. Nickel alloys (Ni-Al-X, Ni-X-Al) qualified for turbine engine ''parts'' or ''components,'' *i.e.,* with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100 μm in 109 alloy particles;

c.1.b. Niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);

c.1.c. Titanium alloys (Ti-Al-X or Ti-X-Al);

c.1.d. Aluminum alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); *or*

c.1.e. Magnesium alloys (Mg-Al-X or Mg-X-Al);

c.2. Made in a controlled environment by any of the following processes:

c.2.a. 'Vacuum atomization';

c.2.b. 'Gas atomization';

c.2.c. 'Rotary atomization';

c.2.d. 'Splat quenching';

c.2.e. 'Melt spinning' and 'comminution';

c.2.f. 'Melt extraction' and 'comminution';

c.2.g. 'Mechanical alloying'; *or*

c.2.h. 'Plasma atomization'; *and*

c.3. Capable of forming materials controlled by 1C002.a or 1C002.b;

d. Alloyed materials, having all the following:

d.1. Made from any of the composition systems specified by 1C002.c.1;

d.2. In the form of uncomminuted flakes, ribbons or thin rods; *and*

d.3. Produced in a controlled environment by any of the following:

d.3.a. 'Splat quenching';

d.3.b. 'Melt spinning'; *or*

d.3.c. 'Melt extraction'.

Technical Notes: *For the purposes of 1C002:*

1. 'Vacuum atomization' is a process to reduce a molten stream of metal to droplets of a diameter of 500 μm or less by the rapid evolution of a dissolved gas upon exposure to a vacuum.

2. 'Gas atomization' is a process to reduce a molten stream of metal alloy to droplets of 500 μm diameter or less by a high pressure gas stream.

3. 'Rotary atomization' is a process to reduce a stream or pool of molten metal to droplets of a diameter of 500 μm or less by centrifugal force.

4. 'Splat quenching' is a process to 'solidify rapidly' a molten metal stream impinging upon a chilled block, forming a flake-like product.

5. 'Melt spinning' is a process to 'solidify rapidly' a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod-like product.

6. 'Comminution' is a process to reduce a material to particles by crushing or grinding.

7. 'Melt extraction' is a process to 'solidify rapidly' and extract a ribbon-like alloy product by the insertion of a short segment of a rotating chilled block into a bath of a molten metal alloy.

8. 'Mechanical alloying' is an alloying process resulting from the bonding, fracturing and rebonding of elemental and master alloy powders by mechanical impact. Non-metallic particles may be incorporated in the alloy by addition of the appropriate powders.

9. 'Plasma atomization' is a process to reduce a molten stream or solid metal to droplets of 500 μm diameter or less, using plasma torches in an inert gas environment.

10. For the purposes of 1C002 Technical Notes, 'solidify rapidly' is a process involving the solidification of molten material at cooling rates exceeding 1000 K/sec.

1C003 Magnetic metals, of all types and of whatever form, having any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. Initial relative permeability of 120,000 or more and a thickness of 0.05 mm or less;

Technical Note: *For the purposes of 1C003.a, measurement of initial relative permeability must be performed on fully annealed materials.*

b. Magnetostrictive alloys having any of the following:

b.1. A saturation magnetostriction of more than 5×104^{-4}; *or*

b.2. A magnetomechanical coupling factor (k) of more than 0.8; *or*

c. Amorphous or 'nanocrystalline' alloy strips, having all of the following:

c.1. A composition having a minimum of 75% by weight of iron, cobalt or nickel;

c.2. A saturation magnetic induction (B_s) of 1.6 T or more; *and*

c.3. Any of the following:

c.3.a. A strip thickness of 0.02 mm or less; *or*

c.3.b. An electrical resistivity of 2×10^{-4} ohm cm or more.

Technical Note: For the purposes of 1C003.c, 'nanocrystalline' materials are those materials having a crystal grain size of 50 nm or less, as determined by X-ray diffraction.

* * * * *

1C005 ''Superconductive'' ''composite'' conductors in lengths exceeding 100 m or with a mass exceeding 100 g, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $1500
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. ''Superconductive'' ''composite'' conductors containing one or more niobium-titanium 'filaments', having all of the following:

a.1. Embedded in a ''matrix'' other than a copper or copper-based mixed ''matrix''; *and*

a.2. Having a cross-section area less than 0.28×10^{-4} mm^2 (6 μm in diameter for circular 'filaments');

b. ''Superconductive'' ''composite'' conductors consisting of one or more ''superconductive'' 'filaments' other than niobium-titanium, having all of the following:

b.1. A ''critical temperature'' at zero magnetic induction exceeding 9.85 K (−263.31 °C); and

b.2. Remaining in the ''superconductive'' state at a temperature of 4.2 K (−268.96 °C) when exposed to a magnetic field oriented in any direction perpendicular to the longitudinal axis of conductor and corresponding to a magnetic induction of 12 T with critical current density exceeding 1750 A/mm^2 on overall cross-section of the conductor.

c. ''Superconductive'' ''composite'' conductors consisting of one or more ''superconductive'' 'filaments' which remain ''superconductive'' above 115 K (−158.16 °C).

Technical Note: *For the purposes of 1C005, 'filaments' may be in wire, cylinder, film, tape or ribbon form.*

* * * * *

1C008 Non-fluorinated polymeric substances as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $200
GBS: N/A

List of Items Controlled

Related Controls: See also 1A003.
Related Definitions: N/A
Items:

a. Imides as follows:

a.1. Bismaleimides;

a.2. Aromatic polyamide-imides (PAI) having a 'glass transition temperature (Tg)' exceeding 563 K (290 °C);

a.3. Aromatic polyimides having a 'glass transition temperature (Tg)' exceeding 505 K (232 °C);

a.4. Aromatic polyetherimides having a 'glass transition temperature (Tg)' exceeding 563 K (290 °C);

Note: *1C008.a controls the substances in liquid or solid ''fusible'' form, including resin, powder, pellet, film, sheet, tape, or ribbon.*

N.B.: *For non-''fusible'' aromatic polyimides in film, sheet, tape, or ribbon form, see ECCN 1A003.*

b. [Reserved]

c. [Reserved]

d. Polyarylene ketones;

e. Polyarylene sulfides, where the arylene group is biphenylene, triphenylene or combinations thereof;

f. Polybiphenylenethersulphone having a 'glass transition temperature (Tg)' exceeding 563 K (290 °C).

Technical Notes:

1. *For the purposes of 1C008.a.2 thermoplastic materials, 1C008.a.4 materials, and 1C008.f materials, the 'glass transition temperature (Tg)' is determined using the method described in ISO 11357–2 (1999) or national equivalents.*

2. *For the purposes of 1C008.a.2 thermosetting materials and 1C008.a.3 materials, the 'glass transition temperature (Tg)' is determined using the 3-point bend method described in ASTM D 7028–07 or equivalent national standard. The test is to be performed using a dry test specimen which has attained a minimum of 90% degree of cure as specified by ASTM E 2160–04 or equivalent national standard, and was cured using the combination of standard- and post-cure processes that yield the highest Tg.*

* * * * *

1C010 ''Fibrous or filamentary materials'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
NP applies to 1C010.a (aramid ''fibrous or filamentary materials'', b (carbon ''fibrous and filamentary materials''), and e.1 for ''fibrous and filamentary materials'' that meet or exceed the control criteria of ECCN 1C210.	NP Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $1500, N/A for NP
GBS: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any item in 1C010.c to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See ECCNs 1E001 (''development'' and ''production'') and 1E201 (''use'') for technology for items controlled by this entry. (2) Also see ECCNs 1C210 and 1C990. (3) See also 9C110 for material not controlled by 1C010.e, as defined by notes 1 or 2.

Related Definitions: (1) ''Specific modulus'': Young's modulus in pascals, equivalent to N/m2 divided by specific weight in N/m^3, measured at a temperature of (296+2) K ((23+2) °C) and a relative humidity of (50+5) %. (2) ''Specific tensile strength'': ultimate tensile strength in pascals, equivalent to N/m2 divided by specific weight in N/m^3, measured at a temperature of (296+2) K ((23+2) °C) and a relative humidity of (50+5) %.

Items:

Technical Notes:

1. *For the purposes of calculating ''specific tensile strength'', ''specific modulus'' or specific weight of ''fibrous or filamentary materials'' in 1C010.a, 1C010.b, 1C010.c, or 1C010.e.1.b the tensile strength and modulus should be determined by using Method A described in ISO 10618 (2004) or national equivalents.*

2. *For the purposes of assessing the ''specific tensile strength'', ''specific modulus'' or specific weight of non-unidirectional ''fibrous or filamentary materials'' (e.g., fabrics, random mats or braids) in 1C010, this is to be based on the mechanical properties of the constituent unidirectional monofilaments (e.g., monofilaments, yarns, rovings or tows) prior to processing into the non-unidirectional ''fibrous or filamentary materials''.*

a. Organic ''fibrous or filamentary materials'', having all of the following:

a.1. ''Specific modulus'' exceeding 12.7×10^6 m; *and*

a.2. ''Specific tensile strength'' exceeding 23.5×10^4 m;

Note: *1C010.a does not control polyethylene.*

b. Carbon ''fibrous or filamentary materials'', having all of the following:

b.1. ''Specific modulus'' exceeding 14.65×10^6 m; *and*

b.2. ''Specific tensile strength'' exceeding 26.82×10^4 m;

Note: *1C010.b does not control:*

a. ''Fibrous or filamentary materials'', for the repair of ''civil aircraft'' structures or laminates, having all of the following:

1. An area not exceeding 1 m^2;

2. A length not exceeding 2.5 m; and

3. A width exceeding 15 mm.

b. Mechanically chopped, milled or cut carbon ''fibrous or filamentary materials'' 25.0 mm or less in length.

c. Inorganic ''fibrous or filamentary materials'', having all of the following:

c.1. Having any of the following:

c.1.a. Composed of 50% or more by weight silicon dioxide (SiO_2) and having a ''specific modulus'' exceeding 2.54×10^6 m; *or*

c.1.b. Not specified in 1C010.c.1.a and having a ''specific modulus'' exceeding 5.6×10^6 m; *and*

c.2. Melting, softening, decomposition or sublimation point exceeding 1,922 K (1,649 °C) in an inert environment;

Note: *1C010.c does not control:*

a. Discontinuous, multiphase, polycrystalline alumina fibers in chopped fiber or random mat form, containing 3% by weight or more silica, with a ''specific modulus'' of less than 10×10^6 m;

b. Molybdenum and molybdenum alloy fibers;

c. Boron fibers;

d. Discontinuous ceramic fibers with a melting, softening, decomposition or sublimation point lower than 2,043 K (1,770 °C) in an inert environment.

d. ''Fibrous or filamentary materials'', having any of the following:

d.1. Composed of any of the following:

d.1.a. Polyetherimides controlled by 1C008.a; *or*

d.1.b. Materials controlled by 1C008.b to 1C008.f; *or*

d.2. Composed of materials controlled by 1C010.d.1.a or 1C010.d.1.b and 'commingled' with other fibers controlled by 1C010.a, 1C010.b or 1C010.c;

Technical Note: *For the purposes of 1C010.d.2, 'commingled' is filament to filament blending of thermoplastic fibers and reinforcement fibers in order to produce a fiber reinforcement ''matrix'' mix in total fiber form.*

e. Fully or partially resin impregnated or pitch impregnated ''fibrous or filamentary materials'' (prepregs), metal or carbon coated ''fibrous or filamentary materials'' (preforms) or 'carbon fiber preforms', having all of the following:

e.1. Having any of the following:

e.1.a. Inorganic ''fibrous or filamentary materials'' controlled by 1C010.c; *or*

e.1.b. Organic or carbon ''fibrous or filamentary materials'', having all of the following:

e.1.b.1. ''Specific modulus'' exceeding 10.15×10^6 m; and

e.1.b.2 ''Specific tensile strength'' exceeding 17.7×10^4m; and

e.2. Having any of the following:

e.2.a. Resin or pitch, controlled by 1C008 or 1C009.b;

e.2.b. 'Dynamic Mechanical Analysis glass transition temperature (DMA T_g)' equal to or exceeding 453 K (180°C) and having a phenolic resin; *or*

e.2.c. 'Dynamic Mechanical Analysis glass transition temperature (DMA T_g)' equal to or exceeding 505 K (232°C) and having a resin or pitch, not specified by 1C008 or 1C009.b, and not being a phenolic resin;

Note 1: *Metal or carbon coated ''fibrous or filamentary materials'' (preforms) or 'carbon fiber preforms', not impregnated with resin or pitch, are specified by ''fibrous or filamentary materials'' in 1C010.a, 1C010.b or 1C010.c.*

Note 2: *1C010.e does not apply to:*

a. Epoxy resin ''matrix'' impregnated carbon ''fibrous or filamentary materials'' (prepregs) for the repair of ''civil aircraft'' structures or laminates, having all of the following:

1. An area not exceeding 1 m^2

2. A length not exceeding 2.5 m; and

3. A width exceeding 15 mm;

b. Fully or partially resin-impregnated or pitch-impregnated mechanically chopped, milled or cut carbon ''fibrous or filamentary materials'' 25.0 mm or less in length when using a resin or pitch other than those specified by 1C008 or 1C009.b.

Technical Notes:

1. *For the purposes of 1C010.e and Note 1, 'carbon fiber preforms' are an ordered arrangement of uncoated or coated fibers intended to constitute a framework of a part before the ''matrix'' is introduced to form a ''composite''.*

2. *For the purposes of 1C010.e.2, 'Dynamic Mechanical Analysis glass transition temperature (DMA Tg)' is determined using the method described in ASTM D 7028 –07, or equivalent national standard, on a dry test specimen. In the case of thermoset materials, degree of cure of a dry test specimen shall be a minimum of 90% as defined by ASTM E 2160 04 or equivalent national standard.*

1C011 Metals and compounds, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to 1C011.a and .b for items that meet or exceed the parameters in 1C111..	MT Column 1

Control(s)	*Country chart (see supp. No. 1 to part 738)*
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See also ECCNs 1C111 and 1C608. (2) All of the following are ''subject to the ITAR'' (see 22 CFR parts 120 through 130): (a) Materials controlled by 1C011.a, and metal fuels in particle form, whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99 percent or more of items controlled by 1C011.b; and (b) Metal powders mixed with other substances to form a mixture formulated for military purposes.
Related Definitions: N/A
Items:

a. Metals in particle sizes of less than 60 μm whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of zirconium, magnesium and alloys thereof;

Technical Note: *For the purposes of 1C011.a, the natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.*

Note: *The metals or alloys specified by 1C011.a also refer to metals or alloys encapsulated in aluminum, magnesium, zirconium or beryllium.*

b. Boron or boron alloys, with a particle size of 60 μm or less, as follows:

b.1. Boron with a purity of 85% by weight or more;

b.2. Boron alloys with a boron content of 85% by weight or more;

Note: *The metals or alloys specified by 1C011.b also refer to metals or alloys encapsulated in aluminum, magnesium, zirconium or beryllium.*

c. Guanidine nitrate (CAS 506–93–4);

d. Nitroguanidine (NQ) (CAS 556–88–7).

* * * * *

2A001 Anti-friction bearings, bearing systems and ''components,'' as follows, (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to radial ball bearings having all tolerances specified in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC–9, or other national equivalents) or better and having all the following characteristics: an inner ring bore diameter between 12 and 50 mm; an outer ring outside diameter between 25 and 100 mm; and a width between 10 and 20 mm..	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000, N/A for MT
GBS: Yes, for 2A001.a, N/A for MT

List of Items Controlled

Related Controls: (1) See also 2A991. (2) Quiet running bearings are ''subject to the ITAR'' (see 22 CFR parts 120 through 130.)
Related Definitions: Annular Bearing Engineers Committee (ABEC).
Items:

Note: *2A001.a includes ball bearing and roller elements ''specially designed'' for the items specified therein.*

a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 2 or Class 4 (or national equivalents), or better, and having both 'rings' and 'rolling elements', made from monel or beryllium;

Note: *2A001.a does not control tapered roller bearings.*

Technical Notes: *For the purposes of 2A001.a:*

1. 'Ring'—is an annular part of a radial rolling bearing incorporating one or more raceways (ISO 5593:1997).

2. 'Rolling element'—is a ball or roller which rolls between raceways (ISO 5593:1997).

b. [Reserved]

c. Active magnetic bearing systems using any of the following, and ''specially designed'' components therefor:

c.1. Materials with flux densities of 2.0 T or greater and yield strengths greater than 414 MPa;

c.2. All-electromagnetic 3D homopolar bias designs for actuators; *or*

c.3. High temperature (450 K (177 °C) and above) position sensors.

* * * * *

B. ''Test,'' ''Inspection'' and ''Production Equipment''

Technical Notes for 2B001 to 2B009, 2B201, and 2B991 to 2B999:

1. For the purposes of 2B, secondary parallel contouring axes, (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the center line of which is parallel to the primary rotary axis) are not counted in the total number of contouring axes. Rotary axes need not rotate over 360 °. A rotary axis can be driven by a linear device (e.g., a screw or a rack-and-pinion).

2. For the purposes of 2B, the number of axes which can be coordinated simultaneously for ''contouring control'' is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative motions within the machine are performed, such as:

2.a. Wheel-dressing systems in grinding machines;

2.b. Parallel rotary axes designed for mounting of separate workpieces;

2.c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.

3. For the purposes of 2B, axis nomenclature shall be in accordance with International Standard ISO 841:2001, Industrial automation systems and integration—Numerical control of machines—Coordinate system and motion nomenclature.

4. For the purposes of this Category, a ''tilting spindle'' is counted as a rotary axis.

5. For the purposes of 2B, 'stated ''unidirectional positioning repeatability''' may be used for each specific machine model as an alternative to individual machine tests, and is determined as follows:

5.a. Select five machines of a model to be evaluated;

5.b. Measure the linear axis repeatability ($R\uparrow$,$R\downarrow$) according to ISO 230–2:2014 and evaluate ''unidirectional positioning repeatability'' for each axis of each of the five machines;

5.c. Determine the arithmetic mean value of the ''unidirectional positioning repeatability''-values for each axis of all five machines together. These arithmetic mean values ''unidirectional positioning repeatability'' ($\overline{UPR}$) become the stated value of each axis for the model. . .)($\overline{UPR}_x$, $\overline{UPR}_y$, . . .);

5.d. Since the Category 2 list refers to each linear axis there will be as many 'stated ''unidirectional positioning repeatability''' values as there are linear axes;

5.e. If any axis of a machine model not controlled by 2B001.a. to 2B001.c. has a 'stated ''unidirectional positioning repeatability''' equal to or less than the specified ''unidirectional positioning repeatability'' of each machine tool model plus 0.7 μm, the builder should be required to reaffirm the accuracy level once every eighteen months.

6. For the purposes of 2B, measurement uncertainty for the ''unidirectional positioning repeatability'' of machine tools, as defined in the International Standard ISO 230–2:2014, shall not be considered.

7. For the purposes of 2B, the measurement of axes shall be made according to test procedures in 5.3.2. of ISO 230–2:2014. Tests for axes longer than 2 meters shall be made over 2 m segments. Axes longer than 4 m require multiple tests (e.g., two tests for axes longer than 4 m and up to 8 m, three tests for axes longer than 8 m and up to 12 m), each over 2 m segments and distributed in equal intervals over the axis length. Test segments are equally spaced along the full axis length, with any excess length equally divided at the beginning, in between, and at the end of the test segments. The smallest ''*unidirectional positioning repeatability*''*-value of all test segments is to be reported.*

* * * * *

2B004 Hot ''isostatic presses'' having all of the characteristics described in the List of Items Controlled, and ''specially designed'' ''components'' and ''accessories'' therefor.

License Requirements

Reason for Control: NS, MT NP, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to entire entry.	MT Column 1
NP applies to entire entry, except 2B004.b.3 and presses with maximum working pressures below 69 MPa.	NP Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See ECCN 2D001 for software for items controlled under this entry. (2) See ECCNs 2E001 (''development''), 2E002 (''production''), and 2E101 (''use'') for technology for items controlled under this entry. (3) For ''specially designed'' dies, molds and tooling, see ECCNs 0B501, 0B602, 0B606, 1B003, 9B004, and 9B009. (4) For additional controls on dies, molds and tooling, see ECCNs 1B101.d, 2B104 and 2B204. (5) Also see ECCNs 2B117 and 2B999.a.
Related Definitions: N/A
Items:

a. A controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; *and*

b. Having any of the following:

b.1. A maximum working pressure exceeding 207 MPa;

b.2. A controlled thermal environment exceeding 1,773 K (1,500 °C); *or*

b.3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products.

Technical Note: *For the purposes of 2B004, the inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.*

* * * * *

2B006 Dimensional inspection or measuring systems, equipment, position feedback units and ''electronic assemblies'', as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country chart (see supp. no. 1 to part 738)*
NS applies to entire entry.	NS Column 2
NP applies to those items in 2B006.a, b.1, b.3, and .c (angular displacement measuring instruments) that meet or exceed the technical parameters in 2B206..	NP Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 2D001 and 2D002 for ''software'' for items controlled under this entry. (2) See ECCNs 2E001 (''development''), 2E002 (''production''), and 2E201 (''use'') for technology for items controlled under this entry. (3) Also see ECCNs 2B206 and 2B996.
Related Definitions: N/A
Items:

a. Computer controlled or ''numerically controlled'' Coordinate Measuring Machines (CMM), having a three dimensional length (volumetric) maximum permissible error of length measurement ($E_{0,MPE}$) at any point within the operating range of the machine (*i.e.,* within the length of axes) equal to or less (better) than (1.7 + L/1,000) µm (L is the measured length in mm) according to ISO 10360–2 (2009);

Technical Note: *For the purposes of 2B006.a, $E_{0,MPE}$ of the most accurate configuration of the CMM specified by the manufacturer (e.g.,best of the following: Probe, stylus length, motion parameters, environment) and with* ''*all compensations available*'' *shall be compared to the 1.7 + L/1,000* µm *threshold.*

b. Linear displacement measuring instruments or systems, linear position feedback units, and ''electronic assemblies'', as follows:

Note: *Interferometer and optical-encoder measuring systems containing a* ''*laser*'' *are only specified by 2B006.b.3.*

b.1. 'Non-contact type measuring systems' with a 'resolution' equal to or less (better) than 0.2 µm within 0 to 0.2 mm of the 'measuring range';

Technical Notes: *For the purposes of 2B006.b.1:*

1. 'Non-contact type measuring systems' are designed to measure the distance between the probe and measured object along a single vector, where the probe or measured object is in motion.

2. 'Measuring range' means the distance between the minimum and maximum working distance.

b.2. Linear position feedback units ''specially designed'' for machine tools and having an overall ''accuracy'' less (better) than (800 + (600 × L/1,000)) nm (L equals effective length in mm);

b.3. Measuring systems having all of the following:

b.3.a. Containing a ''laser'';

b.3.b. A 'resolution' over their full scale of 0.200 nm or less (better); *and*

b.3.c. Capable of achieving a ''measurement uncertainty'' equal to or less (better) than (1.6 + L/2,000) nm (L is the measured length in mm) at any point within a measuring range, when compensated for the refractive index of air and measured over a period of 30 seconds at a temperature of 20±0.01°C;

Technical Note: *For the purposes of 2B006.b, 'resolution' is the least increment of a measuring device; on digital instruments, the least significant bit.*

b.4. ''Electronic assemblies'' ''specially designed'' to provide feedback capability in systems controlled by 2B006.b.3;

c. Rotary position feedback units ''specially designed'' for machine tools or angular displacement measuring instruments, having an angular position ''accuracy'' equal to or less (better) than 0.9 second of arc;

Note: *2B006.c does not control optical instruments, such as autocollimators, using collimated light (e.g.,* ''*laser*'' *light) to detect angular displacement of a mirror.*

d. Equipment for measuring surface roughness (including surface defects), by measuring optical scatter with a sensitivity of 0.5 nm or less (better).

Note: *2B006 includes machine tools, other than those specified by 2B001, that can be used as measuring machines, if they meet or exceed the criteria specified for the measuring machine function.*

* * * * *

2B008 'Compound rotary tables' and ''tilting spindles'', ''specially designed'' for machine tools, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see supp. no. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: See also 2B998.
Related Definition: N/A
Items:

a. [Reserved]
b. [Reserved]
c. 'Compound rotary tables' having all of the following:
c.1. Designed for machine tools for turning, milling or grinding; *and*
c.2. Two rotary axes designed to be coordinated simultaneously for ''contouring control''.

Technical Note: *For the purposes of 2B008.c, a 'compound rotary table' is a table allowing the workpiece to rotate and tilt about two non-parallel axes.*

d. ''Tilting spindles'' having all of the following:
d.1. Designed for machine tools for turning, milling or grinding; *and*
d.2. Designed to be coordinated simultaneously for ''contouring control''.

* * * * *

2B009 Spin-forming machines and flow-forming machines, which, according to the manufacturer's technical specifications, can be equipped with ''numerical control'' units or a computer control and having all of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country chart (see supp. no. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to: spin-forming. machines combining the functions of spin-forming and flow-forming; and flow-forming machines that meet or exceed the parameters of 2B009.a and 2B109.	MT Column 1
NP applies to flow-forming machines, and spin-forming machines capable of flow-forming functions, that meet or exceed the parameters of 2B209.	NP Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See ECCN 2D001 for ''software'' for items controlled under this entry. (2) See ECCNs 2E001 (''development''), 2E002 (''production''), and 2E101 (''use'') for technology for items controlled under this entry. (3) Also see ECCNs 2B109 and 2B209 for additional flow-forming machines for MT and NP reasons.
Related Definitions: N/A
Items:

a. Three or more axes which can be coordinated simultaneously for ''contouring control''; *and*
b. A roller force more than 60 kN.

Technical Note: *For the purposes of 2B009, machines combining the function of spin-forming and flow-forming are regarded as flow-forming machines.*

* * * * *

2E003 Other ''technology'', as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes, except 2E003.b, .e and .f

List of Items Controlled

Related Controls: See 2E001, 2E002, and 2E101 for ''development'' and ''use'' technology for equipment that are designed or modified for densification of carbon-carbon composites, structural composite rocket nozzles and reentry vehicle nose tips.
Related Definitions: N/A
Items:

a. [Reserved]
b. ''Technology'' for metal-working manufacturing processes, as follows:
b.1. ''Technology'' for the design of tools, dies or fixtures ''specially designed'' for any of the following processes:
b.1.a. ''Superplastic forming'';
b.1.b. ''Diffusion bonding''; *or*
b.1.c. 'Direct-acting hydraulic pressing';
b.2. [Reserved]

N.B.: *For ''technology'' for metal-working manufacturing processes for gas turbine engines and components, see 9E003 and USML Category XIX*

Technical Note: *For the purposes of 2E003.b.1.c, 'direct-acting hydraulic pressing' is a deformation process which uses a fluid-filled flexible bladder in direct contact with the workpiece.*

c. ''Technology'' for the ''development'' or ''production'' of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;
d. [Reserved]
e. ''Technology'' for the ''development'' of integration ''software'' for incorporation of expert systems for advanced decision support of shop floor operations into ''numerical control'' units;
f. ''Technology'' for the application of inorganic overlay coatings or inorganic surface modification coatings (specified in column 3 of the following table) to non-electronic substrates (specified in column 2 of the following table), by processes specified in column 1 of the following table and defined in the Technical Note.

N.B. *This table should be read to control the technology of a particular 'Coating Process' only when the resultant coating in column 3 is in a paragraph directly across from the relevant 'Substrate' under column 2. For example, Chemical Vapor Deposition (CVD) 'coating process' control the ''technology'' for a particular 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)

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

1. *Coating process* (1) [1]	2. *Substrate*	3. *Resultant coating*
	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)
	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)
	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)

1. *Coating process* (1) [1]	2. *Substrate*	3. *Resultant coating*
	Polymers (11) and Organic "matrix" "composites".	Borides Carbides Nitrides Diamond-like carbon (17)
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)
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
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)

1. *Coating process* (1) [1]	2. *Substrate*	3. *Resultant coating*
	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 the multiple use of single-step pack cementation processes to achieve alloyed aluminides.

3. The term ''noble metal modified aluminide'' coating includes multiple-step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.

4. The term ''mixtures thereof'' includes infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.

5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01% by weight in various proportions and combinations, except:

a. CoCrAlY coatings which contain less than 22% by weight of chromium, less than 7% by weight of aluminum and less than 2% by weight of yttrium;

b. CoCrAlY coatings which contain 22 to 24% by weight of chromium, 10 to 12% by weight of aluminum and 0.5 to 0.7% by weight of yttrium; or

c. NiCrAlY coatings which contain 21 to 23% by weight of chromium, 10 to 12% by weight of aluminum and 0.9 to 1.1% by weight of yttrium.

6. The term ''aluminum alloys'' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20 °C).

7. The term ''corrosion resistant steel'' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.

8. ''Refractory metals and alloys'' include the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. ''Sensor window materials'', as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide, diamond, gallium phosphide, sapphire and the following metal halides: sensor window materials of more than 40 mm diameter for zirconium fluoride and hafnium fluoride.

10. Category 2 does not include ''technology'' for single-step pack cementation of solid airfoils.

11. ''Polymers'', as follows: polyimide, polyester, polysulfide, polycarbonates and polyurethanes.

12. ''Modified zirconia'' refers to additions of other metal oxides, (e.g., calcia, magnesia, yttria, hafnia, rare earth oxides) to zirconia in order to stabilize certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not controlled.

13. ''Titanium alloys'' refers only to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20 °C).

14. ''Low-expansion glasses'' refers to glasses which have a coefficient of thermal expansion of 1 x 10^{-7} K^{-1} or less measured at 293 K (20 °C).

15. ''Dielectric layers'' are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal ''composite'' layers.

16. ''Cemented tungsten carbide'' does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium and chromium carbide/nickel.

17. ''Technology'' for depositing diamond-like carbon on any of the following is not controlled: magnetic disk drives and heads, equipment for the manufacture of disposables, valves for faucets, acoustic diaphragms for speakers, engine parts for automobiles, cutting tools, punching-pressing dies, office automation equipment, microphones, medical devices or molds, for casting or molding of plastics, manufactured from alloys containing less than 5% beryllium.

18. ''Silicon carbide'' does not include cutting and forming tool materials.

19. Ceramic substrates, as used in this entry, does not include ceramic materials containing 5% by weight, or greater, clay or cement content, either as separate constituents or in combination.

Technical Note to Table on Deposition Techniques: *Processes specified in Column 1 of the Table are defined as follows:*

a. Chemical Vapor Deposition (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, ''composite'', dielectric or ceramic is deposited upon a heated substrate. Gaseous reactants are decomposed or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloy or compound material on the substrate. Energy for this decomposition or chemical reaction process may be provided by the heat of the substrate, a glow discharge plasma, or ''laser'' irradiation.

Note 1: *CVD includes the following processes: directed gas flow out-of-pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.*

Note 2: *Pack denotes a substrate immersed in a powder mixture.*

Note 3: *The gaseous reactants used in the out-of-pack process are produced using the same basic reactions and parameters as the pack cementation process, except that the substrate to be coated is not in contact with the powder mixture.*

b. Thermal Evaporation-Physical Vapor Deposition (TE–PVD) is an overlay coating process conducted in a vacuum with a pressure less than 0.1 Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates. The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process. The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can

be a feature of these processes. Specific TE–PVD processes are as follows:

1. Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;

2. Ion Assisted Resistive Heating PVD employs electrically resistive heating sources in combination with impinging ion beam(s) to produce a controlled and uniform flux of evaporated coating species;

3. ''Laser'' Vaporization uses either pulsed or continuous wave ''laser'' beams to vaporize the material which forms the coating;

4. Cathodic Arc Deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line-of-sight deposition;

Note: *This definition does not include random cathodic arc deposition with non-biased substrates.*

5. Ion Plating is a special modification of a general TE–PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.

c. Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:

1. The metallic powders that are to be deposited (usually aluminum, chromium, silicon or combinations thereof);

2. An activator (normally a halide salt); and

3. An inert powder, most frequently alumina.

Note: *The substrate and powder mixture is contained within a retort which is heated to between 1,030 K (757°C) to 1,375 K (1,102°C) for sufficient time to deposit the coating.*

d. Plasma Spraying is an overlay coating process wherein a gun (spray torch) which produces and controls a plasma accepts powder or wire coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed. Plasma spraying constitutes either low pressure plasma spraying or high velocity plasma spraying.

Note 1: *Low pressure means less than ambient atmospheric pressure.*

Note 2: *High velocity refers to nozzle-exit gas velocity exceeding 750 m/s calculated at 293 K (20°C) at 0.1 MPa.*

e. Slurry Deposition is a surface modification coating or overlay coating process wherein a metallic or ceramic powder with an organic binder is suspended in a liquid and is applied to a substrate by either spraying, dipping or painting, subsequent air or oven drying, and heat treatment to obtain the desired coating.

f. Sputter Deposition is an overlay coating process based on a momentum transfer phenomenon, wherein positive ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on an appropriately positioned substrate.

Note 1: *The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vaporization of non-metallic coating materials.*

Note 2: *Low-energy ion beams (less than 5 keV) can be used to activate the deposition.*

g. Ion Implantation is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapor deposition or sputter deposition.

Accompanying Technical Information to Table on Deposition Techniques:

1. Technical information for pretreatments of the substrates listed in the Table, as follows:

a. Chemical stripping and cleaning bath cycle parameters, as follows:

1. Bath composition;

a. For the removal of old or defective coatings corrosion product or foreign deposits;

b. For preparation of virgin substrates;

2. Time in bath;

3. Temperature of bath;

4. Number and sequences of wash cycles;

b. Visual and macroscopic criteria for acceptance of the cleaned part;

c. Heat treatment cycle parameters, as follows:

1. Atmosphere parameters, as follows:

a. Composition of the atmosphere;

b. Pressure of the atmosphere;

2. Temperature for heat treatment;

3. Time of heat treatment;

d. Substrate surface preparation parameters, as follows:

1. Grit blasting parameters, as follows:

a. Grit composition;

b. Grit size and shape;

c. Grit velocity;

2. Time and sequence of cleaning cycle after grit blast;

3. Surface finish parameters;

4. Application of binders to promote adhesion;

e. Masking technique parameters, as follows:

1. Material of mask;

2. Location of mask;

2. Technical information for in situ quality assurance techniques for evaluation of the coating processes listed in the Table, as follows:

a. Atmosphere parameters, as follows:

1. Composition of the atmosphere;

2. Pressure of the atmosphere;

b. Time parameters;

c. Temperature parameters;

d. Thickness parameters;

e. Index of refraction parameters;

f. Control of composition;

3. Technical information for post deposition treatments of the coated substrates listed in the Table, as follows:

a. Shot peening parameters, as follows:

1. Shot composition;

2. Shot size;

3. Shot velocity;

b. Post shot peening cleaning parameters;

c. Heat treatment cycle parameters, as follows:

1. Atmosphere parameters, as follows:

a. Composition of the atmosphere;

b. Pressure of the atmosphere;

2. Time-temperature cycles;

d. Post heat treatment visual and macroscopic criteria for acceptance of the coated substrates;

4. Technical information for quality assurance techniques for the evaluation of the coated substrates listed in the Table, as follows:

a. Statistical sampling criteria;

b. Microscopic criteria for:

1. Magnification;

2. Coating thickness, uniformity;

3. Coating integrity;

4. Coating composition;

5. Coating and substrates bonding;

6. Microstructural uniformity.

c. Criteria for optical properties assessment (measured as a function of wavelength):

1. Reflectance;

2. Transmission;

3. Absorption;

4. Scatter;

5. Technical information and parameters related to specific coating and surface modification processes listed in the Table, as follows:

a. For Chemical Vapor Deposition (CVD):

1. Coating source composition and formulation;

2. Carrier gas composition;

3. Substrate temperature;

4. Time-temperature-pressure cycles;

5. Gas control and part manipulation;

b. For Thermal Evaporation-Physical Vapor Deposition (PVD):

1. Ingot or coating material source composition;

2. Substrate temperature;

3. Reactive gas composition;

4. Ingot feed rate or material vaporization rate;

5. Time-temperature-pressure cycles;

6. Beam and part manipulation;

7. ''Laser'' parameters, as follows:

a. Wave length;

b. Power density;

c. Pulse length;

d. Repetition ratio;

e. Source;

c. For Pack Cementation:

1. Pack composition and formulation;

2. Carrier gas composition;

3. Time-temperature-pressure cycles;

d. For Plasma Spraying:

1. Powder composition, preparation and size distributions;

2. Feed gas composition and parameters;

3. Substrate temperature;

4. Gun power parameters;

5. Spray distance;

6. Spray angle;

7. Cover gas composition, pressure and flow rates;

8. Gun control and part manipulation;

e. For Sputter Deposition:

1. Target composition and fabrication;

2. Geometrical positioning of part and target;

3. Reactive gas composition;

4. Electrical bias;

5. Time-temperature-pressure cycles;

6. Triode power;

7. Part manipulation;

f. For Ion Implantation:

1. Beam control and part manipulation;

2. Ion source design details;

3. Control techniques for ion beam and deposition rate parameters;

4. Time-temperature-pressure cycles.

g. For Ion Plating:

1. Beam control and part manipulation;

2. Ion source design details;

3. Control techniques for ion beam and deposition rate parameters;

4. Time-temperature-pressure cycles;

5. Coating material feed rate and vaporization rate;

6. Substrate temperature;

7. Substrate bias parameters.

* * * * *

3A001 Electronic items as follows (see List of Items Controlled).

Reason for Control: NS, RS, MT, NP, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to ''Monolithic Microwave Integrated Circuit'' (''MMIC'') amplifiers in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those 3A001.b.2 and b.3 items being exported or reexported for use in civil telecommunications applications.	NS Column 1
NS applies to entire entry.	NS Column 2
RS applies ''Monolithic Microwave Integrated Circuit'' (''MMIC'') amplifiers in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those 3A001.b.2 and b.3 items being exported or reexported for use in civil telecommunications applications.	RS Column 1
MT applies to 3A001.a.1.a when usable in ''missiles''; and to 3A001.a.5.a when ''designed or modified'' for military use, hermetically sealed and rated for operation in the temperature range from below −54 °C to above +125 °C.	MT Column 1
NP applies to pulse discharge capacitors in 3A001.e.2 and superconducting solenoidal electromagnets in 3A001.e.3 that meet or exceed the technical parameters in 3A201.a and 3A201.b, respectively.	NP Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements: See § 743.1 of the EAR for reporting requirements for exports under 3A001.b.2 or b.3 under License Exceptions, and Validated End-User authorizations.

License Requirements Note: *See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating ''information security'' functionality, and associated ''software'' and ''technology'' for the ''production'' or ''development'' of such microprocessors.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A for MT or NP; N/A for ''Monolithic Microwave Integrated Circuit'' (''MMIC'') amplifiers in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those that are being exported or reexported for use in civil telecommunications applications.

Yes for:

$1500: 3A001.c

$3000: 3A001.b.1, b.2 (exported or reexported for use in civil telecommunications applications), b.3 (exported or reexported for use in civil telecommunications applications), b.9, .d, .e, .f, and .g.

$5000: 3A001.a (except a.1.a and a.5.a when controlled for MT), .b.4 to b.7, and b.12.

GBS: Yes for 3A001.a.1.b, a.2 to a.14 (except .a.5.a when controlled for MT), b.2 (exported or reexported for use in civil telecommunications applications), b.8 (except for ''vacuum electronic devices'' exceeding 18 GHz), b.9., b.10, .g, and .h, and .i.

Special Conditions for STA

STA: License Exception STA may not be used to ship any item in 3A001.b.2 or b.3, except those that are being exported or reexported for use in civil telecommunications applications, to any of the destinations listed in Country Group A:5 or A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See Category XV of the USML for certain ''space-qualified'' electronics and Category XI of the USML for certain ASICs, 'transmit/receive modules,' or 'transmit modules' ''subject to the ITAR'' (see 22 CFR parts 120 through 130). (2) See also 3A101, 3A201, 3A611, 3A991, and 9A515.

Related Definitions: 'Microcircuit' means a device in which a number of passive or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit. For the purposes of integrated circuits in 3A001.a.1, 5×10^3 Gy(Si) = 5×10^5 Rads (Si); 5×10^6 Gy (Si)/s = 5×10^8 Rads (Si)/s.

Items:

a. General purpose integrated circuits, as follows:

Note 1: *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*'';
—''*Three dimensional integrated circuits*'';
—''*Monolithic Microwave Integrated Circuits*'' (''*MMICs*'').

a.1. Integrated circuits designed or rated as radiation hardened to withstand any of the following:

a.1.a. A total dose of 5×10^3 Gy (Si), or higher;

a.1.b. A dose rate upset of 5×10^6 Gy (Si)/s, or higher; *or*

a.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5×10^{13} n/cm^2 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, integrated circuits that contain analog-to-digital converters and store or process the digitized data, 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, Static Random-Access Memories (SRAMs), or 'non-volatile memories,' having any of the following:

Technical Note: *For the purposes of 3A001.a.2, 'non-volatile memories' are*

memories with data retention over a period of time after a power shutdown.

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);

Note: *3A001.a.2 does not apply to integrated circuits designed for civil automobile or railway train applications.*

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 a ''sample rate'' greater than 1.3 Giga Samples Per Second (GSPS);

a.5.a.2. A resolution of 10 bit or more, but less than 12 bit, with a ''sample rate'' greater than 600 Mega Samples Per Second (MSPS);

a.5.a.3. A resolution of 12 bit or more, but less than 14 bit, with a ''sample rate'' greater than 400 MSPS;

a.5.a.4. A resolution of 14 bit or more, but less than 16 bit, with a ''sample rate'' greater than 250 MSPS; *or*

a.5.a.5. A resolution of 16 bit or more with a ''sample rate'' greater than 65 MSPS;

N.B.: *For integrated circuits that contain analog-to-digital converters and store or process the digitized data see 3A001.a.14.*

Technical Notes: *For the purposes of 3A001.a.5.a:*

1. *A resolution of n bit corresponds to a quantization of* 2^n *levels.*

2. *The resolution of the ADC is the number of bits of the digital output that represents the measured analog input. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

3. *For ''multiple channel ADCs'', the ''sample rate'' is not aggregated and the ''sample rate'' is the maximum rate of any single channel.*

4. *For ''interleaved ADCs'' or for ''multiple channel ADCs'' that are specified to have an interleaved mode of operation, the ''sample rates'' are aggregated and the ''sample rate'' is the maximum combined total rate of all of the interleaved channels.*

a.5.b. Digital-to-Analog Converters (DAC) having any of the following:

a.5.b.1. A resolution of 10-bit or more but less than 12-bit,with an 'adjusted update rate' of exceeding 3,500 MSPS; *or*

a.5.b.2. A resolution of 12-bit or more and having any of the following:

a.5.b.2.a. An 'adjusted update rate' exceeding 1,250 MSPS but not exceeding 3,500 MSPS, and having any of the following:

a.5.b.2.a.1. A settling time less than 9 ns to arrive at or within 0.024% of full scale from a full scale step; *or*

a.5.b.2.a.2. A 'Spurious Free Dynamic Range' (SFDR) greater than 68 dBc (carrier) when synthesizing a full scale analog signal of 100 MHz or the highest full scale analog signal frequency specified below 100 MHz; *or*

a.5.b.2.b. An 'adjusted update rate' exceeding 3,500 MSPS;

Technical Notes: *For the purposes of 3A001.a.5.b:*

1. *'Spurious Free Dynamic Range' (SFDR) is defined as the ratio of the RMS value of the carrier frequency (maximum signal component) at the input of the DAC to the RMS value of the next largest noise or harmonic distortion component at its output.*

2. *SFDR is determined directly from the specification table or from the characterization plots of SFDR versus frequency.*

3. *A signal is defined to be full scale when its amplitude is greater than −3 dBfs (full scale).*

4. *'Adjusted update rate' for DACs is:*

a. *For conventional (non-interpolating) DACs, the 'adjusted update rate' is the rate at which the digital signal is converted to an analog signal and the output analog values are changed by the DAC. For DACs where the interpolation mode may be bypassed (interpolation factor of one), the DAC should be considered as a conventional (non-interpolating) DAC.*

b. *For interpolating DACs (oversampling DACs), the 'adjusted update rate' is defined as the DAC update rate divided by the smallest interpolating factor. For interpolating DACs, the 'adjusted update rate' may be referred to by different terms including:*

- input data rate
- input word rate
- input sample rate
- maximum total input bus rate
- maximum DAC clock rate for DAC clock input.

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;

a.7. 'Field programmable logic devices' having any of the following:

a.7.a. A maximum number of single-ended digital input/outputs of greater than 700; *or*

a.7.b. An 'aggregate one-way peak serial transceiver data rate' of 500 Gb/s or greater;

Note: *3A001.a.7 includes:*

—Complex Programmable Logic Devices (CPLDs);
—Field Programmable Gate Arrays (FPGAs);
—Field Programmable Logic Arrays (FPLAs);
—Field Programmable Interconnects (FPICs).

N.B.: *For integrated circuits having field programmable logic devices that are combined with an analog-to-digital converter, see 3A001.a.14.*

Technical Notes: *For the purposes of 3A001.a.7:*

1. *Maximum number of digital input/outputs in 3A001.a.7.a is also referred to as maximum user input/outputs or maximum available input/outputs, whether the integrated circuit is packaged or bare die.*

2. *'Aggregate one-way peak serial transceiver data rate' is the product of the peak serial one-way transceiver data rate times the number of transceivers on the FPGA.*

a.8. [Reserved]

a.9. Neural network integrated circuits;

a.10. Custom integrated circuits for which the function is unknown, or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:

a.10.a. More than 1,500 terminals;

a.10.b. A typical ''basic gate propagation delay time'' of less than 0.02 ns; *or*

a.10.c. An operating frequency exceeding 3 GHz;

a.11. Digital integrated circuits, other than those described in 3A001.a.3 to 3A001.a.10 and 3A001.a.12, based upon any compound semiconductor and having any of the following:

a.11.a. An equivalent gate count of more than 3,000 (2 input gates); *or*

a.11.b. A toggle frequency exceeding 1.2 GHz;

a.12. Fast Fourier Transform (FFT) processors having a rated execution time for an N-point complex FFT of less than ($N \log_2 N$)/20,480 ms, where N is the number of points;

Technical Note: *For the purposes of 3A001.a.12, when N is equal to 1,024 points, the formula in 3A001.a.12 gives an execution time of 500* μ*s.*

a.13. Direct Digital Synthesizer (DDS) integrated circuits having any of the following:

a.13.a. A Digital-to-Analog Converter (DAC) clock frequency of 3.5 GHz or more and a DAC resolution of 10 bit or more, but less than 12 bit; *or*

a.13.b. A DAC clock frequency of 1.25 GHz or more and a DAC resolution of 12 bit or more;

Technical Note: *For the purposes of 3A001.a.13, the DAC clock frequency may be specified as the master clock frequency or the input clock frequency.*

a.14. Integrated circuits that perform or are programmable to perform all of the following:

a.14.a. Analog-to-digital conversions meeting any of the following:

a.14.a.1. A resolution of 8 bit or more, but less than 10 bit, with a ''sample rate'' greater than 1.3 Giga Samples Per Second (GSPS);

a.14.a.2. A resolution of 10 bit or more, but less than 12 bit, with a ''sample rate'' greater than 1.0 GSPS;

a.14.a.3. A resolution of 12 bit or more, but less than 14 bit, with a ''sample rate'' greater than 1.0 GSPS;

a.14.a.4. A resolution of 14 bit or more, but less than 16 bit, with a ''sample rate'' greater than 400 Mega Samples Per Second (MSPS); *or*

a.14.a.5. A resolution of 16 bit or more with a ''sample rate'' greater than 180 MSPS; *and*

a.14.b. Any of the following:

a.14.b.1. Storage of digitized data; *or*

a.14.b.2. Processing of digitized data;

N.B. 1: *For analog-to-digital converter integrated circuits see 3A001.a.5.a.*

N.B. 2: *For field programmable logic devices see 3A001.a.7.*

Technical Notes: *For the purposes of 3A001.a.14:*

1. *A resolution of n bit corresponds to a quantization of 2^n levels.*

2. *The resolution of the ADC is the number of bits of the digital output of the ADC that represents the measured analog input. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

3. *For integrated circuits with non-interleaving ''multiple channel ADCs'', the ''sample rate'' is not aggregated and the ''sample rate'' is the maximum rate of any single channel.*

4. *For integrated circuits with ''interleaved ADCs'' or with ''multiple channel ADCs'' that are specified to have an interleaved mode of operation, the ''sample rates'' are aggregated and the ''sample rate'' is the maximum combined total rate of all of the interleaved channels.*

b. Microwave or millimeter wave items, as follows:

Technical Note: *For the purposes of 3A001.b, the parameter peak saturated power output may also be referred to on product data sheets as output power, saturated power output, maximum power output, peak power output, or peak envelope power output.*

b.1. ''Vacuum electronic devices'' and cathodes, as follows:

Note 1: *3A001.b.1 does not control ''vacuum electronic devices'' designed or rated for operation in any frequency band and having all of the following:*

a. *Does not exceed 31.8 GHz; and*

b. *Is ''allocated by the ITU'' for radio-communications services, but not for radio-determination.*

Note 2: *3A001.b.1 does not control non-''space-qualified'' ''vacuum electronic devices'' having all the following:*

a. *An average output power equal to or less than 50 W; and*

b. *Designed or rated for operation in any frequency band and having all of the following:*

1. *Exceeds 31.8 GHz but does not exceed 43.5 GHz; and*

2. *Is ''allocated by the ITU'' for radio-communications services, but not for radio-determination.*

b.1.a. Traveling-wave ''vacuum electronic devices,'' pulsed or continuous wave, as follows:

b.1.a.1. Devices operating at frequencies exceeding 31.8 GHz;

b.1.a.2. Devices having a cathode heater with a turn on time to rated RF power of less than 3 seconds;

b.1.a.3. Coupled cavity devices, or derivatives thereof, with a ''fractional bandwidth'' of more than 7% or a peak power exceeding 2.5 kW;

b.1.a.4. Devices based on helix, folded waveguide, or serpentine waveguide circuits, or derivatives thereof, having any of the following:

b.1.a.4.a. An ''instantaneous bandwidth'' of more than one octave, and average power (expressed in kW) times frequency (expressed in GHz) of more than 0.5;

b.1.a.4.b. An ''instantaneous bandwidth'' of one octave or less, and average power (expressed in kW) times frequency (expressed in GHz) of more than 1;

b.1.a.4.c. Being ''space-qualified''; *or*

b.1.a.4.d. Having a gridded electron gun;

b.1.a.5. Devices with a ''fractional bandwidth'' greater than or equal to 10%, with any of the following:

b.1.a.5.a. An annular electron beam;

b.1.a.5.b. A non-axisymmetric electron beam; *or*

b.1.a.5.c. Multiple electron beams;

b.1.b. Crossed-field amplifier ''vacuum electronic devices'' with a gain of more than 17 dB;

b.1.c. Thermionic cathodes, designed for ''vacuum electronic devices,'' producing an emission current density at rated operating conditions exceeding 5 A/cm² or a pulsed (non-continuous) current density at rated operating conditions exceeding 10 A/cm²;

b.1.d. ''Vacuum electronic devices'' with the capability to operate in a 'dual mode.'

Technical Note: *For the purposes of 3A001.b.1.d, 'dual mode' means the ''vacuum electronic device'' beam current can be intentionally changed between continuous-wave and pulsed mode operation by use of a grid and produces a peak pulse output power greater than the continuous-wave output power.*

b.2. ''Monolithic Microwave Integrated Circuit'' (''MMIC'') amplifiers that are any of the following:

N.B.: *For ''MMIC'' amplifiers that have an integrated phase shifter see 3A001.b.12.*

b.2.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz with a ''fractional bandwidth'' greater than 15%, and having any of the following:

b.2.a.1. A peak saturated power output greater than 75 W (48.75 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.2.a.2. A peak saturated power output greater than 55 W (47.4 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.2.a.3. A peak saturated power output greater than 40 W (46 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.2.a.4. A peak saturated power output greater than 20 W (43 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.2.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 16 GHz with a ''fractional bandwidth'' greater than 10%, and having any of the following:

b.2.b.1. A peak saturated power output greater than 10 W (40 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz; *or*

b.2.b.2. A peak saturated power output greater than 5 W (37 dBm) at any frequency exceeding 8.5 GHz up to and including 16 GHz;

b.2.c. Rated for operation with a peak saturated power output greater than 3 W (34.77 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz, and with a ''fractional bandwidth'' of greater than 10%;

b.2.d. Rated for operation with a peak saturated power output greater than 0.1 nW (−70 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.2.e. Rated for operation with a peak saturated power output greater than 1 W (30 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz, and with a ''fractional bandwidth'' of greater than 10%;

b.2.f. Rated for operation with a peak saturated power output greater than 31.62 mW (15 dBm) at any frequency exceeding 43.5 GHz up to and including 75 GHz, and with a ''fractional bandwidth'' of greater than 10%;

b.2.g. Rated for operation with a peak saturated power output greater than 10 mW (10 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, and with a ''fractional bandwidth'' of greater than 5%; *or*

b.2.h. Rated for operation with a peak saturated power output greater than 0.1 nW (−70 dBm) at any frequency exceeding 90 GHz;

Note 1: *[Reserved]*

Note 2: *The control status of the ''MMIC'' whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.2.a through 3A001.b.2.h, is determined by the lowest peak saturated power output control threshold.*

Note 3: *Notes 1 and 2 following the Category 3 heading for product group A. Systems, Equipment, and Components mean that 3A001.b.2 does not control ''MMICs'' if they are ''specially designed'' for other applications, e.g., telecommunications, radar, automobiles.*

b.3. Discrete microwave transistors that are any of the following:

b.3.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz and having any of the following:

b.3.a.1. A peak saturated power output greater than 400 W (56 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.3.a.2. A peak saturated power output greater than 205 W (53.12 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.3.a.3. A peak saturated power output greater than 115 W (50.61 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.3.a.4. A peak saturated power output greater than 60 W (47.78 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.3.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 31.8 GHz and having any of the following:

b.3.b.1. A peak saturated power output greater than 50 W (47 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

b.3.b.2. A peak saturated power output greater than 15 W (41.76 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

b.3.b.3. A peak saturated power output greater than 40 W (46 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz; *or*

b.3.b.4. A peak saturated power output greater than 7 W (38.45 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

b.3.c. Rated for operation with a peak saturated power output greater than 0.5 W (27 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.3.d. Rated for operation with a peak saturated power output greater than 1 W (30 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz;

b.3.e. Rated for operation with a peak saturated power output greater than 0.1 nW (−70 dBm) at any frequency exceeding 43.5 GHz; *or*

b.3.f. Other than those specified by 3A001.b.3.a to 3A001.b.3.e and rated for operation with a peak saturated power output greater than 5 W (37.0 dBm) at all frequencies exceeding 8.5 GHz up to and including 31.8 GHz;

Note 1: *The control status of a transistor in 3A001.b.3.a through 3A001.b.3.e, whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.3.a through 3A001.b.3.e, is determined by the lowest peak saturated power output control threshold.*

Note 2: *3A001.b.3 includes bare dice, dice mounted on carriers, or dice mounted in packages. Some discrete transistors may also be referred to as power amplifiers, but the status of these discrete transistors is determined by 3A001.b.3.*

b.4. Microwave solid state amplifiers and microwave assemblies/modules containing microwave solid state amplifiers, that are any of the following:

b.4.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz with a ''fractional bandwidth'' greater than 15%, and having any of the following:

b.4.a.1. A peak saturated power output greater than 500 W (57 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.4.a.2. A peak saturated power output greater than 270 W (54.3 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.4.a.3. A peak saturated power output greater than 200 W (53 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.4.a.4. A peak saturated power output greater than 90 W (49.54 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.4.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 31.8 GHz with a ''fractional bandwidth'' greater than 10%, and having any of the following:

b.4.b.1. A peak saturated power output greater than 70 W (48.45 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

b.4.b.2. A peak saturated power output greater than 50 W (47 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

b.4.b.3. A peak saturated power output greater than 30 W (44.77 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz; *or*

b.4.b.4. A peak saturated power output greater than 20 W (43 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

b.4.c. Rated for operation with a peak saturated power output greater than 0.5 W (27 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.4.d. Rated for operation with a peak saturated power output greater than 2 W (33 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz, and with a ''fractional bandwidth'' of greater than 10%;

b.4.e. Rated for operation at frequencies exceeding 43.5 GHz and having any of the following:

b.4.e.1. A peak saturated power output greater than 0.2 W (23 dBm) at any frequency exceeding 43.5 GHz up to and including 75 GHz, and with a ''fractional bandwidth'' of greater than 10%;

b.4.e.2. A peak saturated power output greater than 20 mW (13 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, and with a ''fractional bandwidth'' of greater than 5%; *or*

b.4.e.3. A peak saturated power output greater than 0.1 nW (−70 dBm) at any frequency exceeding 90 GHz; *or*

b.4.f. [Reserved]

N.B.:

1. *For ''MMIC'' amplifiers see 3A001.b.2.*

2. *For 'transmit/receive modules' and 'transmit modules' see 3A001.b.12.*

3. *For converters and harmonic mixers, designed to extend the operating or frequency range of signal analyzers, signal generators, network analyzers or microwave test receivers, see 3A001.b.7.*

Note 1: *[Reserved]*

Note 2: *The control status of an item whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.4.a through 3A001.b.4.e, is determined by the lowest peak saturated power output control threshold.*

b.5. Electronically or magnetically tunable band-pass or band-stop filters, having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (f_{max}/f_{min}) in less than 10 μs and having any of the following:

b.5.a. A band-pass bandwidth of more than 0.5% of center frequency; *or*

b.5.b. A band-stop bandwidth of less than 0.5% of center frequency;

b.6. [Reserved]

b.7. Converters and harmonic mixers, that are any of the following:

b.7.a. Designed to extend the frequency range of ''signal analyzers'' beyond 90 GHz;

b.7.b. Designed to extend the operating range of signal generators as follows:

b.7.b.1. Beyond 90 GHz;

b.7.b.2. To an output power greater than 100 mW (20 dBm) anywhere within the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

b.7.c. Designed to extend the operating range of network analyzers as follows:

b.7.c.1. Beyond 110 GHz;

b.7.c.2. To an output power greater than 31.62 mW (15 dBm) anywhere within the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

b.7.c.3. To an output power greater than 1 mW (0 dBm) anywhere within the frequency range exceeding 90 GHz but not exceeding 110 GHz; *or*

b.7.d. Designed to extend the frequency range of microwave test receivers beyond 110 GHz;

b.8. Microwave power amplifiers containing ''vacuum electronic devices'' controlled by 3A001.b.1 and having all of the following:

b.8.a. Operating frequencies above 3 GHz;

b.8.b. An average output power to mass ratio exceeding 80 W/kg; *and*

b.8.c. A volume of less than 400 cm^3;

Note: *3A001.b.8 does not control equipment designed or rated for operation in any frequency band which is ''allocated by the ITU'' for radio-communications services, but not for radio-determination.*

b.9. Microwave Power Modules (MPM) consisting of, at least, a traveling-wave ''vacuum electronic device,'' a ''Monolithic Microwave Integrated Circuit'' (''MMIC'') and an integrated electronic power conditioner and having all of the following:

b.9.a. A 'turn-on time' from off to fully operational in less than 10 seconds;

b.9.b. A volume less than the maximum rated power in Watts multiplied by 10 cm^3/W; *and*

b.9.c. An ''instantaneous bandwidth'' greater than 1 octave ($f_{max} > 2f_{min}$) and having any of the following:

b.9.c.1. For frequencies equal to or less than 18 GHz, an RF output power greater than 100 W; *or*

b.9.c.2. A frequency greater than 18 GHz;

Technical Notes: *For the purposes of 3A001.b.9:*

1. *To calculate the volume in 3A001.b.9.b, the following example is provided: for a maximum rated power of 20 W, the volume would be: 20 W X 10 cm^3/W = 200 cm^3.*

2. *The 'turn-on time' in 3A001.b.9.a refers to the time from fully-off to fully operational, i.e., it includes the warm-up time of the MPM.*

b.10. Oscillators or oscillator assemblies, specified to operate with a single sideband (SSB) phase noise, in dBc/Hz, less (better) than $-(126 + 20\log_{10}F - 20\log_{10}f)$ anywhere within the range of 10 Hz ≤ F ≤ 10 kHz;

Technical Note: *For the purposes of 3A001.b.10, F is the offset from the operating frequency in Hz and f is the operating frequency in MHz.*

b.11. 'Frequency synthesizer' ''electronic assemblies'' having a ''frequency switching time'' as specified by any of the following:

b.11.a. Less than 143 ps;

b.11.b. Less than 100 μs for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

b.11.c. [Reserved]

b.11.d. Less than 500 μs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 31.8 GHz but not exceeding 37 GHz;

b.11.e. Less than 100 μs for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 37 GHz but not exceeding 75 GHz;

b.11.f. Less than 100 μs for any frequency change exceeding 5.0 GHz within the synthesized frequency range exceeding 75 GHz but not exceeding 90 GHz; *or*

b.11.g. Less than 1 ms within the synthesized frequency range exceeding 90 GHz;

Technical Note: *For the purposes of 3A001.b.11, a 'frequency synthesizer' is any kind of frequency source, regardless of the actual technique used, providing a*

multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies.

N.B.: *For general purpose ''signal analyzers'', signal generators, network analyzers and microwave test receivers, see 3A002.c, 3A002.d, 3A002.e and 3A002.f, respectively.*

b.12. 'Transmit/receive modules,' 'transmit/receive MMICs,' 'transmit modules,' and 'transmit MMICs,' rated for operation at frequencies above 2.7 GHz and having all of the following:

b.12.a. 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 W*GHz^2/f_{GHz}^2] for any channel;

b.12.b. A ''fractional bandwidth'' of 5% or greater for any channel;

b.12.c. Any planar side with length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [d ≤ 15cm*GHz*N/f_{GHz}] where N is the number of transmit or transmit/receive channels; *and*

b.12.d. An electronically variable phase shifter per channel.

Technical Notes: *For the purposes of 3A001.b.12:*

1. *A 'transmit/receive module' is a multifunction ''electronic assembly'' that provides bi-directional amplitude and phase control for transmission and reception of signals.*

2. *A 'transmit module' is an ''electronic assembly'' that provides amplitude and phase control for transmission of signals.*

3. *A 'transmit/receive MMIC' is a multifunction ''MMIC'' that provides bi-directional amplitude and phase control for transmission and reception of signals.*

4. *A 'transmit MMIC' is a ''MMIC'' that provides amplitude and phase control for transmission of signals.*

5. *2.7 GHz should be used as the lowest operating frequency (f_{GHz}) in the formula in 3A001.b.12.c for transmit/receive or transmit modules that have a rated operation range extending downward to 2.7 GHz and below [d≤15cm*GHz*N/2.7 GHz].*

6. *3A001.b.12 applies to 'transmit/receive modules' or 'transmit modules' with or without a heat sink. The value of d in 3A001.b.12.c does not include any portion of the 'transmit/receive module' or 'transmit module' that functions as a heat sink.*

7. *'Transmit/receive modules' or 'transmit modules,' 'transmit/receive MMICs' or 'transmit MMICs' may or may not have N integrated radiating antenna elements where N is the number of transmit or transmit/receive channels.*

c. Acoustic wave devices as follows and ''specially designed'' ''components'' therefor:

c.1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices, having any of the following:

c.1.a. A carrier frequency exceeding 6 GHz;

c.1.b. A carrier frequency exceeding 1 GHz, but not exceeding 6 GHz and having any of the following:

c.1.b.1. A 'frequency side-lobe rejection' exceeding 65 dB;

c.1.b.2. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;

c.1.b.3. A bandwidth greater than 250 MHz; *or*

c.1.b.4. A dispersive delay of more than 10 μs; *or*

c.1.c. A carrier frequency of 1 GHz or less and having any of the following:

c.1.c.1. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;

c.1.c.2. A dispersive delay of more than 10 μs; *or*

c.1.c.3. A 'frequency side-lobe rejection' exceeding 65 dB and a bandwidth greater than 100 MHz;

Technical Note: *For the purposes of 3A001.c.1, 'frequency side-lobe rejection' is the maximum rejection value specified in data sheet.*

c.2. Bulk (volume) acoustic wave devices that permit the direct processing of signals at frequencies exceeding 6 GHz;

c.3. Acoustic-optic ''signal processing'' devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves that permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

Note: *3A001.c does not control acoustic wave devices that are limited to a single band pass, low pass, high pass or notch filtering, or resonating function.*

d. Electronic devices and circuits containing ''components,'' manufactured from ''superconductive'' materials, ''specially designed'' for operation at temperatures below the ''critical temperature'' of at least one of the ''superconductive'' constituents and having any of the following:

d.1. Current switching for digital circuits using ''superconductive'' gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; *or*

d.2. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

e. High energy devices as follows:

e.1. 'Cells' as follows:

e.1.a 'Primary cells' having any of the following at 20°C:

e.1.a.1. 'Energy density' exceeding 550 Wh/kg and a 'continuous power density' exceeding 50 W/kg; *or*

e.1.a.2. 'Energy density' exceeding 50 Wh/kg and a 'continuous power density' exceeding 350 W/kg;

e.1.b. 'Secondary cells' having an 'energy density' exceeding 350 Wh/kg at 20°C;

Technical Notes:

1. *For the purposes of 3A001.e.1, 'energy density' (Wh/kg) is calculated from the nominal voltage multiplied by the nominal capacity in ampere-hours (Ah) divided by the mass in kilograms. If the nominal capacity is not stated, energy density is calculated from the nominal voltage squared then multiplied by the discharge duration in hours divided by the discharge load in Ohms and the mass in kilograms.*

2. *For the purposes of 3A001.e.1, a 'cell' is defined as an electrochemical device, which has positive and negative electrodes, an electrolyte, and is a source of electrical energy. It is the basic building block of a battery.*

3. *For the purposes of 3A001.e.1.a, a 'primary cell' is a 'cell' that is not designed to be charged by any other source.*

4. *For the purposes of 3A001.e.1.b, a 'secondary cell' is a 'cell' that is designed to be charged by an external electrical source.*

5. *For the purposes of 3A001.e.1.a, 'continuous power density' (W/kg) is calculated from the nominal voltage multiplied by the specified maximum continuous discharge current in amperes (A) divided by the mass in kilograms. 'Continuous power density' is also referred to as specific power.*

Note: *3A001.e does not control batteries, including single-cell batteries.*

e.2. High energy storage capacitors as follows:

e.2.a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) and having all of the following:

e.2.a.1. A voltage rating equal to or more than 5 kV;

e.2.a.2. An energy density equal to or more than 250 J/kg; *and*

e.2.a.3. A total energy equal to or more than 25 kJ;

e.2.b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) and having all of the following:

e.2.b.1. A voltage rating equal to or more than 5 kV;

e.2.b.2. An energy density equal to or more than 50 J/kg;

e.2.b.3. A total energy equal to or more than 100 J; *and*

e.2.b.4. A charge/discharge cycle life equal to or more than 10,000;

e.3. ''Superconductive'' electromagnets and solenoids, ''specially designed'' to be fully charged or discharged in less than one second and having all of the following:

Note: *3A001.e.3 does not control ''superconductive'' electromagnets or solenoids ''specially designed'' for Magnetic Resonance Imaging (MRI) medical equipment.*

e.3.a. Energy delivered during the discharge exceeding 10 kJ in the first second;

e.3.b. Inner diameter of the current carrying windings of more than 250 mm; *and*

e.3.c. Rated for a magnetic induction of more than 8 T or ''overall current density'' in the winding of more than 300 A/mm^2;

e.4. Solar cells, cell-interconnect-coverglass (CIC) assemblies, solar panels, and solar arrays, which are ''space-qualified,'' having a minimum average efficiency exceeding 20% at an operating temperature of 301 K (28 °C) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m^2);

Technical Note: *For the purposes of 3A001.e.4, 'AM0', or 'Air Mass Zero', refers to the spectral irradiance of sun light in the earth's outer atmosphere when the distance between the earth and sun is one astronomical unit (AU).*

f. Rotary input type absolute position encoders having an ''accuracy'' equal to or less (better) than 1.0 second of arc and ''specially designed'' encoder rings, discs or scales therefor;

g. Solid-state pulsed power switching thyristor devices and 'thyristor modules',

using either electrically, optically, or electron radiation controlled switch methods and having any of the following:

g.1. A maximum turn-on current rate of rise (di/dt) greater than 30,000 A/µs and off-state voltage greater than 1,100 V; *or*

g.2. A maximum turn-on current rate of rise (di/dt) greater than 2,000 A/µs and having all of the following:

g.2.a. An off-state peak voltage equal to or greater than 3,000 V; *and*

g.2.b. A peak (surge) current equal to or greater than 3,000 A;

Note 1: *3A001.g. includes:*

—Silicon Controlled Rectifiers (SCRs)
—Electrical Triggering Thyristors (ETTs)
—Light Triggering Thyristors (LTTs)
—Integrated Gate Commutated Thyristors (IGCTs)
—Gate Turn-off Thyristors (GTOs)
—MOS Controlled Thyristors (MCTs)
—Solidtrons

Note 2: *3A001.g does not control thyristor devices and 'thyristor modules' incorporated into equipment designed for civil railway or ''civil aircraft'' applications.*

Technical Note: *For the purposes of 3A001.g, a 'thyristor module' contains one or more thyristor devices.*

h. Solid-state power semiconductor switches, diodes, or 'modules', having all of the following:

h.1. Rated for a maximum operating junction temperature greater than 488 K (215°C);

h.2. Repetitive peak off-state voltage (blocking voltage) exceeding 300 V; *and*

h.3. Continuous current greater than 1 A.

Technical Note: *For the purposes of 3A001.h, 'modules' contain one or more solid-state power semiconductor switches or diodes.*

Note 1: *Repetitive peak off-state voltage in 3A001.h includes drain to source voltage, collector to emitter voltage, repetitive peak reverse voltage and peak repetitive off-state blocking voltage.*

Note 2: *3A001.h includes:*

—Junction Field Effect Transistors (JFETs)
—Vertical Junction Field Effect Transistors (VJFETs)
—Metal Oxide Semiconductor Field Effect Transistors (MOSFETs)
—Double Diffused Metal Oxide Semiconductor Field Effect Transistor (DMOSFET)
—Insulated Gate Bipolar Transistor (IGBT)
—High Electron Mobility Transistors (HEMTs)
—Bipolar Junction Transistors (BJTs)
—Thyristors and Silicon Controlled Rectifiers (SCRs)
—Gate Turn-Off Thyristors (GTOs)
—Emitter Turn-Off Thyristors (ETOs)
—PiN Diodes
—Schottky Diodes

Note 3: *3A001.h does not apply to switches, diodes, or 'modules', incorporated into equipment designed for civil automobile, civil railway, or ''civil aircraft'' applications.*

i. Intensity, amplitude, or phase electro-optic modulators, designed for analog signals and having any of the following:

i.1. A maximum operating frequency of more than 10 GHz but less than 20 GHz, an optical insertion loss equal to or less than 3 dB and having any of the following:

i.1.a. A 'half-wave voltage' ('Vπ') less than 2.7 V when measured at a frequency of 1 GHz or below; *or*

i.1.b. A 'Vπ' of less than 4 V when measured at a frequency of more than 1 GHz; *or*

i.2. A maximum operating frequency equal to or greater than 20 GHz, an optical insertion loss equal to or less than 3 dB and having any of the following:

i.2.a. A 'Vπ' less than 3.3 V when measured at a frequency of 1 GHz or below; *or*

i.2.b. A 'Vπ' less than 5 V when measured at a frequency of more than 1 GHz.

Note: *3A001.i includes electro-optic modulators having optical input and output connectors (e.g., fiber-optic pigtails).*

Technical Note: *For the purposes of 3A001.i, a 'half-wave voltage' ('Vπ') is the applied voltage necessary to make a phase change of 180 degrees in the wavelength of light propagating through the optical modulator.*

* * * * *

3A002 General purpose ''electronic assemblies,'' modules and equipment, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to 3A002.h when the parameters in 3A101.a.2.b are met or exceeded.	MT Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements: *See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000: 3A002.a, .e, .f, and .g
$5000: 3A002.c to .d, and .h (unless controlled for MT);
GBS: Yes, for 3A002.h (unless controlled for MT)

Special Conditions for STA

STA: License Exception STA may not be used to ship any item in 3A002.g.1 to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See Category XV(e)(9) of the USML for certain ''space-qualified'' atomic frequency standards ''subject to the ITAR'' (see 22 CFR parts 120 through 130). See also 3A101, 3A992 and 9A515.x.
Related Definitions: Constant percentage bandwidth filters are also known as octave or fractional octave filters.
Items:

a. Recording equipment and oscilloscopes, as follows:

a.1. to a.5. [Reserved]

N.B.: *For waveform digitizers and transient recorders, see 3A002.h.*

a.6. Digital data recorders having all of the following:

a.6.a. A sustained 'continuous throughput' of more than 6.4 Gbit/s to disk or solid-state drive memory; *and*

a.6.b. ''Signal processing'' of the radio frequency signal data while it is being recorded;

Technical Notes: *For the purposes of 3A002.a.6:*

1. *For recorders 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 record to disk or solid-state drive memory without the loss of any information while sustaining the input digital data rate or digitizer conversion rate.*

a.7. Real-time oscilloscopes having a vertical root-mean-square (rms) noise voltage of less than 2% of full-scale at the vertical scale setting that provides the lowest noise value for any input 3dB bandwidth of 60 GHz or greater per channel;

Note: *3A002.a.7 does not apply to equivalent-time sampling oscilloscopes.*

b. [Reserved]

c. ''Signal analyzers'' as follows:

c.1. ''Signal analyzers'' having a 3 dB resolution bandwidth (RBW) exceeding 40 MHz anywhere within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz;

c.2. ''Signal analyzers'' having a Displayed Average Noise Level (DANL) less (better) than −150 dBm/Hz anywhere within the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

c.3. ''Signal analyzers'' having a frequency exceeding 90 GHz;

c.4. ''Signal analyzers'' having all of the following:

c.4.a. 'Real-time bandwidth' exceeding 170 MHz; *and*

c.4.b. Having any of the following:

c.4.b.1. 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; *or*

c.4.b.2. A 'frequency mask trigger' function, with 100% probability of trigger (capture) for signals having a duration of 15 µs or less;

Technical Notes:

1. *For the purposes of 3A002.c.4.a, 'real-time bandwidth' is the widest frequency range for which the analyzer can continuously transform time-domain data entirely into frequency-domain results, using a Fourier or other discrete time transform that processes every incoming time point, without a reduction of measured amplitude of more than 3 dB below the actual signal amplitude caused by gaps or windowing effects, while outputting or displaying the transformed data.*

2. *For the purposes of 3A002.c.4.b.1., probability of discovery is also referred to as probability of intercept or probability of capture.*

3. *For the purposes of 3A002.c.4.b.1, the duration for 100% probability of discovery is equivalent to the minimum signal duration necessary for the specified level measurement uncertainty.*

4. *For the purposes of 3A002.c.4.b.2, a 'frequency mask trigger' is a mechanism where the trigger function is able to select a frequency range to be triggered on as a subset of the acquisition bandwidth while ignoring other signals that may also be present within the same acquisition bandwidth. A 'frequency mask trigger' may contain more than one independent set of limits.*

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).*

c.5. [Reserved]

d. Signal generators having any of the following:

d.1. Specified to generate pulse-modulated signals having all of the following, anywhere within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz:

d.1.a. 'Pulse duration' of less than 25 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 frequency range exceeding 43.5 GHz but not exceeding 90 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 2.2 GHz within the frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

d.3.c. [Reserved]

d.3.d. Less than 500 µs for any frequency change exceeding 550 MHz within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz;

d.3.e. Less than 100 µs for any frequency change exceeding 2.2 GHz within the frequency range exceeding 37 GHz but not exceeding 75 GHz; *or*

d.3.f. [Reserved]

d.3.g. Less than 100 µs for any frequency change exceeding 5.0 GHz within the frequency range exceeding 75 GHz but not exceeding 90 GHz.

d.4. A single sideband (SSB) phase noise, in dBc/Hz, specified as being any of the following:

d.4.a. Less (better) than $-(126 + 20 \log_{10} F - 20\log_{10}f)$ for anywhere within the range of 10 Hz ≤ F ≤ 10 kHz anywhere within the frequency range exceeding 3.2 GHz but not exceeding 90 GHz; *or*

d.4.b. Less (better) than $-(206 - 20\log_{10}f)$ for anywhere within the range of 10 kHz < F ≤ 100 kHz anywhere within the frequency range exceeding 3.2 GHz but not exceeding 90 GHz;

Technical Note: *For the purposes of 3A002.d.4, F is the offset from the operating frequency in Hz and f is the operating frequency in MHz.*

d.5. An 'RF modulation bandwidth' of digital baseband signals as specified by any of the following:

d.5.a. Exceeding 2.2 GHz within the frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

d.5.b. Exceeding 550 MHz within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz;

d.5.c. Exceeding 2.2 GHz within the frequency range exceeding 37 GHz but not exceeding 75 GHz;

d.5.d. Exceeding 5.0 GHz within the frequency range exceeding 75 GHz but not exceeding 90 GHz; *or*

Technical Note: *For the purposes of 3A002.d.5, 'RF modulation bandwidth' is the Radio Frequency (RF) bandwidth occupied by a digitally encoded baseband signal modulated onto an RF signal. It is also referred to as information bandwidth or vector modulation bandwidth. I/Q digital modulation is the technical method for producing a vector-modulated RF output signal, and that output signal is typically specified as having an 'RF modulation bandwidth'.*

d.6. A maximum frequency exceeding 90 GHz;

Note 1: *For the purposes of 3A002.d, 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. *For the purposes of 3A002.d, the maximum 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 from the point on the leading edge that is 50% of the pulse amplitude to the point on the trailing edge that is 50% of the pulse amplitude.*

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 90 GHz;

e.2. An output power exceeding 1 mW (0 dBm) anywhere within the operating frequency range exceeding 90 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: *For the purposes of 3A002.e.3, '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 1×10^{-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 1×10^{-11}/month; *and*

g.3.c. Total power consumption of less than 1 Watt.

h. ''Electronic assemblies,'' modules or equipment, specified to perform all of the following:

h.1. Analog-to-digital conversions meeting any of the following:

h.1.a. A resolution of 8 bit or more, but less than 10 bit, with a ''sample rate'' greater than 1.3 Giga Samples Per Second (GSPS);

h.1.b. A resolution of 10 bit or more, but less than 12 bit, with a ''sample rate'' greater than 1.0 GSPS;

h.1.c. A resolution of 12 bit or more, but less than 14 bit, with a ''sample rate'' greater than 1.0 GSPS;

h.1.d. A resolution of 14 bit or more but less than 16 bit, with a ''sample rate'' greater than 400 Mega Samples Per Second (MSPS); *or*

h.1.e. A resolution of 16 bit or more with a ''sample rate'' greater than 180 MSPS; *and*

h.2. Any of the following:

h.2.a. Output of digitized data;

h.2.b. Storage of digitized data; *or*

h.2.c. Processing of digitized data;

N.B.: *Digital data recorders, oscilloscopes, ''signal analyzers,'' signal generators, network analyzers and microwave test receivers, are specified by 3A002.a.6, 3A002.a.7, 3A002.c, 3A002.d, 3A002.e and 3A002.f, respectively.*

Technical Notes: *For the purposes of 3A002.h:*

1. *A resolution of n bit corresponds to a quantization of 2^n levels.*

2. *The resolution of the ADC is the number of bits of the digital output of the ADC that represents the measured analog input word. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

3. *For non-interleaved multiple-channel ''electronic assemblies'', modules, or equipment, the ''sample rate'' is not aggregated and the ''sample rate'' is the maximum rate of any single channel.*

4. *For interleaved channels on multiple-channel ''electronic assemblies'', modules, or equipment, the ''sample rates'' are aggregated and the ''sample rate'' is the maximum combined total rate of all the interleaved channels.*

Note: *3A002.h includes ADC cards, waveform digitizers, data acquisition cards, signal acquisition boards and transient recorders.*

* * * * *

3B001 Equipment for the manufacturing of semiconductor devices or materials, as follows (see List of Items Controlled) and ''specially designed'' ''components'' and ''accessories'' therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $500
GBS: Yes, except a.3 (molecular beam epitaxial growth equipment using gas sources), .e (automatic loading multi-chamber central wafer handling systems *only* if connected to equipment controlled by 3B001. a.3, or .f), and .f (lithography equipment).

List of Items Controlled

Related Controls: See also 3B991.
Related Definitions: N/A
Items:

a. Equipment designed for epitaxial growth as follows:

a.1. Equipment designed or modified to produce a layer of any material other than silicon with a thickness uniform to less than ±2.5% across a distance of 75 mm or more;

Note: *3B001.a.1 includes atomic layer epitaxy (ALE) equipment.*

a.2. Metal Organic Chemical Vapor Deposition (MOCVD) reactors designed for compound semiconductor epitaxial growth of material having two or more of the following elements: aluminum, gallium, indium, arsenic, phosphorus, antimony, or nitrogen;

a.3. Molecular beam epitaxial growth equipment using gas or solid sources;

b. Equipment designed for ion implantation and having any of the following:

b.1. [Reserved]

b.2. Being designed and optimized to operate at a beam energy of 20 keV or more and a beam current of 10 mA or more for hydrogen, deuterium, or helium implant;

b.3. Direct write capability;

b.4. A beam energy of 65 keV or more and a beam current of 45 mA or more for high energy oxygen implant into a heated semiconductor material ''substrate''; *or*

b.5. Being designed and optimized to operate at beam energy of 20 keV or more and a beam current of 10mA or more for silicon implant into a semiconductor material ''substrate'' heated to 600 °C or greater;

c. [Reserved]

d. [Reserved]

e. Automatic loading multi-chamber central wafer handling systems having all of the following:

e.1. Interfaces for wafer input and output, to which more than two functionally different 'semiconductor process tools' controlled by 3B001.a.1, 3B001.a.2, 3B001.a.3 or 3B001.b are designed to be connected; *and*

e.2. Designed to form an integrated system in a vacuum environment for 'sequential multiple wafer processing';

Note: *3B001.e does not control automatic robotic wafer handling systems ''specially designed'' for parallel wafer processing.*

Technical Notes:

1. For the purposes of 3B001.e.1, 'semiconductor process tools' refers to modular tools that provide physical processes for semiconductor production that are functionally different, such as deposition, implant or thermal processing.

2. For the purposes of 3B001.e.2, 'sequential multiple wafer processing' means the capability to process each wafer in different 'semiconductor process tools', such as by transferring each wafer from one tool to a second tool and on to a third tool with the automatic loading multi-chamber central wafer handling systems.

f. Lithography equipment as follows:

f.1. Align and expose step and repeat (direct step on wafer) or step and scan (scanner) equipment for wafer processing using photo-optical or X-ray methods and having any of the following:

f.1.a. A light source wavelength shorter than 193 nm; *or*

f.1.b. Capable of producing a pattern with a ''Minimum Resolvable Feature size'' (MRF) of 45 nm or less;

Technical Note: *For the purposes of 3B001.f.1.b, the 'Minimum Resolvable Feature size' (MRF) is calculated by the following formula:*

MRF = (an exposure light source wavelength in nm) × (K factor)/numerical aperture

where the K factor = 0.35

f.2 Imprint lithography equipment capable of production features of 45 nm or less;

Note: *3B001.f.2 includes:*

—Micro contact printing tools
—Hot embossing tools
—Nano-imprint lithography tools
—Step and flash imprint lithography (S–FIL) tools

f.3. Equipment ''specially designed'' for mask making having all of the following:

f.3.a. A deflected focused electron beam, ion beam or ''laser'' beam; *and*

f.3.b. Having any of the following:

f.3.b.1. A Full-Width Half-Maximum (FWHM) spot size smaller than 65 nm and an image placement less than 17 nm (mean + 3 sigma); *or*

f.3.b.2. [Reserved]

f.3.b.3. A second-layer overlay error of less than 23 nm (mean + 3 sigma) on the mask;

f.4. Equipment designed for device processing using direct writing methods, having all of the following:

f.4.a. A deflected focused electron beam; *and*

f.4.b. Having any of the following:

f.4.b.1. A minimum beam size equal to or smaller than 15 nm; *or*

f.4.b.2. An overlay error less than 27 nm (mean + 3 sigma);

g. Masks and reticles, designed for integrated circuits controlled by 3A001;

h. Multi-layer masks with a phase shift layer not specified by 3B001.g and designed to be used by lithography equipment having a light source wavelength less than 245 nm;

Note: *3B001.h. does not control multi-layer masks with a phase shift layer designed for the fabrication of memory devices not controlled by 3A001.*

N.B.: *For masks and reticles, ''specially designed'' for optical sensors, see 6B002.*

i. Imprint lithography templates designed for integrated circuits by 3A001;

j. Mask ''substrate blanks'' with multilayer reflector structure consisting of molybdenum and silicon, and having all of the following:

j.1. ''Specially designed'' for 'Extreme Ultraviolet (EUV)' lithography; *and*

j.2. Compliant with SEMI Standard P37.

Technical Note: *For the purposes of 3B001.j, 'Extreme Ultraviolet (EUV)' refers to electromagnetic spectrum wavelengths greater than 5 nm and less than 124 nm.*

* * * * *

3D003 'Computational lithography' ''software'' ''specially designed''for the ''development'' of patterns on EUV-lithography masks or reticles.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes

List of Items Controlled

Related Controls: N/A
Related Definitions: For the purposes of 3D003, 'computational lithography' is the use of computer modelling to predict, correct, optimize and verify imaging performance of the lithography process over a range of patterns, processes, and system conditions.
Items:

The list of items controlled is contained in the ECCN heading.

* * * * *

3D006 'Electronic Computer-Aided Design' ('ECAD') ''software'' ''specially designed'' for the ''development'' of integrated circuits having any ''Gate-All-Around Field-Effect Transistor'' (''GAAFET'') structure, and having any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see supp. no. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for Description of All License Exceptions)

TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. ''Specially designed'' for implementing 'Register Transfer Level' ('RTL') to 'Geometrical Database Standard II' ('GDSII') or equivalent standard; *or*

b. ''Specially designed'' for optimization of power or timing rules.

Technical Notes: *For the purposes of 3D006:*

1. 'Electronic Computer-Aided Design' ('ECAD') is a category of ''software'' tools used for designing, analyzing, optimizing, and validating the performance of an integrated circuit or printed circuit board.

2. 'Register Transfer Level' ('RTL') is a design abstraction which models a synchronous digital circuit in terms of the flow of digital signals between hardware registers and the logical operations performed on those signals.

3. 'Geometrical Database Standard II' ('GDSII') is a database file format for data exchange of integrated circuit or integrated circuit layout artwork.

* * * * *

3E001 ''Technology'' according to the General Technology Note for the ''development'' or ''production'' of commodities controlled by 3A (except 3A980, 3A981, 3A991, 3A992, or 3A999), 3B (except 3B991 or 3B992) or 3C (except 3C992).

License Requirements

Reason for Control: NS, MT, NP, RS, AT

Control(s)	*Country chart (see supp. no. 1 to part 738)*
NS applies to ''technology'' for commodities controlled by 3A001, 3A002, 3A003, 3B001, 3B002, or 3C001 to 3C006.	NS Column 1
MT applies to ''technology'' for commodities controlled by 3A001 or 3A101 for MT reasons.	MT Column 1
NP applies to ''technology'' for commodities controlled by 3A001, 3A201, or 3A225 to 3A234 for NP reasons.	NP Column 1
RS applies to ''technology'' for commodities controlled by 3A090 or 3B090.	China and Macau (See § 742.6(a)(6))
RS applies to ''technology'' for commodities controlled in 3A090, when exported from China or Macau.	Worldwide (See § 742.6(a)(6))
AT applies to entire entry.	AT Column 1

License Requirements Note: *See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating ''information security'' functionality, and associated ''software'' and ''technology'' for the ''production'' or ''development'' of such microprocessors.*

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes, except N/A for MT, and ''technology'' for the ''development'' or ''production'' of: (a) vacuum electronic device amplifiers described in 3A001.b.8, having operating frequencies exceeding 19 GHz; (b) solar cells, coverglass-interconnect-cells or covered-interconnect-cells (CIC) ''assemblies'', solar arrays and/or solar panels described in 3A001.e.4; (c) ''Monolithic Microwave Integrated Circuit'' (''MMIC'') amplifiers in 3A001.b.2; and (d) discrete microwave transistors in 3A001.b.3.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit ''technology'' according to the General Technology Note for the ''development'' or ''production'' of equipment specified by ECCNs 3A002.g.1 or 3B001.a.2 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR). License Exception STA may not be used to ship or transmit ''technology'' according to the General Technology Note for the ''development'' or ''production'' of components specified by ECCN 3A001.b.2 or b.3 to any of the destinations listed in Country Group A:5 or A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) ''Technology'' according to the General Technology Note for the ''development'' or ''production'' of certain ''space-qualified'' atomic frequency standards described in Category XV(e)(9), MMICs described in Category XV(e)(14), and oscillators described in Category XV(e)(15) of the USML are ''subject to the ITAR'' (see 22 CFR parts 120 through 130). See also 3E101, 3E201 and 9E515. (2) ''Technology'' for ''development'' or ''production'' of ''Microwave Monolithic Integrated Circuits'' (''MMIC'') amplifiers in 3A001.b.2 is controlled in this ECCN 3E001; 5E001.d refers only to that additional ''technology'' ''required'' for telecommunications.

Related Definition: N/A

Items:

The list of items controlled is contained in the ECCN heading.

Note 1: *3E001 does not control ''technology'' for equipment or ''components'' controlled by 3A003.*

Note 2: *3E001 does not control ''technology'' for integrated circuits controlled by 3A001.a.3 to a.14, having all of the following:*

(a) Using ''technology'' at or above 0.130 μm; and

(b) Incorporating multi-layer structures with three or fewer metal layers.

Note 3: *3E001 does not apply to 'Process Design Kits' ('PDKs') unless they include libraries implementing functions or technologies for items specified by 3A001 or 3A090.*

Technical Note: *For the purposes of 3E001 Note 3, a 'Process Design Kit' ('PDK') is a software tool provided by a semiconductor manufacturer to ensure that the required design practices and rules are taken into account in order to successfully produce a specific integrated circuit design in a specific semiconductor process, in accordance with technological and manufacturing constraints (each semiconductor manufacturing process has its particular 'PDK').*

3E002 ''Technology'' according to the General Technology Note other than that controlled in 3E001 for the ''development'' or ''production'' of a ''microprocessor microcircuit'', ''microcomputer microcircuit'' and microcontroller microcircuit core, having an arithmetic logic unit with an access width of 32 bits or more and any of the following features or characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

License Requirements Note: *See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating ''information security'' functionality, and associated ''software'' and ''technology'' for the ''production'' or ''development'' of such microprocessors.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes

List of Items Controlled

Related Controls: N/A

Related Definitions: N/A

Items:

a. A 'vector processor unit' designed to perform more than two calculations on 'floating-point' vectors (one-dimensional arrays of 32-bit or larger numbers) simultaneously;

Technical Note: *For the purposes of 3E002.a, a 'vector processor unit' is a processor element with built-in instructions that perform multiple calculations on 'floating-point' vectors (one-dimensional arrays of 32-bit or larger numbers) simultaneously, having at least one vector arithmetic logic unit and vector registers of at least 32 elements each.*

b. Designed to perform more than four 64-bit or larger 'floating-point' operation results per cycle; *or*

c. Designed to perform more than eight 16-bit 'fixed-point' multiply-accumulate results

per cycle (*e.g.,* digital manipulation of analog information that has been previously converted into digital form, also known as digital ''signal processing'').

Note 1: *3E002 does not control ''technology'' for multimedia extensions.*

Note 2: *3E002 does not control ''technology'' for microprocessor cores, having all of the following:*

a. *Using ''technology'' at or above 0.130 μm; and*

b. *Incorporating multi-layer structures with five or fewer metal layers.*

Note 3: *3E002 includes ''technology'' for the ''development'' or ''production'' of digital signal processors and digital array processors.*

Technical Notes:

1. For the purposes of 3E002.a and 3E002.b, 'floating-point' is defined by IEEE–754.

2. For the purposes of 3E002.c, 'fixed-point' refers to a fixed-width real number with both an integer component and a fractional component, and which does not include integer-only formats.

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Category 4—Computers

* * * * *

Technical Note: *For the purposes of Note 2, 'main storage' is the primary storage for data or instructions for rapid access by a central processing unit. It consists of the internal storage of a ''digital computer'' and any hierarchical extension thereto, such as cache storage or non-sequentially accessed extended storage.*

* * * * *

4A004 Computers as follows (see List of Items Controlled) and ''specially designed'' related equipment, ''electronic assemblies'' and ''components'' therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. 'Systolic array computers';
b. 'Neural computers';
c. 'Optical computers'.

Technical Notes:

1. For the purposes of 4A004.a, 'systolic array computers' are computers where the flow and modification of the data is dynamically controllable at the logic gate level by the user.

2. For the purposes of 4A004.b, 'neural computers' are computational devices designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e., computational devices which are distinguished by their hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data.

3. For the purposes of 4A004.c, 'optical computers' are computers designed or modified to use light to represent data and whose computational logic elements are based on directly coupled optical devices.

* * * * *

4D001 ''Software'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, CC, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
CC applies to ''software'' for computerized finger-print equipment controlled by 4A003 for CC reasons.	CC Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes, except for ''software'' for the ''development'' or ''production'' of the following:
(1) Commodities with an ''Adjusted Peak Performance'' (''APP'') exceeding 70 WT; or
(2) Commodities controlled by 4A005 or ''software'' controlled by 4D004.
APP: Yes to specific countries (see § 740.7 of the EAR for eligibility criteria)
ACE: Yes for 4D001.a (for the ''development'', ''production'' or ''use'' of equipment or ''software'' specified in ECCN 4A005 or 4D004), except to Country Group E:1 or E:2. See § 740.22 of the EAR for eligibility criteria.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit ''software'' ''specially designed'' or modified for the ''development'' or ''production'' of equipment specified by ECCN 4A001.a.2 or for the ''development'' or ''production'' of ''digital computers'' having an 'Adjusted Peak Performance' ('APP') exceeding 70 Weighted TeraFLOPS (WT) to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR); and may not be used to ship or transmit ''software'' specified in 4D001.a ''specially designed'' for the ''development'' or ''production'' of equipment specified by ECCN 4A005 to any of the destinations listed in Country Group A:5 or A:6.

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. ''Software'' ''specially designed'' or modified for the ''development'' or ''production'', of equipment or ''software'' controlled by 4A001, 4A003, 4A004, 4A005 or 4D (except 4D090, 4D980, 4D993 or 4D994).

b. ''Software'', other than that controlled by 4D001.a, ''specially designed'' or modified for the ''development'' or ''production'' of equipment as follows:

b.1. ''Digital computers'' having an ''Adjusted Peak Performance'' (''APP'') exceeding 24 Weighted TeraFLOPS (WT);

b.2. ''Electronic assemblies'' ''specially designed'' or modified for enhancing performance by aggregation of processors so that the ''APP'' of the aggregation exceeds the limit in 4D001.b.1.

* * * * *

4E001 ''Technology'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, RS, CC, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry, except 4A090 or ''software'' specified by 4D090.	NS Column 1
MT applies to ''technology'' for items controlled by 4A001.a and 4A101 for MT reasons.	MT Column 1
RS applies to ''technology'' for commodities controlled by 4A090 or ''software'' specified by 4D090.	China and Macau (See § 742.6(a)(6))
CC applies to ''software'' for computerized finger-print equipment controlled by 4A003 for CC reasons.	CC Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes, except for the following:
(1) ''Technology'' for the ''development'' or ''production'' of commodities with an ''Adjusted Peak Performance'' (''APP'') exceeding 70 WT or for the ''development'' or ''production'' of commodities controlled

by 4A005 or ''software'' controlled by 4D004; or

(2) ''Technology'' for the ''development'' of ''intrusion software''.

APP: Yes to specific countries (see § 740.7 of the EAR for eligibility criteria).

ACE: Yes for 4E001.a (for the ''development'', ''production'' or ''use'' of equipment or ''software'' specified in ECCN 4A005 or 4D004) and for 4E001.c, except to Country Group E:1 or E:2. See § 740.22 of the EAR for eligibility criteria.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit ''technology'' according to the General Technology Note for the ''development'' or ''production'' of any of the following equipment or ''software'': a. Equipment specified by ECCN 4A001.a.2; b. ''Digital computers'' having an 'Adjusted Peak Performance' ('APP') exceeding 70 Weighted TeraFLOPS (WT); or c. ''software'' specified in the License Exception STA paragraph found in the License Exception section of ECCN 4D001 to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR); and may not be used to ship or transmit ''technology'' specified in 4E001.a (for the ''development'', ''production'' or ''use'' of equipment or ''software'' specified in ECCN 4A005 or 4D004) and 4E001.c to any of the destinations listed in Country Group A:5 or A:6.

List of Items Controlled

Related Controls: N/A

Related Definitions: N/A

Items:

a. ''Technology'' according to the General Technology Note, for the ''development'', ''production'', or ''use'' of equipment or ''software'' controlled by 4A (except 4A980 or 4A994) or 4D (except 4D980, 4D993, 4D994).

b. ''Technology'' according to the General Technology Note, other than that controlled by 4E001.a, for the ''development'' or ''production'' of equipment as follows:

b.1. ''Digital computers'' having an ''Adjusted Peak Performance'' (''APP'') exceeding 24 Weighted TeraFLOPS (WT);

b.2. ''Electronic assemblies'' ''specially designed'' or modified for enhancing performance by aggregation of processors so that the ''APP'' of the aggregation exceeds the limit in 4E001.b.1.

c. ''Technology'' for the ''development'' of ''intrusion software.''

Note 1: *4E001.a and 4E001.c do not apply to ''vulnerability disclosure'' or ''cyber incident response''.*

Note 2: *Note 1 does not diminish national authorities' rights to ascertain compliance with 4E001.a and 4E001.c.*

* * * * *

5A001 Telecommunications systems, equipment, ''components'' and ''accessories,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, SL, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to 5A001.a, b.5, .e, .f.3 and .h.	NS Column 1
NS applies to 5A001.b (except .b.5), .c, .d, .f (except f.3), .g, and .j.	NS Column 2
SL applies to 5A001.f.1.	A license is required for all destinations, as specified in § 742.13 of the EAR. Accordingly, a column specific to this control does not appear on the Commerce Country Chart (Supplement No. 1 to Part 738 of the EAR). *Note to SL paragraph: This licensing requirement does not supersede, nor does it implement, construe or limit the scope of any criminal statute, including, but not limited to the Omnibus Safe Streets Act of 1968, as amended*
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A for 5A001.a, b.5, .e, f.3 and .h; $5000 for 5A001.b.1, .b.2, .b.3, .b.6, .d, f.2, f.4, and .g;

$3000 for 5A001.c.

GBS: Yes, except 5A001.a, b.5, e, and h.

ACE: Yes for 5A001.j, except to Country Group E:1 or E:2. See § 740.22 of the EAR for eligibility criteria

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in 5A001.j to any of the destinations listed in Country Group A:5 or A:6 (See Supplement No. 1 to part 740 of the EAR), or any commodity in 5A001.b.3, .b.5 or .h to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See USML Category XI for controls on direction-finding ''equipment'' including types of ''equipment'' in ECCN 5A001.e and any other military or intelligence electronic ''equipment'' that is ''subject to the ITAR.'' (2) See USML Category XI(a)(4)(iii) for controls on electronic attack and jamming ''equipment'' defined in 5A001.f and .h that are subject to the ITAR. (3) See also ECCNs 5A101, 5A980, and 5A991.

Related Definitions: N/A

Items:

a. Any type of telecommunications equipment having any of the following characteristics, functions or features:

a.1. ''Specially designed'' to withstand transitory electronic effects or electromagnetic pulse effects, both arising from a nuclear explosion;

a.2. Specially hardened to withstand gamma, neutron or ion radiation;

a.3. ''Specially designed'' to operate below 218 K (−55 °C); *or*

a.4. ''Specially designed'' to operate above 397 K (124 °C);

Note: *5A001.a.3 and 5A001.a.4 apply only to electronic equipment.*

b. Telecommunication systems and equipment, and ''specially designed'' ''components'' and ''accessories'' therefor, having any of the following characteristics, functions or features:

b.1 Being underwater untethered communications systems having any of the following:

b.1.a. An acoustic carrier frequency outside the range from 20 kHz to 60 kHz;

b.1.b. Using an electromagnetic carrier frequency below 30 kHz; *or*

b.1.c. Using electronic beam steering techniques; *or*

b.1.d. Using ''lasers'' or light-emitting diodes (LEDs), with an output wavelength greater than 400 nm and less than 700 nm, in a ''local area network'';

b.2. Being radio equipment operating in the 1.5 MHz to 87.5 MHz band and having all of the following:

b.2.a. Automatically predicting and selecting frequencies and ''total digital transfer rates'' per channel to optimize the transmission; *and*

b.2.b. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the frequency range of 1.5 MHz or more but less than 30 MHz, or 250 W or more in the frequency range of 30 MHz or more but not exceeding 87.5 MHz, over an ''instantaneous bandwidth'' of one octave or more and with an output harmonic and distortion content of better than −80 dB;

b.3. Being radio equipment employing ''spread spectrum'' techniques, including ''frequency hopping'' techniques, not controlled in 5A001.b.4 and having any of the following:

b.3.a. User programmable spreading codes; *or*

b.3.b. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz;

Note: *5A001.b.3.b does not control radio equipment ''specially designed'' for use with any of the following:*

a. Civil cellular radio-communications systems; or

b. Fixed or mobile satellite Earth stations for commercial civil telecommunications.

Note: *5A001.b.3 does not control equipment operating at an output power of 1 W or less.*

b.4. Being radio equipment employing ultra-wideband modulation techniques, having user programmable channelizing codes, scrambling codes, or network identification codes and having any of the following:

b.4.a. A bandwidth exceeding 500 MHz; *or*

b.4.b. A ''fractional bandwidth'' of 20% or more;

b.5. Being digitally controlled radio receivers having all of the following:

b.5.a. More than 1,000 channels;

b.5.b. A 'channel switching time ' of less than 1 ms;

b.5.c. Automatic searching or scanning of a part of the electromagnetic spectrum; *and*

b.5.d. Identification of the received signals or the type of transmitter; *or*

Note: *5A001.b.5 does not control radio equipment ''specially designed'' for use with civil cellular radio-communications systems.*

Technical Note: *For the purposes of 5A001.b.5.b, 'channel switching time' means the time (i.e., delay) to change from one receiving frequency to another, to arrive at or within ±0.05% of the final specified receiving frequency. Items having a specified frequency range of less than ±0.05% around their center frequency are defined to be incapable of channel frequency switching.*

b.6. Employing functions of digital ''signal processing'' to provide 'voice coding' output at rates of less than 700 bit/s.

Technical Notes:

1. For variable rate 'voice coding', 5A001.b.6 applies to the 'voice coding' output of continuous speech.

2. For the purposes of 5A001.b.6, 'voice coding' is defined as the technique to take samples of human voice and then convert these samples of human voice into a digital signal taking into account specific characteristics of human speech.

c. Optical fibers of more than 500 m in length and specified by the manufacturer as being capable of withstanding a 'proof test' tensile stress of 2×10^9 N/m^2 or more;

N.B.: *For underwater umbilical cables, see 8A002.a.3.*

Technical Note: *For the purposes of 5A001.c, 'proof test' is the on-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fiber at a running rate of 2 to 5 m/s while passing between capstans approximately 150 mm in diameter. The ambient temperature is a nominal 293 K (20 °C) and relative humidity 40%. Equivalent national standards may be used for executing the proof test.*

d. ''Electronically steerable phased array antennae'' as follows:

d.1. Rated for operation above 31.8 GHz, but not exceeding 57 GHz, and having an Effective Radiated Power (ERP) equal to or greater than +20 dBm (22.15 dBm Effective Isotropic Radiated Power (EIRP));

d.2. Rated for operation above 57 GHz, but not exceeding 66 GHz, and having an ERP equal to or greater than +24 dBm (26.15 dBm EIRP);

d.3. Rated for operation above 66 GHz, but not exceeding 90 GHz, and having an ERP equal to or greater than +20 dBm (22.15 dBm EIRP);

d.4. Rated for operation above 90 GHz;

Note 1: *5A001.d does not control 'electronically steerable phased array antennae' for landing systems with instruments meeting ICAO standards covering Microwave Landing Systems (MLS).*

Note 2: *5A001.d does not apply to antennae ''specially designed'' for any of the following:*

a. Civil cellular or WLAN radio-communications systems;

b. IEEE 802.15 or wireless HDMI; or

c. Fixed or mobile satellite earth stations for commercial civil telecommunications.

Technical Note: *For the purposes of 5A001.d, 'electronically steerable phased array antenna' is an antenna which forms a beam by means of phase coupling, (i.e., the beam direction is controlled by the complex excitation coefficients of the radiating elements) and the direction of that beam can be varied (both in transmission and reception) in azimuth or in elevation, or both, by application of an electrical signal.*

e. Radio direction finding equipment operating at frequencies above 30 MHz and having all of the following, and ''specially designed'' ''components'' therefor:

e.1. ''Instantaneous bandwidth'' of 10 MHz or more; and

e.2. Capable of finding a Line Of Bearing (LOB) to non-cooperating radio transmitters with a signal duration of less than 1 ms;

f. Mobile telecommunications interception or jamming equipment, and monitoring equipment therefor, as follows, and ''specially designed'' ''components'' therefor:

f.1. Interception equipment designed for the extraction of voice or data, transmitted over the air interface;

f.2. Interception equipment not specified in 5A001.f.1, designed for the extraction of client device or subscriber identifiers (*e.g.,* IMSI, TIMSI or IMEI), signaling, or other metadata transmitted over the air interface;

f.3. Jamming equipment ''specially designed'' or modified to intentionally and selectively interfere with, deny, inhibit, degrade or seduce mobile telecommunication services and performing any of the following:

f.3.a. Simulate the functions of Radio Access Network (RAN) equipment;

f.3.b. Detect and exploit specific characteristics of the mobile telecommunications protocol employed (*e.g.,* GSM); *or*

f.3.c. Exploit specific characteristics of the mobile telecommunications protocol employed (*e.g.,* GSM);

f.4. Radio Frequency (RF) monitoring equipment designed or modified to identify the operation of items specified in 5A001.f.1, 5A001.f.2 or 5A001.f.3.

Note: *5A001.f.1 and 5A001.f.2 do not apply to any of the following:*

a. Equipment ''specially designed'' for the interception of analog Private Mobile Radio (PMR), IEEE 802.11 WLAN;

b. Equipment designed for mobile telecommunications network operators; or

c. Equipment designed for the ''development'' or ''production'' of mobile telecommunications equipment or systems.

N.B. 1: *See also the International Traffic in Arms Regulations (ITAR) (22 CFR parts 120–130). For items specified by 5A001.f.1 (including as previously specified by 5A001.i), see also 5A980 and the U.S. Munitions List (22 CFR part 121).*

N.B. 2: *For radio receivers see 5A001.b.5.*

g. Passive Coherent Location (PCL) systems or equipment, ''specially designed'' for detecting and tracking moving objects by measuring reflections of ambient radio frequency emissions, supplied by non-radar transmitters.

Technical Note: *For the purposes of 5A001.g, non-radar transmitters may include commercial radio, television or cellular telecommunications base stations.*

Note: *5A001.g. does not control:*

a. Radio-astronomical equipment; or

b. Systems or equipment, that require any radio transmission from the target.

h. Counter Improvised Explosive Device (IED) equipment and related equipment, as follows:

h.1. Radio Frequency (RF) transmitting equipment, not specified by 5A001.f, designed or modified for prematurely activating or preventing the initiation of Improvised Explosive Devices (IEDs);

h.2. Equipment using techniques designed to enable radio communications in the same frequency channels on which co-located equipment specified by 5A001.h.1 is transmitting.

N.B.: *See also Category XI of the International Traffic in Arms Regulations (ITAR) (22 CFR parts 120–130).*

i. [Reserved]

N.B.: *See 5A001.f.1 for items previously specified by 5A001.i.*

j. IP network communications surveillance systems or equipment, and ''specially designed'' components therefor, having all of the following:

j.1. Performing all of the following on a carrier class IP network (*e.g.,* national grade IP backbone):

j.1.a. Analysis at the application layer (*e.g.,* Layer 7 of Open Systems Interconnection (OSI) model (ISO/IEC 7498–1));

j.1.b. Extraction of selected metadata and application content (*e.g.,* voice, video, messages, attachments); *and*

j.1.c. Indexing of extracted data; *and*

j.2. Being ''specially designed'' to carry out all of the following:

j.2.a. Execution of searches on the basis of ''hard selectors''; *and*

j.2.b. Mapping of the relational network of an individual or of a group of people.

Note: *5A001.j does not apply to ''systems'' or ''equipment'', ''specially designed'' for any of the following:*

a. Marketing purpose;

b. Network Quality of Service (QoS); or

c. Quality of Experience (QoE).

N.B.: *See also the International Traffic in Arms Regulations (ITAR) (22 CFR parts 120–130). Defense articles described in USML Category XI(b) are ''subject to the ITAR.''*

* * * * *

Category 5—Telecommunications and ''Information Security''

Part 2—''Information Security''

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Technical Note: *For the purposes of the Cryptography Note, 'executable software' means ''software'' in executable form, from*

an existing hardware component excluded from 5A002, by the Cryptography Note.

* * * * *

5A002 ''Information security'' systems, equipment and ''components,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT, EI

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1
EI applies to entire entry.	Refer to § 742.15 of the EAR.

License Requirements Note: *See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating ''information security'' functionality, and associated ''software'' and ''technology'' for the ''production'' or ''development'' of such microprocessors.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: Yes: $500 for ''components''.
N/A for systems and equipment.
GBS: N/A
ENC: Yes for certain EI controlled commodities, see § 740.17 of the EAR for eligibility.

List of Items Controlled

Related Controls: (1) ECCN 5A002.a controls ''components'' providing the means or functions necessary for ''information security.'' All such ''components'' are presumptively ''specially designed'' and controlled by 5A002.a. (2) See USML Categories XI (including XI(b)) and XIII(b) (including XIII(b)(2)) for controls on systems, equipment, and components described in 5A002.d or .e that are subject to the ITAR. (3) For ''satellite navigation system'' receiving equipment containing or employing decryption see 7A005, and for related decryption ''software'' and ''technology'' see 7D005 and 7E001. (4) Noting that items may be controlled elsewhere on the CCL, examples of items not controlled by ECCN 5A002.a.4 include the following: (a) An automobile where the only 'cryptography for data confidentiality' having a 'described security algorithm' is performed by a Category 5—Part 2 Note 3 eligible mobile telephone that is built into the car. In this case, secure phone communications support a non-primary function of the automobile but the mobile telephone (equipment), as a standalone item, is not controlled by ECCN 5A002 because it is excluded by the Cryptography Note (Note 3) (See ECCN 5A992.c). (b) An exercise bike with an embedded Category 5—Part 2 Note 3 eligible web browser, where the only controlled cryptography is performed by the web browser. In this case, secure web browsing supports a non-primary function of the exercise bike but the web browser (''software''), as a standalone item, is not controlled by ECCN 5D002 because it is excluded by the Cryptography Note (Note 3) (See ECCN 5D992.c). (5) After classification or self-classification in accordance with § 740.17(b) of the EAR, mass market encryption commodities that meet eligibility requirements are released from ''EI'' and ''NS'' controls. These commodities are designated 5A992.c.
Related Definitions: N/A
Items:

a. Designed or modified to use 'cryptography for data confidentiality' having a 'described security algorithm', where that cryptographic capability is usable, has been activated, or can be activated by any means other than secure ''cryptographic activation'', as follows:

a.1. Items having ''information security'' as a primary function;

a.2. Digital communication or networking systems, equipment or components, not specified in paragraph 5A002.a.1;

a.3. Computers, other items having information storage or processing as a primary function, and components therefor, not specified in paragraphs 5A002.a.1 or .a.2;

N.B.: *For operating systems see also 5D002.a.1 and .c.1.*

a.4. Items, not specified in paragraphs 5A002.a.1 to a.3, where the 'cryptography for data confidentiality' having a 'described security algorithm' meets all of the following:

a.4.a. It supports a non-primary function of the item; *and*

a.4.b. It is performed by incorporated equipment or ''software'' that would, as a standalone item, be specified by ECCNs 5A002, 5A003, 5A004, 5B002 or 5D002.

N.B. to paragraph a.4: *See Related Control Paragraph (4) of this ECCN 5A002 for examples of items not controlled by 5A002.a.4.*

Technical Notes:

1. For the purposes of 5A002.a, 'cryptography for data confidentiality' means ''cryptography'' that employs digital techniques and performs any cryptographic function other than any of the following:

1.a. ''Authentication;''

1.b. Digital signature;

1.c. Data integrity;

1.d. Non-repudiation;

1.e. Digital rights management, including the execution of copy-protected ''software;''

1.f. Encryption or decryption in support of entertainment, mass commercial broadcasts or medical records management; or

1.g. Key management in support of any function described in paragraphs 1.a to 1.f of this Technical Note paragraph 1.

2. For the purposes of 5A002.a, 'described security algorithm' means any of the following:

2.a. A ''symmetric algorithm'' employing a key length in excess of 56 bits, not including parity bits;

2.b. An ''asymmetric algorithm'' where the security of the algorithm is based on any of the following:

2.b.1. Factorization of integers in excess of 512 bits (e.g., RSA);

2.b.2. Computation of discrete logarithms in a multiplicative group of a finite field of size greater than 512 bits (e.g., Diffie-Hellman over Z/pZ); or

2.b.3. Discrete logarithms in a group other than mentioned in paragraph 2.b.2 of this Technical Note in excess of 112 bits (e.g., Diffie-Hellman over an elliptic curve); or

2.c. An ''asymmetric algorithm'' where the security of the algorithm is based on any of the following:

2.c.1. Shortest vector or closest vector problems associated with lattices (e.g., NewHope, Frodo, NTRUEncrypt, Kyber, Titanium);

2.c.2. Finding isogenies between Supersingular elliptic curves (e.g., Supersingular Isogeny Key Encapsulation); or

2.c.3. Decoding random codes (e.g., McEliece, Niederreiter).

Technical Note: *An algorithm described by Technical Note 2.c. may be referred to as being post-quantum, quantum-safe or quantum-resistant.*

Note 1: *Details of items must be accessible and provided upon request, in order to establish any of the following:*

a. Whether the item meets the criteria of 5A002.a.1 to a.4; or

b. Whether the cryptographic capability for data confidentiality specified by 5A002.a is usable without ''cryptographic activation.''

Note 2: *5A002.a does not control any of the following items, or specially designed ''information security'' components therefor:*

a. Smart cards and smart card 'readers/writers' as follows:

a.1. A smart card or an electronically readable personal document (e.g., token coin, e-passport) that meets any of the following:

a.1.a. The cryptographic capability meets all of the following:

a.1.a.1. It is restricted for use in any of the following:

a.1.a.1.a. Equipment or systems, not described by 5A002.a.1 to a.4;

a.1.a.1.b. Equipment or systems, not using 'cryptography for data confidentiality' having a 'described security algorithm'; or

a.1.a.1.c. Equipment or systems, excluded from 5A002.a by entries b. to f. of this Note; and

a.1.a.2. It cannot be reprogrammed for any other use; or

a.1.b. Having all of the following:

a.1.b.1. It is specially designed and limited to allow protection of 'personal data' stored within;

a.1.b.2. Has been, or can only be, personalized for public or commercial transactions or individual identification; and

a.1.b.3. Where the cryptographic capability is not user-accessible;

Technical Note to paragraph a.1.b.1 of Note 2: *For the purposes of 5A002.a Note 2.a.1.b.1, 'personal data' includes any data specific to a particular person or entity, such as the amount of money stored and data necessary for ''authentication.''*

a.2. 'Readers/writers' specially designed or modified, and limited, for items specified by paragraph a.1 of this Note;

Technical Note to paragraph a.2 of Note 2: *For the purposes of 5A002.a Note 2.a.2, 'readers/writers' include equipment that communicates with smart cards or electronically readable documents through a network.*

b. Cryptographic equipment specially designed and limited for banking use or 'money transactions';

Technical Note to paragraph b of Note 2: *For the purposes of 5A002.a Note 2.b, 'money transactions' in 5A002 Note 2 paragraph b. includes the collection and settlement of fares or credit functions.*

c. Portable or mobile radiotelephones for civil use (e.g., for use with commercial civil cellular radio communication systems) that are not capable of transmitting encrypted data directly to another radiotelephone or equipment (other than Radio Access Network (RAN) equipment), nor of passing encrypted data through RAN equipment (e.g., Radio Network Controller (RNC) or Base Station Controller (BSC));

d. Cordless telephone equipment not capable of end-to-end encryption where the maximum effective range of unboosted cordless operation (i.e., a single, unrelayed hop between terminal and home base station) is less than 400 meters according to the manufacturer's specifications;

e. Portable or mobile radiotelephones and similar client wireless devices for civil use, that implement only published or commercial cryptographic standards (except for anti-piracy functions, which may be non-published) and also meet the provisions of paragraphs a.2 to a.4 of the Cryptography Note (Note 3 in Category 5—Part 2), that have been customized for a specific civil industry application with features that do not affect the cryptographic functionality of these original non-customized devices;

f. Items, where the ''information security'' functionality is limited to wireless ''personal area network'' functionality implementing only published or commercial cryptographic standards;

g. Mobile telecommunications Radio Access Network (RAN) equipment designed for civil use, which also meet the provisions of paragraphs a.2 to a.4 of the Cryptography Note (Note 3 in Category 5—Part 2), having an RF output power limited to 0.1W (20 dBm) or less, and supporting 16 or fewer concurrent users;

h. Routers, switches, gateways or relays, where the ''information security'' functionality is limited to the tasks of ''Operations, Administration or Maintenance'' (''OAM'') implementing only published or commercial cryptographic standards;

i. General purpose computing equipment or servers, where the ''information security'' functionality meets all of the following:

i.1. Uses only published or commercial cryptographic standards; and

i.2. Is any of the following:

i.2.a. Integral to a CPU that meets the provisions of Note 3 in Category 5—Part 2;

i.2.b. Integral to an operating system that is not specified by 5D002; or

i.2.c. Limited to ''OAM'' of the equipment; or

j. Items specially designed for a 'connected civil industry application', meeting all of the following:

j.1. Being any of the following:

j.1.a. A network-capable endpoint device meeting any of the following:

j.1.a.1. The ''information security'' functionality is limited to securing 'non-arbitrary data' or the tasks of ''Operations, Administration or Maintenance'' (''OAM''); or

j.1.a.2. The device is limited to a specific 'connected civil industry application'; or

j.1.b. Networking equipment meeting all of the following:

j.1.b.1. Being specially designed to communicate with the devices specified by paragraph j.1.a. above; and

j.1.b.2. The ''information security'' functionality is limited to supporting the 'connected civil industry application' of devices specified by paragraph j.1.a. above, or the tasks of ''OAM'' of this networking equipment or of other items specified by paragraph j. of this Note; and

j.2. Where the ''information security'' functionality implements only published or commercial cryptographic standards, and the cryptographic functionality cannot easily be changed by the user.

Technical Notes:

1. *For the purposes of 5A002.a Note 2.j, 'connected civil industry application' means a network-connected consumer or civil industry application other than ''information security'', digital communication, general purpose networking or computing.*

2. For the purposes of 5A002.a Note 2.j.1.a.1, 'non-arbitrary data' means sensor or metering data directly related to the stability, performance or physical measurement of a system (e.g., temperature, pressure, flow rate, mass, volume, voltage, physical location, etc.), that cannot be changed by the user of the device.

b. Being a 'cryptographic activation token';

Technical Note: *For the purposes of 5A002.b, a 'cryptographic activation token' is an item designed or modified for any of the following:*

1. Converting, by means of ''cryptographic activation'', an item not specified by Category 5–Part 2 into an item specified by 5A002.a or 5D002.c.1, and not released by the Cryptography Note (Note 3 in Category 5–Part 2); or

2. Enabling by means of ''cryptographic activation'', additional functionality specified by 5A002.a of an item already specified by Category 5–Part 2;

c. Designed or modified to use or perform ''quantum cryptography'';

Technical Note: *For the purposes of 5A002.c, ''quantum cryptography'' is also known as Quantum Key Distribution (QKD).*

d. Designed or modified to use cryptographic techniques to generate channelizing codes, scrambling codes or network identification codes, for systems using ultra-wideband modulation techniques and having any of the following:

d.1. A bandwidth exceeding 500 MHz; *or*

d.2. A ''fractional bandwidth'' of 20% or more;

e. Designed or modified to use cryptographic techniques to generate the spreading code for ''spread spectrum'' systems, not specified by 5A002.d, including the hopping code for ''frequency hopping'' systems.

* * * * *

5A004 ''Systems,'' ''equipment'' and ''components'' for defeating, weakening or bypassing ''information security,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT, EI

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1
EI applies to entire entry.	Refer to § 742.15 of the EAR

License Requirements Note: *See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating ''information security'' functionality, and associated ''software'' and ''technology'' for the ''production'' or ''development'' of such microprocessors.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: Yes: $500 for ''components.''
N/A for systems and equipment.
GBS: N/A
ENC: Yes for certain EI controlled commodities. See § 740.17 of the EAR for eligibility.

List of Items Controlled

Related Controls: ECCN 5A004.a controls ''components'' providing the means or functions necessary for ''information security.'' All such ''components'' are presumptively ''specially designed'' and controlled by 5A004.a.
Related Definitions: N/A
Items:

a. Designed or modified to perform 'cryptanalytic functions.'

Note: *5A004.a includes systems or equipment, designed or modified to perform 'cryptanalytic functions' by means of reverse engineering.*

Technical Note: *For the purposes of 5A004.a, 'cryptanalytic functions' are functions designed to defeat cryptographic mechanisms in order to derive confidential variables or sensitive data, including clear text passwords or cryptographic keys.*

b. Items, not specified by ECCNs 4A005 or 5A004.a, designed to perform all of the following:

b.1. 'Extract raw data' from a computing or communications device; *and*

b.2. Circumvent ''authentication'' or authorization controls of the device, in order to perform the function described in 5A004.b.1.

Technical Note: *For the purposes of 5A004.b.1, 'extract raw data' from a computing or communications device means to retrieve binary data from a storage medium, e.g., RAM, flash or hard disk, of the device without interpretation by the device's operating system or filesystem.*

Note 1: *5A004.b does not apply to systems or equipment specially designed for the ''development'' or ''production'' of a computing or communications device.*

Note 2: *5A004.b does not include:*

a. Debuggers, hypervisors;

b. Items limited to logical data extraction;

c. Data extraction items using chip-off or JTAG; or

d. Items specially designed and limited to jail-breaking or rooting.

* * * * *

6A001 Acoustic systems, equipment and ''components,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000; N/A for 6A001.a.1.b.1 object detection and location systems having a transmitting frequency below 5 kHz or a sound pressure level exceeding 210 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band from 2 kHz to 30 kHz inclusive; 6A001.a.1.e, 6A001.a.2.a.1, a.2.a.2, 6A001.a.2.a.3, a.2.a.5, a.2.a.6, 6A001.a.2.b; processing equipment controlled by 6A001.a.2.c, and ''specially designed'' for real-time application with towed acoustic hydrophone arrays; a.2.e.1, a.2.e.2; and bottom or bay cable systems controlled by 6A001.a.2.f and having processing equipment ''specially designed'' for real-time application with bottom or bay cable systems.

GBS: Yes for 6A001.a.1.b.4.

Special Conditions for STA

STA: License Exception STA may not be used to ship commodities in 6A001.a.1.b, 6A001.a.1.e or 6A001.a.2 (except .a.2.a.4) to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See also 6A991.

Related Definitions: N/A

Items:

a. Marine acoustic systems, equipment and ''specially designed'' ''components'' therefor, as follows:

a.1. Active (transmitting or transmitting-and-receiving) systems, equipment and ''specially designed'' ''components'' therefor, as follows:

Note: *6A001.a.1 does not control equipment as follows:*

a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding ± 20°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;

b. Acoustic beacons, as follows:

1. Acoustic emergency beacons;

2. Pingers ''specially designed'' for relocating or returning to an underwater position.

a.1.a. Acoustic seabed survey equipment as follows:

a.1.a.1. Surface vessel survey equipment designed for sea bed topographic mapping and having all of the following:

a.1.a.1.a. Designed to take measurements at an angle exceeding 20° from the vertical;

a.1.a.1.b. Designed to measure seabed topography at seabed depths exceeding 600 m;

a.1.a.1.c.'Sounding resolution' less than 2; and

a.1.a.1.d. 'Enhancement' of the depth ''accuracy'' through compensation for all the following:

a.1.a.1.d.1. Motion of the acoustic sensor;

a.1.a.1.d.2. In-water propagation from sensor to the seabed and back; and

a.1.a.1.d.3. Sound speed at the sensor;

Technical Notes:

1. For the purposes of 6A001.a.1.a.1.c, 'sounding resolution' is the swath width (degrees) divided by the maximum number of soundings per swath.

2. For the purposes of 6A001.a.1.a, 'enhancement' includes the ability to compensate by external means.

a.1.a.2. Underwater survey equipment designed for seabed topographic mapping and having any of the following:

Technical Note: *For the purposes of 6A001.a.1.a.2, the acoustic sensor pressure rating determines the depth rating.*

a.1.a.2.a. Having all of the following:

a.1.a.2.a.1. Designed or modified to operate at depths exceeding 300 m; and

a.1.a.2.a.2. 'Sounding rate' greater than 3,800 m/s; *or*

Technical Note: *For the purposes of 6A001.a.1.a.2.a.2, 'sounding rate' is the product of the maximum speed (m/s) at which the sensor can operate and the maximum number of soundings per swath assuming 100% coverage. For systems that produce soundings in two directions (3D sonars), the maximum of the 'sounding rate' in either direction should be used.*

a.1.a.2.b. Survey equipment, not specified by 6A001.a.1.a.2.a, having all of the following:

a.1.a.2.b.1. Designed or modified to operate at depths exceeding 100 m;

a.1.a.2.b.2. Designed to take measurements at an angle exceeding 20° from the vertical;

a.1.a.2.b.3. Having any of the following:

a.1.a.2.b.3.a. Operating frequency below 350 kHz; *or*

a.1.a.2.b.3.b. Designed to measure seabed topography at a range exceeding 200 m from the acoustic sensor; *and*

a.1.a.2.b.4. 'Enhancement' of the depth ''accuracy'' through compensation of all of the following:

a.1.a.2.b.4.a. Motion of the acoustic sensor;

a.1.a.2.b.4.b. In-water propagation from sensor to the seabed and back; *and*

a.1.a.2.b.4.c. Sound speed at the sensor.

a.1.a.3. Side Scan Sonar (SSS) or Synthetic Aperture Sonar (SAS), designed for seabed imaging and having all of the following, and ''specially designed'' transmitting and receiving acoustic arrays therefor:

a.1.a.3.a. Designed or modified to operate at depths exceeding 500 m; and

a.1.a.3.b. An 'area coverage rate' of greater than 570 m^2/s while operating at the maximum range that it can operate with an 'along track resolution' of less than 15 cm; *and*

a.1.a.3.c. An 'across track resolution' of less than 15 cm;

Technical Notes:

For the purposes of 6A001.a.1.a.3:

1. 'Area coverage rate' (m_2/s) is twice the product of the sonar range (m) and the maximum speed (m/s) at which the sensor can operate at that range.

2. 'Along track resolution' (cm), for SSS only, is the product of azimuth (horizontal) beamwidth (degrees) and sonar range (m) and 0.873.

3. 'Across track resolution' (cm) is 75 divided by the signal bandwidth (kHz).

a.1.b Systems or transmitting and receiving arrays, designed for object detection or location, having any of the following:

a.1.b.1. A transmitting frequency below 10 kHz;

a.1.b.2. Sound pressure level exceeding 224dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

a.1.b.3. Sound pressure level exceeding 235 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

a.1.b.4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

a.1.b.5. Designed to operate with an unambiguous display range exceeding 5,120 m; *or*

a.1.b.6. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers with any of the following:

a.1.b.6.a. Dynamic compensation for pressure; *or*

a.1.b.6.b. Incorporating other than lead zirconate titanate as the transduction element;

a.1.c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination and having any of the following:

Notes:

1. The control status of acoustic projectors, including transducers, ''specially designed'' for other equipment is determined by the control status of the other equipment.

2. 6A001.a.1.c does not control electronic sources that direct the sound vertically only, or mechanical (e.g., air gun or vapor-shock gun) or chemical (e.g., explosive) sources.

3. Piezoelectric elements specified in 6A001.a.1.c include those made from lead-magnesium-niobate/lead-titanate ($Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$, or PMN–PT) single crystals grown from solid solution or lead-indium-niobate/lead-magnesium niobate/lead-titanate ($Pb(In_{1/2}Nb_{1/2})O_3$–$Pb(Mg_{1/3}Nb_{2/3})O_3$–$PbTiO_3$, or PIN–PMN–PT) single crystals grown from solid solution.

a.1.c.1. Operating at frequencies below 10 kHz and having any of the following:

a.1.c.1.a. Not designed for continuous operation at 100% duty cycle and having a

radiated 'free-field Source Level (SLRMS)' exceeding (10log(f) + 169.77)dB (reference 1 μPa at 1 m) where f is the frequency in Hertz of maximum Transmitting Voltage Response (TVR) below 10 kHz; *or*

a.1.c.1.b. Designed for continuous operation at 100% duty cycle and having a continuously radiated 'free-field Source Level (SLRMS)' at 100% duty cycle exceeding (10log(f) + 159.77)dB (reference 1 μPa at 1 m) where f is the frequency in Hertz of maximum Transmitting Voltage Response (TVR) below 10 kHz; *or*

Technical Note: *For the purposes of 6A001.a.1.c.1, the 'free-field Source Level (SL_{RMS})' is defined along the maximum response axis and in the far field of the acoustic projector. It can be obtained from the Transmitting Voltage Response using the following equation: SL_{RMS} = (TVR + 20log V_{RMS}) dB (ref 1μPa at 1 m), where SL_{RMS} is the source level, TVR is the Transmitting Voltage Response and V_{RMS} is the Driving Voltage of the Projector.*

a.1.c.2. [Reserved]

N.B. *See 6A001.a.1.c.1 for items previously specified in 6A001.a.1.c.2.*

a.1.c.3. Side-lobe suppression exceeding 22 dB;

a.1.d. Acoustic systems and equipment, designed to determine the position of surface vessels or underwater vehicles and having all of the following, and ''specially designed'' ''components'' therefor:

a.1.d.1. Detection range exceeding 1,000 m; *and*

a.1.d.2. Determined position error of less than 10 m rms (root mean square) when measured at a range of 1,000 m;

Note: *6A001.a.1.d includes:*

a. Equipment using coherent ''signal processing'' between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle;

b. Equipment capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

a.1.e. Active individual sonars, ''specially designed'' or modified to detect, locate and automatically classify swimmers or divers, having all of the following, and ''specially designed'' transmitting and receiving acoustic arrays therefor:

a.1.e.1. Detection range exceeding 530 m;

a.1.e.2. Determined position error of less than 15 m rms (root mean square) when measured at a range of 530 m; *and*

a.1.e.3. Transmitted pulse signal bandwidth exceeding 3 kHz;

N.B.: *For diver detection systems ''specially designed'' or modified for military use, see the U.S. Munitions List in the International Traffic in Arms Regulations (ITAR) (22 CFR part 121).*

Note: *For 6A001.a.1.e, where multiple detection ranges are specified for various environments, the greatest detection range is used.*

a.2. Passive systems, equipment and ''specially designed'' ''components'' therefor, as follows:

Note: *6A001.a.2 also applies to receiving equipment, whether or not related in normal application to separate active equipment, and ''specially designed'' components therefor.*

a.2.a. Hydrophones having any of the following:

Note: *The control status of hydrophones ''specially designed'' for other equipment is determined by the control status of the other equipment.*

Technical Notes:

For the purposes of 6A001.a.2.a:

1. Hydrophones consist of one or more sensing elements producing a single acoustic output channel. Those that contain multiple elements can be referred to as a hydrophone group.

2. Underwater acoustic transducers designed to operate as passive receivers are hydrophones.

a.2.a.1. Incorporating continuous flexible sensing elements;

a.2.a.2. Incorporating flexible assemblies of discrete sensing elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;

a.2.a.3. Having any of the following sensing elements:

a.2.a.3.a. Optical fibers;

a.2.a.3.b. 'Piezoelectric polymer films' other than polyvinylidene-fluoride (PVDF) and its co-polymers {P(VDF-TrFE) and P(VDF–TFE)};

a.2.a.3.c. 'Flexible piezoelectric composites';

a.2.a.3.d. Lead-magnesium- niobate/lead-titanate (*i.e.,* $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$, or PMN–PT) piezoelectric single crystals grown from solid solution; *or*

a.2.a.3.e. Lead-indium-niobate/lead-magnesium niobate/lead-titanate (*i.e.,* $Pb(In_{1/2}Nb_{1/2})O_3$-$Pb(Mg_{1/3}Nb_{2/3})O_3$–$PbTiO_3$, or PIN–PMN–PT) piezoelectric single crystals grown from solid solution;

a.2.a.4. A 'hydrophone sensitivity' better than −180dB at any depth with no acceleration compensation;

a.2.a.5. Designed to operate at depths exceeding 35 m with acceleration compensation; *or*

a.2.a.6. Designed for operation at depths exceeding 1,000 m and having a 'hydrophone sensitivity' better than −230 dB below 4 kHz;

Technical Notes:

1. For the purposes of 6A001.a.2.a.3.b, 'piezoelectric polymer film' sensing elements consist of polarized polymer film that is stretched over and attached to a supporting frame or spool (mandrel).

2. For the purposes of 6A001.a.2.a.3.c, 'flexible piezoelectric composite' sensing elements consist of piezoelectric ceramic particles or fibers combined with an electrically insulating, acoustically transparent rubber, polymer or epoxy compound, where the compound is an integral part of the sensing elements.

3. For the purposes of 6A001.a.2.a, 'hydrophone sensitivity' is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 μPa. For example, a hydrophone of −160 dB (reference 1 V per μPa) would yield an output voltage of 10^{-8} V in such a field, while one of −180 dB sensitivity would yield only 10^{-9} V output. Thus, −160 dB is better than −180 dB.

a.2.b. Towed acoustic hydrophone arrays having any of the following:

Technical Note: *For the purposes of 6A001.a.2.b, hydrophones arrays consist of a number of hydrophones providing multiple acoustic output channels.*

a.2.b.1. Hydrophone group spacing of less than 12.5 m or 'able to be modified' to have hydrophone group spacing of less than 12.5 m;

a.2.b.2. Designed or 'able to be modified' to operate at depths exceeding 35m;

Technical Note: *For the purposes of 6A001.a.2.b.2, 'able to be modified' in 6A001.a.2.b means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.*

a.2.b.3. Heading sensors controlled by 6A001.a.2.d;

a.2.b.4. Longitudinally reinforced array hoses;

a.2.b.5. An assembled array of less than 40 mm in diameter;

a.2.b.6. [Reserved];

a.2.b.7. Hydrophone characteristics controlled by 6A001.a.2.a; *or*

a.2.b.8. Accelerometer-based hydro-acoustic sensors specified by 6A001.a.2.g;

a.2.c. Processing equipment, ''specially designed'' for towed acoustic hydrophone arrays, having ''user-accessible programmability'' and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

a.2.d. Heading sensors having all of the following:

a.2.d.1. An ''accuracy'' of better than ± 0.5°; *and*

a.2.d.2. Designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m;

N.B.: *For inertial heading systems, see 7A003.c.*

a.2.e. Bottom or bay-cable hydrophone arrays having any of the following:

a.2.e.1. Incorporating hydrophones controlled by 6A001.a.2.a;

a.2.e.2. Incorporating multiplexed hydrophone group signal modules having all of the following characteristics:

a.2.e.2.a. Designed to operate at depths exceeding 35 m or having an adjustable or removal depth sensing device in order to operate at depths exceeding 35 m; *and*

a.2.e.2.b. Capable of being operationally interchanged with towed acoustic hydrophone array modules; *or*

a.2.e.3. Incorporating accelerometer-based hydro-acoustic sensors specified by 6A001.a.2.g;

a.2.f. Processing equipment, ''specially designed'' for bottom or bay cable systems, having ''user-accessible programmability'' and time or frequency domain processing and correlation, including spectral analysis,

digital filtering and beamforming using Fast Fourier or other transforms or processes;

a.2.g. Accelerometer-based hydro-acoustic sensors having all of the following:

a.2.g.1. Composed of three accelerometers arranged along three distinct axes;

a.2.g.2. Having an overall 'acceleration sensitivity' better than 48 dB (reference 1,000 mV rms per 1g);

a.2.g.3. Designed to operate at depths greater than 35 meters; *and*

a.2.g.4. Operating frequency below 20 kHz;

Note: *6A001.a.2.g does not apply to particle velocity sensors or geophones.*

Technical Notes:

1. *For the purposes of 6A001.a.2.g, accelerometer-based hydro-acoustic sensors are also known as vector sensors.*

2. *For the purposes of 6A001.a.2.g.2, 'acceleration sensitivity' is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydro-acoustic sensor, without a preamplifier, is placed in a plane wave acoustic field with an rms acceleration of 1 g (i.e., 9.81 m/s²).*

b. Correlation-velocity and Doppler-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed, as follows:

b.1. Correlation-velocity sonar log equipment having any of the following characteristics:

b.1.a. Designed to operate at distances between the carrier and the sea bed exceeding 500 m; *or*

b.1.b. Having speed ''accuracy'' better than 1% of speed;

b.2. Doppler-velocity sonar log equipment having speed ''accuracy'' better than 1% of speed;

Note 1: *6A001.b does not apply to depth sounders limited to any of the following:*

a. Measuring the depth of water;

b. Measuring the distance of submerged or buried objects; or

c. Fish finding.

Note 2: *6A001.b does not apply to equipment ''specially designed'' for installation on surface vessels.*

c. [Reserved]

N.B.: *For diver deterrent acoustic systems, see 8A002.r.*

6A002 Optical sensors and equipment, and ''components'' therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, CC, RS, AT, UN

Control(s)	*Country chart* (see Supp. No. 1 to part 738)
NS applies to entire entry.	NS Column 2
MT applies to optical detectors in 6A002.a.1, or a.3 that are ''specially designed'' or modified to protect ''missiles'' against nuclear effects (*e.g.,* Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for ''missiles''.	MT Column 1
RS applies to 6A002.a.1, a.2, a.3 (except a.3.d.2.a and a.3.e for lead selenide based focal plane arrays (FPAs)), .c, and .f..	RS Column 1
CC applies to police-model infrared viewers in 6A002.c.	CC Column 1
AT applies to entire entry.	AT Column 1
UN applies to 6A002.a.1, a.2, a.3 and .c.	See § 746.1(b) for UN controls

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $500 for 6A002.f.
$3000; except N/A for MT and for 6A002.a.1, a.2, a.3, .c, and .f.
GBS: N/A

List of Items Controlled

Related Controls: (1) See USML Category XII(e) for infrared focal plane arrays, image intensifier tubes, and related parts and components, subject to the ITAR. (2) See USML Category XV(e) for space-qualified focal plane arrays subject to the ITAR. (3) See also ECCNs 6A102, 6A202, and 6A992. (4) See ECCN 0A919 for foreign-made military commodities that incorporate commodities described in 6A002. (5) Section 744.9 imposes a license requirement on commodities described in ECCN 6A002 if being exported, reexported, or transferred (in-country) for use by a military end-user or for incorporation into an item controlled by ECCN 0A919. (6) See USML Categories XII(e) and XV(e)(3) for read-out integrated circuits ''subject to the ITAR.'' (7) See 6B002 for masks and reticles, ''specially designed'' for optical sensors specified by 6A002.a.1.b or 6A002.a.1.d.
Related Definitions: N/A
Items:

a. Optical detectors as follows:

a.1. ''Space-qualified'' solid-state detectors as follows:

Note: *For the purposes of 6A002.a.1, solid-state detectors include ''focal plane arrays''.*

a.1.a. ''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. ''Space-qualified'' solid-state detectors having all of the following:

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;

a.2. Image intensifier tubes and ''specially designed'' ''components'' therefor, as follows:

Note: *6A002.a.2 does not control non-imaging photomultiplier tubes having an electron sensing device in the vacuum space limited solely to any of the following:*

a. A single metal anode; or

b. Metal anodes with a center to center spacing greater than 500 µm.

Technical Note: *For the purposes of 6A002.a.2, 'charge multiplication' is a form of electronic image amplification and is defined as the generation of charge carriers as a result of an impact ionization gain process. 'Charge multiplication' sensors may take the form of an image intensifier tube, solid state detector or ''focal plane array''.*

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 µm or less; *or*

a.2.a.2.b. An electron sensing device with a non-binned pixel pitch of 500 µm 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–5) having a luminous sensitivity exceeding 350 µA/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 μm or less; *or*

a.2.b.2.b. An electron sensing device with a non-binned pixel pitch of 500 μm or less, ''specially designed'' or modified to achieve '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 μm or less;

a.2.c.2. An electron sensing device with a non-binned pixel pitch of 500 μm or less, ''specially designed'' or modified to achieve 'charge 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.

a.3. Non-''space-qualified'' ''focal plane arrays'' as follows:

N.B.: *'Microbolometer' non-''space-qualified'' ''focal plane arrays'' are only specified by 6A002.a.3.f.*

Technical Note: *For the purposes of 6A002.a.3, linear or two-dimensional multi-element detector arrays are referred to as ''focal plane arrays'';*

Note 1: *6A002.a.3 includes photoconductive arrays and photovoltaic arrays.*

Note 2: *6A002.a.3 does not control:*

a. Multi-element (not to exceed 16 elements) encapsulated photoconductive cells using either lead sulphide or lead selenide;

b. Pyroelectric detectors using any of the following:

b.1. Triglycine sulphate and variants;

b.2. Lead-lanthanum-zirconium titanate and variants;

b.3. Lithium tantalate;

b.4. Polyvinylidene fluoride and variants; or

b.5. Strontium barium niobate and variants.

c. ''Focal plane arrays'' ''specially designed'' or modified to achieve 'charge multiplication' and limited by design to have a maximum ''radiant sensitivity'' of 10 mA/W or less for wavelengths exceeding 760 nm, having all of the following:

c.1. Incorporating a response limiting mechanism designed not to be removed or modified; and

c.2. Any of the following:

c.2.a. The response limiting mechanism is integral to or combined with the detector element; or

c.2.b. The ''focal plane array'' is only operable with the response limiting mechanism in place.

d. Thermopile arrays having less than 5,130 elements;

Technical Note: *For the purposes of 6A002.a.3 Note 2.c.2.a, a response limiting mechanism integral to the detector element is designed not to be removed or modified without rendering the detector inoperable.*

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;

N.B.: *Silicon and other material based 'microbolometer' non-''space-qualified'' ''focal plane arrays'' are only specified by 6A002.a.3.f.*

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 detector elements;

Note: *6A002.a.3.d does not control ''focal plane arrays'' (not to exceed 32 elements) having detector elements limited solely to germanium material.*

Technical Note: *For the purposes of 6A002.a.3.d, 'cross-scan direction' is defined as the axis parallel to the linear array of detector elements and the 'scan direction' is defined as the axis perpendicular to the linear array of detector elements.*

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;

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 μrad (microradians); *or*

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 operation, using other than silicon detectors, and 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'.

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: *For the purposes of 6A002.c,'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 or counting systems;

b. Medical equipment;

c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. Flame detectors for industrial furnaces;

e. Equipment ''specially designed'' for laboratory use.

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 218 K (−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.*

e. [Reserved]

f. 'Read-Out Integrated Circuits' ('ROIC') ''specially designed'' for ''focal plane arrays'' specified by 6A002.a.3.

Note: *6A002.f does not apply to read-out integrated circuits ''specially designed'' for civil automotive applications.*

Technical Note: *For the purposes of 6A002.f, a 'Read-Out Integrated Circuit' ('ROIC') is an integrated circuit designed to underlie or be bonded to a ''focal plane array'' (''FPA'') and used to read-out (i.e., extract and register) signals produced by the detector elements. At a minimum the 'ROIC' reads the charge from the detector elements by extracting the charge and applying a multiplexing function in a manner that retains the relative spatial position and orientation information of the detector elements for processing inside or outside the 'ROIC'.*

6A003 Cameras, systems or equipment, and ''components'' therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, RS, AT, UN

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
NP applies to cameras controlled by 6A003.a.3 or a.4 and to plug-ins in 6A003.a.6 for cameras controlled by 6A003.a.3 or a.4.	NP Column 1
RS applies to 6A003.b.3, 6A003.b.4.a, 6A003.b.4.c and to items controlled in 6A003.b.4.b that have a frame rate greater than 60 Hz or that incorporate a focal plane array with more than 111,000 elements, or to items in 6A003.b.4.b when being exported or reexported to be embedded in a civil product. (But see § 742.6(a)(2)(iii) and (v) for certain exemptions).	RS Column 1
RS applies to items controlled in 6A003.b.4.b that have a frame rate of 60 Hz or less and that incorporate a focal plane array with not more than 111,000 elements if not being exported or reexported to be embedded in a civil product.	RS Column 2
AT applies to entire entry.	AT Column 1
UN applies to 6A003.b.3 and b.4.	See § 746.1(b) for UN controls

License Requirement Note: Commodities that are not subject to the ITAR but are of the type described in USML Category XII(c) are controlled as cameras in ECCN 6A003 when they incorporate a camera controlled in this ECCN.

Reporting Requirements

See § 743.3 of the EAR for thermal camera reporting for exports that are not authorized by an individually validated license of thermal imaging cameras controlled by ECCN 6A003.b.4.b to destinations in Country Group A:1 (see Supplement No. 1 to part 740 of the EAR), must be reported to BIS.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $1,500, except N/A for 6A003.a.3 through a.6, b.1, b.3 and b.4

GBS: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in 6A003.b.3 or b.4 to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See ECCNs 6E001 (''development''), 6E002 (''production''), and 6E201 (''use'') for technology for items controlled under this entry. (2) Also see ECCN 6A203. (3) See ECCN 0A919 for foreign made military commodities that incorporate cameras described in 6A003. (4) Section 744.9 imposes a license requirement on cameras described in 6A003 if being exported, reexported, or transferred (in-country) for use by a military end-user or for incorporation into a commodity controlled by ECCN 0A919. (5) See USML Category XII(c) and (e) for cameras subject to the ITAR. *Related Definitions:* N/A.

Items:

a. Instrumentation cameras and ''specially designed'' ''components'' therefor, as follows:

Note: *Instrumentation cameras, controlled by 6A003.a.3 to 6A003.a.5, with modular structures should be evaluated by their maximum capability, using plug-ins available according to the camera manufacturer's specifications.*

a.1. [Reserved]

a.2. [Reserved]

a.3. Electronic streak cameras having temporal resolution better than 50 ns;

a.4. Electronic framing cameras having a speed exceeding 1,000,000 frames/s;

a.5. Electronic cameras having all of the following:

a.5.a. An electronic shutter speed (gating capability) of less than 1µs per full frame; *and*

a.5.b. A read out time allowing a framing rate of more than 125 full frames per second;

a.6. Plug-ins having all of the following characteristics:

a.6.a. ''Specially designed'' for instrumentation cameras which have modular structures and that are controlled by 6A003.a; *and*

a.6.b. Enabling these cameras to meet the characteristics specified by 6A003.a.3, 6A003.a.4 or 6A003.a.5, according to the manufacturer's specifications;

b. Imaging cameras as follows:

Note: *6A003.b does not control television or video cameras ''specially designed'' for television broadcasting.*

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:

b.1.a. Having any of the following:

b.1.a.1. More than 4×10^6 ''active pixels'' per solid state array for monochrome (black and white) cameras;

b.1.a.2. More than 4×10^6 ''active pixels'' per solid state array for color cameras incorporating three solid state arrays; *or*

b.1.a.3. More than 12×10^6 ''active pixels'' for solid state array color cameras incorporating one solid state array; *and*

b.1.b. Having any of the following:

b.1.b.1. Optical mirrors controlled by 6A004.a.;

b.1.b.2. Optical control equipment controlled by 6A004.d.; *or*

b.1.b.3. The capability for annotating internally generated 'camera tracking data';

Technical Notes:

1. For the purposes of 6A003.b.1, digital video cameras should be evaluated by the maximum number of ''active pixels'' used for capturing moving images.

2. For the purposes of 6A003.b.1.b.3, 'camera tracking data' is the information

necessary to define camera line of sight orientation with respect to the earth. This includes: (1) the horizontal angle the camera line of sight makes with respect to the earth's magnetic field direction and; (2) the vertical angle between the camera line of sight and the earth's horizon.

b.2. Scanning cameras and scanning camera systems, having all of the following:

b.2.a. A peak response in the wavelength range exceeding 10 nm, but not exceeding 30,000 nm;

b.2.b. Linear detector arrays with more than 8,192 elements per array; *and*

b.2.c. Mechanical scanning in one direction;

Note: *6A003.b.2 does not apply to scanning cameras and scanning camera systems, ''specially designed'' for any of the following:*

a. Industrial or civilian photocopiers;

b. Image scanners ''specially designed'' for civil, stationary, close proximity scanning applications (e.g., reproduction of images or print contained in documents, artwork or photographs); or

c. Medical equipment.

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:

b.4.a. Incorporating ''focal plane arrays'' controlled by 6A002.a.3.a to 6A002.a.3.e;

b.4.b. Incorporating ''focal plane arrays'' controlled by 6A002.a.3.f; *or*

b.4.c. Incorporating ''focal plane arrays'' controlled by 6A002.a.3.g;

Note 1: *Imaging cameras described in 6A003.b.4 include ''focal plane arrays'' combined with sufficient ''signal processing'' electronics, beyond the read out integrated circuit, to enable as a minimum the output of an analog or digital signal once power is supplied.*

Note 2: *6A003.b.4.a does not control imaging cameras incorporating linear ''focal plane arrays'' with 12 elements or fewer, not employing time-delay-and-integration within the element and designed for any of the following:*

a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

b. Industrial equipment used for inspection or monitoring of heat flows in buildings, equipment or industrial processes;

c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. Equipment ''specially designed'' for laboratory use; or

e. Medical equipment.

Note 3: *6A003.b.4.b does not control imaging cameras having any of the following:*

a. A maximum frame rate equal to or less than 9 Hz;

b. Having all of the following:

1. Having a minimum horizontal or vertical 'Instantaneous-Field-of-View (IFOV)' of at least 2 mrad (milliradians);

2. Incorporating a fixed focal-length lens that is not designed to be removed;

3. Not incorporating a 'direct view' display; and

Technical Note: *For the purposes of 6A003.b.4 Note 3.b.3, 'direct view' refers to an imaging camera operating in the infrared spectrum that presents a visual image to a human observer using a near-to-eye micro display incorporating any light-security mechanism.*

4. Having any of the following:

a. No facility to obtain a viewable image of the detected field-of-view; or

b. The camera is designed for a single kind of application and designed not to be user modified; or

Technical Note:

For the purposes of 6A003.b.4 Note 3.b.1, 'Instantaneous-Field-of-View (IFOV)' is the lesser figure of the 'Horizontal IFOV' or the 'Vertical IFOV'.

'Horizontal IFOV' = horizontal Field-of-View (FOV)/number of horizontal detector elements.

'Vertical IFOV' = vertical Field-of-View (FOV)/number of vertical detector elements.

c. The camera is ''specially designed'' for installation into a civilian passenger land vehicle and having all of the following:

1. The placement and configuration of the camera within the vehicle are solely to assist the driver in the safe operation of the vehicle;

2. Is operable only when installed in any of the following:

a. The civilian passenger land vehicle for which it was intended and the vehicle weighs less than 4,500 kg (gross vehicle weight); or

b. A ''specially designed'', authorized maintenance test facility; and

3. Incorporates an active mechanism that forces the camera not to function when it is removed from the vehicle for which it was intended.

Note: *When necessary, details of the items will be provided, upon request, to the Bureau of Industry and Security in order to ascertain compliance with the conditions described in Note 3.b.4 and Note 3.c in this Note to 6A003.b.4.b.*

Note 4: *6A003.b.4.c does not apply to 'imaging cameras' having any of the following characteristics:*

a. Having all of the following:

1. Where the camera is ''specially designed'' for installation as an integrated component into indoor and wall-plug-operated systems or equipment, limited by design for a single kind of application, as follows:

a. Industrial process monitoring, quality control, or analysis of the properties of materials;

b. Laboratory equipment ''specially designed'' for scientific research;

c. Medical equipment;

d. Financial fraud detection equipment; and

2. Is only operable when installed in any of the following:

a. The system(s) or equipment for which it was intended; or

b. A ''specially designed,'' authorized maintenance facility; and

3. Incorporates an active mechanism that forces the camera not to function when it is removed from the system(s) or equipment for which it was intended;

b. Where the camera is ''specially designed'' for installation into a civilian passenger land vehicle or passenger and vehicle ferries and having all of the following:

1. The placement and configuration of the camera within the vehicle or ferry are solely to assist the driver or operator in the safe operation of the vehicle or ferry;

2. Is only operable when installed in any of the following:

a. The civilian passenger land vehicle for which it was intended and the vehicle weighs less than 4,500 kg (gross vehicle weight);

b. The passenger and vehicle ferry for which it was intended and having a length overall (LOA) 65 m or greater; or

c. A ''specially designed'', authorized maintenance test facility; and

3. Incorporates an active mechanism that forces the camera not to function when it is removed from the vehicle for which it was intended;

c. Limited by design to have a maximum ''radiant sensitivity'' of 10 mA/W or less for wavelengths exceeding 760 nm, having all of the following:

1. Incorporating a response limiting mechanism designed not to be removed or modified; and

2. Incorporates an active mechanism that forces the camera not to function when the response limiting mechanism is removed; and

3. Not ''specially designed'' or modified for underwater use; or

d. Having all of the following:

1. Not incorporating a 'direct view' or electronic image display;

2. Has no facility to output a viewable image of the detected field of view;

3. The ''focal plane array'' is only operable when installed in the camera for which it was intended; and

4. The ''focal plane array'' incorporates an active mechanism that forces it to be permanently inoperable when removed from the camera for which it was intended.

Note: *When necessary, details of the item will be provided, upon request, to the Bureau of Industry and Security in order to ascertain compliance with the conditions described in Note 4 above.*

b.5. Imaging cameras incorporating solid-state detectors specified by 6A002.a.1.

6A004 Optical equipment and ''components,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000

GBS: Yes for 6A004.a.1, a.2, a.4, .b, d.2, and .f.

Special Conditions for STA

STA: Paragraph (c)(2) of License Exception STA may not be used to ship any commodity in 6A004.c or .d to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) For optical mirrors or 'aspheric optical elements' ''specially designed'' for lithography ''equipment,'' see ECCN 3B001. (2) See USML Category XII(e) for gimbals ''subject to the ITAR.'' (3) See also 6A994.

Related Definitions: An 'aspheric optical element' is any element used in an optical system whose imaging surface or surfaces are designed to depart from the shape of an ideal sphere.

Items:

a. Optical mirrors (reflectors) as follows:

Technical Note: *For the purposes of 6A004.a, Laser Induced Damage Threshold (LIDT) is measured according to ISO 21254–1:2011.*

a.1. 'Deformable mirrors' having an active optical aperture greater than 10 mm and having any of the following, and ''specially designed'' components therefor:

a.1.a. Having all the following:

a.1.a.1. A mechanical resonant frequency of 750 Hz or more; *and*

a.1.a.2. More than 200 actuators; *or*

a.1.b. A Laser Induced Damage Threshold (LIDT) being any of the following:

a.1.b.1. Greater than 1 kW/cm^2 using a ''CW laser''; *or*

a.1.b.2. Greater than 2 J/cm^2 using 20 ns ''laser'' pulses at 20 Hz repetition rate;

Technical Notes:

For the purposes of 6A004.a.1:

1. *'Deformable mirrors' are mirrors having any of the following:*

a. A single continuous optical reflecting surface which is dynamically deformed by the application of individual torques or forces to compensate for distortions in the optical waveform incident upon the mirror; or

b. Multiple optical reflecting elements that can be individually and dynamically repositioned by the application of torques or forces to compensate for distortions in the optical waveform incident upon the mirror.

2. *'Deformable mirrors' are also known as adaptive optic mirrors.*

a.2. Lightweight monolithic mirrors having an average ''equivalent density'' of less than 30 kg/m^2 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;

Note: *6A004.a.2 and 6A004.a.3 do not apply to mirrors ''specially designed'' to direct solar radiation for terrestrial heliostat installations.*

a.4. Mirrors ''specially designed'' for beam steering mirror stages specified in 6A004.d.2.a with a flatness of λ/10 or better (λ is equal to 633 nm) and having any of the following:

a.4.a. Diameter or major axis length greater than or equal to 100 mm; *or*

a.4.b. Having all of the following:

a.4.b.1. Diameter or major axis length greater than 50 mm but less than 100 mm; *and*

a.4.b.2. A Laser Induced Damage Threshold (LIDT) being any of the following:

a.4.b.2.a. Greater than 10 kW/cm2 using a ''CW laser''; *or*

a.4.b.2.b. Greater than 20 J/cm2 using 20 ns ''laser'' pulses at 20 Hz repetition rate;

N.B. *For optical mirrors ''specially designed'' for lithography equipment, see 3B001.*

b. Optical ''components'' made from zinc selenide (ZnSe) or zinc sulfide (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^3 in volume; *or*

b.2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth);

c. ''Space-qualified'' ''components'' for optical systems, as follows:

c.1. ''Components'' lightweighted 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, in any coordinate direction, equal to or less than 5×10^{-6}/K;

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. Steering, tracking, stabilisation and resonator alignment equipment as follows:

d.2.a. Beam steering mirror stages designed to carry mirrors having diameter or major axis length greater than 50 mm and having all of the following, and ''specially designed'' electronic control equipment therefor:

d.2.a.1. A maximum angular travel of ±26 mrad or more;

d.2.a.2. A mechanical resonant frequency of 500 Hz or more; *and*

d.2.a.3. An angular ''accuracy'' of 10 μrad (microradians) or less (better);

d.2.b. Resonator alignment equipment having bandwidths equal to or more than 100 Hz and an ''accuracy'' of 10 μrad or less (better);

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)/s^2; *or*

d.3.d.2. Exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0.5 rad (radians)/s^2;

d.4. [Reserved]

e. 'Aspheric optical elements' having all of the following:

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 3×10^{-6}/K at 25°C;

Technical Note:

1. For the purposes of 6A004.e, an 'aspheric optical element' is any element used in an optical system whose imaging surface or surfaces are designed to depart from the shape of an ideal sphere.

2. For the purposes of 6A004.e.2, manufacturers are not required to measure the surface roughness 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 2.5×10^{-6}/K at 25°C; or

e. An x-ray optical element having inner mirror capabilities (e.g., tube-type mirrors).

f. Dynamic wavefront measuring equipment having all of the following:

f.1. 'Frame rates' equal to or more than 1 kHz; *and*

f.2. A wavefront accuracy equal to or less (better) than λ/20 at the designed wavelength.

Technical Note: *For the purposes of 6A004.f, 'frame rate' is a frequency at which all ''active pixels'' in the ''focal plane array'' are integrated for recording images projected by the wavefront sensor optics.*

6A005 ''Lasers'', ''components'' and optical equipment, as follows (see List of Items Controlled), excluding items that are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country chart* (see Supp. No. 1 to part 738)
NS applies to entire entry.	NS Column 2
NP applies to lasers controlled by 6A005.a.2, a.3, a.4, b.2.b, b.3, b.4, b.6.c, c.1.b, c.2.b, d.2, d.3.c, or d.4.c that meet or exceed the technical parameters described in 6A205.	NP Column 1

Control(s)	*Country chart* (see Supp. No. 1 to part 738)
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A for NP items
$3000 for all other items
GBS: Neodymium-doped (other than glass) ''lasers'' controlled by 6A005.b.6.d.2 (except 6A005.b.6.d.2.b) that have an output wavelength exceeding 1,000 nm, but not exceeding 1,100 nm, and an average or CW output power not exceeding 2 kW, and operate in a pulse-excited, non-''Q-switched'' multiple-transverse mode, or in a continuously excited, multiple-transverse mode; Dye and Liquid Lasers controlled by 6A005.c.1, c.2 and c.3, except for a pulsed single longitudinal mode oscillator having an average output power exceeding 1 W and a repetition rate exceeding 1 kHz if the ''pulse duration'' is less than 100 ns; CO ''lasers'' controlled by 6A005.d.2 having a CW maximum rated single or multimode output power not exceeding 10 kW; CO_2 or CO/CO_2 ''lasers'' controlled by 6A005.d.3 having an output wavelength in the range from 9,000 to 11,000 nm and having a pulsed output not exceeding 2 J per pulse and a maximum rated average single or multimode output power not exceeding 5 kW; and CO_2 ''lasers'' controlled by 6A005.d.3 that operate in CW multiple-transverse mode, and having a CW output power not exceeding 15 kW.

List of Items Controlled

Related Controls (1) See ECCN *6D001* for ''software'' for items controlled under this entry. (2) See ECCNs *6E001* (''development''), *6E002* (''production''), and *6E201* (''use'') for technology for items controlled under this entry. (3) Also see ECCNs *6A205* and *6A995.* (4) See ECCN 3B001 for excimer ''lasers'' ''specially designed'' for lithography equipment. (5) ''Lasers'' ''especially designed'' or prepared for use in isotope separation are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110). (6) See USML Category XII(b) and (e) for laser systems or lasers subject to the ITAR. (7) See USML Category XVIII for certain laser-based directed energy weapon systems, equipment, and components subject to the ITAR.
Related Definitions: For the purposes of 6A005: (1) 'Wall-plug efficiency' is defined as the ratio of ''laser'' output power (or ''average output power'') to total electrical input power required to operate the ''laser'', including the power supply/conditioning and thermal conditioning/heat exchanger, see 6A005.a.6.b.1 and 6A005.b.6; (2) 'Non-repetitive pulsed' refers to ''lasers'' that produce either a single output pulse or that have a time interval between pulses exceeding one minute, see Note 2 of 6A005 and 6A005.d.6.
Items:

Notes:

1. *Pulsed ''lasers'' include those that run in a continuous wave (CW) mode with pulses superimposed.*

2. *Excimer, semiconductor, chemical, CO, CO^2, and 'non-repetitive pulsed' Nd:glass ''lasers'' are only specified by 6A005.d.*

Technical Note: *For the purposes of 6A005 Note 2, 'non-repetitive pulsed' refers to ''lasers'' that produce either a single output pulse or that have a time interval between pulses exceeding one minute.*

3. *6A005 includes fiber ''lasers''.*

4. *The control status of ''lasers'' incorporating frequency conversion (i.e., wavelength change) by means other than one ''laser'' pumping another ''laser'' is determined by applying the control parameters for both the output of the source ''laser'' and the frequency-converted optical output.*

5. *6A005 does not control ''lasers'' as follows:*

a. Ruby with output energy below 20 J;

b. Nitrogen;

c. Krypton.

6. *For the purposes of 6A005.a and 6A005.b, 'single transverse mode' refers to ''lasers'' with a beam profile having an M^2-factor of less than 1.3, while 'multiple transverse mode' refers to ''lasers'' with a beam profile having an M^2-factor of 1.3 or higher*

a. Non-''tunable'' continuous wave ''(CW) lasers'' having any of the following:

a.1. Output wavelength less than 150 nm and output power exceeding 1W;

a.2. Output wavelength of 150 nm or more but not exceeding 510 nm and output power exceeding 30 W;

Note: *6A005.a.2 does not control Argon ''lasers'' having an output power equal to or less than 50 W.*

a.3. Output wavelength exceeding 510 nm but not exceeding 540 nm and any of the following:

a.3.a. 'Single transverse mode' output and output power exceeding 50 W; *or*

a.3.b. 'Multiple transverse mode' output and output power exceeding 150 W;

a.4. Output wavelength exceeding 540 nm but not exceeding 800 nm and output power exceeding 30 W;

a.5. Output wavelength exceeding 800 nm but not exceeding 975 nm and any of the following:

a.5.a. 'Single transverse mode' output and output power exceeding 50 W; *or*

a.5.b. 'Multiple transverse mode' output and output power exceeding 80 W;

a.6. Output wavelength exceeding 975 nm but not exceeding 1,150 nm and any of the following;

a.6.a. 'Single transverse mode' output and any of the following:

a.6.a.1. Output power exceeding 1,000 W; *or*

a.6.a.2. Having all of the following:

a.6.a.2.a. Output power exceeding 500 W; *and*

a.6.a.2.b. Spectral bandwidth less than 40 GHz; *or*

a.6.b. 'Multiple transverse mode' output and any of the following:

a.6.b.1. 'Wall-plug efficiency' exceeding 18% and output power exceeding 1,000 W; or

a.6.b.2. Output power exceeding 2 kW;

Note 1: *6A005.a.6.b does not control 'multiple transverse mode', industrial ''lasers'' with output power exceeding 2 kW and not exceeding 6 kW with a total mass greater than 1,200 kg. For the purpose of this note, total mass includes all ''components'' required to operate the ''laser,'' e.g., ''laser,'' power supply, heat exchanger, but excludes external optics for beam conditioning or delivery.*

Note 2: *6A005.a.6.b does not apply to 'multiple transverse mode', industrial ''lasers'' having any of the following:*

a. [Reserved];

b. Output power exceeding 1 kW but not exceeding 1.6 kW and having a BPP exceeding 1.25 mm·mrad;

c. Output power exceeding 1.6 kW but not exceeding 2.5 kW and having a BPP exceeding 1.7 mm·mrad;

d. Output power exceeding 2.5 kW but not exceeding 3.3 kW and having a BPP exceeding 2.5 mm·mrad;

e. Output power exceeding 3.3 kW but not exceeding 6 kW and having a BPP exceeding 3.5 mm·mrad;

f. [Reserved]

g. [Reserved]

h. Output power exceeding 6 kW but not exceeding 8 kW and having a BPP exceeding 12 mm·mrad; or

i. Output power exceeding 8 kW but not exceeding 10 kW and having a BPP exceeding 24 mm·mrad;

a.7. Output wavelength exceeding 1,150 nm but not exceeding 1,555 nm and any of the following:

a.7.a. 'Single transverse mode' and output power exceeding 50 W; *or*

a.7.b. 'Multiple transverse mode' and output power exceeding 80 W;

a.8. Output wavelength exceeding 1,555 nm but not exceeding 1,850 nm and output power exceeding 1 W;

a.9. Output wavelength exceeding 1,850 nm but not exceeding 2,100 nm, and any of the following:

a.9.a. 'Single transverse mode' and output power exceeding 1 W; *or*

a.9.b. 'Multiple transverse mode' output and output power exceeding 120 W; *or*

a.10. Output wavelength exceeding 2,100 nm and output power exceeding 1 W;

b. Non-''tunable'' ''pulsed lasers'' having any of the following:

b.1. Output wavelength less than 150 nm and any of the following:

b.1.a. Output energy exceeding 50 mJ per pulse and ''peak power'' exceeding 1 W; *or*

b.1.b. ''Average output power'' exceeding 1 W;

b.2. Output wavelength of 150 nm or more but not exceeding 510 nm and any of the following:

b.2.a. Output energy exceeding 1.5 J per pulse and ''peak power'' exceeding 30 W; *or*

b.2.b. ''Average output power'' exceeding 30 W;

Note: *6A005.b.2.b does not control Argon ''lasers'' having an ''average output power'' equal to or less than 50 W.*

b.3. Output wavelength exceeding 510 nm, but not exceeding 540 nm and any of the following:

b.3.a. 'Single transverse mode' output and any of the following:

b.3.a.1. Output energy exceeding 1.5 J per pulse and ''peak power'' exceeding 50 W; *or*

b.3.a.2. ''Average output power'' exceeding 80 W; *or*

b.3.b. 'Multiple transverse mode' output and any of the following:

b.3.b.1. Output energy exceeding 1.5 J per pulse and ''peak power'' exceeding 150 W; or

b.3.b.2. ''Average output power'' exceeding 150 W;

b.4. Output wavelength exceeding 540 nm but not exceeding 800 nm and any of the following:

b.4.a. ''Pulse duration'' less than 1 ps and any of the following:

b.4.a.1. Output energy exceeding 0.005 J per pulse and ''peak power'' exceeding 5 GW; *or*

b.4.a.2. ''Average output power'' exceeding 20 W; *or*

b.4.b. ''Pulse duration'' equal to or exceeding 1 ps and any of the following:

b.4.b.1. Output energy exceeding 1.5 J per pulse and ''peak power'' exceeding 30 W; *or*

b.4.b.2. ''Average output power'' exceeding 30 W;

b.5. Output wavelength exceeding 800 nm but not exceeding 975 nm and any of the following:

b.5.a. ''Pulse duration'' less than 1ps and any of the following:

b.5.a.1. Output energy exceeding 0.005 J per pulse and ''peak power'' exceeding 5 GW; *or*

b.5.a.2. 'Single transverse mode' output and ''average output power'' exceeding 20 W;

b.5.b. ''Pulse duration'' equal to or exceeding 1 ps and not exceeding 1 μs and any of the following:

b.5.b.1. Output energy exceeding 0.5 J per pulse and ''peak power'' exceeding 50 W;

b.5.b.2. 'Single transverse mode' output and ''average output power'' exceeding 20 W; *or*

b.5.b.3. 'Multiple transverse mode' output and ''average output power'' exceeding 50 W; *or*

b.5.c. ''Pulse duration'' exceeding 1 μs and any of the following:

b.5.c.1. Output energy exceeding 2 J per pulse and ''peak power'' exceeding 50 W;

b.5.c.2. 'Single transverse mode' output and ''average output power'' exceeding 50 W; *or*

b.5.c.3. 'Multiple transverse mode' output and ''average output power'' exceeding 80 W.

b.6. Output wavelength exceeding 975 nm but not exceeding 1,150 nm and any of the following:

b.6.a. ''Pulse duration'' of less than 1 ps, and any of the following:

b.6.a.1. Output ''peak power'' exceeding 2 GW per pulse;

b.6.a.2. ''Average output power'' exceeding 30 W; *or*

b.6.a.3. Output energy exceeding 0.002 J per pulse;

b.6.b. ''Pulse duration'' equal to or exceeding 1 ps and less than 1 ns, and any of the following:

b.6.b.1. Output ''peak power'' exceeding 5 GW per pulse;

b.6.b.2. ''Average output power'' exceeding 50 W; *or*

b.6.b.3. Output energy exceeding 0.1 J per pulse;

b.6.c. ''Pulse duration'' equal to or exceeding 1 ns but not exceeding 1 μs and any of the following:

b.6.c.1. 'Single transverse mode' output and any of the following:

b.6.c.1.a. ''Peak power'' exceeding 100 MW;

b.6.c.1.b. ''Average output power'' exceeding 20 W limited by design to a maximum pulse repetition frequency less than or equal to 1 kHz;

b.6.c.1.c. 'Wall-plug efficiency' exceeding 12%, ''average output power'' exceeding 100 W and capable of operating at a pulse repetition frequency greater than 1 kHz;

b.6.c.1.d. ''Average output power'' exceeding 150 W and capable of operating at a pulse repetition frequency greater than 1 kHz; *or*

b.6.c.1.e. Output energy exceeding 2 J per pulse; *or*

b.6.c.2. 'Multiple transverse mode' output and any of the following:

b.6.c.2.a. ''Peak power'' exceeding 400 MW;

b.6.c.2.b. 'Wall-plug efficiency' exceeding 18% and ''average output power'' exceeding 500 W;

b.6.c.2.c. ''Average output power'' exceeding 2 kW; or

b.6.c.2.d. Output energy exceeding 4 J per pulse; *or*

b.6.d. ''Pulse duration'' exceeding 1 μs and any of the following:

b.6.d.1. 'Single transverse mode' output and any of the following:

b.6.d.1.a. ''Peak power'' exceeding 500 kW;

b.6.d.1.b. 'Wall-plug efficiency' exceeding 12% and ''average output power'' exceeding 100 W; *or*

b.6.d.1.c. ''Average output power'' exceeding 150 W; *or*

b.6.d.2. 'Multiple transverse mode' output and any of the following:

b.6.d.2.a. ''Peak power'' exceeding 1 MW;

b.6.d.2.b. 'Wall-plug efficiency' exceeding 18% and ''average output power'' exceeding 500 W; *or*

b.6.d.2.c. ''Average output power'' exceeding 2 kW;

b.7. Output wavelength exceeding 1,150 nm but not exceeding 1,555 nm and any of the following:

b.7.a. ''Pulse duration'' not exceeding 1 μs and any of the following:

b.7.a.1. Output energy exceeding 0.5 J per pulse and ''peak power'' exceeding 50 W;

b.7.a.2. 'Single transverse mode' output and ''average output power'' exceeding 20 W; *or*

b.7.a.3. 'Multiple transverse mode' output and ''average output power'' exceeding 50 W; *or*

b.7.b. ''Pulse duration'' exceeding 1 μs and any of the following:

b.7.b.1. Output energy exceeding 2 J per pulse and ''peak power'' exceeding 50 W;

b.7.b.2. 'Single transverse mode' output and ''average output power'' exceeding 50 W; *or*

b.7.b.3. 'Multiple transverse mode' output and ''average output power'' exceeding 80 W;

b.8. Output wavelength exceeding 1,555 nm but not exceeding 1,850 nm, and any of the following:

b.8.a. Output energy exceeding 100 mJ per pulse and ''peak power'' exceeding 1 W; *or*

b.8.b. ''Average output power'' exceeding 1 W;

b.9. Output wavelength exceeding 1,850 nm but not exceeding 2,100 nm, and any of the following:

b.9.a. 'Single transverse mode' and any of the following:

b.9.a.1. Output energy exceeding 100 mJ per pulse and ''peak power'' exceeding 1 W; *or*

b.9.a.2. ''Average output power'' exceeding 1 W;

b.9.b. 'Multiple transverse mode' and any of the following:

b.9.b.1. Output energy exceeding 100 mJ per pulse and ''peak power'' exceeding 10 kW; *or*

b.9.b.2. ''Average output power'' exceeding 120 W; *or*

b.10. Output wavelength exceeding 2,100 nm and any of the following:

b.10.a. Output energy exceeding 100 mJ per pulse and ''peak power'' exceeding 1 W; *or*

b.10.b. ''Average output power'' exceeding 1 W;

c. ''Tunable'' lasers having any of the following:

c.1. Output wavelength less than 600 nm and any of the following:

c.1.a. Output energy exceeding 50 mJ per pulse and ''peak power'' exceeding 1 W; *or*

c.1.b. Average or CW output power exceeding 1W;

Note: *6A005.c.1 does not apply to dye ''lasers'' or other liquid ''lasers,'' having a multimode output and a wavelength of 150 nm or more but not exceeding 600 nm and all of the following:*

1. Output energy less than 1.5 J per pulse or a ''peak power'' less than 20 W; and

2. Average or CW output power less than 20 W.

c.2. Output wavelength of 600 nm or more but not exceeding 1,400 nm, and any of the following:

c.2.a. Output energy exceeding 1 J per pulse and ''peak power'' exceeding 20 W; *or*

c.2.b. Average or CW output power exceeding 20 W; *or*

c.3. Output wavelength exceeding 1,400 nm and any of the following:

c.3.a. Output energy exceeding 50 mJ per pulse and ''peak power'' exceeding 1 W; *or*

c.3.b. Average or CW output power exceeding 1 W;

d. Other ''lasers'', not controlled by 6A005.a, 6A005.b, or 6A005.c as follows:

d.1. Semiconductor ''lasers'' as follows:

Notes:

1. 6A005.d.1 includes semiconductor ''lasers'' having optical output connectors (e.g., fiber optic pigtails).

2. The control status of semiconductor ''lasers'' ''specially designed'' for other equipment is determined by the control status of the other equipment.

d.1.a. Individual single-transverse mode semiconductor ''lasers'' having any of the following:

d.1.a.1. Wavelength equal to or less than 1,570 nm and average or CW output power, exceeding 2.0 W; *or*

d.1.a.2. Wavelength greater than 1,570 nm and average or CW output power, exceeding 500 mW;

d.1.b. Individual 'multiple-transverse mode' semiconductor ''lasers'' having any of the following:

d.1.b.1. Wavelength of less than 1,400 nm and average or CW output power, exceeding 25 W;

d.1.b.2. Wavelength equal to or greater than 1,400 nm and less than 1,900 nm and average or CW output power, exceeding 2.5 W; *or*

d.1.b.3. Wavelength equal to or greater than 1,900 nm and average or CW output power, exceeding 1 W;

d.1.c. Individual semiconductor ''laser'' 'bars' having any of the following:

d.1.c.1. Wavelength of less than 1,400 nm and average or CW output power, exceeding 100 W;

d.1.c.2. Wavelength equal to or greater than 1,400 nm and less than 1,900 nm and average or CW output power, exceeding 25 W; *or*

d.1.c.3. Wavelength equal to or greater than 1,900 nm and average or CW output power, exceeding 10 W;

d.1.d. Semiconductor ''laser'' 'stacked arrays' (two dimensional arrays) having any of the following:

d.1.d.1. Wavelength less than 1,400 nm and having any of the following:

d.1.d.1.a. Average or CW total output power less than 3 kW and having average or CW output 'power density' greater than 500 W/cm^2;

d.1.d.1.b. Average or CW total output power equal to or exceeding 3 kW but less than or equal to 5 kW, and having average or CW output 'power density' greater than 350W/cm^2;

d.1.d.1.c. Average or CW total output power exceeding 5 kW;

d.1.d.1.d. Peak pulsed 'power density' exceeding 2,500 W/cm^2; *or*

Note: *6A005.d.1.d.1.d does not apply to epitaxially-fabricated monolithic devices.*

d.1.d.1.e. Spatially coherent average or CW total output power, greater than 150 W;

d.1.d.2. Wavelength greater than or equal to 1,400 nm but less than 1,900 nm, and having any of the following:

d.1.d.2.a. Average or CW total output power less than 250 W and average or CW output 'power density' greater than 150 W/cm2;

d.1.d.2.b. Average or CW total output power equal to or exceeding 250 W but less than or equal to 500 W, and having average or CW output 'power density' greater than 50W/cm^2;

d.1.d.2.c. Average or CW total output power exceeding 500 W;

d.1.d.2.d. Peak pulsed 'power density' exceeding 500 W/cm^2; *or*

Note: *6A005.d.1.d.2.d does not apply to epitaxially-fabricated monolithic devices.*

d.1.d.2.e. Spatially coherent average or CW total output power, exceeding 15 W;

d.1.d.3. Wavelength greater than or equal to 1,900 nm and having any of the following:

d.1.d.3.a. Average or CW output 'power density' greater than 50 W/cm^2;

d.1.d.3.b. Average or CW output power greater than 10 W; *or*

d.1.d.3.c. Spatially coherent average or CW total output power, exceeding 1.5 W; *or*

d.1.d.4. At least one ''laser'' 'bar' specified by 6A005.d.1.c;

Technical Note: *For the purposes of 6A005.d.1.d, 'power density' means the total ''laser'' output power divided by the emitter surface area of the 'stacked array'.*

d.1.e. Semiconductor ''laser'' 'stacked arrays', other than those specified by 6A005.d.1.d, having all of the following:

d.1.e.1. ''Specially designed'' or modified to be combined with other 'stacked arrays' to form a larger 'stacked array'; *and*

d.1.e.2. Integrated connections, common for both electronics and cooling;

Note 1: *'Stacked arrays', formed by combining semiconductor ''laser'' 'stacked arrays' specified by 6A005.d.1.e, that are not designed to be further combined or modified are specified by 6A005.d.1.d.*

Note 2: *'Stacked arrays', formed by combining semiconductor ''laser'' 'stacked arrays' specified by 6A005.d.1.e, that are designed to be further combined or modified are specified by 6A005.d.1.e.*

Note 3: *6A005.d.1.e does not apply to modular assemblies of single 'bars' designed to be fabricated into end to end stacked linear arrays.*

Technical Notes:

For the purposes of 6A005.d.1.e:

1. Semiconductor ''lasers'' are commonly called ''laser'' diodes.

2. A 'bar' (also called a semiconductor ''laser'' 'bar', a ''laser'' diode 'bar' or diode 'bar') consists of multiple semiconductor ''lasers'' in a one-dimensional array.

3. A 'stacked array' consists of multiple 'bars' forming a two-dimensional array of semiconductor ''lasers''.

d.2. Carbon monoxide (CO) ''lasers'' having any of the following:

d.2.a. Output energy exceeding 2 J per pulse and ''peak power'' exceeding 5 kW; *or*

d.2.b. Average or CW output power, exceeding 5 kW;

d.3. Carbon dioxide (CO_2) ''lasers'' having any of the following:

d.3.a. CW output power exceeding 15 kW;

d.3.b. Pulsed output with ''pulse duration'' exceeding 10 µs and any of the following:

d.3.b.1. ''Average output power'' exceeding 10 kW; *or*

d.3.b.2. ''Peak power'' exceeding 100 kW; *or*

d.3.c. Pulsed output with a ''pulse duration'' equal to or less than 10 µs and any of the following:

d.3.c.1. Pulse energy exceeding 5 J per pulse; *or*

d.3.c.2. ''Average output power'' exceeding 2.5 kW;

d.4. Excimer ''lasers'' having any of the following:

d.4.a. Output wavelength not exceeding 150 nm and any of the following:

d.4.a.1. Output energy exceeding 50 mJ per pulse; *or*

d.4.a.2. ''Average output power'' exceeding 1 W;

d.4.b. Output wavelength exceeding 150 nm but not exceeding 190 nm and any of the following:

d.4.b.1. Output energy exceeding 1.5 J per pulse; *or*

d.4.b.2. ''Average output power'' exceeding 120 W;

d.4.c. Output wavelength exceeding 190 nm but not exceeding 360 nm and any of the following:

d.4.c.1. Output energy exceeding 10 J per pulse; *or*

d.4.c.2. ''Average output power'' exceeding 500 W; *or*

d.4.d. Output wavelength exceeding 360 nm and any of the following:

d.4.d.1. Output energy exceeding 1.5 J per pulse; *or*

d.4.d.2. ''Average output power'' exceeding 30 W;

Note: *For excimer ''lasers'' ''specially designed'' for lithography equipment, see 3B001.*

d.5. ''Chemical lasers'' as follows:

d.5.a. Hydrogen Fluoride (HF) ''lasers';

d.5.b. Deuterium Fluoride (DF) ''lasers'';

d.5.c. 'Transfer lasers' as follows:

d.5.c.1. Oxygen Iodine (O_2-I) ''lasers'';

d.5.c.2. Deuterium Fluoride-Carbon dioxide (DF–CO_2) ''lasers'';

Technical Note: *For the purposes of 6A005.d.5.c, 'transfer lasers' are ''lasers'' in which the lasing species are excited through the transfer of energy by collision of a non-lasing atom or molecule with a lasing atom or molecule species.*

d.6. 'Non-repetitive pulsed' Neodymium (Nd) glass ''lasers'' having any of the following:

d.6.a. A ''pulse duration'' not exceeding 1 µs and output energy exceeding 50 J per pulse; *or*

d.6.b. A ''pulse duration'' exceeding 1 µs and output energy exceeding 100 J per pulse;

e. ''Components'' as follows:

e.1. Mirrors cooled either by 'active cooling' or by heat pipe cooling;

Technical Note: *For the purposes of 6A005.e.1, 'active cooling' is a cooling technique for optical ''components'' using flowing fluids within the subsurface (nominally less than 1 mm below the optical surface) of the optical component to remove heat from the optic.*

e.2. Optical mirrors or transmissive or partially transmissive optical or electro-optical-''components,'' other than fused tapered fiber combiners and Multi-Layer Dielectric gratings (MLDs), ''specially designed'' for use with controlled ''lasers'';

Note to 6A005.e.2: *Fiber combiners and MLDs are specified by 6A005.e.3.*

e.3. Fiber ''laser'' ''components'' as follows:

e.3.a. Multimode to multimode fused tapered fiber combiners having all of the following:

e.3.a.1. An insertion loss better (less) than or equal to 0.3 dB maintained at a rated total average or CW output power (excluding output power transmitted through the single mode core if present) exceeding 1,000 W; *and*

e.3.a.2. Number of input fibers equal to or greater than 3;

e.3.b. Single mode to multimode fused tapered fiber combiners having all of the following:

e.3.b.1. An insertion loss better (less) than 0.5 dB maintained at a rated total average or CW output power exceeding 4,600 W;

e.3.b.2. Number of input fibers equal to or greater than 3; *and*

e.3.b.3. Having any of the following:

e.3.b.3.a. A Beam Parameter Product (BPP) measured at the output not exceeding 1.5 mm mrad for a number of input fibers less than or equal to 5; *or*

e.3.b.3.b. A BPP measured at the output not exceeding 2.5 mm mrad for a number of input fibers greater than 5;

e.3.c. MLDs having all of the following:

e.3.c.1. Designed for spectral or coherent beam combination of 5 or more fiber ''lasers;'' *and*

e.3.c.2. CW ''Laser'' Induced Damage Threshold (LIDT) greater than or equal to 10 kW/cm^2;

f. Optical equipment as follows:

N.B.: *For shared aperture optical elements, capable of operating in ''Super-High Power Laser'' (''SHPL'') applications, see the U.S. Munitions List (22 CFR part 121).*

f.1. [Reserved]

N.B.: *For items previously specified by 6A005.f.1, see 6A004.f.*

f.2. ''Laser'' diagnostic equipment ''specially designed'' for dynamic measurement of ''SHPL'' system angular beam steering errors and having an angular ''accuracy'' of 10 μrad (microradians) or less (better);

f.3. Optical equipment and ''components'', ''specially designed'' for coherent beam combination in a phased-array ''SHPL'' system and having any of the following:

f.3.a. An ''accuracy'' of 0.1 μm or less, for wavelengths greater than 1 μm; *or*

f.3.b. An ''accuracy'' of λ/10 or less (better) at the designed wavelength, for wavelengths equal to or less than 1 μm;

f.4. Projection telescopes ''specially designed'' for use with ''SHPL'' systems;

g. 'Laser acoustic detection equipment' having all of the following:

g.1. CW ''laser'' output power greater than or equal to 20 mW;

g.2. ''Laser'' frequency stability equal to or better (less) than 10 MHz;

g.3. ''Laser'' wavelengths equal to or exceeding 1,000 nm but not exceeding 2,000 nm;

g.4. Optical system resolution better (less) than 1 nm; *and*

g.5. Optical Signal to Noise ratio equal to or exceeding 10^3.

Technical Note: *For the purposes of 6A005.g, 'laser acoustic detection equipment' is sometimes referred to as a ''Laser'' Microphone or Particle Flow Detection Microphone.*

6A006 ''Magnetometers'', ''magnetic gradiometers'', ''intrinsic magnetic gradiometers'', underwater electric field sensors, ''compensation systems'', and ''specially designed'' ''components'' therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $1500, N/A for 6A006.a.1; ''Magnetometers'' and subsystems defined in 6A006.a.2 using optically pumped or nuclear precession (proton/Overhauser) having a 'sensitivity' lower (better) than 2 pT (rms) per square root Hz; and 6A006.d, and 6A006.e.

GBS: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in: 6A006.a.1; or 6A006.a.2; or 6A006.c.1 ''Magnetic gradiometers'' using multiple ''magnetometers'' specified by 6A006.a.1 or 6.A006.a.2; or 6A006.d or .e (only for underwater receivers incorporating magnetometers specified in 6A006.a.1 or 6A006.a.2) to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See also 6A996. This entry does not control instruments ''specially designed'' for fishery applications or biomagnetic measurements for medical diagnostics.

Related Definitions: N/A

Items:

a. ''Magnetometers'' and subsystems, as follows:

a.1. ''Magnetometers'' using ''superconductive'' (SQUID) ''technology'' and having any of the following:

a.1.a. SQUID systems designed for stationary operation, without ''specially designed'' subsystems designed to reduce in-motion noise, and having a 'sensitivity' equal to or lower (better) than 50 fT (rms) per square root Hz at a frequency of 1 Hz; *or*

a.1.b. SQUID systems having an in-motion-magnetometer 'sensitivity' lower (better) than 20 pT (rms) per square root Hz at a frequency of 1 Hz and ''specially designed'' to reduce in-motion noise;

a.2. ''Magnetometers'' using optically pumped or nuclear precession (proton/Overhauser) ''technology'' having a 'sensitivity' lower (better) than 20 pT (rms) per square root Hz at a frequency of 1 Hz;

a.3. ''Magnetometers'' using fluxgate ''technology'' having a 'sensitivity' equal to or lower (better) than 10 pT (rms) per square root Hz at a frequency of 1 Hz;

a.4. Induction coil ''magnetometers'' having a 'sensitivity' lower (better) than any of the following:

a.4.a. 0.05 nT (rms)/square root Hz at frequencies of less than 1 Hz;

a.4.b. 1×10^{-3} nT (rms)/square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; *or*

a.4.c. 1×10^{-4} nT (rms)/square root Hz at frequencies exceeding 10 Hz;

a.5. Fiber optic ''magnetometers'' having a 'sensitivity' lower (better) than 1 nT (rms) per square root Hz;

b. Underwater electric field sensors having a 'sensitivity' lower (better) than 8 nanovolt per meter per square root Hz when measured at 1 Hz;

c. ''Magnetic gradiometers'' as follows:

c.1. ''Magnetic gradiometers'' using multiple ''magnetometers'' controlled by 6A006.a;

c.2. Fiber optic ''intrinsic magnetic gradiometers'' having a magnetic gradient field 'sensitivity' lower (better) than 0.3 nT/m (rms) per square root Hz;

c.3. ''Intrinsic magnetic gradiometers'', using ''technology'' other than fiber-optic ''technology'', having a magnetic gradient field 'sensitivity' lower (better) than 0.015 nT/m (rms) per square root Hz;

d. ''Compensation systems'' for magnetic and underwater electric field sensors resulting in a performance equal to or better than the control parameters of 6A006.a, 6A006.b, and 6A006.c; and

e. Underwater electromagnetic receivers incorporating magnetic field sensors specified by 6A006.a or underwater electric field sensors specified by 6A006.b.

Technical Note: *For the purposes of 6A006, 'sensitivity' (noise level) is the root mean square of the device-limited noise floor which is the lowest signal that can be measured.*

6A007 Gravity meters (gravimeters) and gravity gradiometers, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to 6A007.b and .c when the accuracies in 6A007.b.1 and b.2 are met or exceeded.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000; N/A for MT

GBS: N/A

List of Items Controlled

Related Controls: (1) See USML Category XII(d) for certain gravity meters (gravimeters) and gravity gradiometers subject to the ITAR. (2) See also ECCNs 6A107, 6A997, and 7A611.

Related Definitions: N/A

Items:

a. Gravity meters designed or modified for ground use and having a static ''accuracy'' of less (better) than 10 μGal;

Note: *6A007.a does not control ground gravity meters of the quartz element (Worden) type.*

b. Gravity meters designed for mobile platforms and having all of the following:

b.1. A static ''accuracy'' of less (better) than 0.7 mGal; *and*

b.2. An in-service (operational) ''accuracy'' of less (better) than 0.7 mGal having a 'time-to-steady-state registration' of less than 2 minutes under any combination of attendant corrective compensations and motional influences;

Technical Note: For the purposes of 6A007.b.2, 'time-to-steady-state registration' (also referred to as the gravimeter's response time) is the time over which the disturbing effects of platform induced accelerations (high frequency noise) are reduced.

c. Gravity gradiometers.

6A008 Radar systems, equipment and assemblies, having any of the following (see List of Items Controlled), and ''specially designed'' ''components'' therefor.

License Requirements

Reason for Control: NS, MT, RS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
MT applies to items that are designed for airborne applications and that are usable in systems controlled for MT reasons.	MT Column 1
RS applies to 6A008.j.1.	RS Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000; N/A for MT and for 6A008.j.1.
GBS: Yes, for 6A008.b, .c, and l.1 only

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in 6A008.d, 6A008.h or 6A008.k to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See also ECCNs 6A108 and 6A998. ECCN 6A998 controls, inter alia, the Light Detection and Ranging (LIDAR) equipment excluded by the note to paragraph j of this ECCN (6A008). (2) See USML Category XII(b) for certain LIDAR, Laser Detection and Ranging (LADAR), or range-gated systems subject to the ITAR.
Related Definitions: N/A
Items:

Note: *6A008 does not control:*

—Secondary surveillance radar (SSR);
—Civil Automotive Radar;
—Displays or monitors used for air traffic control (ATC);
—Meteorological (weather) radar;
—Precision Approach Radar (PAR) equipment conforming to ICAO standards and employing electronically steerable linear (1-dimensional) arrays or mechanically positioned passive antennas.

a. Operating at frequencies from 40 GHz to 230 GHz and having any of the following:

a.1. An average output power exceeding 100 mW; *or*

a.2. Locating ''accuracy'' of 1 m or less (better) in range and 0.2 degree or less (better) in azimuth;

b. A tunable bandwidth exceeding ±6.25% of the 'center operating frequency';

Technical Note: *For the purposes of 6A008.b, the 'center operating frequency' equals one half of the sum of the highest plus the lowest specified operating frequencies.*

c. Capable of operating simultaneously on more than two carrier frequencies;

d. Capable of operating in synthetic aperture (SAR), inverse synthetic aperture (ISAR) radar mode, or sidelooking airborne (SLAR) radar mode;

e. Incorporating electronically scanned array antennae;

Technical Note: *For the purposes of 6A008.e, electronically scanned array antennae are also known as electronically steerable array antennae.*

f. Capable of heightfinding non-cooperative targets;

g. ''Specially designed'' for airborne (balloon or airframe mounted) operation and having Doppler ''signal processing'' for the detection of moving targets;

h. Employing processing of radar signals and using any of the following:

h.1. ''Radar spread spectrum'' techniques; *or*

h.2. ''Radar frequency agility'' techniques;

i. Providing ground-based operation with a maximum 'instrumented range' exceeding 185 km;

Note: *6A008.i does not control:*

a. Fishing ground surveillance radar;

b. Ground radar equipment ''specially designed'' for en route air traffic control, and having all of the following:

1. A maximum 'instrumented range' of 500 km or less;

2. Configured so that radar target data can be transmitted only one way from the radar site to one or more civil ATC centers;

3. Contains no provisions for remote control of the radar scan rate from the en route ATC center; and

4. Permanently installed;

c. Weather balloon tracking radars.

Technical Note: *For the purposes of 6A008.i, 'instrumented range' is the specified unambiguous display range of a radar.*

j. Being ''laser'' radar or Light Detection and Ranging (LIDAR) equipment and having any of the following:

j.1. ''Space-qualified'';

j.2. Employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 μrad (microradians); *or*

j.3. Designed for carrying out airborne bathymetric littoral surveys to International Hydrographic Organization (IHO) Order 1a Standard (5th Edition February 2008) for Hydrographic Surveys or better, and using one or more ''lasers'' with a wavelength exceeding 400 nm but not exceeding 600 nm;

Note 1: *LIDAR equipment ''specially designed'' for surveying is only specified by 6A008.j.3.*

Note 2: *6A008.j does not apply to LIDAR equipment ''specially designed'' for meteorological observation.*

Note 3: *Parameters in the IHO Order 1a Standard 5th Edition February 2008 are summarized as follows:*

Horizontal Accuracy (95% Confidence Level)= 5 m + 5% of depth.

Depth Accuracy for Reduced Depths (95% confidence level) = $\pm\sqrt{(a^2 + (b*d)^2)}$ where:

a = 0.5 m = constant depth error, i.e., the sum of all constant depth errors
b = 0.013 = factor of depth dependent error
*b*d = depth dependent error, i.e., the sum of all depth dependent errors*
d = depth

Feature Detection = Cubic features > 2 m in depths up to 40 m; 10% of depth beyond 40 m.

k. Having ''signal processing'' sub-systems using ''pulse compression'' and having any of the following:

k.1. A ''pulse compression'' ratio exceeding 150; *or*

k.2. A compressed pulse width of less than 200 ns; *or*

Note: *6A008.k.2 does not apply to two dimensional 'marine radar' or 'vessel traffic service' radar, having all of the following:*

a. ''Pulse compression'' ratio not exceeding 150;

b. Compressed pulse width of greater than 30 ns;

c. Single and rotating mechanically scanned antenna;

d. Peak output power not exceeding 250 W; and

e. Not capable of ''frequency hopping''.

l. Having data processing sub-systems and having any of the following:

l.1. 'Automatic target tracking' providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage; or

Note: *6A008.l.1 does not control conflict alert capability in ATC systems, or 'marine radar'.*

Technical Note: *For the purposes of 6A008.l.1, 'automatic target tracking' is a processing technique that automatically determines and provides as output an extrapolated value of the most probable position of the target in real time.*

l.2. [Reserved]

l.3. [Reserved]

l.4. Configured to provide superposition and correlation, or fusion, of target data within six seconds from two or more 'geographically dispersed' radar sensors to improve the aggregate performance beyond that of any single sensor specified by 6A008.f, or 6A008.i.

Technical Note: *For the purposes of 6A008.l.4, sensors are considered 'geographically dispersed' when each location is distant from any other more than 1,500 m in any direction. Mobile sensors are always considered 'geographically dispersed'.*

N.B.: *See also the U.S. Munitions List (22 CFR part 121).*

Note: *6A008.l does not apply to systems, equipment and assemblies designed for 'vessel traffic services'.*

Technical Notes:

1. *For the purposes of 6A008, 'marine radar' is a radar that is designed to navigate*

safely at sea, inland waterways or near-shore environments.

2. *For the purposes of 6A008, 'vessel traffic service' is a vessel traffic monitoring and control service similar to air traffic control for ''aircraft.''*

* * * * *

6B007 Equipment to produce, align and calibrate land-based gravity meters with a static ''accuracy'' of less (better) than 0.1 mGal.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

* * * * *

6C002 Optical sensor materials as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000
GBS: N/A

List of Items Controlled

Related Controls: See also 6C992.
Related Definitions: N/A
Items:

a. Elemental tellurium (Te) of purity levels of 99.9995% or more;

b. Single crystals (including epitaxial wafers) of any of the following:

b.1. Cadmium zinc telluride (CdZnTe), with zinc content less than 6% by 'mole fraction';

b.2. Cadmium telluride (CdTe) of any purity level; *or*

b.3. Mercury cadmium telluride (HgCdTe) of any purity level.

Technical Note: *For the purposes of 6C002.b.1, 'mole fraction' is defined as the ratio of moles of ZnTe to the sum of the moles of CdTe and ZnTe present in the crystal.*

* * * * *

6C005 ''Laser'' materials as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $1500
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. Synthetic crystalline ''laser'' host material in unfinished form as follows:

a.1. Titanium doped sapphire;

a.2. [Reserved]

b. Rare-earth-metal doped double-clad fibers having any of the following:

b.1. Nominal ''laser'' wavelength of 975 nm to 1,150 nm and having all of the following:

b.1.a. Average core diameter equal to or greater than 25 μm; *and*

b.1.b. Core 'Numerical Aperture' ('NA') less than 0.065; *or*

Note to 6C005.b.1: *6C005.b.1 does not apply to double-clad fibers having an inner glass cladding diameter exceeding 150* μm *and not exceeding 300* μm.

b.2. Nominal ''laser'' wavelength exceeding 1,530 nm and having all of the following:

b.2.a. Average core diameter equal to or greater than 20 μm; *and*

b.2.b. Core 'NA' less than 0.1.

Technical Notes:

1. For the purposes of 6C005.b.1.b, the core 'Numerical Aperture' ('NA') is measured at the emission wavelengths of the fiber.

2. 6C005.b includes fibers assembled with end caps.

* * * * *

6D003 Other ''software'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, RS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
RS applies to paragraph c.	RS Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes, except for 6D003.c and exports or reexports to destinations outside of those countries listed in Country Group A:5 (See Supplement No. 1 to part 740 of the EAR) of ''software'' for items controlled by 6D003.a.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit software in 6D003.a to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See also ECCNs 6D103, 6D991, and 6D993.
Related Definitions: N/A
Items:

Acoustics

a. ''Software'' as follows:

a.1. ''Software'' ''specially designed'' for acoustic beam forming for the ''real-time processing'' of acoustic data for passive reception using towed hydrophone arrays;

a.2. ''Source code'' for the ''real-time processing'' of acoustic data for passive reception using towed hydrophone arrays;

a.3. ''Software'' ''specially designed'' for acoustic beam forming for the ''real-time processing'' of acoustic data for passive reception using bottom or bay cable systems;

a.4. ''Source code'' for the ''real-time processing'' of acoustic data for passive reception using bottom or bay cable systems;

a.5. ''Software'' or ''source code'', ''specially designed'' for all of the following:

a.5.a. ''Real-time processing'' of acoustic data from sonar systems controlled by 6A001.a.1.e; *and*

a.5.b. Automatically detecting, classifying and determining the location of divers or swimmers;

N.B.: *For diver detection ''software'' or ''source code'', ''specially designed'' or modified for military use, see the U.S. Munitions List of the International Traffic in Arms Regulations (ITAR) (22 CFR part 121).*

b. Optical sensors. None.

Cameras

c. ''Software'' designed or modified for cameras incorporating ''focal plane arrays'' specified by 6A002.a.3.f and designed or modified to remove a frame rate restriction and allow the camera to exceed the frame rate specified in 6A003.b.4 Note 3.a;

Optics

d. ''Software'' ''specially designed'' to maintain the alignment and phasing of segmented mirror systems consisting of mirror segments having a diameter or major axis length equal to or larger than 1 m;

e. Lasers. None.

Magnetic and Electric Field Sensors

f. ''Software'' as follows:

f.1. ''Software'' ''specially designed'' for magnetic and electric field ''compensation systems'' for magnetic sensors designed to operate on mobile platforms;

f.2. ''Software'' ''specially designed'' for magnetic and electric field anomaly detection on mobile platforms;

f.3. ''Software'' ''specially designed'' for ''real-time processing'' of electromagnetic data using underwater electromagnetic receivers specified by 6A006.e;

f.4. ''Source code'' for ''real-time processing'' of electromagnetic data using underwater electromagnetic receivers specified by 6A006.e;

Gravimeters

g. ''Software'' ''specially designed'' to correct motional influences of gravity meters or gravity gradiometers;

Radar

h. ''Software'' as follows:

h.1. Air Traffic Control (ATC) ''software'' designed to be hosted on general purpose computers located at Air Traffic Control centers and capable of accepting radar target data from more than four primary radars;

h.2. ''Software'' for the design or ''production'' of radomes having all of the following:

h.2.a. ''Specially designed'' to protect the ''electronically scanned array antennae'' specified by 6A008.e; *and*

h.2.b. Resulting in an antenna pattern having an 'average side lobe level' more than 40 dB below the peak of the main beam level.

Technical Note: *For the purposes of 6D003.h.2.b 'average side lobe level' is measured over the entire array excluding the angular extent of the main beam and the first two side lobes on either side of the main beam.*

* * * * *

6E003 Other ''technology'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: Yes

List of Items Controlled

Related Controls: See also 6E993.
Related Definitions: N/A
Items:

Acoustics

a. [Reserved]

Optical Sensors

b. [Reserved]

Cameras

c. [Reserved]

Optics

d. ''Technology'' as follows:

d.1. ''Technology'' ''required'' for the coating and treatment of optical surfaces to achieve an 'optical thickness' uniformity of 99.5% or better for optical coatings 500 mm or more in diameter or major axis length and with a total loss (absorption and scatter) of less than 5×10^{-3};

N.B.: *See also 2E003.f.*

Technical Note: *For the purposes of 6E003.d.1, 'optical thickness' is the mathematical product of the index of refraction and the physical thickness of the coating.*

d.2. ''Technology'' for the fabrication of optics using single point diamond turning techniques to produce surface finish ''accuracies'' of better than 10 nm rms on non-planar surfaces exceeding 0.5 m^2;

Lasers

e. ''Technology'' ''required'' for the ''development,'' ''production'' or ''use'' of ''specially designed'' diagnostic instruments or targets in test facilities for ''SHPL'' testing or testing or evaluation of materials irradiated by ''SHPL'' beams;

Magnetic and Electric Field Sensors

f. [Reserved]

Gravimeters

g. [Reserved]

Radar

h. [Reserved]

* * * * *

7A003 'Inertial measurement equipment or systems', having any of the following.

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to commodities in 7A003.d that meet or exceed the parameters of 7A103.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See also ECCNs 7A103, 7A611, and 7A994. (2) See USML Category XII(d) for guidance or navigation systems subject to the ITAR.
Related Definitions: N/A
Items:

7A003 does not apply to 'inertial measurement equipment or systems' which are certified for use on ''civil aircraft'' by civil aviation authorities of one or more Wassenaar Arrangement Participating States, see Supplement No. 1 to part 743 of the EAR.

Technical Notes:

1. For the purposes of 7A003, 'inertial measurement equipment or systems' incorporate accelerometers or gyroscopes to measure changes in velocity and orientation in order to determine or maintain heading or position without requiring an external reference once aligned. 'Inertial measurement equipment or systems' include:

Attitude and Heading Reference Systems (AHRSs);

Gyrocompasses;

Inertial Measurement Units (IMUs);

Inertial Navigation Systems (INSs);

Inertial Reference Systems (IRSs);

Inertial Reference Units (IRUs).

2. For the purposes of 7A003, 'positional aiding references' independently provide position, and include:

a. ''Satellite navigation system'';

b.''Data-Based Referenced Navigation'' (''DBRN'').

a. Designed for ''aircraft'', land vehicles or vessels, providing position without the use of 'positional aiding references', and having any of the following ''accuracies'' subsequent to normal alignment:

a.1. 0.8 nautical miles per hour (nm/hr) ''Circular Error Probable'' (''CEP'') rate or less (better);

a.2. 0.5% distanced travelled ''CEP'' or less (better); *or*

a.3. Total drift of 1 nautical mile ''CEP'' or less (better) in a 24 hr period;

Technical Note: *For the purposes of 7A003.a.1, 7A003.a.2 and 7A003.a.3, the performance parameters typically apply to 'inertia measurement equipment or systems' designed for ''aircraft'', vehicles and vessels, respectively. These parameters result from the utilization of specialized non-'positional aiding references' (e.g., altimeter, odometer, velocity log). As a consequence, the specified performance values cannot be readily converted between these parameters. Equipment designed for multiple platforms are evaluated against each applicable entry 7A003.a.1, 7A003.a.2, or 7A003.a.3.*

b. Designed for ''aircraft'', land vehicles or vessels, with an embedded 'positional aiding reference' and providing position after loss of all 'positional aiding references' for a period of up to 4 minutes, having an ''accuracy'' of less (better) than 10 meters ''CEP'';

Technical Note: *For the purposes of 7A003.b, this entry refers to systems in which 'inertial measurement equipment or systems' and other independent 'positional aiding references' are built into a single unit (i.e., embedded) in order to achieve improved performance.*

c. Designed for ''aircraft'', land vehicles or vessels, providing heading or True North determination and having any of the following:

c.1. A maximum operating angular rate less (lower) than 500 deg/s and a heading ''accuracy'' without the use of 'positional aiding references' equal to or less (better) than 0.07 deg sec (Lat) (equivalent to 6 arc minutes rms at 45 degrees latitude); *or*

c.2. A maximum operating angular rate equal to or greater (higher) than 500 deg/s and a heading ''accuracy'' without the use of 'positional aiding references' equal to or less (better) than 0.2 deg sec (Lat) (equivalent to 17 arc minutes rms at 45 degrees latitude);

d. Providing acceleration measurements or angular rate measurements, in more than one dimension, and having any of the following:

d.1. Performance specified by 7A001 or 7A002 along any axis, without the use of any aiding references; *or*

d.2. Being ''space-qualified'' and providing angular rate measurements having an ''angle random walk'' along any axis of less (better) than or equal to 0.1 degree per square root hour.

Note: *7A003.d.2 does not apply to 'inertial measurement equipment or systems' that contain ''spinning mass gyros'' as the only type of gyro.*

7A004 'Star trackers' and ''components'' therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to entire entry.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See USML Category XV for certain 'star trackers' that are ''subject to the ITAR'' (see 22 CFR parts 120 through 130). (2) See also 7A104 and 7A994.
Related Definitions: N/A
Items:

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: *For the purposes of 7A004.a, 'star trackers' are also referred to as stellar attitude sensors or gyro-astro compasses.*

7A005 ''Satellite navigation system'' receiving equipment having any of the following and ''specially designed'' ''components'' therefor.

License Requirements

Reason for Control: NS, MT and AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to 7A005.b.	NS Column 1
MT applies to commodities in 7A005.b that meet or exceed the parameters of 7A105.	MT Column 1
AT applies to 7A005.b.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See also ECCNs 7A105, 7A611 and 7A994. Commercially available ''satellite navigation system'' receivers do not typically employ decryption or adaptive antennae and are classified as 7A994. (2) See USML Category XII(d) for ''satellite navigation system'' receiving equipment subject to the ITAR and USML Category XI(c)(10) for antennae that are subject to the ITAR. (3) Items that otherwise would be covered by ECCN 7A005.a are ''subject to the ITAR'' (see 22 CFR parts 120 through 130).
Related Definitions: N/A
Items:

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 ''satellite navigation system'' 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.*

7A006 Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive and having any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to commodities in this entry that meet or exceed the parameters of 7A106.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: See also 7A106, 7A994 and Category 6 for controls on radar.
Related Definitions: N/A
Items:

a. 'Power management'; *or*

Technical Note: *For the purposes of 7A006.a, 'power management' is changing the transmitted power of the altimeter signal so that received power at the ''aircraft'' altitude is always at the minimum necessary to determine the altitude.*

b. Using phase shift key modulation.

* * * * *

7B001 Test, calibration or alignment equipment, ''specially designed'' for equipment controlled by 7A (except 7A994).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to entire entry.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See also 7B101, 7B102 and 7B994. (2) This entry does not control test, calibration or alignment equipment for 'Maintenance level I' or 'Maintenance Level II'.
Related Definition: For the purposes of 7B001: (1) 'Maintenance Level I': The failure of an inertial navigation unit is detected on the ''aircraft'' by indications from the Control and Display Unit (CDU) or by the status message from the corresponding sub-system. By following the manufacturer's manual, the cause of the failure may be localized at the level of the malfunctioning Line Replaceable Unit (LRU). The operator then removes the LRU and replaces it with a spare. (2) 'Maintenance Level II': The defective LRU is sent to the maintenance workshop (the manufacturer's or that of the operator responsible for level II maintenance). At the maintenance workshop, the malfunctioning LRU is tested by various appropriate means to verify and localize the defective Shop Replaceable Assembly (SRA) module responsible for the failure. This SRA is removed and replaced by an operative spare. The defective SRA (or possibly the complete LRU) is then shipped to the manufacturer. 'Maintenance Level II' does not include the disassembly or repair of controlled accelerometers or gyro sensors.
Items:

The list of items controlled is contained in the ECCN heading.

* * * * *

7D002 ''Source code'' for the operation or maintenance of any inertial navigation equipment, including inertial equipment not controlled by 7A003 or 7A004, or Attitude and Heading Reference Systems ('AHRS').

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to entire entry.	MT Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

List of Items Controlled

Related Controls: (1.) See also 7D102 and 7D994. (2.) This entry does not control ''source code'' for the operation or maintenance of gimballed 'AHRS'.

Related Definition: For the purposes of 7D002, 'AHRS' generally differ from Inertial Navigation Systems (INS) in that an 'AHRS' provides attitude and heading information and normally does not provide the acceleration, velocity and position information associated with an INS.

Items:

The list of items controlled is contained in the ECCN heading.

* * * * *

7E004 Other ''technology'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to ''technology'' for equipment or systems controlled for MT reasons.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

Special Conditions for STA

STA: (1) Paragraph (c)(1) of License Exception STA (§ 740.20(c)(1) of the EAR) may not be used for 7E004, except for 7E004.a.7. (2) Paragraph (c)(2) of License Exception STA (§ 740.20(c)(2) of the EAR) may not be used for 7E004, except for 7E004.a.7.

List of Items Controlled

Related Controls: (1) See also 7E001, 7E002, 7E101, and 7E994. (2) In addition to the Related Controls in 7E001, 7E002, and 7E101 that include MT controls, also see the MT controls in 7E104 for design ''technology'' for the integration of the flight control, guidance, and propulsion data into a flight management system, designed or modified for rockets or missiles capable of achieving a ''range'' equal to or greater than 300 km, for optimization of rocket system trajectory; and also see 9E101 for design ''technology'' for integration of air vehicle fuselage, propulsion system and lifting control surfaces, designed or modified for unmanned aerial vehicles capable of achieving a ''range'' equal to or greater than 300 km, to optimize aerodynamic performance throughout the flight regime of an unmanned aerial vehicle.

Related Definitions: N/A.

Items:

a. ''Technology'' for the ''development'' or ''production'' of any of the following:

a.1. [Reserved]

a.2. Air data systems based on surface static data only, *i.e.,* which dispense with conventional air data probes;

a.3. Three dimensional displays for ''aircraft'';

a.4. [Reserved]

a.5. Electric actuators (*i.e.,* electromechanical, electrohydrostatic and integrated actuator package) ''specially designed'' for 'primary flight control';

Technical Note: *For the purposes of 7E004.a.5, 'primary flight control' is ''aircraft'' stability or maneuvering control using force/moment generators, i.e., aerodynamic control surfaces or propulsive thrust vectoring.*

a.6. 'Flight control optical sensor array' ''specially designed'' for implementing ''active flight control systems''; *or*

Technical Note: *For the purposes of 7E004.a.6, a 'flight control optical sensor array' is a network of distributed optical sensors, using ''laser'' beams, to provide real-time flight control data for on-board processing.*

a.7. ''DBRN'' systems designed to navigate underwater, using sonar or gravity databases, that provide a positioning ''accuracy'' equal to or less (better) than 0.4 nautical miles;

b. ''Development'' ''technology'', as follows, for ''active flight control systems'' (including ''fly-by-wire systems'' or ''fly-by-light systems''):

b.1. Photonic-based ''technology'' for sensing ''aircraft'' or flight control component state, transferring flight control data, or commanding actuator movement, ''required'' for ''fly-by-light systems'' ''active flight control systems'';

b.2. [Reserved]

b.3. Real-time algorithms to analyze component sensor information to predict and preemptively mitigate impending degradation and failures of components within an ''active flight control system'';

Note: *7E004.b.3 does not include algorithms for purpose of off-line maintenance.*

b.4. Real-time algorithms to identify component failures and reconfigure force and moment controls to mitigate ''active flight control system'' degradations and failures;

Note: *7E004.b.4 does not include algorithms for the elimination of fault effects through comparison of redundant data sources, or off-line pre-planned responses to anticipated failures.*

b.5. Integration of digital flight control, navigation and propulsion control data, into a digital flight management system for ''total control of flight'';

Note: *7E004.b.5 does not apply to:*

1. ''Technology'' for integration of digital flight control, navigation and propulsion control data, into a digital flight management system for 'flight path optimization';

2. ''Technology'' for ''aircraft'' flight instrument systems integrated solely for VOR, DME, ILS or MLS navigation or approaches.

Technical Note: *'Flight path optimization' is a procedure that minimizes deviations from a four-dimensional (space and time) desired trajectory based on maximizing performance or effectiveness for mission tasks.*

b.6. [Reserved]

b.7. ''Technology'' ''required'' for deriving the functional requirements for ''fly-by-wire systems'' having all of the following:

b.7.a. 'Inner-loop' airframe stability controls requiring loop closure rates of 40 Hz or greater; *and*

Technical Note: *For the purposes of 7E004.b.7.a, 'inner-loop' refers to functions of ''active flight control systems'' that automate airframe stability controls.*

b.7.b. Having any of the following:

b.7.b.1. Corrects an aerodynamically unstable airframe, measured at any point in the design flight envelope, that would lose recoverable control if not corrected within 0.5 seconds;

b.7.b.2. Couples controls in two or more axes while compensating for 'abnormal changes in aircraft state';

Technical Note: *For the purposes of 7E004.b.7.b.2, 'abnormal changes in aircraft state' include in-flight structural damage, loss of engine thrust, disabled control surface, or destabilizing shifts in cargo load.*

b.7.b.3. Performs the functions specified in 7E004.b.5; *or*

Note: *7E004.b.7.b.3 does not apply to autopilots.*

b.7.b.4. Enables ''aircraft'' to have stable controlled flight, other than during take-off or landing, at greater than 18 degrees angle of attack, 15 degrees side slip, 15 degrees/second pitch or yaw rate, or 90 degrees/second roll rate;

b.8. ''Technology'' ''required'' for deriving the functional requirements of ''fly-by-wire systems'' to achieve all of the following:

b.8.a. No loss of control of the ''aircraft'' in the event of a consecutive sequence of any two individual faults within the ''fly-by-wire system''; *and*

b.8.b. Probability of loss of control of the ''aircraft'' being less (better) than 1×10^{-9} failures per flight hour;

Note: *7E004.b does not apply to ''technology'' associated with common computer elements and utilities (e.g., input signal acquisition, output signal transmission, computer ''program'' and data loading, built-in test, task scheduling mechanisms) not providing a specific flight control system function.*

c. ''Technology'' for the ''development'' of helicopter systems, as follows:

c.1. Multi-axis fly-by-wire or fly-by-light controllers, which combine the functions of at least two of the following into one controlling element:

c.1.a. Collective controls;
c.1.b. Cyclic controls;
c.1.c. Yaw controls;
c.2. ''Circulation-controlled anti-torque or circulation-controlled direction control systems'';
c.3. Rotor blades incorporating 'variable geometry airfoils', for use in systems using individual blade control.

Technical Note: *For the purposes of 7E004.c.3, 'variable geometry airfoils' use trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, the position of which can be controlled in flight.*

* * * * *

8A001 Submersible vehicles and surface vessels, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000; N/A for 8A001.b and .c.1
GBS: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in 8A001.b, 8A001.c or 8A001.d to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: For the control status of equipment for submersible vehicles, see: Category 6 for sensors; Categories 7 and 8 for navigation equipment; Category 8A for underwater equipment.
Related Definitions: N/A
Items:

a. Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m;
b. Manned, untethered submersible vehicles having any of the following:
b.1. Designed to 'operate autonomously' and having a lifting capacity of all the following:
b.1.a. 10% or more of their weight in air; *and*
b.1.b. 15 kN or more;
b.2. Designed to operate at depths exceeding 1,000 m; *or*
b.3. Having all of the following:
b.3.a. Designed to continuously 'operate autonomously' for 10 hours or more; *and*
b.3.b. 'Range' of 25 nautical miles or more;

Technical Notes:

1. For the purposes of 8A001.b, 'operate autonomously' means fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

2. For the purposes of 8A001.b, 'range' means half the maximum distance a submersible vehicle can 'operate autonomously'.

c. Unmanned submersible vehicles as follows:
c.1. Unmanned submersible vehicles having any of the following:
c.1.a. Designed for deciding a course relative to any geographical reference without real-time human assistance;
c.1.b. Acoustic data or command link; or
c.1.c. Wireless optical data or command link exceeding 1,000 m;
c.2. Unmanned, submersible vehicles, not specified in 8A001.c.1, having all of the following:
c.2.a. Designed to operate with a tether;
c.2.b. Designed to operate at depths exceeding 1,000 m; and
c.2.c. Having any of the following:
c.2.c.1. Designed for self-propelled maneuver using propulsion motors or thrusters specified by 8A002.a.2; or
c.2.c.2. Fiber optic data link;
d. [Reserved]
e. Ocean salvage systems with a lifting capacity exceeding 5 MN for salvaging objects from depths exceeding 250 m and having any of the following:
e.1. Dynamic positioning systems capable of position keeping within 20 m of a given point provided by the navigation system; *or*
e.2. Seafloor navigation and navigation integration systems, for depths exceeding 1,000 m and with positioning ''accuracies'' to within 10 m of a predetermined point.

8A002 Marine systems, equipment, ''parts'' and ''components,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart* (see Supp. No. 1 to part 738)
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000; N/A for 8A002.o.3.b
GBS: Yes for manipulators for civil end uses (*e.g.,* underwater oil, gas or mining operations) controlled by 8A002.i.2 and having 5 degrees of freedom of movement; and 8A002.r.

Special Conditions for STA

STA: License Exception STA may not be used to ship any commodity in 8A002.b, h, j, o.3, or p to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See also 8A992 and for underwater communications systems, see Category 5, Part I—Telecommunications. (2) See also 8A992 for self-contained underwater breathing apparatus that is not controlled by 8A002 or released for control by the 8A002.q Note. (3) For electronic imaging systems ''specially designed'' or modified for underwater use incorporating image intensifier tubes specified by 6A002.a.2.a or 6A002.a.2.b, see 6A003.b.3. (4) For electronic imaging systems ''specially designed'' or modified for underwater use incorporating ''focal plane arrays'' specified by 6A002.a.3.g, see 6A003.b.4.c. (5) Section 744.9 imposes a license requirement on commodities described in 8A002.d if being exported, reexported, or transferred (in-country) for use by a military end-user or for incorporation into an item controlled by ECCN 0A919.
Related Definitions: N/A
Items:

a. Systems, equipment, ''parts'' and ''components,'' ''specially designed'' or modified for submersible vehicles and designed to operate at depths exceeding 1,000 m, as follows:
a.1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;
a.2. Direct current propulsion motors or thrusters;
a.3. Umbilical cables, and connectors therefor, using optical fiber and having synthetic strength members;
a.4. ''Parts'' and ''components'' manufactured from material specified by ECCN 8C001;

Technical Note: *For the purposes of 8A002.a.4, this entry should not be defeated by the export of 'syntactic foam' controlled by 8C001 when an intermediate stage of manufacture has been performed and it is not yet in its final component form.*

b. Systems ''specially designed'' or modified for the automated control of the motion of submersible vehicles controlled by 8A001, using navigation data, having closed loop servo-controls and having any of the following:
b.1. Enabling a vehicle to move within 10 m of a predetermined point in the water column;
b.2. Maintaining the position of the vehicle within 10 m of a predetermined point in the water column; *or*
b.3. Maintaining the position of the vehicle within 10 m while following a cable on or under the seabed;
c. Fiber optic pressure hull penetrators;
d. Underwater vision systems having all of the following:
d.1. ''Specially designed'' or modified for remote operation with an underwater vehicle; and

d.2. Employing any of the following techniques to minimize the effects of back scatter:

d.2.a. Range-gated illuminators; or

d.2.b. Range-gated ''laser'' systems;

e. [Reserved]

f. [Reserved]

g. Light systems ''specially designed'' or modified for underwater use, as follows:

g.1. Stroboscopic light systems capable of a light output energy of more than 300 J per flash and a flash rate of more than 5 flashes per second;

g.2. Argon arc light systems ''specially designed'' for use below 1,000 m;

h. ''Robots'' ''specially designed'' for underwater use, controlled by using a dedicated computer and having any of the following:

h.1. Systems that control the ''robot'' using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the ''robot'' and an external object; *or*

h.2. The ability to exert a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or ''composite'' ''fibrous or filamentary materials'' in their structural members;

i. Remotely controlled articulated manipulators ''specially designed'' or modified for use with submersible vehicles and having any of the following:

i.1. Systems which control the manipulator using information from sensors which measure any of the following:

i.1.a. Torque or force applied to an external object; *or*

i.1.b. Tactile sense between the manipulator and an external object; *or*

i.2. Controlled by proportional master-slave techniques and having 5 degrees of 'freedom of movement' or more;

Technical Note: *For the purposes of 8A002.i.2, only functions having proportionally related motion control using positional feedback are counted when determining the number of degrees of 'freedom of movement'.*

j. Air independent power systems ''specially designed'' for underwater use, as follows:

j.1. Brayton or Rankine cycle engine air independent power systems having any of the following:

j.1.a. Chemical scrubber or absorber systems, ''specially designed'' to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

j.1.b. Systems ''specially designed'' to use a monoatomic gas;

j.1.c. Devices or enclosures, ''specially designed'' for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; *or*

j.1.d. Systems having all of the following:

j.1.d.1. ''Specially designed'' to pressurize the products of reaction or for fuel reformation;

j.1.d.2. ''Specially designed'' to store the products of the reaction; *and*

j.1.d.3. ''Specially designed'' to discharge the products of the reaction against a pressure of 100 kPa or more;

j.2. Diesel cycle engine air independent systems having all of the following:

j.2.a. Chemical scrubber or absorber systems, ''specially designed'' to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

j.2.b. Systems ''specially designed'' to use a monoatomic gas;

j.2.c. Devices or enclosures, ''specially designed'' for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; *and*

j.2.d. ''Specially designed'' exhaust systems that do not exhaust continuously the products of combustion;

j.3. ''Fuel cell'' air independent power systems with an output exceeding 2 kW and having any of the following:

j.3.a. Devices or enclosures, ''specially designed'' for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; *or*

j.3.b. Systems having all of the following:

j.3.b.1. ''Specially designed'' to pressurize the products of reaction or for fuel reformation;

j.3.b.2. ''Specially designed'' to store the products of the reaction; *and*

j.3.b.3. ''Specially designed'' to discharge the products of the reaction against a pressure of 100 kPa or more;

j.4. Stirling cycle engine air independent power systems having all of the following:

j.4.a. Devices or enclosures, ''specially designed'' for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; *and*

j.4.b. ''Specially designed'' exhaust systems which discharge the products of combustion against a pressure of 100 kPa or more;

k. [Reserved]

l. [Reserved]

m. [Reserved]

n. [Reserved]

o. Propellers, power transmission systems, power generation systems and noise reduction systems, as follows:

o.1. [Reserved]

o.2. Water-screw propeller, power generation systems or transmission systems, designed for use on vessels, as follows:

o.2.a. Controllable-pitch propellers and hub assemblies, rated at more than 30 MW;

o.2.b. Internally liquid-cooled electric propulsion motors with a power output exceeding 2.5 MW;

o.2.c. ''Superconductive'' propulsion motors with a power output exceeding 0.1 MW;

o.2.d. Power transmission shaft systems incorporating ''composite'' material ''parts'' or ''components'' and capable of transmitting more than 2 MW;

o.2.e. Ventilated or base-ventilated propeller systems, rated at more than 2.5 MW;

o.3. Noise reduction systems designed for use on vessels of 1,000 tonnes displacement or more, as follows:

o.3.a. Systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, ''specially designed'' for sound or vibration isolation and having an intermediate mass exceeding 30% of the equipment to be mounted;

o.3.b. 'Active noise reduction or cancellation systems' or magnetic bearings, ''specially designed'' for power transmission systems;

Technical Note: *For the purposes of 8A002.o.3.b, 'active noise reduction or cancellation systems' incorporate electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source.*

o.4. Permanent magnet electric propulsion motors ''specially designed'' for submersible vehicles, having a power output exceeding 0.1 MW.

Note: *8A002.o.4. includes rim-driven propulsion systems.*

p. Pumpjet propulsion systems having all of the following:

p.1. Power output exceeding 2.5 MW; *and*

p.2. Using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater-radiated noise;

q. Underwater swimming and diving equipment as follows;

q.1. Closed circuit rebreathers;

q.2. Semi-closed circuit rebreathers;

Note: *8A002.q does not control individual rebreathers for personal use when accompanying their users.*

N.B. *For equipment and devices ''specially designed'' for military use see ECCN 8A620.f.*

r. Diver deterrent acoustic systems ''specially designed'' or modified to disrupt divers and having a sound pressure level equal to or exceeding 190 dB (reference 1 μPa at 1 m) at frequencies of 200 Hz and below.

Note 1: *8A002.r does not apply to diver deterrent systems based on under-water-explosive devices, air guns or combustible sources.*

Note 2: *8A002.r includes diver deterrent acoustic systems that use spark gap sources, also known as plasma sound sources.*

* * * * *

8C001 'Syntactic foam' designed for underwater use and having all of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart* (see Supp. No. 1 to part 738)
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: See also 8A002.a.4.
Related Definition: For the purposes of 8C001, 'Syntactic foam' consists of hollow spheres of plastic or glass embedded in a resin ''matrix.''

Items:

a. Designed for marine depths exceeding 1,000 m; *and*

b. A density less than 561 kg/m^3.

* * * * *

8E002 Other ''technology'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

License Exceptions Note: *License Exception TSU is not applicable for the repair ''technology'' controlled by 8E002.a or .b, see Supplement No. 2 to part 774.*

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit technology in 8E002.a to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR).

List of Items Controlled

Related Controls: See also 8E992.
Related Definitions: N/A
Items:

a. ''Technology'' for the ''development'', ''production'', repair, overhaul or refurbishing (re-machining) of propellers ''specially designed'' for underwater noise reduction;

b. ''Technology'' for the overhaul or refurbishing of equipment controlled by 8A001, 8A002.b, 8A002.j, 8A002.o or 8A002.p.

c. ''Technology'' according to the General Technology Note for the ''development'' or ''production'' of any of the following:

c.1. Surface-effect vehicles (fully skirted variety) having all of the following:

c.1.a. Maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1.25 m or more;

c.1.b. Cushion pressure exceeding 3,830 Pa; *and*

c.1.c. Light-ship-to-full-load displacement ratio of less than 0.70;

c.2. Surface-effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3.25 m or more;

c.3. Hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3.25 m or more; *or*

c.4. 'Small waterplane area vessels' having any of the following:

c.4.a. Full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3.25 m or more; *or*

c.4.b. Full load displacement exceeding 1,500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a significant wave height of 4 m or more.

Technical Note: *For the purposes of 8E002.c.4, a 'small waterplane area vessel' is defined by the following formula: waterplane area at an operational design draft less than 2x (displaced volume at the operational design draft)$^{2/3}$.*

* * * * *

9A001 Aero gas turbine engines having any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to only to those engines that meet the characteristics listed in 9A101.	MT Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: See also 9A101 and 9A991.
Related Definitions: N/A
Items:

a. Incorporating any of the ''technologies'' controlled by 9E003.a, 9E003.h, or 9E003.i;

Note 1: *9A001 does not control aero gas turbine engines which meet all of the following:*

a. Certified by the civil aviation authority in a country listed in Supplement No. 1 to Part 743; and

b. Intended to power non-military manned ''aircraft'' for which any of the following has been issued by a Wassenaar Arrangement Participating State listed in Supplement No. 1 to Part 743 for the ''aircraft'' with this specific engine type:

b.1. A civil type certificate; or

b.2. An equivalent document recognized by the International Civil Aviation Organization (ICAO).

Note 2: *9A001 does not apply to aero gas turbine engines designed for Auxiliary Power Units (APUs) approved by the civil aviation authority in a Wassenaar Arrangement Participating State (see Supplement No. 1 to part 743 of the EAR).*

b. [Reserved]

* * * * *

9A003 ''Specially designed'' assemblies or ''components'', incorporating any of the ''technologies'' controlled by 9E003.a, 9E003.h, 9E003.i, or 9E003.k, for any of the following aero gas turbine engines (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 2
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $5000
GBS: N/A

List of Items Controlled

Related Controls: N/A
Related Definition: N/A
Items:

a. Controlled by 9A001; *or*

b. Whose design or production origins are either not from a Wassenaar Participating State (see Supplement No. 1 to part 743 of the EAR) or unknown to the manufacturer.

9A004 Space launch vehicles and ''spacecraft,'' ''spacecraft buses'', ''spacecraft payloads'', ''spacecraft'' on-board systems or equipment, terrestrial equipment, air-launch platforms, and ''sub-orbital craft'', as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS and AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to 9A004.g, .u, .v, .w and .x.	NS Column 1
AT applies to 9A004.g, .u, .v, .w, .x and .y.	AT Column 1

License Requirement Note: *9A004.b through .f, and .h are controlled under ECCN 9A515.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A
GBS: N/A

List of Items Controlled

Related Controls: (1) See also 9A104, 9A515, and 9B515. (2) See ECCNs 9E001 (''development'') and 9E002 (''production'') for technology for items controlled by this entry. (3) See USML Categories IV for the space launch vehicles and XV for other spacecraft that are ''subject to the ITAR'' (see 22 CFR parts 120 through 130).
Related Definition: N/A
Items:

a. Space launch vehicles;

b. ''Spacecraft'';

c. ''Spacecraft buses'';

d. ''Spacecraft payloads'' incorporating items specified by 3A001.b.1.a.4, 3A002.g,

5A001.a.1, 5A001.b.3, 5A002.c, 5A002.e, 6A002.a.1, 6A002.a.2, 6A002.b, 6A002.d, 6A003.b, 6A004.c, 6A004.e, 6A008.d, 6A008.e, 6A008.k, 6A008.l or 9A010.c;

e. On-board systems or equipment, ''specially designed'' for ''spacecraft'' and having any of the following functions:

e.1. 'Command and telemetry data handling';

Note: *For the purposes of 9A004.e.1, 'command and telemetry data handling' includes bus data management, storage, and processing.*

e.2. 'Payload data handling'; *or*

Note: *For the purposes of 9A004.e.2, 'payload data handling' includes payload data management, storage, and processing.*

e.3. 'Attitude and orbit control';

Note: *For the purposes of 9A004.e.3, 'attitude and orbit control' includes sensing and actuation to determine and control the position and orientation of a ''spacecraft''.*

N.B.: *Equipment ''specially designed'' for military use is ''subject to the ITAR''. See 22 CFR parts 120 through 130.*

f. Terrestrial equipment ''specially designed'' for ''spacecraft'', as follows:

f.1. Telemetry and telecommand equipment ''specially designed'' for any of the following data processing functions:

f.1.a. Telemetry data processing of frame synchronization and error corrections, for monitoring of operational status (also known as health and safe status) of the ''spacecraft bus''; *or*

f.1.b. Command data processing for formatting command data being sent to the ''spacecraft'' to control the ''spacecraft bus'';

f.2. Simulators ''specially designed'' for 'verification of operational procedures' of ''spacecraft''.

Technical Note: *For the purposes of 9A004.f.2, 'verification of operational procedures' is any of the following:*

1. Command sequence confirmation;

2. Operational training;

3. Operational rehearsals; or

4. Operational analysis.

g. ''Aircraft'' ''specially designed'' or modified to be air-launch platforms for space launch vehicles or ''sub-orbital craft''.

h. ''Sub-orbital craft''.

i. through t. [Reserved]

u. The James Webb Space Telescope (JWST) being developed, launched, and operated under the supervision of the U.S. National Aeronautics and Space Administration (NASA).

v. ''Parts,'' ''components,'' ''accessories'' and ''attachments'' that are ''specially designed'' for the James Webb Space Telescope and that are *not:*

v.1. Enumerated or controlled in the USML;

v.2. Microelectronic circuits;

v.3. Described in ECCN 7A004 or 7A104; *or*

v.4. Described in an ECCN containing ''space-qualified'' as a control criterion (*See* ECCN 9A515.x.4).

w. The International Space Station being developed, launched, and operated under the supervision of the U.S. National Aeronautics and Space Administration.

x. ''Parts,'' ''components,'' ''accessories'' and ''attachments'' that are ''specially designed'' for the International Space Station.

y. Items that would otherwise be within the scope of ECCN 9A004.v or .x but that have been identified in an interagency-cleared commodity classification (CCATS) pursuant to § 748.3(e) as warranting control in 9A004.y.

9B005 On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, ''specially designed'' for use with any of the following (see List of Items Controlled).

Reason for Control: NS, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
AT applies to entire entry.	AT Column 1

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: N/A

GBS: N/A

List of Items Controlled

Related Controls: See also 9B105.

Related Definitions: N/A

Items:

a. Wind tunnels designed for speeds of Mach 1.2 or more;

Note: *9B005.a does not control wind tunnels ''specially designed'' for educational purposes and having a 'test section size' (measured laterally) of less than 250 mm.*

Technical Note: *For the purposes of 9B005.a Note, 'test section size' means the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test section location.*

b. Devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns; *or*

c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25×10^6.

* * * * *

9E001 ''Technology'' according to the General Technology Note for the ''development'' of equipment or ''software'', controlled by 9A004, 9A012, 9B (except for ECCNs 9B604, 9B610, 9B619, 9B990 and 9B991), or ECCN 9D001 to 9D004, 9D101, or 9D104.

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to ''technology'' for items controlled by 9A004, 9A012, 9B001 to 9B010, 9D001 to 9D004 for NS reasons.	NS Column 1
MT applies to ''technology'' for items controlled by 9A012, 9B001, 9B002, 9B003, 9B004, 9B005, 9B007, 9B104, 9B105, 9B106, 9B115, 9B116, 9B117, 9D001, 9D002, 9D003, or 9D004 for MT reasons.	MT Column 1
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit any technology in this entry to any of the destinations listed in Country Group A:6 (See Supplement No. 1 to part 740 of the EAR)

List of Items Controlled

Related Controls: (1) See also 9E101 and 1E002.f (for controls on ''technology'' for the repair of controlled structures, laminates or materials). (2) ''Technology'' required for the ''development'' of equipment described in ECCNs 9A005 to 9A011 or ''software'' described in ECCNs 9D103 and 9D105 is ''subject to the ITAR.''

Related Definitions: N/A

Items:

The list of items controlled is contained in the ECCN heading.

9E002 ''Technology'' according to the General Technology Note for the ''production'' of ''equipment'' controlled by ECCN 9A004 or 9B (except for ECCNs 9B117, 9B604, 9B610, 9B619, 9B990, and 9B991).

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country chart (see Supp. No. 1 to part 738)*
NS applies to entire entry.	NS Column 1
MT applies to ''technology'' for equipment controlled by 9B001, 9B002, 9B003, 9B004, 9B005, 9B007, 9B104, 9B105, 9B106, 9B115 or 9B116 for MT reasons.	MT Column 1

Control(s)	Country chart (see Supp. No. 1 to part 738)
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit any technology in this entry to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See also 9E102. (2) See also 1E002.f for 'technology'' for the repair of controlled structures, laminates, or materials. (3) ''Technology'' that is required for the ''production'' of equipment described in ECCNs 9A005 to 9A011 is ''subject to the ITAR.''

Related Definitions: N/A

Items:

The list of items controlled is contained in the ECCN heading.

9E003 Other ''technology'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, SI, AT

Control(s)	Country chart (see Supp. No. 1 to part 738)
NS applies to entire entry.	NS Column 1
SI applies to 9E003.a.1 through a.8, .h, .i, and .l.	See § 742.14 of the EAR for additional information.
AT applies to entire entry.	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

TSR: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit any technology in 9E003.a.1 to a.5, 9E003.c., 9E003.h, or 9E003.i (other than technology for fan or power turbines) to any of the destinations listed in Country Group A:5 or A:6 (See Supplement No.1 to part 740 of the EAR).

License Exception STA may not be used to ship or transmit any technology in 9E003.k to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) Hot section ''technology'' specifically designed, modified, or equipped for military uses or purposes, or developed principally with U.S. Department of Defense funding, is ''subject to the ITAR'' (see 22 CFR parts 120 through 130). (2) ''Technology'' is subject to the EAR when actually applied to a commercial ''aircraft'' engine program. Exporters may seek to establish commercial application either on a case-by-case basis through submission of documentation demonstrating application to a commercial program in requesting an export license from the Department of Commerce in respect to a specific export, or in the case of use for broad categories of ''aircraft,'' engines, ''parts'' or ''components,'' a commodity jurisdiction determination from the Department of State.

Related Definitions: N/A

Items:

a. ''Technology'' ''required'' for the ''development'' or ''production'' of any of the following gas turbine engine ''parts,'' ''components'' or systems:

a.1. Gas turbine blades, vanes or ''tip shrouds'', made from Directionally Solidified (DS) or Single Crystal (SC) alloys and having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K (1,000 °C) at a stress of 200 MPa, based on the average property values;

Technical Note: *For the purposes of 9E003.a.1, stress-rupture life testing is typically conducted on a test specimen.*

a.2. Combustors having any of the following:

a.2.a. 'Thermally decoupled liners' designed to operate at 'combustor exit temperature' exceeding 1,883 K (1,610 °C);

a.2.b. Non-metallic liners;

a.2.c. Non-metallic shells; *or*

a.2. d. Liners designed to operate at 'combustor exit temperature' exceeding 1,883 K (1,610 °C) and having holes that meet the parameters specified by 9E003.c;

a.2.e. Utilizing 'pressure gain combustion';

Technical Note: *For the purposes of 9E003.a.2.e, in 'pressure gain combustion' the bulk average stagnation pressure at the combustor outlet is greater than the bulk average stagnation pressure at the combustor inlet due primarily to the combustion process, when the engine is running in a ''steady state mode'' of operation.*

Note: *The ''required'' ''technology'' for holes in 9E003.a.2 is limited to the derivation of the geometry and location of the holes.*

Technical Notes:

1. *For the purposes of 9E003.a.2.a, 'thermally decoupled liners' are liners that feature at least a support structure designed to carry mechanical loads and a combustion facing structure designed to protect the support structure from the heat of combustion. The combustion facing structure and support structure have independent thermal displacement (mechanical displacement due to thermal load) with respect to one another, i.e., they are thermally decoupled.*

2. *For the purposes of 9E003.a.2.d, 'combustor exit temperature' is the bulk average gas path total (stagnation) temperature between the combustor exit plane and the leading edge of the turbine inlet guide vane (i.e., measured at engine station T40 as defined in SAE ARP 755A) when the engine is running in a ''steady state mode'' of operation at the certificated maximum continuous operating temperature.*

N.B.: *See 9E003.c for ''technology'' ''required'' for manufacturing cooling holes.*

a.3. ''Parts'' or ''components,'' that are any of the following:

a.3.a. Manufactured from organic ''composite'' materials designed to operate above 588 K (315 °C);

a.3.b. Manufactured from any of the following:

a.3.b.1. Metal ''matrix'' ''composites'' reinforced by any of the following:

a.3.b.1.a. Materials controlled by 1C007;

a.3.b.1.b. ''Fibrous or filamentary materials'' specified by 1C010; *or*

a.3.b.1.c. Aluminides specified by 1C002.a; *or*

a.3.b.2. Ceramic ''matrix'' ''composites'' specified by 1C007; *or*

a.3.c. Stators, vanes, blades, tip seals (shrouds), rotating blings, rotating blisks or 'splitter ducts', that are all of the following:

a.3.c.1. Not specified in 9E003.a.3.a;

a.3.c.2. Designed for compressors or fans; *and*

a.3.c.3. Manufactured from material controlled by 1C010.e with resins controlled by 1C008;

Technical Note: For the purposes of 9E003.a.3.c, a 'splitter duct' performs the initial separation of the air-mass flow between the bypass and core sections of the engine.

a.4. Uncooled turbine blades, vanes or ''tip shrouds'' designed to operate at a 'gas path temperature' of 1,373 K (1,100 °C) or more;

a.5. Cooled turbine blades, vanes or ''tip shrouds'', other than those described in 9E003.a.1, designed to operate at a 'gas path temperature' of 1,693 K (1,420 °C) or more;

Technical Note: *For the purposes of 9E003.a.5, 'gas path temperature' is the bulk average gas path total (stagnation) temperature at the leading-edge plane of the turbine component when the engine is running in a ''steady state mode'' of operation at the certificated or specified maximum continuous operating temperature.*

a.6. Airfoil-to-disk blade combinations using solid state joining;

a.7. [Reserved]

a.8. 'Damage tolerant' gas turbine engine rotor ''parts'' or ''components'' using powder metallurgy materials controlled by 1C002.b; *or*

Technical Note: *For the purposes of 9E003.a.8, 'damage tolerant' ''parts'' and ''components'' are designed using methodology and substantiation to predict and limit crack growth.*

a.9. [Reserved]

N.B.: *For ''FADEC systems'', see 9E003.h.*

a.10. [Reserved]

N.B.: *For adjustable flow path geometry, see 9E003.i.*

a.11. 'Fan blades' having all of the following:

a.11.a. 20% or more of the total volume being one or more closed cavities containing vacuum or gas only; *and*

a.11.b. One or more closed cavities having a volume of 5 cm^3 or larger;

Technical Note: *For the purposes of 9E003.a.11, a 'fan blade' is the aerofoil portion of the rotating stage or stages, which provide both compressor and bypass flow in a gas turbine engine.*

b. ''Technology'' ''required'' for the ''development'' or ''production'' of any of the following:

b.1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; *or*

b.2. ''Composite'' propeller blades or prop-fans, capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. ''Technology'' ''required'' for manufacturing cooling holes in gas turbine engine ''parts'' or ''components'' incorporating any of the ''technologies'' specified by 9E003.a.1, 9E003.a.2, or 9E003.a.5, and having any of the following:

c.1. Having all of the following:

c.1.a. Minimum 'cross-sectional area' less than 0.45 mm^2;

c.1.b. 'Hole shape ratio' greater than 4.52; *and*

c.1.c. 'Incidence angle' equal to or less than 25°; *or*

c.2. Having all of the following:

c.2.a. Minimum 'cross-sectional area' less than 0.12 mm^2;

c.2.b. 'Hole shape ratio' greater than 5.65; *and*

c.2.c. 'Incidence angle' more than 25°;

Note: *9E003.c does not apply to ''technology'' for manufacturing constant radius cylindrical holes that are straight through and enter and exit on the external surfaces of the component.*

Technical Notes:

1. *For the purposes of 9E003.c, the 'cross-sectional area' is the area of the hole in the plane perpendicular to the hole axis.*

2. *For the purposes of 9E003.c, 'hole shape ratio' is the nominal length of the axis of the hole divided by the square root of its minimum 'cross-sectional area'.*

3. *For the purposes of 9E003.c, 'incidence angle' is the acute angle measured between the plane tangential to the airfoil surface and the hole axis at the point where the hole axis enters the airfoil surface.*

4. *For the purposes of 9E003.c, methods for manufacturing holes include ''laser'' beam machining, water jet machining, Electro-Chemical Machining (ECM) or Electrical Discharge Machining (EDM).*

d. ''Technology'' ''required'' for the ''development'' or ''production'' of helicopter power transfer systems or tilt rotor or tilt wing ''aircraft'' power transfer systems;

e. ''Technology'' for the ''development'' or ''production'' of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

e.1. 'Box volume' of 1.2 m^3 or less;

e.2. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; *and*

e.3. Power density of more than 700 kW/m^3 of 'box volume';

Technical Note: *For the purposes of 9E003.e.1., 'box volume' is the product of three perpendicular dimensions measured in the following way:*

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

Width: The widest of any of the following:

a. The outside dimension from valve cover to valve cover;

b. The dimensions of the outside edges of the cylinder heads; or

c. The diameter of the flywheel housing;

Height: The largest of any of the following:

a. The dimension of the crankshaft centerline to the top plane of the valve cover (or cylinder head) plus twice the stroke; or

b. The diameter of the flywheel housing.

f. ''Technology'' ''required'' for the ''production'' of ''specially designed'' ''parts'' or ''components'' for high output diesel engines, as follows:

f.1. ''Technology'' ''required'' for the ''production'' of engine systems having all of the following ''parts'' and ''components'' employing ceramics materials controlled by 1C007:

f.1.a Cylinder liners;

f.1.b. Pistons;

f.1.c. Cylinder heads; *and*

f.1.d. One or more other ''part'' or ''component'' (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

f.2. ''Technology'' ''required'' for the ''production'' of turbocharger systems with single-stage compressors and having all of the following:

f.2.a. Operating at pressure ratios of 4:1 or higher;

f.2.b. Mass flow in the range from 30 to 130 kg per minute; *and*

f.2.c. Variable flow area capability within the compressor or turbine sections;

f.3. ''Technology'' ''required'' for the ''production'' of fuel injection systems with a ''specially designed'' multifuel (*e.g.,* diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8 °C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8 °C)) and having all of the following:

f.3.a. Injection amount in excess of 230 mm^3 per injection per cylinder; *and*

f.3.b. Electronic control features ''specially designed'' for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

g. ''Technology'' ''required'' for the ''development'' or ''production'' of 'high output diesel engines' for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication and permitting operation to temperatures exceeding 723 K (450 °C), measured on the cylinder wall at the top limit of travel of the top ring of the piston;

Technical Note: *For the purposes of 9E003.g, 'high output diesel engines' are diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.*

h. ''Technology'' for gas turbine engine ''FADEC systems'' as follows:

h.1. ''Development'' ''technology'' for deriving the functional requirements for the ''parts'' or ''components'' necessary for the ''FADEC system'' to regulate engine thrust or shaft power (*e.g.,* feedback sensor time constants and accuracies, fuel valve slew rate);

h.2. ''Development'' or ''production'' ''technology'' for control and diagnostic ''parts'' or ''components'' unique to the ''FADEC system'' and used to regulate engine thrust or shaft power;

h.3. ''Development'' ''technology'' for the control law algorithms, including ''source code'', unique to the ''FADEC system'' and used to regulate engine thrust or shaft power;

Note: *9E003.h does not apply to technology related to engine-''aircraft'' integration required by civil aviation authorities of one or more Wassenaar Arrangement Participating States (See Supplement No. 1 to part 743 of the EAR) to be published for general airline use (e.g., installation manuals, operating instructions, instructions for continued airworthiness) or interface functions (e.g., input/output processing, airframe thrust or shaft power demand).*

i. ''Technology'' for adjustable flow path systems designed to maintain engine stability for gas generator turbines, fan or power turbines, or propelling nozzles, as follows:

i.1. ''Development'' ''technology'' for deriving the functional requirements for the ''parts'' or ''components'' that maintain engine stability;

i.2. ''Development'' or ''production'' ''technology'' for ''parts'' or ''components'' unique to the adjustable flow path system and that maintain engine stability;

i.3. ''Development'' ''technology'' for the control law algorithms, including ''source code'', unique to the adjustable flow path system and that maintain engine stability;

Note: *9E003.i does not apply to ''technology'' for any of the following:*

a. Inlet guide vanes;

b. Variable pitch fans or prop-fans;

c. Variable compressor vanes;

d. Compressor bleed valves; or

e. Adjustable flow path geometry for reverse thrust.

j. ''Technology'' ''required'' for the ''development'' of wing-folding systems designed for fixed-wing ''aircraft'' powered by gas turbine engines.

N.B.: *For ''technology'' ''required'' for the ''development'' of wing-folding systems designed for fixed-wing ''aircraft'' specified in USML Category VIII (a), see USML Category VIII (i).*

k. ''Technology'', not specified in 9E003.a, 9E003.h, or 9E003.i, ''required'' for the ''development'' of any of the following components or systems, ''specially designed'' for aero gas turbine engines to enable ''aircraft'' to cruise at Mach 1 or greater for more than 30 minutes:

k.1. Propulsion inlet systems;

k.2. Propulsion exhaust systems;

k.3. 'Reheat systems';

k.4. 'Active thermal management systems' to condition fluids used to lubricate or cool 'engine rotor supports';

k.5. Oil-free 'engine rotor supports'; or

k.6. Systems to remove heat from 'compression system' core gas path flow.

Technical Notes: *For the purposes of 9E003.k:*

1. Propulsion inlet systems include core flow pre-coolers.

2. 'Reheat systems' provide additional thrust by combusting fuel in exhaust and/or bypass flow downstream of the last turbomachinery stage. 'Reheat systems' are also referred to as afterburners.

3. 'Active thermal management systems' employ methods other than passive oil-to-air cooling or oil-to-fuel cooling, such as vapor cycle systems.

4. 'Compression system' is any stage or combination of stages between the engine inlet face and the combustor that increases gas path pressure through mechanical work.

5. An 'engine rotor support' is the bearing supporting the main engine shaft that drives the compression system or turbine rotors.

N.B. 1 *See 9E003.h, for engine control technology.*

N.B. 2 *See 9E003.i, for adjustable flow path systems technology.*

l. ''Technology'' not otherwise controlled in 9E003.a.1 through a.8, a.10, and .h and used in the ''development'', ''production'', or overhaul of hot section ''parts'' or ''components'' of civil derivatives of military engines controlled on the U.S. Munitions List.

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■ 13. Supplement no. 6 to part 774 is amended by revising paragraph (4) to read as follows:

Supplement No. 6 to Part 774—Sensitive List

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(4) Category 4

(i) 4A001.a.2.

(ii) [Reserved]

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Thea D. Rozman Kendler,

Assistant Secretary for Export Administration.

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