



# Federal Register

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**Wednesday,  
July 12, 2000**

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## **Part III**

# **Department of Commerce**

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**Export Administration Bureau**

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**15 CFR Part 740 et al.**

**Implementation of the Wassenaar  
Arrangement List of Dual-Use Items:  
Revisions to Categories 1, 2, 3, 4, 5, 6  
and 9 of the Commerce Control List;  
Final Rule**

**DEPARTMENT OF COMMERCE****Bureau of Export Administration****15 CFR Parts 740, 772 and 774**

[Docket No. 000616178-0178-01]

RIN 0694-AC19

**Implementation of the Wassenaar Arrangement List of Dual-Use Items: Revisions to Categories 1, 2, 3, 4, 5, 6 and 9 of the Commerce Control List****AGENCY:** Bureau of Export Administration, Commerce.**ACTION:** Final rule.

**SUMMARY:** The Bureau of Export Administration (BXA) maintains the Commerce Control List (CCL), which identifies those items subject to Department of Commerce export controls. This final rule revises certain entries controlled for national security reasons in Categories 1, 2, 3, 4, 5, 6 and 9 to conform with changes in the Wassenaar Arrangement's List of Dual-Use Goods and Technologies maintained and agreed to by governments participating in the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (Wassenaar Arrangement). The Wassenaar Arrangement controls strategic items with the objective of improving regional and international security and stability. The purpose of this final rule is to make the necessary changes to the CCL to implement recently agreed revisions to the Wassenaar List of Dual-Use Goods and Technologies.

**DATES:** This rule is effective July 12, 2000.**FOR FURTHER INFORMATION CONTACT:** For questions of technical nature, the following persons in the Office of Strategic Trade are available:

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**SUPPLEMENTARY INFORMATION:****Background**

In July 1996, the United States and thirty-two other countries gave final approval to the establishment of a new multilateral export control arrangement, called the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (Wassenaar Arrangement). The Wassenaar Arrangement contributes to regional and international security and stability by promoting transparency and greater responsibility in transfers of conventional arms and dual-use goods and technologies, thus preventing destabilizing accumulations of such items. Participating states have committed to exchange information on exports of dual-use goods and technologies to non-participating states for the purposes of enhancing transparency and assisting in developing common understandings of the risks associated with the transfers of these items.

On January 15, 1998, BXA published an interim rule (63 FR 2452) fulfilling U.S. commitments to the Wassenaar Arrangement by implementing the Wassenaar Arrangement list of dual-use items and imposing reporting requirements for exports of certain items controlled under the Wassenaar Arrangement.

On July 23, 1999, BXA published a final rule (64 FR 40106) that revised certain entries controlled for national security reasons to conform with the 1998 changes in the Wassenaar Arrangement's List of Dual-Use Goods and Technologies agreed to by participating governments.

This final rule revises a number of national security controlled entries on the Commerce Control List (CCL) to conform with recently agreed changes in the Wassenaar List of Dual-Use Goods and Technologies. The most significant revisions include liberalizations in national security thresholds for microprocessors. A detailed description of revisions to the CCL is provided below.

Specifically, this rule makes the following amendments to the Commerce Control List:

**Category 1—Materials, Chemicals, Microorganisms, and Toxins**

1A001—amended by clarifying the term “vinylether monomer” to read “vinylether group as a constitutional unit” (1A001.c).

1C011—amended by (1) adding a new technical note to add hafnium as an impurity in the control of raw zirconium. This revision allows for the natural content of hafnium in zirconium

(2–7%) to be counted with the zirconium (technical note to 1C011.a); and (2) adding nitroguanidine to the list of metals and compounds controlled by 1C011 (1C011.d). Previously nitroguanidine was controlled on the Munitions List (ML). This revision places nitroguanidine under control as a dual-use item on the Commerce Control List (CCL).

1C012—amended by revising the entry heading to remove the reference “for nuclear heat sources” and by revising the related definitions section to clarify that “these materials are typically used for nuclear heat sources” (1C012, Related Definitions).

1E002—amended by reformatting 1E002.c.1.c by merging the technical parameters of the note into 1E002.c.1.c.1 and by clarifying paragraphs c.1.c.2 and c.1.c.3. These reformatting revisions do not alter the scope of existing controls.

**Category 3—Electronics**

3A001—amended by (1) revising for clarity the phrase “integrated circuits described in 3A001.a.3 to 3A001.a.10 or 3A001.a.12” to provide a narrative description of the items identified by these paragraph references and by revising the phrase “field programmable gate arrays” to read “field programmable logic devices” (3A001.a.2); (2) increasing the composite theoretical performance (CTP) for microprocessors in 3A001.a.3.a from 260 million operations per second (MTOPS) to 3,500 MTOPS to account for technological advances and controllability factors (3A001.a.3.a); (3) removing the phrase “maximum resolution” from 3A001.a.5.a.1 to a.5.a.3 and adding a technical note to 3A001.a.5.b stating that “a resolution of n bit corresponds to a quantization of 2n levels and a total conversion time is the inverse of the sample rate” (3A001.a.5); (4) replacing the reference to “gate arrays” with “logic devices” in 3A001.a.7, combining the control criteria described in 3A001.a.8 into 3A001.a.7 to create a single entry for logic devices, and creating a note specifying that 3A001.a.7 includes Simple Programmable Logic Devices (SPLDs), Complex Programmable Logic Devices (CPLDs), Field Programmable Gate Arrays (FPGAs), Field Programmable Logic Arrays (FPLAs), Field Programmable Interconnects (FPICs) and adding a nota bene stating that field programmable logic devices are also known as field programmable logic arrays (3A001.a.7). These clarifications are designed to reflect new technology and terms; (5) removing from control on the CCL—impregnated cathodes designed for electronic tubes

with a turn on time to rate emission of less than 3 seconds (3A001.b.1.c.1).

These impregnated cathodes are now controlled on the Munitions List and are subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls (see 22 CFR, part 121); and (6) removing from control on the CCL—electromagnetic amplification at frequencies equal to or less than 31 GHz with a noise figure of less than 0.5 Db, or at frequencies exceeding 31 GHz (3A001.d.1). These items are now controlled on the Munitions List and are subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls (see 22 CFR, part 121).

3B002—amended by (1) liberalizing the pattern rate for testing integrated circuits from 60 MHz to 333 MHz and adding a technical note explaining which technical parameter should be used in defining the pattern rate (3B002.b); (2) clarifying that “stored program controlled” test equipment for testing microwave integrated circuits are controlled by 3A001.b.2 (3B002.c) and removing the duplicative decontrol note (decontrol note to 3B002.c), as this decontrol note is described by 3A001.b.2; (3) removing from national security controls, electronic beam systems and laser beams described by 3B002.d. These items continue to be subject to the CCL and remain controlled for antiterrorism reasons under 3B992.

3E002—amended by adding a new paragraph 3E002.g controlling control technology according to the General Technology Note (not controlled by 3E001) for the development or production of microprocessors above 530 MTOPS and an access width of 32 bits or more (3E001.g).

#### Category 5—Telecommunications, Part I

5A001—amended by: (1) revising for clarity the phrase “‘spread spectrum’ or ‘frequency agility’ (frequency hopping) techniques” to read “‘spread spectrum’ techniques, including ‘frequency hopping’ techniques” (5A001.b.3); and (2) revising decontrol notes to 5A001.b.3.b and 5A001.b.4 by stating that these subparagraphs do not control radio equipment specially designed for use with civil cellular radiocommunications (5A001.b.3 and b.4).

5B001—amended by removing national security controls on test equipment used to test radio equipment operating at input or output frequencies exceeding 31 GHz (5B001.b.4).

5D001—amended by removing national security controls on software used for the development of radio

equipment operating at input or output frequencies exceeding 31 GHz (5D001.d.4).

5E001—amended by revising for clarity the phrase “‘spread spectrum’ or ‘frequency agility’ (frequency hopping) techniques” to read “‘spread spectrum’ techniques, including ‘frequency hopping’ techniques” (5E001.b.4).

#### Category 5—Information Security, Part 2

5A002—amended by (1) revising the phrase “receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type” to read “receiving equipment for radio broadcast, pay television or similar restricted audience broadcast of the consumer type” in paragraph c of the related controls section of 5A002; (2) revising the phrase “‘spread spectrum’ or the hopping code for ‘frequency agility’ systems” to read “‘spread spectrum’ systems, including the hopping code for ‘frequency hopping’ systems” (5A002.a.5). This revision is consistent with the revision made to 5A001.b.3.

#### Category 6—Sensors and Lasers

6A001—amended by (1) removing from control acoustic projectors designed to withstand pressure during normal operation at depths exceeding 1,000 m (6A001.a.1.c.3); (2) removing from control acoustic systems designed to withstand pressure during normal operation at depths exceeding 1,000 m (6A001.a.1.d.2) and reformatting 6A001.a.1.d by merging the technical parameters described in 6A001.a.1.d.1 into 6A001.a.1.d.; (3) revising 6A001.a.2.a by removing the reference to “transducers”, adding a note specifying that the controls status of hydrophones specially designed for other equipment is determined by the control status of the other equipment and simplifying the control criteria for towed hydrophones arrays by establishing a clear 35 meter point of demarcation between commercial and military applications (6A001.a.2.).

6A002—amended by revising the second note to 6A002.a.3 for clarity.

6A003—amended by adding a note to 6A003.a specifying that instrumentation cameras controlled by 6A003.a.3 to a.5, with modular structures should be evaluated by their maximum capability, using electronic assemblies available according to the camera manufacturer’s specifications (note to 6A003.a).

6A004—amended by adding a new paragraph 6A004.e to control for national security reasons certain aspheric optical elements. This revision is also accompanied by the addition of new technical notes and decontrol notes

designed to clarify the scope of this new control. Due to the sensitive nature of these aspheric optical elements controlled by 6A004.e, a validated license is required to all destinations, except Canada for the technology for the development (6E001) and production (6E002) of these aspheric optical elements.

#### Category 9—Propulsion Systems, Space Vehicles and Related Equipment

9B001—amended by removing national security controls on ceramic core manufacturing equipment or tools and ceramic shell wax pattern preparation equipment (9B001.c. and d.).

9E003—amended by (1) adding national security controls on technology for components manufactured from composite material controlled by 1C010 and manufactured with resins controlled by 1C008 (9E003.a.3); and (2) removing national security controls on technology for rotor blade tip clearance control systems employing active compensating casing “technology” limited to a design and development data base (9E003.a.11 and a.12). This equipment will continue to be controlled for antiterrorism reasons under newly created ECCN 9E993.

#### Editorial Revisions of Notes, Technical Notes and Nota Bene

This final rule makes a number of conforming revisions to the CCL in order to provide consistency with the use of the terms Notes, Technical Notes and Nota Bene. These conforming revisions do not affect or change the scope of control, but merely provide consistency with the use of these terms. There is a common understanding that a Note could directly affect control status, whereas a Technical Note clarifies issues and a Nota Bene (N.B.) directs the reader to a related item or issue. Specific revisions on the CCL include: ECCNs 1C001, 1C006, 1C011, Technical Notes to Category 2B, ECCNs 2B007, 2B008, 3B001, Notes to Category 4, ECCNs 5A001, and 9E002.

In addition, this rule corrects inadvertent omissions to the CCL. These corrections include a minor editorial revision to 6A995.c.2.a.1 by correcting a typographic error and revisions to 9E003.a and .d to conform with previously agreed Wassenaar text.

Items placed under control will be subject to both national security (NS) and antiterrorism (AT) controls. These actions are taken in consultation with the Departments of State and Defense and pursuant to agreements reached in the Wassenaar Arrangement.

All items removed from national security (NS) controls as a result of the

Wassenaar List of Dual-Use Goods and Technologies will continue to be controlled for antiterrorism (AT) reasons.

BXA is continuing a comprehensive review of the Commerce Control List (CCL) to account for items controlled by the Nuclear Suppliers Group (NSG), the Missile Technology Control Regime (MTCR), and the Australia Group (AG) and to correct errors unavoidably reprinted in this version of the CCL. The review will be based in large part upon the comments received and upon ongoing efforts to harmonize the CCL with the EU's control list.

Although the Export Administration Act (EAA) expired on August 20, 1994, the President invoked the International Emergency Economic Powers Act and continued in effect the EAR, and, to the extent permitted by law, the provisions of the EAA in Executive Order 12924 of August 19, 1994, extended by Presidential notice of August 10, 1999, 64 FR 44101 (August 13, 1999).

**Saving Clause**

Shipments of items removed from eligibility for export or reexport under a particular License Exception authorization or the designator NLR, as a result of this regulatory action, may continue to be exported or reexported under that License Exception authorization or designator until August 11, 2000. In addition, this rule revises the numbering and structure of certain entries on the Commerce Control List. For items under such entries and for October 10, 2000, BXA will accept license applications for items described either by the entries in effect immediately before July 12, 2000 or the entries described in this rule.

**Rulemaking Requirements**

1. This interim rule has been determined to be not significant for purposes of Executive Order 12866.
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 (PRA), unless that collection of information displays a currently valid OMB Control Number. This rule involves collections of information subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*) These collections have been approved by the Office of Management and Budget under control numbers 0694-0073, 0694-0106, and 0694-0088. Send comments regarding these burden estimates or any other aspect of these collections of information, including

suggestions for reducing the burden, to OMB Desk Officer, New Executive Office Building, Washington, DC 20503; and to the Regulatory Policy Division, Bureau of Export Administration, Department of Commerce, P.O. Box 273, Washington, DC 20044.

3. This rule does not contain policies with Federalism implications sufficient to warrant preparation of a Federalism assessment under Executive Order 13132.

4. The provisions of the Administrative Procedure Act (5 U.S.C. 553) requiring notice of proposed rulemaking, the opportunity for public participation, and a delay in effective date, are inapplicable because this regulation involves a military and foreign affairs function of the United States (Sec. 5 U.S.C. 553(a)(1)). Further, no other law requires that a notice of proposed rulemaking and an opportunity for public comment be given for this interim rule. Because a notice of proposed rulemaking and an opportunity for public comment are not required to be given for this rule under 5 U.S.C. or by any other law, the analytical requirements of the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) are not applicable.

**List of Subjects**

15 CFR Part 740

Administrative practice and procedure, Exports, Foreign trade, Reporting and recordkeeping requirements.

15 CFR Parts 772 and 774

Exports, Foreign trade.

Accordingly, parts 740, 772 and 774 of the Export Administration Regulations (15 CFR parts 730 through 799) are amended as follows:

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

**Authority:** 50 U.S.C. app. 2401 *et seq.*; 50 U.S.C. 1701 *et seq.*; E.O. 12924, 59 FR 43437, 3 CFR, 1994 Comp., p. 917; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; Notice of August 10, 1999, 64 FR 44101 (August 13, 1999).

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

**Authority:** 50 U.S.C. app. 2401 *et seq.*; 50 U.S.C. 1701 *et seq.*; E.O. 12924, 59 FR 43437, 3 CFR, 1994 Comp., p. 917; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; Notice of August 10, 1999, 64 FR 44101 (August 13, 1999).

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

**Authority:** 50 U.S.C. app. 2401 *et seq.*; 50 U.S.C. 1701 *et seq.*; 10 U.S.C. 7420; 10 U.S.C. 7430(e); 18 U.S.C. 2510 *et seq.*; 22 U.S.C.

287c, 22 U.S.C. 3201 *et seq.*, 22 U.S.C. 6004; 30 U.S.C. 185(s), 185(u); 42 U.S.C. 2139a; 42 U.S.C. 6212; 43 U.S.C. 1354; 46 U.S.C. app. 466c; 50 U.S.C. app. 5; E.O. 12924, 59 FR 43437, 3 CFR, 1994 Comp., p. 917; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; Notice of August 10, 1999, 64 FR 44101 (August 13, 1999).

**PART 740—[AMENDED]**

4. Section 740.11 is amended by revising paragraph (a)(2) introductory text and paragraph (a)(2)(v) to read as follows:

**§ 740.11 Governments, international organizations, and international inspections under the Chemical Weapons Convention (GOV).**

\* \* \* \* \*

(a) \* \* \*

(2) The following items controlled for national security (NS) reasons under Export Control Classification Numbers (ECCNs) identified on the Commerce Control List may not be exported or reexported under this License Exception to destinations other than Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom: 1C001, 1C012, 5A001.b.4, 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.e., 6A002.a.1.c, 6A008.1.3., 6B008, 8A001.b., 8A001.d., 8A002.o.3.b., 9A011; and

\* \* \* \* \*

(v) 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; and

\* \* \* \* \*

5. Supplement No. 1 to section 740.11 is amended:

- a. By revising paragraph (a)(1) introductory text;
- b. By revising paragraph (a)(1)(v);
- c. By revising paragraphs (a)(1)(vii)(C) and (a)(1)(vii)(D);
- d. By revising paragraph (b)(1) introductory text;
- e. By revising paragraph (b)(1)(v); and
- f. By revising paragraphs (b)(1)(vii)(C) and (b)(1)(vii)(D), to read as follows:

**Supplement No. 1 to § 740.11—Additional Restrictions on Use of License Exception Gov**

(a) \* \* \*

(1) Items identified on the Commerce Control List as controlled for national security (NS) reasons under Export Control Classification Numbers (ECCNs) as follows for export or reexport to destinations other than Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, or the United Kingdom:

1C001, 1C012, 5A001.b.4, 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.e, 6A002.a.1.c, 6A008.1.3., 6B008, 8A001.b., 8A001.d., 8A002.o.3.b., 9A011; and  
\* \* \* \* \*

(v) 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; and  
\* \* \* \* \*

(vii) \* \* \*

(C) Controlled by 6E001 for the "development" of equipment or "software" in 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.c, 6A001.a.2.e, 6A001.a.2.f, 6A002.a.1.c, 6A008.1.3, or 6B008, as described in paragraph (a)(1) of this Supplement; and

(D) Controlled by 6E002 for the "production" of equipment controlled by 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.c, 6A001.a.2.e, 6A001.a.2.f, 6A002.a.1.c, 6A008.1.3, or 6B008, as described in paragraph (a)(1) of this Supplement; and  
\* \* \* \* \*

(b) \* \* \*

(1) Items identified on the Commerce Control List as controlled for national security (NS) reasons under Export Control Classification Numbers (ECCNs) as follows for export or reexport to destinations other than Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, or the United Kingdom: 1C001, 1C012, 5A001.b.4, 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.e, 6A002.a.1.c, 6A008.1.3., 6B008, 8A001.b., 8A001.d., 8A002.o.3.b., 9A011; and  
\* \* \* \* \*

(v) 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; and  
\* \* \* \* \*

(vii) \* \* \*

(C) Controlled by 6E001 for the "development" of equipment or "software" in 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.c, 6A001.a.2.e, 6A001.a.2.f, 6A002.a.1.c, 6A008.1.3, or 6B008, as described in paragraph (b)(1) of this Supplement; and

(D) Controlled by 6E002 for the "production" of equipment controlled by 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, 6A001.a.2.c, 6A001.a.2.e, 6A001.a.2.f, 6A002.a.1.c, 6A008.1.3, or 6B008, as described in paragraph (b)(1) of this Supplement; and  
\* \* \* \* \*

## PART 772—[AMENDED]

6. Part 772 is amended by removing the two definitions for "Frequency agility" [two references] and by adding a new definition "Frequency hopping" to be added in alphabetical order to read as follows:

## PART 772—DEFINITIONS OF TERMS

"*Frequency hopping*". (Cat 5 part 1 and 5 part 2)—A form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by a random or pseudo-random sequence of discrete steps.  
\* \* \* \* \*

## PART 774—[AMENDED]

7. In Supplement No. 1 to part 774 (the Commerce Control List), Category 1—Materials, Chemicals, Microorganisms, and Toxins, Export Control Classification Numbers (ECCNs) are amended:

a. By revising the List of Items Controlled section for ECCNs 1A001, 1C001, 1C006, 1C011, and 1E002; and

b. By revising the entry heading and List of Items Controlled section for ECCN 1C012, to read as follows:

### 1A001 Components Made From Fluorinated Compounds, as Follows (See List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Kilograms.

*Related Controls:* Items specially designed or modified for missiles or for items on the U.S. Munitions List are subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls (see 22 CFR part 121.)

*Related Definitions:* N/A.

*Items:*

a. Seals, gaskets, sealants or fuel bladders specially designed for "aircraft" or aerospace use made from more than 50% by weight of any of the materials controlled by 1C009.b or 1C009.c;

b. Piezoelectric polymers and copolymers made from vinylidene fluoride materials controlled by 1C009.a:

b.1. In sheet or film form; *and*

b.2. With a thickness exceeding 200  $\mu\text{m}$

c. Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers containing at least one vinyl ether group as a constitutional unit, specially designed for "aircraft", aerospace or missile use.

### 1C001 Materials Specially Designed for Use as Absorbers of Electromagnetic Waves, or Intrinsically Conductive Polymers, as Follows (see List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Kilograms.

*Related Controls:* See also 1C101.

*Related Definitions:* N/A.

*Items:*

a. Materials for absorbing frequencies exceeding  $2 \times 10^8$  Hz but less than  $3 \times 10^{12}$  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 characteristics:

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  $\pm 15\%$  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  $\pm 15\%$  of the center frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527° C);

**Technical Note:** Absorption test samples for 1C001.a. Note 1.c.1 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  $7 \times 10^6$  N/m<sup>2</sup>; *and*

3. Compressive strength less than  $14 \times 10^6$  N/m<sup>2</sup>;

d. Planar absorbers made of sintered ferrite, having:

1. A specific gravity exceeding 4.4; *and*

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

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

b. Materials for absorbing frequencies exceeding  $1.5 \times 10^{14}$  Hz but less than  $3.7 \times 10^{14}$  Hz and not transparent to visible light;

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. Polypyrrrole;

c.3. Polythiophene;

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

c.5. Poly thienylene-vinylene.

**Technical Note:** Bulk electrical conductivity and sheet (surface) resistivity should be determined using ASTM D-257 or national equivalents.

### 1C006 Fluids and Lubricating Materials, as Follows (see List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Barrels (55 U.S. gallons/209 liters).

*Related Controls:* N/A.

*Related Definitions:* N/A.

*Items:*

a. Hydraulic fluids containing, as their principal ingredients, any of the following compounds or materials:

a.1. Synthetic or silahydrocarbon oils, having all of the following:

**Technical Note:** For the purpose of 1C006.a.1, silahydrocarbon oils contain exclusively silicon, hydrogen and carbon.

- a.1.a. A flash point exceeding 477 K (204° C);
- a.1.b. A pour point at 239 K (−34° C) or less;
- a.1.c. A viscosity index of 75 or more; *and*
- a.1.d. A thermal stability at 616 K (343° C);
- or*
- a.2. Chlorofluorocarbons, having all of the following:

**Technical Note:** For the purpose of 1C006.a.2, chlorofluorocarbons contain exclusively carbon, fluorine and chlorine.

- a.2.a. No flash point;
- a.2.b. An autogenous ignition temperature exceeding 977 K (704° C);
- a.2.c. A pour point at 219 K (−54° C) or less;
- a.2.d. A viscosity index of 80 or more; *and*
- a.2.e. A boiling point at 473 K (200° C) or higher;

b. Lubricating materials containing, as their principal ingredients, any of the following compounds or materials:

- b.1. Phenylene or alkylphenylene ethers or thio-ethers, or their mixtures, containing more than two ether or thio-ether functions or mixtures thereof; *or*
- b.2. Fluorinated silicone fluids with a kinematic viscosity of less than 5,000 mm<sup>2</sup>/s (5,000 centistokes) measured at 298 K (25° C);

c. Damping or flotation fluids with a purity exceeding 99.8%, containing less than 25 particles of 200 μm or larger in size per 100 ml and made from at least 85% of any of the following compounds or materials:

- c.1. Dibromotetrafluoroethane;
- c.2. Polychlorotrifluoroethylene (oily and waxy modifications only); *or*
- c.3. Polybromotrifluoroethylene;
- d. Fluorocarbon electronic cooling fluids, having all of the following characteristics:
- d.1. Containing 85% by weight or more of any of the following, or mixtures thereof:

d.1.a. Monomeric forms of perfluoropolyalkylether-triazines or perfluoroaliphatic-ethers;

- d.1.b. Perfluoroalkylamines;
- d.1.c. Perfluorocycloalkanes; *or*
- d.1.d. Perfluoroalkanes;

d.2. Density at 298 K (25° C) of 1.5 g/ml or more;

- d.3. In a liquid state at 273 K (0° C); *and*
- d.4. Containing 60% or more by weight of fluorine.

**Technical Note:** For the purpose of 1C006:

- a. Flash point is determined using the Cleveland Open Cup Method described in ASTM D-92 or national equivalents;
- b. Pour point is determined using the method described in ASTM D-97 or national equivalents;
- c. Viscosity index is determined using the method described in ASTM D-2270 or national equivalents;
- d. Thermal stability is determined by the following test procedure or national equivalents:

Twenty ml of the fluid under test is placed in a 46 ml type 317 stainless steel chamber containing one each of 12.5 mm (nominal) diameter balls of M-10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0.75% Sn);

The chamber is purged with nitrogen, sealed at atmospheric pressure and the

temperature raised to and maintained at 644 ± 6 K (371 ± 6° C) for six hours;

The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:

1. The loss in weight of each ball is less than 10 mg/mm<sup>2</sup> of ball surface;
2. The change in original viscosity as determined at 311 K (38° C) is less than 25%; *and*
3. The total acid or base number is less than 0.40;
- e. Autogenous ignition temperature is determined using the method described in ASTM E-659 or national equivalents.

#### 1C011 Metals and Compounds, as Follows (see List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* N/A.

*Related Controls:* 1.) See also 1C111. 2.) Items 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. are subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls (see 22 CFR part 121).

*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 of these;

**Technical Note:** The natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.

**Note:** The metals or alloys listed in 1C011.a are controlled whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium or beryllium.

b. Boron or boron carbide of 85% purity or higher and a particle size of 60 μm or less;

**Note:** The metals or alloys listed in 1C011.b are controlled whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium or beryllium.

c. Guanidine nitrate;

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

#### 1C012 Materials, as Follows (See List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* N/A.

*Related Controls:* N/A.

*Related Definitions:* These materials are typically used for nuclear heat sources.

*Items:*

a. Plutonium in any form with a plutonium isotopic assay of plutonium-238 of more than 50% by weight;

**Note:** 1C012.a does not control:

1. Shipments with a plutonium content of 1 g or less;

2. Shipments of 3 effective grams or less when contained in a sensing component in instruments.

b. Previously separated neptunium-237 in any form.

**Note:** 1C012.b does not control shipments with a neptunium-237 content of 1 g or less.

#### 1E002 Other "Technology", as Follows (See List of Items Controlled)

\* \* \* \* \*

#### List of Items Controlled

*Unit:* N/A.

*Related Controls:* See also 1E102, 1E202, and 1E101 for "technology" related to 1E002.e.

*Related Definitions:* N/A.

*Items:*

a. "Technology" for the "development" or "production" of polybenzothiazoles or polybenzoxazoles;

b. "Technology" for the "development" or "production" of fluoroelastomer compounds containing at least one vinyl ether monomer;

c. "Technology" for the design or "production" of the following base materials or non-"composite" ceramic materials:

c.1. Base materials having all of the following characteristics:

c.1.a. Any of the following compositions:

c.1.a.1. Single or complex oxides of zirconium and complex oxides of silicon or aluminum;

c.1.a.2. Single nitrides of boron (cubic crystalline forms);

c.1.a.3. Single or complex carbides of silicon or boron; *or*

c.1.a.4. Single or complex nitrides of silicon;

c.1.b. Total metallic impurities, excluding intentional additions, of less than:

c.1.b.1. 1,000 ppm for single oxides or carbides; *or*

c.1.b.2. 5,000 ppm for complex compounds or single nitrides; *and*

c.1.c. Being any of the following:

c.1.c.1. Zirconia with an average particle size equal to or less than 1 μm and no more than 10% of the particles larger than 5 μm;

c.1.c.2. Other base materials with an average particle size equal to or less than 5 μm and no more than 10% of the particles larger than 10 μm; *or*

c.1.c.3. Having all of the following:

c.1.c.3.a. Platelets with a length to thickness ratio exceeding 5;

c.1.c.3.b. Whiskers with a length to diameter ratio exceeding 10 for diameters less than 2 μm; *and*

c.1.c.3.c. Continuous or chopped fibers less than 10 μm in diameter;

c.2. Non-"composite" ceramic materials composed of the materials described in 1E002.c.1;

**Note:** 1E002.c.2 does not control technology for the design or production of abrasives.

d. "Technology" for the "production" of aromatic polyamide fibers;

e. "Technology" for the installation, maintenance or repair of materials controlled by 1C001;

f. "Technology" for the repair of "composite" structures, laminates or

materials controlled by 1A002, 1C007.c or 1C007.d.

**Note:** 1E002.f does not control "technology" for the repair of "civil aircraft" structures using carbon "fibrous or filamentary materials" and epoxy resins, contained in aircraft manufacturers' manuals.

8. In Supplement No. 1 to part 774 (the Commerce Control List), Category 2—Materials Processing is amended by revising the Technical Notes to Category 2B (Test, Inspection and Production Equipment), to read as follows:

#### Category 2—Materials Processing

\* \* \* \* \*

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

##### Notes for Category 2B

1. 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. Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machines—Axis and Motion Nomenclature".

3. For the purposes of 2B001 to 2B009 a "tilting spindle" is counted as a rotary axis.

4. Guaranteed positioning accuracy levels instead of individual test protocols may be used for each machine tool model using the agreed ISO test procedure.

5. The positioning accuracy of "numerically controlled" machine tools is to be determined and presented in accordance with ISO 230/2 (1988)

9. In Supplement No. 1 to part 774 (the Commerce Control List), Category 2—Materials Processing, Export Control Classification Numbers (ECCNs) 2B007 and 2B008 are amended by revising the List of Items Controlled section, to read as follows:

#### 2B007 "Robots" Having Any of the Following Characteristics Described in the List of Items Controlled and Specially Designed Controllers and "End-Effectors" Therefor

\* \* \* \* \*

##### List of Items Controlled

*Unit:* \$ value.

*Related Controls:* See also 2B207 and 2B997.

*Related Definitions:* N/A.

*Items:*

a. Capable in real time of full three-dimensional image processing or full three-dimensional scene analysis to generate or modify "programs" or to generate or modify numerical program data;

**Technical Note:** The scene analysis limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (2½ D).

b. Specially designed to comply with national safety standards applicable to explosive munitions environments;

c. Specially designed or rated as radiation-hardened to withstand greater than  $5 \times 10^3$  Gy (Si) without operational degradation; or

d. Specially designed to operate at altitudes exceeding 30,000 m.

#### 2B008 Assemblies, Units or Inserts Specially Designed for Machine tools, or for Equipment Controlled by 2B006 or 2B007, as Follows (See List of Items Controlled)

\* \* \* \* \*

##### List of Items Controlled

*Unit:* \$ value.

*Related Controls:* See also 2B998.

*Related Definition:* N/A.

*Items:*

a. Linear position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an overall "accuracy" less (better) than  $(800+(600 \times L \times 10^{-3}))$  nm (L equals the effective length in mm);

**N.B.:** For "laser" systems see also Note to 2B006.b.1.

b. Rotary position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an "accuracy" less (better) than 0.00025°;

**N.B.:** For "laser" systems see also Note to 2B006.b.1.

c. "Compound rotary tables" and "tilting spindles", capable of upgrading, according to the manufacturer's specifications, machine tools to or above the levels controlled by 2B001 to 2B009.

10. In Supplement No. 1 to part 774 (the Commerce Control List), Category 3—Electronics, Export Control Classification Numbers (ECCNs), are amended by revising the List of Items Controlled section for ECCNs 3A001, 3A991, 3B001, 3B002, 3B992 and 3E002, to read as follows:

#### 3A001 Electronic Components, as Follows (See List of Items Controlled)

\* \* \* \* \*

##### List of Items Controlled

*Unit:* Number.

*Related Controls:* See also 3A101, 3A201, and 3A991

*Related Definitions:* For the purposes of integrated circuits in 3A001.a.1,  $5 \times 10^3$  Gy(Si)= $5 \times 10^5$  Rads (Si);  $5 \times 10^6$  Gy (Si)/s= $5 \times 10^8$  Rads (Si)/s.

*Items:*

a. General purpose integrated circuits, as follows:

**Note 1:** The control status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3A001.a.

**Note 2:** Integrated circuits include the following types:

"Monolithic integrated circuits";

"Hybrid integrated circuits";

"Multichip integrated circuits";

"Film type integrated circuits", including silicon-on-sapphire integrated circuits;

"Optical integrated circuits".

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

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

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

a.2. "Microprocessor microcircuits", "microcomputer microcircuits", microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analog-to-digital converters, digital-to-analog converters, electro-optical or "optical integrated circuits" designed for "signal processing", field programmable logic devices, neural network integrated circuits, custom integrated circuits for which either the function is unknown or the control status of the equipment in which the integrated circuit will be used in unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following:

a.2.a. Rated for operation at an ambient temperature above 398 K (125° C);

a.2.b. Rated for operation at an ambient temperature below 218 K (−55° C); or

a.2.c. Rated for operation over the entire ambient temperature range from 218 K (−55° C) to 398 K (125° C);

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

a.3. "Microprocessor microcircuits", "micro-computer microcircuits" and microcontroller microcircuits, having any of the following characteristics:

**Note:** 3A001.a.3 includes digital signal processors, digital array processors and digital coprocessors.

a.3.a. A "composite theoretical performance" ("CTP") of 3500 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of 32 bit or more;

a.3.b. Manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz; or

a.3.c. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.5 Mbyte/s;

a.4. Storage integrated circuits manufactured from a compound semiconductor;

a.5. Analog-to-digital and digital-to-analog converter integrated circuits, as follows:

a.5.a. Analog-to-digital converters having any of the following:

a.5.a.1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time of less than 10 ns;

a.5.a.2. A resolution of 12 bit with a total conversion time of less than 200 ns; or

a.5.a.3. A resolution of more than 12 bit with a total conversion time of less than 2 μs;

a.5.b. Digital-to-analog converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

**Technical Note:**

1. A resolution of n bit corresponds to a quantization of 2<sup>n</sup> levels.

2. Total conversion time is the inverse of the sample rate.

a.6. Electro-optical and "optical integrated circuits" designed for "signal processing" 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. An equivalent usable gate count of more than 30,000 (2 input gates);
  - a.7.b. A typical "basic gate propagation delay time" of less than 0.4 ns; *or*
  - a.7.c. A toggle frequency exceeding 133 Mhz;

**Note:** 3A001.a.7 includes: Simple Programmable Logic Devices (SPLDs), Complex Programmable Logic Devices (CPLDs), Field Programmable Gate Arrays (FPGAs), Field Programmable Logic Arrays (FPLAs), and Field Programmable Interconnects (FPICs).

**N.B.:** Field programmable logic devices are also known as field programmable gate or field programmable logic arrays.

- 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 208 terminals;
  - a.10.b. A typical "basic gate propagation delay time" of less than 0.35 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 any of the following:
      - a.12.a. A rated execution time for a 1,024 point complex FFT of less than 1 ms;
      - a.12.b. A rated execution time for an N-point complex FFT of other than 1,024 points of less than  $N \log^2 N / 10,240$  ms, where N is the number of points; *or*
      - a.11.c. A butterfly throughput of more than 5.12 MHz;
  - b. Microwave or millimeter wave components, as follows:
    - b.1. Electronic vacuum tubes and cathodes, as follows:
 

**Note:** 3A001.b.1 does not control tubes designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.

      - b.1.a. Traveling wave tubes, pulsed or continuous wave, as follows:
        - b.1.a.1. Operating at frequencies higher than 31 GHz;
        - b.1.a.2. Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;
        - b.1.a.3. Coupled cavity tubes, or derivatives thereof, with an "instantaneous

bandwidth" of more than 7% or a peak power exceeding 2.5 kW;

- b.1.a.4. Helix tubes, or derivatives thereof, with any of the following characteristics:
  - 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; *or*
  - b.1.a.4.c. Being "space qualified";
- b.1.b. Crossed-field amplifier tubes with a gain of more than 17 Db;
- b.1.c. Impregnated cathodes designed for electronic tubes producing a continuous emission current density at rated operating conditions exceeding 5 A/cm<sup>2</sup>;
- b.2. Microwave integrated circuits or modules having all of the following:
  - b.2.a. Containing "monolithic integrated circuits"; *and*
  - b.2.b. Operating at frequencies above 3 GHz;

**Note:** 3A001.b.2 does not control circuits or modules for equipment designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.

- b.3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;
- b.4. Microwave solid state amplifiers, having any of the following:
  - b.4.a. Operating frequencies exceeding 10.5 GHz and an "instantaneous bandwidth" of more than half an octave; *or*
  - b.4.b. Operating frequencies exceeding 31 GHz;
  - 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  $\mu$ s 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. Microwave "assemblies" capable of operating at frequencies exceeding 31 GHz;
  - b.7. Mixers and converters designed to extend the frequency range of equipment described in 3A002.c, 3A002.e or 3A002.f beyond the limits stated therein;
  - b.8. Microwave power amplifiers containing tubes controlled by 3A001.b and having all of the following:
    - b.8.a. Operating frequencies above 3 GHz;
    - b.8.b. An average output power density exceeding 80 W/kg; *and*
    - b.8.c. A volume of less than 400 cm<sup>3</sup>;

**Note:** 3A001.b.8 does not control equipment designed or rated for operation in an ITU allocated band.

- c. Acoustic wave devices, as follows, and specially designed components therefor:
  - c.1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (*i.e.*, "signal processing" devices employing elastic waves in materials), having any of the following:
    - c.1.a. A carrier frequency exceeding 2.5 GHz;
    - c.1.b. A carrier frequency exceeding 1 GHz, but not exceeding 2.5 GHz, and having any of the following:
      - c.1.b.1. A frequency side-lobe rejection exceeding 55 Db;
      - c.1.b.2. A product of the maximum delay time and the bandwidth (time in  $\mu$ s 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  $\mu$ s; *or*
      - c.1.c. A carrier frequency of 1 GHz or less, having any of the following:
        - c.1.c.1. A product of the maximum delay time and the bandwidth (time in  $\mu$ s and bandwidth in MHz) of more than 100;
        - c.1.c.2. A dispersive delay of more than 10  $\mu$ s; *or*
        - c.1.c.3. A frequency side-lobe rejection exceeding 55 Db and a bandwidth greater than 50 MHz;
    - c.2. Bulk (volume) acoustic wave devices (*i.e.*, "signal processing" devices employing elastic waves) that permit the direct processing of signals at frequencies exceeding 1 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;
    - 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, with 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. Batteries and photovoltaic arrays, as follows:
 

**Note:** 3A001.e.1 does not control batteries with volumes equal to or less than 27 cm<sup>3</sup> (*e.g.*, standard C-cells or R14 batteries).

        - e.1.a. Primary cells and batteries having an energy density exceeding 480 Wh/kg and rated for operation in the temperature range from below 243 K (-30°C) to above 343 K (70°C);
        - e.1.b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20°C) to above 333 K (60°C);

- c.1.b.1. A frequency side-lobe rejection exceeding 55 Db;
  - c.1.b.2. A product of the maximum delay time and the bandwidth (time in  $\mu$ s 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  $\mu$ s; *or*
  - c.1.c. A carrier frequency of 1 GHz or less, having any of the following:
    - c.1.c.1. A product of the maximum delay time and the bandwidth (time in  $\mu$ s and bandwidth in MHz) of more than 100;
    - c.1.c.2. A dispersive delay of more than 10  $\mu$ s; *or*
    - c.1.c.3. A frequency side-lobe rejection exceeding 55 Db and a bandwidth greater than 50 MHz;
  - c.2. Bulk (volume) acoustic wave devices (*i.e.*, "signal processing" devices employing elastic waves) that permit the direct processing of signals at frequencies exceeding 1 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;
  - 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, with 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. Batteries and photovoltaic arrays, as follows:
 

**Note:** 3A001.e.1 does not control batteries with volumes equal to or less than 27 cm<sup>3</sup> (*e.g.*, standard C-cells or R14 batteries).

      - e.1.a. Primary cells and batteries having an energy density exceeding 480 Wh/kg and rated for operation in the temperature range from below 243 K (-30°C) to above 343 K (70°C);
      - e.1.b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20°C) to above 333 K (60°C);
- Technical Note:** Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75% of the open circuit voltage divided by the total mass of the cell (or battery) in kg.
- e.1.c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m<sup>2</sup> at an operating temperature of 301 K (28°C) under a tungsten illumination of 1 kW/m<sup>2</sup> at 2,800 K (2,527°C);



e.2. High energy storage capacitors, as follows:

- e.2.a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) 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) 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, 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<sup>2</sup>;
- f. Rotary input type shaft absolute position encoders having any of the following:
  - f.1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; *or*
  - f.2. An accuracy better than  $\pm 2.5$  seconds of arc.

### 3A991 Electronic Devices and Components Not Controlled by 3A001

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Equipment in number.

*Related Controls:* N/A.

*Related Definitions:* N/A.

*Items:*

- a. "Microprocessor microcircuits", "microcomputer microcircuits", and microcontroller microcircuits having a clock frequency exceeding 25 MHz;
  - b. Storage integrated circuits, as follows:
    - b.1. Electrical erasable programmable read-only memories (EEPROMs) with a storage capacity;
      - b.1.a. Exceeding 16 Mbits per package for flash memory types; *or*
      - b.1.b. Exceeding either of the following limits for all other EEPROM types:
        - b.1.b.1. Exceeding 1 Mbit per package; *or*
        - b.1.b.2. Exceeding 256 kbit per package and a maximum access time of less than 80 ns;
      - b.2. Static random access memories (SRAMs) with a storage capacity:
        - b.2.a. Exceeding 1 Mbit per package; *or*
        - b.2.b. Exceeding 256 kbit per package and a maximum access time of less than 25 ns;
      - c. Field programmable logic devices having either of the following:

c.1. An equivalent gate count of more than 5000 (2 input gates); *or*

c.2. A toggle frequency exceeding 100 MHz;

d. Custom integrated circuits for which either 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:

- d.1. More than 144 terminals; *or*
- d.2. A typical "basic propagation delay time" of less than 0.4 ns.
- e. Travelling wave tubes, pulsed or continuous wave, as follows:
  - e.1. Coupled cavity tubes, or derivatives thereof;
    - e.2. Helix tubes, or derivatives thereof, with any of the following:
      - e.2.a.1. An "instantaneous bandwidth" of half an octave or more; *and*
      - e.2.a.2. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.2;
        - e.2.b.1. An "instantaneous bandwidth" of less than half an octave; *and*
        - e.2.b.2. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.4;
    - f. Flexible waveguides designed for use at frequencies exceeding 40 GHz;
    - g. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (*i.e.*, "signal processing" devices employing elastic waves in materials), having either of the following:
      - g.1. A carrier frequency exceeding 1 GHz; *or*
      - g.2. A carrier frequency of 1 GHz or less; *and*
        - g.2.a. A frequency side-lobe rejection exceeding 55 Db;
        - g.2.b. A product of the maximum delay time and bandwidth (time in microseconds and bandwidth in MHz) of more than 100; *or*
        - g.2.c. A dispersive delay of more than 10 microseconds.

h. Batteries, as follows:

- Note:** 3A991.h does not control batteries with volumes equal to or less than 26 cm<sup>3</sup> (*e.g.*, standard C-cells or UM-2 batteries).
- h.1. Primary cells and batteries having an energy density exceeding 350 Wh/kg and rated for operation in the temperature range from below 243 K (-30 °C) to above 343 K (70 °C);
- h.2. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20 °C) to above 333 K (60 °C);

**Technical Note:** Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75 percent of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

- i. "Superconductive" electromagnets or solenoids specially designed to be fully charged or discharged in less than one minute, having all of the following:

**Note:** 3A991.i does not control "superconductive" electromagnets or solenoids designed for Magnetic Resonance Imaging (MRI) medical equipment.

- i.1. Maximum energy delivered during the discharge divided by the duration of the discharge of more than 500 kJ per minute;
- i.2. Inner diameter of the current carrying windings of more than 250 mm; *and*
- i.3. Rated for a magnetic induction of more than 8T or "overall current density" in the winding of more than 300 A/mm<sup>2</sup>.

j. Circuits or systems for electromagnetic energy storage, containing components manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents, having all of the following:

- j.1. Resonant operating frequencies exceeding 1 MHz;
- j.2. A stored energy density of 1 MJ/M<sup>3</sup> or more; *and*
- j.3. A discharge time of less than 1 ms;
- k. Hydrogen/hydrogen-isotope thyatrons of ceramic-metal construction and rate for a peak current of 500 A or more;
- l. Digital integrated circuits based on any compound semiconductor having an equivalent gate count of more than 300 (2 input gates).

### 3B001 Equipment for the Manufacturing of Semiconductor Devices or Materials and Specially Designed Components and Accessories Therefor

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Number.

*Related Controls:* See also 3B991.

*Related Definitions:* N/A.

*Items:*

- a. "Stored program controlled" equipment designed for epitaxial growth, as follows:
  - a.1. Equipment capable of producing a layer thickness uniform to less than  $\pm 2.5\%$  across a distance of 75 mm or more;
    - a.2. Metal organic chemical vapor deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials controlled by 3C003 or 3C004;
    - a.3. Molecular beam epitaxial growth equipment using gas or solid sources;
  - b. "Stored program controlled" equipment designed for ion implantation, having any of the following:
    - b.1. A beam energy (accelerating voltage) exceeding 1MeV;
    - b.2. Being specially designed and optimized to operate at a beam energy (accelerating voltage of less than 2 keV;
    - b.3. Direct write capability; *or*
    - b.4. Being capable of high energy oxygen implant into a heated semiconductor material "substrate";
  - c. "Stored program controlled" anisotropic plasma dry etching equipment, as follows:
    - c.1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:
      - c.1.a. Magnetic confinement; *or*
      - c.1.b. Electron cyclotron resonance (ECR);

c.2. Equipment specially designed for equipment controlled by 3B001.e. and having any of the following:

c.2.a. Magnetic confinement; or  
c.2.b. ECR;

d. "Stored program controlled" plasma enhanced CVD equipment, as follows:  
d.1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:

d.1.a. Magnetic confinement; or  
d.1.b. ECR;

d.2. Equipment specially designed for equipment controlled by 3B001.e. and having any of the following:

d.2.a. Magnetic confinement; or  
d.2.b. ECR;

e. "Stored program controlled" 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 pieces of semiconductor processing equipment are 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 not designed to operate in a vacuum environment.

f. "Stored program controlled" 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, having any of the following:

f.1.a. A light source wavelength shorter than 350 nm; or

f.1.b. Capable of producing a pattern with a minimum resolvable feature size of 0.5 µm or less;

**Technical Note:** The minimum resolvable feature size is calculated by the following formula:

$$\text{MRF} = \frac{\text{numerical aperture}}{\text{exposure light source wavelength in } \mu\text{m}} \times (\text{K factor})$$

MRF =

numerical aperture

Where the K factor = 0.7.

MRF = minimum resolvable feature size.

f.2. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, having any of the following:

f.2.a. A spot size smaller than 0.2 µm;

f.2.b. Being capable of producing a pattern with a feature size of less than 1 µm; or

f.2.c. An overlay accuracy of better than ± 0.20 µm (3 sigma);

g. Masks and reticles designed for integrated circuits controlled by 3A001;

h. Multi-layer masks with a phase shift layer.

**3B002 "Stored Program Controlled" Test Equipment, Specially Designed for Testing Finished or Unfinished Semiconductor Devices and Specially Designed Components and Accessories Therefor**

\* \* \* \* \*

**List of Items Controlled**

Unit: Number.

Related Controls: See also 3B992.

Related Definitions: N/A.

Items:

a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;

b. For testing integrated circuits capable of performing functional (truth table) testing at a pattern rate of more than 333 MHz;

**Note:** 3B002.b does not control test equipment specially designed for testing:

1. "Assemblies" or a class of "assemblies" for home or entertainment applications;

2. Uncontrolled electronic components, "assemblies" or integrated circuits.

**Technical Note:** For purposes of 3B002.b, pattern rate is defined as the maximum frequency of digital operation of a tester. It is therefore equivalent to the highest data rate that a tester can provide in non-multiplexed mode. It is also referred to as test speed, maximum digital frequency or maximum digital speed.

c. For testing microwave integrated circuits controlled by 3A001.b.2.

**3B992 Equipment Not Controlled by 3B002 for the Inspection or Testing of Electronic Components and Materials, and Specially Designed Components and Accessories Therefor**

\* \* \* \* \*

**List of Items Controlled**

Unit: Equipment in number.

Related Controls: N/A.

Related Definitions: N/A.

Items:

a. Equipment specially designed for the inspection or testing of electron tubes, optical elements and specially designed components therefor controlled by 3A001 or 3A991;

b. Equipment specially designed for the inspection or testing of semiconductor devices, integrated circuits and "assemblies", as follows, and systems incorporating or having the characteristics of such equipment:

**Note:** 3B992.b also controls equipment used or modified for use in the inspection or testing of other devices, such as imaging devices, electro-optical devices, acoustic-wave devices.

b.1. "Stored program controlled" inspection equipment for the automatic detection of defects, errors or contaminants of 0.6 micrometer or less in or on processed wafers, "substrates", other than printed circuit boards or chips, using optical image acquisition techniques for pattern comparison;

**Note:** 3B992.b.1 does not control general purpose scanning electron microscopes, except when specially designed and instrumented for automatic pattern inspection.

b.2. Specially designed "stored program controlled" measuring and analysis equipment, as follows:

b.2.a. Specially designed for the measurement of oxygen or carbon content in semiconductor materials;

b.2.b. Equipment for line width measurement with a resolution of 1 micrometer or finer;

b.2.c. Specially designed flatness measurement instruments capable of measuring deviations from flatness of 10 micrometer or less with a resolution of 1 micrometer or finer.

b.3. "Stored program controlled" wafer probing equipment having any of the following characteristics:

b.3.a. Positioning accuracy finer than 3.5 micrometer;

b.3.b. Capable of testing devices having more than 68 terminals; or

b.3.c. Capable of testing at a frequency exceeding 1 GHz;

b.4. Test equipment as follows:

b.4.a. "Stored program controlled" equipment specially designed for testing discrete semiconductor devices and unencapsulated dice, capable of testing at frequencies exceeding 18 GHz;

**Technical Note:** Discrete semiconductor devices include photocells and solar cells.

b.4.b. "Stored program controlled" equipment specially designed for testing integrated circuits and "assemblies" thereof, capable of functional testing:

b.4.b.1. At a pattern rate exceeding 20 MHz; or

b.4.b.2. At a pattern rate exceeding 10 MHz but not exceeding 20 MHz and capable of testing packages of more than 68 terminals;

**Note:** 3B992.b.4.b does not control equipment specially designed for testing integrated circuits not controlled by 3A001 or 3A991.

**Notes:** 1. 3B992.b.4.b does not control test equipment specially designed for testing "assemblies" or a class of "assemblies" for home and entertainment applications.

2. 3B992.b.4.b does not control test equipment specially designed for testing electronic components, "assemblies" and integrated circuits not controlled by 3A001 or 3A991 provided such test equipment does not incorporate computing facilities with "user accessible programmability".

b.4.c. Equipment specially designed for determining the performance of focal-plane arrays at wavelengths of more than 1,200 nm, using "stored program controlled" measurements or computer aided evaluation and having any of the following characteristics:

b.4.c.1. Using scanning light spot diameters of less than 0.12 mm;

b.4.c.2. Designed for measuring photosensitive performance parameters and for evaluating frequency response, modulation transfer function, uniformity of responsivity or noise; or

b.4.c.3. Designed for evaluating arrays capable of creating images with more than 32 × 32 line elements;

b.5. Electron beam test systems designed for operation at 3 keV or below, or "laser" beam systems, for non-contactive probing of powered-up semiconductor devices having any of the following:

b.5.a. Stroboscopic capability with either beam blanking or detector strobing;

b.5.b. An electron spectrometer for voltage measurements with a resolution of less than 0.5 V; or

b.5.c. Electrical tests fixtures for performance analysis of integrated circuits;

**Note:** 3B992.b.5 does not control scanning electron microscopes, except when specially designed and instrumented for non-contactive probing of a powered-up semiconductor device.

b.6. "Stored program controlled" multifunctional focused ion beam systems specially designed for manufacturing, repairing, physical layout analysis and testing of masks or semiconductor devices and having either of the following characteristics:

b.6.a. Target-to-beam position feedback control precision of 1 micrometer or finer; or

b.6.b. Digital-to-analog conversion accuracy exceeding 12 bit;

b.7. Particle measuring systems employing "lasers" designed for measuring particle size and concentration in air having both of the following characteristics:

b.7.a. Capable of measuring particle sizes of 0.2 micrometer or less at a flow rate of 0.02832 m<sup>3</sup> per minute or more; *and*

b.7.b. Capable of characterizing Class 10 clean air or better.

### 3E002 Other "Technology" for the "Development" or "Production" of Items Described in the List of Items Controlled

\* \* \* \* \*

#### List of Items Controlled

*Unit:* N/A.

*Related Controls:* (1.) See 3E001 for silicon-on-insulation (SOI) technology for the "development" or "production" related to radiation hardening of integrated circuits.

*Related Definitions:* N/A.

*Items:*

- a. Vacuum microelectronic devices;
- b. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices;
- c. "Superconductive" electronic devices;
- d. Substrates of films of diamond for electronic components;
- e. Substrates of silicon-on-insulator (SOI) for integrated circuits in which the insulator is silicon dioxide;
- f. Substrates of silicon carbide for electronic components.

g. "Technology" according to the General Technology Note other than that controlled in 3E001 for the "development" or "production" of "microprocessor microcircuits", "micro-computer microcircuits" and microcontroller microcircuits having a "composite theoretical performance" ("CTP") of 530 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of more than 32 bits or more.

**Note:** 3E002.g does not control "technology" for the "development" or "production" of: (a) Microwave transistors operating at frequencies below 31 GHz; (b) Integrated circuits controlled by 3A001.a.3 to a.12, having all of the following: (1.) Using "technology" of 0.7 micrometer or more, and (2.) Not incorporating multi-layer structures. The term multi-layer structures in this entry does not include devices incorporating a maximum of two metal layers and two polysilicon layers.

11. In Supplement No. 1 to part 774 (the Commerce Control List), Category 4—Computers is amended by revising the Notes that immediately follow the Category heading, to read as follows:

#### Category 4—Computers

**Note 1:** Computers, related equipment and "software" performing telecommunications or "local area network" functions must also be evaluated against the performance characteristics of Category 5, Part 1 (Telecommunications).

**Note 2:** Control units that directly interconnect the buses or channels of central processing units, "main storage" or disk controllers are not regarded as telecommunications equipment described in Category 5, Part 1 (Telecommunications).

**N.B:** For the control status of "software" specially designed for packet switching, see ECCN 5D001. (Telecommunications).

**Note 3:** Computers, related equipment and "software" performing cryptographic, cryptoanalytic, certifiable multi-level security or certifiable user isolation functions, or that limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 5, Part 2 ("Information Security").

12. In Supplement No. 1 to part 774 (the Commerce Control List), Category 5—Telecommunications and "Information Security", Part I—Telecommunications is amended by revising the List of Items Controlled section for Export Control Classification Numbers (ECCNs) 5A001, 5B001, 5D001, and 5E001, to read as follows:

#### 5A001 Telecommunications Systems, Equipment, and Components

\* \* \* \* \*

#### List of Items Controlled

*Unit:* Equipment in number; parts and accessories in \$ value.

*Related Controls:* See also 5A101 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; *or*
  - a.3. Specially designed to operate outside the temperature range from 218 K (–55 °C) to 397 K (124 °C).

**Note:** 5A001.a.3 applies only to electronic equipment.

**Note:** 5A001.a.2 and 5A001.a.3 do not apply to equipment on board satellites.

b. Telecommunication transmission equipment and systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

b.1 Being underwater communications systems having any of the following characteristics:

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;

b.2. Being radio equipment operating in the 1.5 MHz to 87.5 MHz band and having any of the following characteristics:

b.2.a. Incorporating adaptive techniques providing more than 15 Db suppression of an interfering signal; *or*

b.2.b. Having all of the following:

b.2.b.1. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimize the transmission; *and*

b.2.b.2. 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 1.5 MHz to 30 MHz frequency range or 250 W or more in the 30 MHz to 87.5 MHz frequency range, 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, having any of the following characteristics:

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 civil cellular radio-communications systems.

**Note:** 5A001.b.3 does not control equipment operating at an output power of 1.0 Watt or less.

b.4. Being digitally controlled radio receivers having all of the following:

b.4.a. More than 1,000 channels;

b.4.b. A "frequency switching time" of less than 1 ms;

b.4.c. Automatic searching or scanning of a part of the electromagnetic spectrum; *and*

b.4.d. Identification of the received signals or the type of transmitter; *or*

**Note:** 5A001.b.4 does not control radio equipment specially designed for use with civil cellular radio-communications systems.

b.5. Employing functions of digital "signal processing" to provide voice coding at rates of less than 2,400 bit/s.

c. Optical fiber communication cables, optical fibers and accessories, as follows:

c.1. Optical fibers of more than 500 m in length specified by the manufacturer as being capable of withstanding a proof test tensile stress of  $2 \times 10^9$  N/m<sup>2</sup> or more;

**Technical Note:** Proof Test: 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.

c.2. Optical fiber cables and accessories designed for underwater use.

**Note:** 5A001.c.2 does not control standard civil telecommunication cables and accessories.

N.B. 1: For underwater umbilical cables, and connectors thereof, see 8A002.a.3.

N.B. 2: For fiber-optic hull penetrators or connectors, see 8A002.c.

d. "Electronically steerable phased array antennae" operating above 31 GHz.

**Note:** 5A001.d does not control "electronically steerable phased array antennae" for landing systems with instruments meeting ICAO standards covering microwave landing systems (MLS).

**5B001 Telecommunication Test, Inspection and Production Equipment, as Follows (See List of Items Controlled)**

\* \* \* \* \*

**List of Items Controlled**

*Unit:* Equipment in number; parts and accessories in \$ value.

*Related Controls:* See also 5B991.

*Related Definition:* N/A.

*Items:*

a. Equipment and specially designed components or accessories therefor, specially designed for the "development", "production" or "use" of equipment, functions or features controlled by 5A001, 5D001 or 5E001.

**Note:** 5B001.a. does not control optical fiber characterization equipment not using semiconductor "lasers".

b. Equipment and specially designed components or accessories therefor, specially designed for the "development" of any of the following telecommunication transmission or "stored program controlled" switching equipment:

b.1. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;

b.2. Equipment employing a "laser" and having any of the following:

b.2.a. A transmission wavelength exceeding 1750 nm;

b.2.b. Performing "optical amplification";

b.2.c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques); or

b.2.d. Employing analog techniques and having a bandwidth exceeding 2.5 GHz;

**Note:** 5B001.b.2.d. does not include equipment specially designed for the "development" of commercial TV systems.

b.3. Equipment employing "optical switching";

b.4. Radio equipment employing quadrature-amplitude-modulation (QAM) techniques above level 128;

b.5. Equipment employing "common channel signalling" operating in either non-associated mode of operation or quasi-associated mode of operation.

**5D001 "Software", as Described in the List of Items Controlled**

\* \* \* \* \*

**List of Items Controlled**

*Unit:* \$ value.

*Related Controls:* See also 5D991.

*Related Definitions:* N/A.

*Items:*

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment, functions or features controlled by 5A001 or 5B001.

b. "Software" specially designed or modified to support "technology" controlled by 5E001.

c. Specific "software" as follows:

c.1. "Software" specially designed or modified to provide characteristics, functions or features of equipment controlled by 5A001 or 5B001;

c.2. "Software" which provides the capability of recovering "source code" of telecommunications "software" controlled by 5D001;

c.3. "Software", other than in machine-executable form, specially designed for "dynamic adaptive routing".

d. "Software" specially designed or modified for the "development" of any of the following telecommunication transmission or "stored program controlled" switching equipment:

d.1. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;

d.2. Equipment employing a "laser" and having any of the following:

d.2.a. A transmission wavelength exceeding 1750 nm; or

d.2.b. Employing analog techniques and having a bandwidth exceeding 2.5 GHz;

**Note:** 5D001.d.2.b. does not control "software" specially designed or modified for the "development" of commercial TV systems.

d.3. Equipment employing "optical switching"; or

d.4. Radio equipment employing quadrature-amplitude-modulation (QAM) techniques above level 128;

**5E001 "Technology" (See List of Items Controlled)**

\* \* \* \* \*

**List of Items Controlled**

*Unit:* \$ value.

*Related Controls:* See also 5E101 and 5E991.

*Related Definitions:* N/A.

*Items:*

a. "Technology" according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, functions or features or "software" controlled by 5A001, 5B001 or 5D001.

b. Specific "technologies", as follows:

b.1. "Required" "technology" for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;

b.2. "Technology" for the "development" or "use" of "laser" communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media;

b.3. "Technology" for the "development" of digital cellular radio systems;

b.4. "Technology" for the "development" of "spread spectrum" techniques, including "frequency hopping" techniques.

c. "Technology" according to the General Technology Note for the "development" or "production" of any of the following telecommunication transmission or "stored program controlled" switching equipment, functions or features:

c.1. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;

c.2. Equipment employing a "laser" and having any of the following:

c.2.a. A transmission wavelength exceeding 1750 nm;

c.2.b. Performing "optical amplification" using praseodymium-doped fluoride fiber amplifiers (PDFFA);

c.2.c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);

c.2.d. Employing wavelength division multiplexing techniques exceeding 8 optical carriers in a single optical window; or

c.2.e. Employing analog techniques and having a bandwidth exceeding 2.5 GHz;

**Note:** 5E001.c.2.e. does not control "technology" for the "development" or "production" of commercial TV systems.

c.3. Equipment employing "optical switching"; or

c.4. Radio equipment having any of the following:

c.4.a. Quadrature-amplitude-modulation (QAM) techniques above level 128; or

c.4.b. Operating at input or output frequencies exceeding 31 GHz; or

**Note:** 5E001.c.4.b. does not control "technology" for the "development" or "production" of equipment designed or modified for operation in any ITU allocated band.

c.5. Equipment employing "common channel signalling" operating in either non-associated or quasi-associated mode of operation.

13. In Supplement No. 1 to part 774 (the Commerce Control List), Category 5, part 2—Information Security is amended by revising the List of Items Controlled section for Export Control Classification Number (ECCN) 5A002 to read as follows:

**5A002 Systems, Equipment, Application Specific "Electronic assemblies", Modules and Integrated Circuits for "Information security", and Other Specially Designed Components Therefor**

\* \* \* \* \*

**List of Items Controlled**

*Unit:* \$ value.

**Related Controls:** See also 5A992. This entry does not control: (a) "Personalized smart cards" where the cryptographic capability is restricted for use in equipment or systems excluded from control paragraphs (b) through (f) of this note. Note that if a "personalized smart card" has multiple functions, the control status of each function is assessed individually; (b) Receiving equipment for radio broadcast, pay television or similar restricted audience broadcast of the consumer type, without digital encryption except that exclusively used for sending the billing or program-related information back to the broadcast providers; (c) Portable or mobile radiotelephones for civil use (e.g., for use with commercial civil cellular radio communications systems) that are not capable of end-to-end encryption; (d) Equipment where the cryptographic capability is not user-accessible and which is specially designed and limited to allow any of the following: (1) Execution of copy-protected "software"; (2) access to any of the following: (a) Copy-protected read-only media; or (b) Information stored in encrypted form on media (e.g., in connection with the protection of intellectual property rights) where the media is offered for sale in identical sets to the public; or (3) one-time encryption of copyright protected audio/video data; (e) Cryptographic equipment specially designed and limited for banking use or money transactions; (f) Cordless telephone equipment not capable of end-to-end encryption where the maximum effective range of unboosted cordless operation (e.g., a single, unrelayed hop between terminal and home basestation) is less than 400 meters according to the manufacturer's specifications.

**Related Definitions:** (1) The term "money transactions" in paragraph (e) of Related Controls includes the collection and settlement of fares or credit functions. (2) For the control of global navigation satellite systems receiving equipment containing or employing decryption (e.g., GPS or GLONASS) see 7A005.

**Items:**

**Technical Note:** Parity bits are not included in the key length.

a. Systems, equipment, application specific "electronic assemblies", modules and integrated circuits for "information security", and other specially designed components therefor:

a.1. Designed or modified to use "cryptography" employing digital techniques performing any cryptographic function other than authentication or digital signature having any of the following:

**Technical Notes:**

1. Authentication and digital signature functions include their associated key management function.

2. Authentication includes all aspects of access control where there is no encryption of files or text except as directly related to the protection of passwords, Personal Identification Numbers (PINs) or similar data to prevent unauthorized access.

3. "Cryptography" does not include "fixed" data compression or coding techniques.

**Note:** 5A002.a.1 includes equipment designed or modified to use "cryptography" employing analog principles when implemented with digital techniques.

a.1.a. A "symmetric algorithm" employing a key length in excess of 56-bits; or

a.1.b. An "asymmetric algorithm" where the security of the algorithm is based on any of the following:

a.1.b.1. Factorization of integers in excess of 512 bits (e.g., RSA);

a.1.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

a.1.b.3. Discrete logarithms in a group other than mentioned in 5A002.a.1.b.2 in excess of 112 bits (e.g., Diffie-Hellman over an elliptic curve);

a.2. Designed or modified to perform cryptoanalytic functions;

a.3. [Reserved]

a.4. Specially designed or modified to reduce the compromising emanations of information-bearing signals beyond what is necessary for health, safety or electromagnetic interference standards;

a.5. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" systems, including the hopping code for "frequency hopping" systems;

a.6. Designed or modified to provide certified or certifiable "multilevel security" or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent;

a.7. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion.

14. In Supplement No. 1 to part 774 (the Commerce Control List), Category 6—Sensors, the following Export Control Classification Numbers (ECCNs) are amended:

a. By revising the License Exceptions and List of Items Controlled section for ECCN 6A001;

b. By revising the List of Items Controlled section for 6A002, 6A003, and 6A995;

c. By revising the License Requirements and List of Items Controlled sections for ECCN 6A004; and

d. By revising the License Exceptions section for ECCNs 6E001 and 6E002, to read as follows:

**6A001 Acoustics**

\* \* \* \* \*

**License Exceptions**

LVS: \$3000; N/A for 6A001.a.2.a.1, a.2.a.2, a.2.a.5, 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.

CIV: Yes for 6A001.a.1.b.4.

**List of Items Controlled**

**Unit:** \$ value.

**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:

a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding  $\pm 20^\circ$ , 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. Wide-swath bathymetric survey systems designed for sea bed topographic mapping, having all of the following:

a.1.a.1. Being designed to take measurements at an angle exceeding  $20^\circ$  from the vertical;

a.1.a.2. Being designed to measure depths exceeding 600 m below the water surface; and

a.1.a.3. Being designed to provide any of the following:

a.1.a.3.a. Incorporation of multiple beams any of which is less than  $1.9^\circ$  or

a.1.a.3.b. Data accuracies of better than 0.3% of water depth across the swath averaged over the individual measurements within the swath;

a.1.b. Object detection or location systems having any of the following:

a.1.b.1. A transmitting frequency below 10 Khz;

a.1.b.2. Sound pressure level exceeding 224 Db (reference 1  $\mu$ Pa 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  $\mu$ Pa 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  $1^\circ$  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, 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.a1.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.

a.1.c.1. An instantaneous radiated acoustic power density exceeding 0.01 mW/mm<sup>2</sup>/Hz for devices operating at frequencies below 10 KHz;

a.1.c.2. A continuously radiated acoustic power density exceeding 0.001 mW/mm<sup>2</sup>/Hz for devices operating at frequencies below 10 KHz; or

**Technical Note:** Acoustic power density is obtained by dividing the output acoustic power by the product of the area of the radiating surface and the frequency of operation.

or

a.1.c.3. Side-lobe suppression exceeding 22 Db;

a.1.d. Acoustic systems, equipment and specially designed components for determining the position of surface vessels or underwater vehicles designed to operate at a range exceeding 1,000 m with a positioning accuracy 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.

or

a.2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment and specially designed components therefor, as follows:

a.2.a. Hydrophones having any of the following characteristics:

**Note:** The control status of hydrophones specially designed for other equipment is determined by the control status of the other equipment.

a.2.a.1. Incorporating continuous flexible sensors or assemblies of discrete sensor 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.2. Having any of the following sensing elements:

a.2.a.2.a. Optical fibers;

a.2.a.2.b. Piezoelectric polymers; or

a.2.a.2.c. Flexible piezoelectric ceramic materials;

a.2.a.3. A hydrophone sensitivity better than -180 Db at any depth with no acceleration compensation;

a.2.a.4. When designed to operate at depths exceeding 35 m with acceleration compensation; or

a.2.a.5. Designed for operation at depths exceeding 1,000 m;

**Technical Note:** 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  $\mu$ Pa. For example, a hydrophone of -160 Db (reference 1 V per  $\mu$ Pa) 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:

a.2.b.1. 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:** "Able to be modified" in 6A001.a.2.b.2 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. Multiplexed hydrophone group signals 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; or

a.2.b.7. Hydrophone characteristics controlled by 6A001.a.2.a;

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  $\pm 0.5^\circ$ ; 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;

a.2.e. Bottom or bay cable systems having any of the following:

a.2.e.1. Incorporating hydrophones controlled by 6A001.a.2.a; or

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;

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;

b. Correlation-velocity sonar log equipment designed to measure the horizontal speed of

the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m.

## 6A002 Optical Sensors

\* \* \* \* \*

### List of Items Controlled

*Unit:* Equipment in number; parts and accessories in \$ value.

*Related Controls:* See also 6A102, 6A202, and 6A992.

*Related Definitions:* (1.) "Image intensifiers" defined in 6A002.a.2 and "focal plane arrays" defined in 6A002.a.3 specially designed, modified, or configured for military use and not part of civil equipment are subject to the export licensing authority of U.S. Department of State, Office of Defense Trade Controls (22 CFR part 121). (2.) "Space qualified" "monospectral imaging sensors", and "multispectral imaging sensors" defined in 6A002.b, and "space-qualified" "focal plane arrays" defined in 6A002.e, specially designed or modified for items on the U.S. Munitions List are subject to the export licensing authority of the Department of State, Office of Defense Trade Controls (22 CFR part 121).

*Items:*

a. Optical detectors, as follows:

**Note:** 6A002.a does not control germanium or silicon photodevices.

a.1. "Space-qualified" solid-state detectors, as follows:

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.2. Image intensifier tubes and specially designed components therefor, as follows:

a.2.a. Image intensifier tubes having all of the following:

a.2.a.1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;

a.2.a.2. A microchannel plate for electron image amplification with a hole pitch (center-to-center spacing) of 15  $\mu$ m or less; and

a.2.a.3. Photocathodes, as follows:

a.2.a.3.a. S-20, S-25 or multialkali photocathodes with a luminous sensitivity exceeding 240  $\mu$ mA/lm;

a.2.a.3.b. GaAs or GaInAs photocathodes;

or

a.2.a.3.c. Other III-V compound semiconductor photocathodes;

**Note:** 6A002.a.2.a.3.c does not control compound semiconductor photocathodes

with a maximum radiant sensitivity of 10 mA/W or less.

a.2.b. Specially designed components, as follows:

a.2.b.1. Microchannel plates having a hole pitch (center-to-center spacing) of 15  $\mu\text{m}$  or less;

a.2.b.2. GaAs or GaInAs photocathodes;

a.2.b.3. Other III-V compound semiconductor photocathodes;

**Note:** 6A002.a.2.b.3 does not control compound semiconductor photocathodes with a maximum radiant sensitivity of 10 mA/W or less.

a.3. Non-"space-qualified" "focal plane arrays", as follows:

**Technical Note:** 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. Silicon "focal plane arrays";

b. Multi-element (not to exceed 16 elements) encapsulated photoconductive cells using either lead sulphide or lead selenide;

c. Pyroelectric detectors using any of the following:

c.1. Triglycine sulphate and variants;

c.2. Lead-lanthanum-zirconium titanate and variants;

c.3. Lithium tantalate;

c.4. Polyvinylidene fluoride and variants;

or

c.5. Strontium barium niobate and variants.

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. A response "time constant" of less than 0.5 ns;

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. A response "time constant" of 95 ns or less;

a.3.c. Non-"space-qualified" "focal plane arrays", having individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm.

b. "Monospectral imaging sensors" and "multispectral imaging sensors" designed for remote sensing applications, having any of the following:

b.1. An Instantaneous-Field-Of-View (IFOV) of less than 200  $\mu\text{r}$  (microradians); *or*

b.2. Being 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. Being any of the following:

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 mr (milliradians).

c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:

c.1. Image intensifier tubes having the characteristics listed in 6A002.a.2.a; *or*

c.2. "Focal plane arrays" having the characteristics listed in 6A002.a.3.

**Technical Note:** "Direct view" refers to imaging equipment, operating in the visible or infrared spectrum, 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 the following equipment 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 ( $-55\text{ }^\circ\text{C}$ ), 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.

e. "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.

**6A003 Cameras**

\* \* \* \* \*

**List of Items Controlled**

*Unit:* Number.

*Related Controls:* See also 6A203. See 8A002.d and .e for cameras specially designed or modified for underwater use.

*Related Definitions:* N/A.

*Items:*

a. Instrumentation cameras, 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 "electronic assemblies" available according to the camera manufacturer's specifications.

a.1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames/s;

**Note:** 6A003.a.1 does not control cinema recording cameras designed for civil purposes.

a.2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames/s for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;

a.3. Mechanical or electronic streak cameras having writing speeds exceeding 10 mm/ $\mu$ .

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 1  $\mu\text{s}$  per full frame; *and*

a.5.b. A read out time allowing a framing rate of more than 125 full frames per second.

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 any of the following:

b.1.a. More than  $4 \times 10^6$  "active pixels" per solid state array for monochrome (black and white) cameras;

b.1.b. More than  $4 \times 10^6$  "active pixels" per solid state array for color cameras incorporating three solid state arrays; *or*

b.1.c. More than  $12 \times 10^6$  "active pixels" for solid state array color cameras incorporating one solid state array;

b.2. Scanning cameras and scanning camera systems, having all of the following:

b.2.a. Linear detector arrays with more than 8,192 elements per array; *and*

b.2.b. Mechanical scanning in one direction;

b.3. Imaging cameras incorporating image intensifier tubes having the characteristics listed in 6A002.a.2.a;

b.4. Imaging cameras incorporating "focal plane arrays" having the characteristics listed in 6A002.a.3.

**Note:** 6A003.b.4 does not control imaging cameras incorporating linear "focal plane arrays" with twelve elements or fewer, not employing time-delay-and-integration with the element, 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.



**6A004 Optics**

**License Requirements**

*Reason for Control:* NS, AT.

Control(s)	Country chart
NS applies to entire entry ....	NS Column 2.
AT applies to entire entry .....	AT Column 1.

**License Requirement Notes:** See § 743.1 of the EAR for reporting requirements for exports under License Exceptions.

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**List of Items Controlled**

*Unit:* Equipment in number; cable in meters/feet; components in \$ value.

*Related Controls:* See also 6A994.

*Related Definitions:* N/A.

*Items:* a. Optical mirrors (reflectors), as follows:

a.1. "Deformable mirrors" having either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;

a.2. Lightweight monolithic mirrors having an average "equivalent density" of less than 30 kg/m<sup>2</sup> 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<sup>2</sup> and a total mass exceeding 2 kg;

a.4. Beam steering mirrors more than 100 mm in diameter or length of major axis, that maintain a flatness of  $\lambda/2$  or better ( $\lambda$  is equal to 633 nm) having a control bandwidth exceeding 100 Hz.

b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and having any of the following:

b.1. Exceeding 100 cm<sup>3</sup> 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. Lightweighted to less than 20% "equivalent density" compared with a solid blank of the same aperture and thickness;

c.2. Substrates, 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. Manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than  $5 \times 10^{-6}$  in any coordinate direction.

d. Optical control equipment, as follows:

d.1. 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. Having steering, tracking, stabilization or resonator alignment bandwidths equal to

or more than 100 Hz and an accuracy of 10  $\mu$ r (microradians) or less;

d.3. Gimbals having all of the following:

d.3.a. A maximum slew exceeding 5°;

d.3.b. A bandwidth of 100 Hz or more;

d.3.c. Angular pointing errors of 200  $\mu$ r (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 r (radians)/s<sup>2</sup>; *or*

d.3.d.2. Exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0.5 r (radians)/s<sup>2</sup>;

d.4. Specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more.

e. Aspheric optical elements having all of the following characteristics:

e.1. The largest dimension of the optical-aperture is greater than 400 mm;

e.2. The surface roughness is less than 1 nm (rms) for sampling lengths equal to or greater than 1 mm; *and*

e.3. The coefficient of linear thermal expansion's absolute magnitude is less than  $3 \times 10^{-6}/K$  at 25° C;

**Technical Notes:**

1. 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. Manufacturers are not required to measure the surface roughness listed in 6A004.e.2 unless the optical element was designed or manufactured with the intent to meet, or exceed, the control parameter.

**Note:** 6A004.e does not control aspheric optical elements having any of the following:

a. A largest optical-aperture dimension less than 1 m and a focal length to aperture ratio equal to or greater than 4.5:1;

b. A largest optical-aperture dimension equal to or greater than 1 m and a focal length to aperture ratio equal to or greater than 7:1;

c. Being designed as Fresnel, flyeye, stripe, prism or diffractive optical elements;

d. Being fabricated from borosilicate glass having a coefficient of linear thermal expansion greater than  $2.5 \times 10^{-6}/K$  at 25° C; *or*

e. Being an x-ray optical element having inner mirror capabilities (e.g., tube-type mirrors).

*N.B.:* For aspheric optical elements specially designed for lithographic equipment, see 3B001.

**6A995 "Lasers", Not Controlled by 6A005 or 6A205**

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**List of Items Controlled**

*Unit:* Equipment in number; parts and accessories in \$ value.

*Related Controls:* N/A.

*Related Definitions:* N/A.

*Items:*

a. Carbon dioxide (CO<sub>2</sub>) "lasers" having any of the following:

a.1. A CW output power exceeding 10 kW;

a.2. A pulsed output with a "pulse duration" exceeding 10 microseconds; *and*  
a.2.a. An average output power exceeding 10 kW; *or*

a.2.b. A pulsed "peak power" exceeding 100 kW; *or*

a.3. A pulsed output with a "pulse duration" equal to or less than 10 microseconds; *and*

a.3.a. A pulse energy exceeding 5 J per pulse and "peak power" exceeding 2.5 kW; *or*

a.3.b. An average output power exceeding 2.5 kW;

b. Semiconductor lasers, as follows:

b.1. Individual, single-transverse mode semiconductor "lasers" having:

b.1.a. An average output power exceeding 100 MW; *or*

b.1.b. A wavelength exceeding 1,050 nm;

b.2. Individual, multiple-transverse mode semiconductor "lasers", or arrays of individual semiconductor "lasers", having a wavelength exceeding 1,050 nm;

c. Solid state, non-"tunable" "lasers", as follows:

c.1. Ruby "lasers" having an output energy exceeding 20 J per pulse;

c.2. Neodymium-doped (other than glass) "lasers", as follows, with an output wavelength exceeding 1,000 nm but not exceeding 1,100 nm:

c.2.a. Pulse-excited, "Q-switched lasers", with a pulse duration equal to or more than 1 ns, and a multiple-transverse mode output with any of the following:

c.2.a.1. A "peak power" exceeding 200 MW; *or*

c.2.a.2. An average output power exceeding 50 W;

c.2.b. Pulse-excited, non-"Q-switched lasers", having a multiple-transverse mode output with an average power exceeding 500 W; *or*

c.2.c. Continuously excited "lasers" having a multiple-transverse mode output with an average or CW output power exceeding 500 W;

d. Free electron "lasers".

**6E001 "Technology" According to the General Technology Note for the "Development" of Equipment, Materials or "Software" Controlled by 6A (Except 6A018, 6A991, 6A992, 6A994, 6A995, 6A996, 6A997, or 6A998), 6B (Except 6B995), 6C (Except 6C992 or 6C994), or 6D (Except 6D991, 6D992, or 6D993).**

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**License Exceptions**

CIV: N/A.

TSR: Yes, except for the following:

(1) Items controlled for MT reasons;

(2) Items controlled by 6A004.e; *or*

(3) Exports or reexports to destinations

outside of Austria, Belgium, Canada,

Denmark, Finland, France, Germany, Greece,

Ireland, Italy, Japan, Luxembourg, the

Netherlands, Portugal, Spain, Sweden, or the

United Kingdom of "technology" for the

"development" of the following:

(a) Items controlled by 6A001.a.2.a.1,

6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b,

6A001.a.2.e., 6A002.a.1.c, 6A008.l.3, 6B008,

6D003.a;



(b) Equipment controlled by 6A001.a.2.c or 6A001.a.2.f when specially designed for real time applications; or

(c) "Software" controlled by 6D001 and specially designed for the "development" or "production" of equipment controlled by 6A008.l.3 or 6B008.

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**6E002 "Technology" According to the General Technology Note for the "Production" of Equipment or Materials Controlled by 6A (Except 6A018, 6A991, 6A992, 6A994, 6A995, 6A996, 6A997 or 6A998), 6B (Except 6B995) or 6C (Except 6C992 or 6C994).**

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#### License Exceptions

CIV: N/A.

TSR: Yes, except for the following:

(1) Items controlled for MT reasons;  
 (2) Items controlled by 6A004.e; or  
 (3) Exports or reexports to destinations outside of Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, Portugal, Spain, Sweden, or the United Kingdom of "technology" for the "development" of the following:

(a) Items controlled by 6A001.a.2.a.1, 6A001.a.2.a.2, 6A001.a.2.a.5, 6A001.a.2.b, and 6A001.a.2.c; and

(b) Equipment controlled by 6A001.a.2.e and 6A001.a.2.f when specially designed for real time applications; or

(c) "Software" controlled by 6D001 and specially designed for the "development" or "production" of equipment controlled by 6A002.a.1.c, 6A008.l.3 or 6B008.

\* \* \* \* \*

15. In Supplement No. 1 to part 774 (the Commerce Control List), Category 9—Propulsion Systems, Space Vehicles and Related Equipment is amended as follows:

a. By revising the List of Items Controlled section for ECCNs 9B001, 9B991, 9E002, and 9E003; and

b. By adding a new ECCN 9E993, to read as follows:

**9B001 Specially Designed Equipment, Tooling and Fixtures, as Follows (See List of Items Controlled), for Manufacturing or Measuring Gas Turbine Blades, Vanes or Tip Shroud Castings.**

\* \* \* \* \*

#### List of Items Controlled

Unit: \$ value.

*Related Controls:* For specially designed production equipment of systems, sub-systems and components controlled by 9A005 to 9A009, 9A011, 9A101, 9A105 to 9A109, 9A111, and 9A116 to 9A119 usable in "missiles" see 9B115. See also 9B991.

*Related Definitions:* N/A.

*Items:*

a. Directional solidification or single crystal casting equipment;  
 b. Ceramic cores or shells.

**9B991 Specially Designed Equipment, Tooling or Fixtures, Not Controlled by 9B001, as Described in the List of Items Controlled, for Manufacturing or Measuring Gas Turbine Blades, Vanes or Tip Shroud Castings.**

\* \* \* \* \*

#### List of Items Controlled

Unit: \$ value.

*Related Controls:* N/A.

*Related Definitions:* N/A.

*Items:*

a. Automated equipment using non-mechanical methods for measuring airfoil wall thickness;  
 b. Tooling, fixtures or measuring equipment for the "laser", water jet or ECM/EDM hole drilling processes controlled by 9E003.c;  
 c. Ceramic core leaching equipment;  
 d. Ceramic core manufacturing equipment or tools;  
 e. Ceramic shell wax pattern preparation equipment;  
 f. Ceramic shell burn out or firing equipment.

**9E002 "Technology" According to the General Technology Note for the "Production" of Equipment Controlled by 9A001.c, 9A004 to 9A011 or 9B (Except 9B990 or 9B991).**

\* \* \* \* \*

#### List of Items Controlled

Unit: N/A.

*Related Controls:* (1) See also 9E102. (2) See also 1E002.f for "technology" for the repair of controlled structures, laminates or materials. (3) The "technology" required for the "development" of equipment controlled by 9A004 is subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls. (See 22 CFR part 121.) (4) "Technology", required for the "development" of equipment or "software" subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls, is also subject to the same licensing jurisdiction. (See 22 CFR part 121).

*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).**

\* \* \* \* \*

#### List of Items Controlled

Unit: N/A.

*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 licensing authority of the U.S. Department of State. (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, or components, a commodity jurisdiction determination from the Department of State.

*Related Definitions:* N/A.

*Items:*

a. "Technology" "required" for the "development", "production", or overhaul of the following commercial aircraft engines, components or systems:

a.1. Gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys 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;

a.2. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,813 K (1,540°C) or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;

a.3. Components manufactured from any of the following:

a.3.a. Organic "composite" materials designed to operate above 588 K (315°C);

a.3.b. Metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials controlled by 1C007; or

a.3.c. "Composite" material controlled by 1C010 and manufactured with resins controlled by 1C008.

a.4. Uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050°C) or more;

a.5. Cooled turbine blades, vanes or tip-shrouds, other than those described in 9E003.a.1, exposed to gas path temperatures of 1,643 K (1,370°C) or more;

a.6. Airfoil-to-disk blade combinations using solid state joining;

a.7. Gas turbine engine components using "diffusion bonding" "technology" controlled by 2E003.b;

a.8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials controlled by 1C002.b;

a.9. Full authority digital electronic engine control (FADEC) for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;

a.10. Adjustable flow path geometry and associated control systems for:

a.10.a. Gas generator turbines;

a.10.b. Fan or power turbines;

a.10.c. Propelling nozzles;

**Note 1:** Adjustable flow path geometry and associated control systems do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.

**Note 2:** 9E003.a.10 does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.

a.11. Wide chord hollow fan blades without part-span support;

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 propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. "Technology" "required" for the "development" or "production" of gas turbine engine components using "laser", water jet, ECM or EDM hole drilling processes to produce holes having any of the following sets of characteristics:

- c.1. All of the following:
  - c.1.a. Depths more than four times their diameter;
  - c.1.b. Diameters less than 0.76 mm; *and*
  - c.1.c. Incidence angles equal to or less than 25°; *or*
- c.2. All of the following:
  - c.2.a. Depths more than five times their diameter;
  - c.2.b. Diameters less than 0.4 mm; *and*
  - c.2.c. Incidence angles of more than 25°;

**Technical Note:** For the purposes of 9E003.c, incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

d. "Technology" "required" for any of the following:

- d.1. The "development" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems; *or*
- d.2. The "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems;

e.1. "Technology" for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

- e.1.a. A box volume of 1.2 m<sup>3</sup> or less;
- e.1.b. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; *and*
- e.1.c. A power density of more than 700 kW/m<sup>3</sup> of box volume;

**Technical Note:** Box volume: 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 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 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.

e.2. "Technology" "required" for the "production" of specially designed components, as follows, for high output diesel engines:

e.2.a. "Technology" "required" for the "production" of engine systems having all of the following components employing ceramics materials controlled by 1C007:

- e.2.a.1. Cylinder liners;
- e.2.a.2. Pistons;
- e.2.a.3. Cylinder heads; *and*
- e.2.a.4. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

e.2.b. "Technology" "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:

e.2.b.1. Operating at pressure ratios of 4:1 or higher;

e.2.b.2. A mass flow in the range from 30 to 130 kg per minute; *and*

e.2.b.3. Variable flow area capability within the compressor or turbine sections;

e.2.c. "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)), having both of the following:

e.2.c.1. Injection amount in excess of 230 mm<sup>3</sup> per injection per cylinder; *and*

e.2.c.2. Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque

characteristics by using the appropriate sensors;

e.3. "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, 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.

f. "Technology" not otherwise controlled in 9E003.a.1 through a.10 and currently used in the "development", "production", or overhaul of hot section parts and components of civil derivatives of military engines controlled on the U.S. Munitions List.

**9E993 Other "technology", not described by 9E003, as follows (see List of Items Controlled)**

**License Requirements**

Reason for Control: AT.

Control(s)	Country chart
AT applies to entire entry .....	AT Column 1.

**License Exceptions**

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Unit:* \$ value.  
*Related Controls:* N/A.  
*Related Definitions:* N/A.  
*Items:*

- a. Rotor blade tip clearance control systems employing active compensating casing "technology" limited to a design and development data base; *or*
- b. Gas bearing for turbine engine rotor assemblies.

Dated: June 29, 2000.

**R. Roger Majak,**

*Assistant Secretary for Export Administration.*

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