

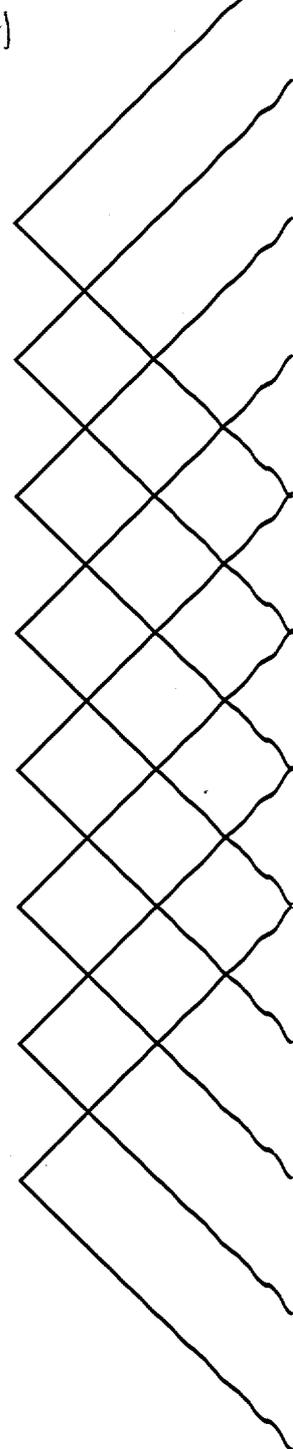
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A Guide to

The Export Control List

August 1990



Canada



External Affairs and
International Trade Canada

Affaires extérieures et
Commerce extérieur Canada

INFORMATION AND ASSISTANCE

The Export Control List and the issuance of Export Permits is administered by the Export Controls Division of External Affairs and International Trade Canada. The division provides assistance to exporters in determining if export permits are required. It also publishes brochures and notices to exporters that are freely available on request.

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**FOR ENQUIRIES ON THE STATUS OF AN EXPORT PERMIT APPLICATION :
CALL (613) 996-2387 AND
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A guide to the EXPORT CONTROL LIST

Dept. of External Affairs
Min. des Affaires extérieures

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INTRODUCTION

General

This publication acts as a guide to the Export Control List as published in the Canada Gazette Part II on August 15, 1990. It has been prepared for information and guidance to exporters. **It does not in this form have the force of law, nor does it cover all goods which may be subject to export control.**

Basis of export controls

The Export and Import Permits Act (EIPA), the Export Control List (ECL) and the Area Control List (ACL) are the vehicles by which Canada controls strategic exports. It authorizes the Government to exercise export controls on natural resources to encourage resource upgrading, to prevent shortages of supply in Canada, to ensure that military or strategic goods are not exported to destinations presenting a strategic threat to Canada, and to enact intergovernmental arrangements or commitments.

Export Control List

The Export Control List (ECL) comprises goods and technologies for which export permits are required. Goods and technologies not listed on the ECL do not require export permits under the EIPA except when the export is to a country included on the Area Control List established pursuant to the Export and Import Permits Act.

The Export Control List is divided into 5 groups.

Group 1 – Industrial goods. This group comprises dual-purpose goods and technologies, that is goods and technologies that have both civilian and military applications. All controls under that group are drawn from Canada's commitment to COCOM.

Group 2 – Munitions This group comprises goods and technologies that are specially designed or modified for military purposes. All controls under that group are drawn from Canada's commitment to COCOM.

Group 3 – Atomic Energy This group includes goods that are nuclear-related. The controls under that group are drawn from COCOM and the Treaty on the Non- Proliferation of Nuclear Weapons.

Group 4 – Technology This group is made of a single item. It covers general technology related to any goods covered in the other groups.

Group 5 – Miscellaneous goods Finally Group 5, covers miscellaneous goods that are controlled in order to protect natural resources, to fulfill Canada's commitment to multilateral agreements other than COCOM or to protect national security.

COCOM

In implementing strategic export controls, Canada participates with its NATO partners (except Iceland), along with Japan and Australia, in the Coordinating Committee for multilateral strategic export controls (COCOM). COCOM establishes lists of strategic goods and technologies the export of which is to be closely controlled to the COCOM-proscribed destinations. The export of these goods and technologies must also be controlled to all other destinations in order to preclude possible diversion. COCOM also advises member countries on the strategic implications of specific exports to the proscribed destinations.

COCOM-proscribed destinations

The destinations proscribed by COCOM are; Albania, Bulgaria, the People's Republic of China, Czechoslovakia, Hungary, Mongolia, the Democratic People's Republic of Korea, Poland, Romania, the Union of Soviet Socialist Republics and Viet Nam. The COCOM-proscribed destinations should not be confused with countries included on the Area Control List (currently Libya and South Africa) established pursuant to the Export and Import Permits Act.

Levels of Control

All goods and technologies listed in Groups 1, 2, 3 and 4 can be classified into one of the four levels of control. The levels of control define the level of sensitivity of the goods and technologies. It is important to find the level of control of a good or a technology because it defines the procedure under which an export permit application is reviewed. These four levels of control are:

General Exception (GE) — This is the level of control that contains goods and technologies having the highest level of strategic sensitivity. Goods and technologies are classified at the General Exception (GE) level when they are included in Groups 1, 2, 3 or 4 of the ECL and when the Administrative Exception, the Favourable Consideration or the China Administrative Exception levels of control do not apply.

Administrative Exception (AE) — This is the level of control that contains goods and technologies having the lowest level of strategic sensitivity. Goods and technologies are classified at the Administrative Exception (AE) level when they are specifically exempt from the General Exception (GE) level of control under Administrative Exception (AE) notes. The AE notes are generally presented as follows: "Governments may permit, as administrative exceptions, the shipment of ...".

Favourable Consideration (FC) — This is a level of control that contains strategic goods and technologies having an intermediate level of strategic sensitivity. Goods and technologies are classified at the Favourable Consideration (FC) level when they are specifically exempt from the General Exception (GE) level of control under Favourable Consideration (FC) notes only. If a good or a technology can be exempt from the GE level of control under both a Favourable Consideration (FC) note and an Administrative Exception (AE) note, then that good or that technology must be classified at the Administrative Exception (AE) level. FC notes are generally presented as follows: "Favourable consideration will be given to the shipment of ...".

China Administrative Exception (China AE) — This is a level of control that contains goods and technologies having an intermediate level of strategic sensitivity. Goods and technologies are classified at the China Administrative Exception (China AE) level when they are specifically exempt from the General Exception (GE) level of control under China Administrative Exception (China AE) notes only. If a good or a technology can be exempt from the GE level of control under both a China AE note and an Administrative Exception (AE) note, then that good or that technology must be classified at the Administrative Exception (AE) level. China AE notes are generally presented as follows: "Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of ...".

Export to United States

Under a bilateral agreement with the United States, the requirement for an export permit to the United States is waived for all goods included in the Export Control List except for all goods included in Group 3 along with any technology associated with those goods and some goods of Group 5.

Re-export of United States origin goods

All United States origin goods not covered by any items under Groups 1, 2, 3 and 4 are controlled for re-export from Canada under item 5400 of Group 5. Although this means that in principle all non-strategic U.S. origin goods requires an individual export permit, exporters may benefit in most cases from the provisions of the General Export Permit # Ex. 12 in order to expedite the licencing. Contact the Export Controls Division for more information.

**COLORED
TYPE**

Defines Administrative Exception
notes.

**COLORED-TINT
BACKGROUND**

Defines China Administrative
Exception notes.

EXPORT CONTROL LIST

Interpretation

1. (1) The following definitions apply in respect of this List:

"civil" means, in respect of articles included in this List, those articles that are not military; (*civil*)

"embargo(ed)" means controlled and not prohibited; (*sous embargo*)

"excluded" means, in respect of articles in this List, those articles that are not subject to export control under an item of this List, and where articles are referred to as "excluded" under another item of this List, reference is to those articles which are not subject to export control under the referenced item; (*exclus*)

"government" means the Export Controls Division, External Affairs and International Trade Canada; (*gouvernement*)

"included" means, in respect of articles in this List, those articles that are subject to export control under an item of this List, and where articles are referred to as "included" in another item of this List, reference is to those articles that are subject to export control under the referenced item; (*inclus*)

"military" means, in respect of articles included in this List, those articles that are specially designed or modified for use by the armed forces or the police of a state. (*militaire*)

(2) The following acronyms and abbreviations apply in respect of this List:

"ABEC" means the Annular Bearing Engineering Committee of the Anti-friction Bearing Manufacturers Association; (*ABEC*)

"AGMA" means the American Gear Manufacturers Association; (*AGMA*)

"AISI" means the American Iron and Steel Institute; (*AISI*)

"ANSI" means the American National Standards Institute; (*ANSI*)

"ASTM" means the American Society for Testing and Materials; (*ASTM*)

"CCIR" means the Commission consultative internationale pour les radios; (*CCIR*)

"CCITT" means the Comité consultatif international des téléphones et télégraphes; (*CCITT*)

"COCOM" means the Coordinating Committee for multilateral strategic export controls; (*COCOM*)

"DIN" means the Deutsche Institut Für Normung; (*DIN*)

"DUKWS" means Detroit United Kaiser Works; (*DUKWS*)

"EIA" means Electronic Industries Association; (*EIA*)

"IEC" means International Electrotechnical Commission; (*CEI*)

"IEEE" means Institute of Electrical and Electronic Engineers; (*IEEE*)

"ISO" means the International Organization for Standardization; (*ISO*)

"ITU" means International Telecommunications Union; (*UIT*)

"OIR" means the Organisation internationale de radiodiffusion; (*OIR*)

"RBEC" means Roller Bearing Engineering Committee of the Anti-friction Bearing Manufacturers Association; (*RBEC*)

"SAE" means Society of Automotive Engineers; (*SAE*)

(3) Unless otherwise indicated, all reference to a standard shall mean the standard as it existed on December 11, 1989."

General

2. In this List, a permit to export goods, referred to in section 7 of the Export and Import Permits Act, is required for the export of

- (a) goods referred to in Groups 1 and 2 to all destinations other than the United States;
- (b) goods referred to in Group 3 to all destinations; and
- (c) goods referred to in Groups 4 and 5 to any destination mentioned in the item in which the goods are described.

INDUSTRIAL GOODS

— GROUP 1

Metal-Working Machinery

NOTE:

For computer related terms, see Item 1565 or 1566.

1001

Technology for metal-working manufacturing processes and specially designed "software" therefor, as follows:

I. Definitions of terms used in this Item:

- (a) "Hot die forging" is a deformation process where die temperatures are at the same nominal temperature as the workpiece and exceed 850 K (577°C, 1,070°F);
- (b) "Superplastic forming" is a deformation process using heat for metals that are normally characterised by low values of elongation (less than 20%) at the breaking point as determined at room temperature by conventional tensile strength testing, in order to achieve elongations during processing which are at least 2 times those values;
- (c) "Diffusion bonding" is a solid-state molecular joining of at least two separate metals into a single piece with a joint strength equivalent to that of the weakest material;
- (d) "Metal powder compaction" is a process capable of yielding parts having a density of 98% or more of the theoretical maximum density;
- (e) "Direct-acting hydraulic pressing" is a deformation process which uses a fluid-filled flexible bladder in direct contact with the workpiece;
- (f) "Hot isostatic densification" is a process of pressurizing a casting at temperatures exceeding 375 K (102°C, 215.6°F) in a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal force in all directions to reduce or eliminate internal voids in the casting;
- (g) "Vacuum hot pressing" is a process which uses a press with heated dies to consolidate metal powder under reduced atmospheric pressure into a part;
- (h) "High pressure extrusion" is a process yielding a single-pass reduction ratio of 4 to 1 or greater in a cross sectional area of the resulting part;
- (i) "Isostatic pressing" is a process which uses a pressurising medium (gas, liquid, solid particles, etc.) in a closed cavity to create equal force in all directions upon a metal powder-filled container for consolidating the powder into a part.

II. Listed as follows:

- (a) Technology for the design of tools, dies and fixtures specially designed for the following processes:
 - (1) "Hot die forging";
 - (2) "Superplastic forming";
 - (3) "Diffusion bonding";
 - (4) "Metal powder compaction" using:
 - (i) "Vacuum hot pressing";
 - (ii) "High-pressure extrusion"; or
 - (iii) "Isostatic pressing";
 - (5) "Direct-acting hydraulic pressing";
- (b) Technical data consisting of process parameters as listed below used to control:
 - (1) "Hot die forging":
 - (i) Temperature;

- (ii) Strain rate;
- (2) "Superplastic forming" of aluminium alloys, titanium alloys and superalloys:
 - (i) Surface preparation;
 - (ii) Strain rate;
 - (iii) Temperature;
 - (iv) Pressure;
- (3) "Diffusion bonding" of superalloys and titanium alloys:
 - (i) Surface preparation;
 - (ii) Temperature;
 - (iii) Pressure;
- (4) "Metal powder compaction" using:
 - (i) "Vacuum hot pressing":
 - (a) Temperature;
 - (b) Pressure;
 - (c) Cycle time;
 - (ii) "High-pressure extrusion":
 - (a) Temperature;
 - (b) Pressure;
 - (c) Cycle time;
 - (iii) "Isostatic pressing":
 - (a) Temperature;
 - (b) Pressure;
 - (c) Cycle time;
- (5) "Direct-acting hydraulic pressing" of aluminium alloys and titanium alloys:
 - (i) Pressure;
 - (ii) Cycle time;
- (6) "Hot isostatic densification" of titanium alloys, aluminium alloys and superalloys:
 - (i) Temperature;
 - (ii) Pressure;
 - (iii) Cycle time.

1080

I. Specially designed equipment, tooling and fixtures for the manufacture or measuring of gas turbine blades or vanes, as follows, and specially designed components and accessories and "specially designed software" for the equipment, components and accessories:

- (a) Blade or vane aerofoil or root automatic measuring equipment;
- (b) Precision vacuum investment casting equipment, including core-making equipment;
- (c) Small-hole drilling equipment for producing holes having depths more than four times their diameter and less than 0.76 mm (0.03 inch) in diameter;
- (d) Directional solidification casting equipment and directional recrystallization equipment;
- (e) Segmented cast blade or vane bonding equipment;
- (f) Integral blade-and-disc casting equipment;
- (g) Blade or vane coating equipment, *except* furnaces, molten-metal baths and ion-plating baths;
- (h) Ceramic blade or vane moulding and finishing machines;
- (i) Moulds, cores and tooling for the manufacture and finishing of:
 - (1) Cast hollow turbine blades or vanes;
 - (2) Turbine blades or vanes produced by powder compaction;
- (j) Composite metal turbine blade or vane moulding and finishing machines;
- (k) Inertial blade or vane welding machines.

II. Technology (*except* installation, operation and maintenance technology) for the use of the following unembargoed equipment:

- (a) Blade or vane belt grinding machines;
- (b) Blade or vane edge radiusing machines;
- (c) Blade or vane aerofoil milling or grinding machines;
- (d) Blade or vane blank preforming machines;

- (e) Blade or vane rolling machines;
- (f) Blade or vane aerofoil shaping machines *except* metal removing types;
- (g) Blade or vane root grinding machines;
- (h) Blade or vane aerofoil scribing equipment.

Technical Note:

Manufacture (making) includes refurbishing.

NOTE:

This definition also covers machinery and equipment for the manufacture of blades or vanes in the compressor section of aircraft or aircraft derived gas turbine engines where the technology is the same as for the manufacture of blades or vanes in the turbine section.

1081

Specially designed or modified equipment, tools, dies, moulds and fixtures for the manufacture or inspection of aircraft, airframe structures or aircraft fasteners, as follows, and specially designed components and accessories and "specially designed software" for the equipment, components and accessories:

- (a) Equipment, tools, dies, moulds or fixtures for:
 - (1) Hydraulic stretch forming:
 - (i) Whose machine motions or forces are digitally controlled or controlled by electrical analogue devices; *or*
 - (ii) Which are capable of thermal conditioning the workpiece;
 - (2) The milling of aircraft skins or spars *except* if they do not present an improvement on machinery in production ten years preceding the year of export;
- (b) Tools, dies, moulds or fixtures for:
 - (1) "Diffusion bonding";
 - (2) "Superplastic forming";
 - (3) "Hot die forging";
 - (4) Metal powder compaction by vacuum hot pressing, high pressure extrusion or isostatic pressing;
 - (5) Direct-acting hydraulic pressing of aluminium alloys and titanium alloys;
 - (6) The manufacture, inspection, inserting or securing of specially designed high-strength aircraft fasteners.

NOTE:

For the definition of the processes and control of the metal working manufacturing technologies mentioned above, see Item 1001.

1086

Specially designed or modified equipment, tools, dies, moulds, fixtures and gauges for the manufacture or inspection of aircraft and aircraft derived gas turbine engines, as follows, and specially designed components and accessories and "specially designed software" for the equipment, components and accessories:

- (a) Equipment, tools, dies, moulds, fixtures and gauges:
 - (1) For automated production inspection;
 - (2) For automated welding;
- (b) Tools, dies, fixtures and gauges:
 - (1) For solid state joining by inertial welding or thermal bonding;
 - (2) For manufacture and inspection of high-performance gas turbine bearings;
 - (3) For rolling specially configured rings such as nacelle rings;
 - (4) For forming and finishing turbine discs;
- (c) Compressor or turbine disc broaching machines.

NOTE:

This sub-item embargoes only broaching machines specially designed for the manufacture of aircraft or aircraft derived gas turbine engines, and not general purpose broaching machines specially adapted for that purpose.

1088

Gear making or finishing machinery, as follows:

- (a) Bevel gear making machinery:
 - (1) Gear grinding machinery (non-generating type);
 - (2) Other machinery capable of the production of bevel gears of module finer than 0.5 mm (diametrical pitch finer than 48) and meeting a quality standard better than DIN 58405 Class 6;

NOTE:

If rated in AGMA or Admiralty standards and not rated in DIN 58405, AGMA 11 or Admiralty Class I shall be considered to be the equivalent of DIN 58405 Class 6.

- (b) Machinery capable of producing gears in excess of AGMA quality level 13 or equivalent.

NOTE:

If not rated in AGMA standards, DIN 3963 Class 4 shall be considered equivalent to AGMA quality level 13.

1091

Numerical control units, numerically controlled machine-tools, dimensional inspection machines, direct numerical control systems, specially designed sub-assemblies, and specially designed "software", as follows:

- (a) Units for numerically controlling simultaneously coordinated (contouring and continuous path) movements of machine-tools and dimensional inspection machines in two or more axes, *except* those having all of the following characteristics:
 - (i) No more than three contouring interpolating (any mathematical function including linear and circular) axes can be simultaneously coordinated. Units may have:
 - (1) One or more additional axes for which rate of movement is not coordinated, varied or modulated with that of another axis;
 - (2) One additional set of up to three contouring axes provided a separate feed rate number, standard or optional, does not control more than any three contouring axes; *or*
 - (3) Up to three contouring axes switchable out of any number of axes;
 - (ii) Minimum programmable increment equal to or greater than 0.001 mm;
 - (iii) Interfaces limited as follows:
 - (1) No integral interface designed to meet ANSI/IEEE standard 488-1978, IEC publication 625-1, or any equivalent standard; *and*
 - (2) No more than two interfaces meeting EIA standard RS-232-C or any equivalent standard;
 - (iv) On-line (real-time) modification of the tool path, feed rate and spindle data limited to the following:
 - (1) Cutter diameter compensation normal to the centreline path;
 - (2) Automatic acceleration and deceleration for starting, cornering and stopping;
 - (3) Axis transducer compensation including lead screw pitch compensation (measurements on one axis may not compensate another axis);
 - (4) Constant surface speed with or without limits;
 - (5) Spindle growth compensation;
 - (6) Manual feed rate and spindle speed override;
 - (7) Fixed and repetitive cycles (does not include automatic cut vector generation);
 - (8) Tool and fixture offset;
 - (9) Part programme tape editing, excluding source programme language and centre-line location data (CLDATA);
 - (10) Tool length compensation;
 - (11) Part programme storage;
 - (12) Variable pitch threading;
 - (13) Inch/metric conversion;

- (14) Feed rate override based on spark voltage for electrical discharge machines;
- (v) Word size equal to or less than 16 bits (excluding parity bits);
- (vi) "Software" or "firmware", including "software" or "firmware" of any programmable unit or device furnished, shall not exceed control unit functions as provided in (i) to (v) above, and is restricted as follows:
- (1) Only the following application programmes can be furnished which shall be executable without further compilation, assembly, interpretation, or processing, other than control unit parameter initialization, and memory storage loading, and each shall be supplied as an entity rather than in modular form:
 - (a) An operating programme to allow the unit to perform its normal functions;
 - (b) One or more diagnostic programmes to verify control or machine performance and permit localization of hardware malfunctions;
 - (c) A translator programme with which the end-user can programme the control-to-machine interface;
 - (2) Programme documentation for application programmes shall not contain the following:
 - (a) Listing of programme instructions (*except* that necessary for diagnostics for routine hardware maintenance);
 - (b) Description of programme organization or function beyond that required for programme use and for maintenance of hardware with which these programmes operate;
 - (c) Flow charts, logic diagrams or the algorithms employed (*except* those necessary for use of diagnostics for routine hardware maintenance);
 - (d) Any reference to specific memory storage locations (*except* those necessary for diagnostics for routine hardware maintenance);
 - (e) Any other information about the design or function of the "software" which would assist in the analysis or modification of all or part of it;

NOTES:

1. For "digital computers" either "incorporated" in or "associated" with, but not "embedded" in, controllers, see Item 1565.
 2. Technology for the design and production (except assembly and testing) of two-axis numerical control units with an "embedded" computer remains embargoed.
 3. Not used.
- (b) Machine-tools and dimensional-inspection machines which, according to the manufacturer's technical specifications, can be equipped with numerical control units covered by sub-item (a) above, *except*:
- (i) Boring mills, milling machines and machining centres having all of the following characteristics:
 - (1) (a) Not more than three axes capable of simultaneously coordinated contouring motion, i.e. the total number of linear plus rotary contouring axes cannot exceed three. (A secondary parallel contouring axis, e.g. W axis on horizontal boring mills, is not counted in the total of three contouring axes. A secondary rotary table, the centreline of which is parallel to the primary rotary table, is also not counted in the total of three contouring axes. Machines may have non-contouring parallel or noncontouring, non-parallel rotary axes in addition to the three axes capable of simultaneously coordinated contouring motion. Machines having the capability of being simultaneously coordinated in more than three axes are not excluded from embargo even if the numerical control unit attached to the machine limits it to three simultaneously coordinated contouring axes. For example, a machine with a control unit switchable between any three out of four contouring axes is not excluded from embargo); *or*

- (b) Not more than three linear axes plus one rotary axis, but no tilting axis, capable of simultaneously coordinated contouring motion, i.e. the total number of linear plus rotary contouring axes cannot exceed four. (A secondary parallel contouring axis, e.g. W axis on horizontal boring mills, is not counted as an additional contouring axis. A secondary rotary table, the centreline of which is parallel to the primary rotary table, is also not counted as an additional contouring axis. Machines may have non-contouring parallel or non-contouring, non parallel rotary axes in addition to the four axes capable of simultaneously coordinated contouring motion. Machines having the capability of being simultaneously coordinated in more than four axes are not excluded from embargo even if the numerical control unit attached to the machine limits it to three simultaneously coordinated contouring axes. For example, a machine with a control unit switchable between any three out of five contouring axes is not excluded from embargo);
- (2) Maximum slide travel in any axis equal to or less than 3,000 mm;
- (3) Spindle drive motor power equal to or less than 35 kW;
- (4) Single working spindle (the machine may have multiple tool heads or turrets as standard or optional, but only one working spindle may be operative at a time). A spindle capable of driving a multiple drill head is considered as a single spindle;
- (5) Axial and radial axis motion measured at the spindle axis in one revolution of the spindle equal to or greater than $D \times 2 \times 10^{-5}$ mm TIR (peak-to-peak) where D is the spindle diameter in mm;
- (6) An incremental positioning accuracy equal to or greater (coarser) than ± 0.002 mm in any 200 mm of travel;
- (7) Overall positioning accuracy in any axis equal to or greater (coarser) than:
 - (a) ± 0.01 mm for machines with total length of axis travel equal to or less than 300 mm;
 - (b) $\pm (0.01 + (0.0025/300) \times (L-300))$ mm for machines with a total length of axis travel, L, greater than 300 mm and equal to or less than 3,300 mm;
 - (c) ± 0.035 mm for machines with a total length of axis travel greater than 3,300 mm;

NOTE:

Positioning accuracy is that accuracy which would be obtained in a temperature-controlled environment of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with any mechanical compensation techniques shipped with the machine or any electronic compensation described in sub-item (a)(iv). Positioning accuracy of machines shipped without numerical control units will be that attained with a control unit used during checkout of the machine and with feedback systems identical to those that will be used with the machine, or by accuracy previously obtained with an identical machine and feedback system and control unit which will be connected to the machine. (See Technical Note 6).

- (ii) Jig grinders having all of the following characteristics:
 - (1) Overall positioning accuracy in any axis equal to or greater (coarser) than:
 - (a) ± 0.005 mm for machines with total length of axis travel equal to or less than 300 mm;
 - (b) $\pm (0.005 + (0.002/300) \times (L-300))$ mm for machines with total length of axis travel, L, greater than 300 mm;
 - (2) Not more than two axes capable of simultaneously coordinated contouring motion;
- (iii) Machine-tools (other than boring mills, milling machines, machining centres and jig grinders described in (b)(i) and (ii) above and dimensional inspection machines described in (b)(iv) below), having all of the following characteristics:
 - (1) Radial-axis motion measured at the spindle axis equal to or greater than 0.0008 mm TIR (peak-to-peak) in one revolution of the spindle (for lathes, turning machines, contour grinding machines, etc.);
 - (2) Meeting the requirements of (b)(i)(1)(a), (i)(6) and (b)(i)(7) above;

(iv) Dimensional inspection machines, having all of the following characteristics:

- (1) A linear positioning accuracy equal to or worse than:
 - (a) $\pm (3 + L/300)$ micrometre for L shorter than or equal to 3,300 mm;
 - (b) ± 14 micrometre for L longer than 3,300 mm;
- (2) A rotary accuracy of equal to or worse than five second in every 90 degrees; and
- (3) Meeting the requirements of (b)(i)(1) above;

(For high precision turning machinery, see also Item 1370.)

- (c) "Direct numerical control systems" (DNC) consisting of a dedicated stored programme computer acting as a host computer and controlling, on-line or off-line, one or more numerically controlled machine-tools or inspection machines, as defined in sub-item (b) above, related "software" and interface and communication equipment for data transfer between the host computer memory, the interpolation functions, and the numerically controlled machine-tools;
- (d) Specially designed sub-assemblies and "software" which, according to the manufacturer's technical specifications, can upgrade the capabilities of numerical control units and machine-tools either so that they would become embargoed by sub-items (a), (b) or (c) above, or so that they would cease to be eligible for administrative exceptions treatment under the Notes below.

NOTE:

Specially designed printed circuit board sub-assemblies are embargoed by this sub-item.

(For machine-tool parts and components, see also Item 1093.)

Technical Notes:

1. "Numerical control" is defined as the "automatic control of a process performed by a device that makes use of numeric data usually introduced as the operation is in progress" (Ref. ISO 2382).
2. "Contouring control" is defined as "two or more numerically controlled motions operating in accordance with instructions that specify the next required position and the required feed rates to that position. These feed rates are varied in relation to each other so that a desired contour is generated" (Ref. ISO/DIS 2806).
3. For computer-related terms, see Item 1565 or 1566.
4. A "direct numerical control system" (DNC) is defined as "a system connecting a set of numerically controlled machines to a common memory for part programme or machine programme storage with provision for on-demand distribution of data to the machines" (Ref. ISO/DIS 2806.2).
5. Axis nomenclature shall be in accordance with international standard ISO 841, "Numerical Control Machines - Axis and Motion Nomenclature".
6. The value of the positioning accuracy does not include the width of backlash. The value is determined by the usual statistical methods (random tests), i.e. by approaching from only one direction a minimum of five measurement points up to a maximum of 25 measurement points as random tests along one axis. National standards may be used for this measuring method: e.g. the German standard VDI "Statistical testing of the operational and positioning accuracy of machine-tools VDI/DGQ3441, March, 1977".
7. A tilting axis is defined as an axis which alters the angular position of the rotary table centreline with respect to the spindle centreline during the machining process.

NOTES:

1. This Item does not embargo floor-type horizontal boring mills embargoed by sub-item (b)(i) above provided all the following conditions are met:
 - (a) Maximum transverse (X-axis) travel equal to or less than 15,000 mm;
 - (b) Maximum vertical (Y-axis) travel equal to or less than 5,000 mm;
 - (c) Maximum Z-axis travel equal to or less than 3,000 mm;
 - (d) Spindle-drive motor power equal to or less than 75 kW;
 - (e) Meeting the requirements of sub-items (b)(i)(1) and (b)(i)(4) to (7) above.
2. Governments may permit, as administrative exceptions, the shipment of jig grinders covered by sub-item (b)(ii) above to non-nuclear end-users, provided all of the following conditions are met:
 - (a) Overall positioning accuracy in any axis equal to or greater (coarser) than:
 - (1) ± 0.002 mm for jig grinders with total length of axis travel equal to or less than 300 mm;

(2) $\pm (0.002 + (0.001/300) \times (L-300))$ mm for jig grinders with total length of axis travel, L, greater than 300 mm;

(b) Not more than two axes capable of simultaneously coordinated contouring motion.

3. Not used.

4. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of numerical control units, numerically controlled machine tools, dimensional inspection machines and specially designed "software" therefor, to civil end users, other than nuclear and aerospace, as follows, and specially designed sub-assemblies therefor:

(a) Numerical control units having all of the following characteristics:

N.B.:

Numerical control units exported separately from equipment must be for use with and specially configured for equipment permitted by paragraph (b) below. Exporters must submit specifications of equipment to which the numerical control units will be interfaced.

(1) No more than four contouring interpolating (any mathematical function including linear and circular) axes can be simultaneously coordinated. Units may have:

- (i) One or more additional axes in which the rate of movement is not coordinated, varied, or modulated with that of another axis; or
- (ii) One additional set of four contouring axes provided separate feedrate numbers, standard or optional, do not control more than any four contouring axes;

(2) Minimum programmable increment equal to or greater than 0.001 mm;

(3) Interfaces as follows:

- (i) No more than one integral interface designed to meet ANSI/IEEE standard 488-1978, IEC publication 625-1, or any equivalent standard; and
- (ii) An unlimited number of interfaces meeting EIA standard RS-232-C or any equivalent standard;

(4) On-line (real-time) modification of the tool path, feed-rate and spindle data limited to the following:

- (i) Cutter diameter compensation normal to the centreline path;
- (ii) Automatic acceleration and deceleration for starting, cornering and stopping;
- (iii) Axis transducer compensation including lead screw pitch compensation (measurements on one axis may not compensate another axis);
- (iv) Constant surface speed with or without limits;
- (v) Spindle growth compensation;
- (vi) Feedrate and spindle speed override;
- (vii) Fixed and repetitive cycles, including automatic cut vector generation;
- (viii) Tool and fixture offset;
- (ix) Part programme tape editing, including source programme language and centreline location data (CLDATA);
- (x) Tool length compensation;
- (xi) Part programme storage;
- (xii) Variable pitch threading;
- (xiii) Inch/metric conversion; and
- (xiv) Feedrate override based on spark voltage for electrical discharge machines;

(5) Word size equal to or less than 32 bits (excluding parity bits);

(6) "Software" or "firmware", including "software" or "firmware" of any programmable unit or device furnished, not exceeding control unit functions as provided in (a)(1) to (a)(5) above, and restricted as follows:

(i) Application programmes executable without further compilation, assembly, interpretation or processing, other than control unit parameter initialization, and memory storage loading, and each supplied as an entity rather than in modular form, as follows:

(a) An operating programme to allow the unit to perform its normal functions;

- (b) One or more diagnostic programmes to verify control or machine performance and to permit localisation of hardware malfunctions; *and*
- (c) A translator programme for programming the control-to-machine interface;
- (ii) Documentation for application programmes not containing the following:
 - (a) Listing of programme instructions, *except* that necessary for diagnostics for routine hardware maintenance;
 - (b) Description of programme organization or function beyond that required for programme use and for maintenance of exported hardware and "software";
 - (c) Flow charts, logic diagrams or algorithms employed, *except* those necessary for use of diagnostics for routine hardware maintenance;
 - (d) Any reference to specific memory storage locations, *except* those necessary for diagnostics for routine hardware maintenance; *and*
 - (e) Any other information which would assist in the analysis or modification of all or of part of the software;
- (b) Machine tools and dimensional inspection machines which, according to the manufacturer's technical specifications, can be equipped with numerical control units covered by paragraph (a) above, as follows:
 - (1) Boring mills, milling machines and machining centres having all of the following characteristics:
 - (i) No more than four axes capable of simultaneously coordinated contouring motion, of which no more than three axes shall be linear and no more than one axis shall be rotary;

N.B.:

A secondary contouring axis, parallel with a primary axis, e.g. W-axis on horizontal boring mills, is not counted in the total of four contouring axes. A secondary rotary table with the centreline parallel to the primary rotary table, is also not counted in the total of four contouring axes. Machines may have non-contouring parallel or non-contouring non-parallel rotary axes in addition to the four axes capable of simultaneously coordinated contouring motion.

- (ii) Maximum traverse (X-axis) travel equal to or less than 30,000 mm;
- (iii) Maximum vertical (Y-axis) travel equal to or less than 8,000 mm;
- (iv) Maximum horizontal (Z-axis) travel equal to or less than 5,000 mm;
- (v) Unlimited spindle drive motor power;
- (vi) No more than two simultaneously working spindles (the machine may have multiple tool heads or turrets; a spindle capable of driving a multiple drill head is considered as a single spindle);
- (vii) Axial and radial axis motions measured at the spindle axis in one revolution of the spindle equal to or greater than $D \times 2 \times 10^{-5}$ mm TIR (peak-to-peak) where D is the spindle diameter in mm;
- (viii) An incremental positioning accuracy equal to or greater (coarser) than ± 0.002 mm in any 200 mm of travel;
- (ix) An overall positioning accuracy in any axis equal to or greater (coarser) than:
 - (a) ± 0.003 mm for machines with a total length of axis travel equal to or less than 300 mm;
 - (b) $\pm (0.003 + (0.001/300) \times (L-300))$ mm for machines with a total length of axis travel, L, greater than 300 mm and equal to or less than 3,300 mm;

- (c) ± 0.013 mm for machines with a total length of axis travel greater than 3,300 mm;
- (2) Machine tools, other than boring mills, milling machines and machining centres described in sub-paragraph (b)(1) above, and dimensional inspection machines, having all the following characteristics:
 - (i) No more than four axes capable of simultaneously coordinated contouring motion, of which no more than three axes shall be linear and no more than one axis shall be rotary;

N.B.:

Up to four secondary contouring axes parallel with the primary axis but not simultaneously coordinated with the four primary axes may be permitted.

- (ii) No more than two simultaneously working spindles (the machine may have multiple tool heads or turrets);
- (iii) Radial axis motion measured at the spindle axis equal to or greater than 0.0008 mm TIR (peak-to-peak) in one revolution of the spindle (for lathes, turning machines, contour grinding machines, etc.);
- (iv) An incremental positioning accuracy equal to or greater (coarser) than ± 0.002 mm in any 200 mm of travel;
- (v) An overall positioning accuracy in any axis equal to or greater (coarser) than:
 - (a) ± 0.005 mm for machines with a total length of axis travel equal to or less than 300 mm;
 - (b) $\pm (0.005 + (0.002/300) \times (L-300))$ mm for machines with a total length of axis travel, L, greater than 300 mm and equal to or less than 3,300 mm;
 - (c) ± 0.025 mm for machines with a total length of axis travel greater than 3,300 mm.

NOTE:

It is understood that the following software is embargoed by Item 1091:

Control "programmes" used with CNC or DNC systems, which are stored in a memory of an electronic computer and implement numerical functions including, but not limited to, velocity and path generation, on-line adaptive control and special purpose data distribution, recall, and editing "programmes" for DNC applications. "Software" used in part programming, e.g., APT, EXAPT, IFAPT, postprocessing and similar "programmes" are not considered among the control "programmes" used for CNC and DNC systems.

Point-to-Point Computerised "Numerical Control" (CNC) systems are not covered by Item 1091.

1093**Components and specially designed parts for machine tools and dimensional inspection machines embargoed by Item 1091, as follows:**

- (a) Spindle assemblies, consisting of spindles and bearings as a minimal assembly, *except* those assemblies with axial and radial axis motion measured along the spindle axis in one revolution of the spindle equal to or greater (coarser) than the following:
 - (i) 0.0008 mm TIR (peak-to-peak) for lathes and turning machines; *or*
 - (ii) $D \times 2 \times 10^{-5}$ mm TIR (peak-to-peak) where D is the spindle diameter in millimetres for milling machines, boring mills, jig grinders, and machining centres;
- (b) Lead screws, including ball nut screws, *except* those having all of the following characteristics:
 - (i) Accuracy equal to or greater (coarser) than 0.004 mm/300 mm;
 - (ii) Overall accuracy equal to or greater (coarser) than $(0.0025 + 5 \times 10^{-6} \times L)$ mm, where L is the effective length in millimetres of the screw; *and*
 - (iii) Concentricity of the centre line of the journal bearing surface and the centre line of the major diameter of the screw equal to or greater (coarser) than 0.005 mm TIR (peak-to-peak) at a distance of 3 times the diameter of the screw or less from the journal bearing surface;

- (c) Linear and rotary position feedback units including inductive type devices, graduated scales and laser systems, *except*:
 - (i) Linear types having an accuracy equal to or greater (coarser) than $(0.0004 + 13 \times 10^{-6} \times L)$ mm, for L equal to or less than 100 mm and $(0.0015 + 2 \times 10^{-6} \times L)$ mm, for L greater than 100 mm, where L is the effective length in millimetres of the linear measurement; *and*
 - (ii) Rotary types having an accuracy equal to or greater (coarser) than 2 seconds of arc;
- (d) Linear induction motors used as drives for slides, having all of the following characteristics:
 - (1) Stroke greater than 200 mm;
 - (2) Nominal force rating greater than 45 N; *and*
 - (3) Minimum controlled incremental movement less than 0.001 mm.

Chemical and Petroleum Equipment

1110

Equipment for the production of liquid fluorine, and specially designed components therefor.

1131

Pumps designed to move molten metals by electromagnetic forces.

1145

Containers, jacketed only, specially designed for the storage or transportation of liquid fluorine.

Electrical and Power-Generating Equipment

NOTE:

For computer-related terms, see Item 1565 or 1566.

1205

Electro-chemical, semiconductor and radio-active devices for the direct conversion of chemical, solar or nuclear energy to electrical energy, as follows:

- (a) Electro-chemical devices, as follows, and specially designed components therefor:
 - (1) Fuel cells operating at temperatures of 523 K (250°C, 482°F) or less, including regenerative cells, i.e. cells for generating electric power, to which all the consumable components are supplied from outside the cell;

NOTE:

The temperature of 523 K or less is intended to refer to the fuel cell and not to the fuel conditioning equipment, which may be either an ancillary or an integral part of the fuel cell battery and which may operate at over 523 K.

- (2) Primary cells and batteries having any of the following characteristics:
 - (i) Reserve (water, electrolyte or thermally activated) batteries possessing a means of activation and having a rated unactivated storage life of three years or more at an ambient temperature of 297 K (24°C, 75°F);
 - (ii) Utilising lithium or calcium (including alloys in which lithium or calcium are constituents) as electrodes and having an energy density at a discharge current equal to C/24 hours (C being the nominal capacity at 297 K (24°C, 75°F) in ampere-hours) of more than 250 watt-hours per kg (114 watt-hours per lb) at 297 K (24°C, 75°F) and more than 80 watt-hours per kg (36 watt-hours per lb) at 244 K (-29°C, -20°F); *or*

NOTE:

Energy density is obtained by multiplying the average power in watts (average voltage in volts times the average current in amperes) by the duration of the discharge in hours to 80% of the open-circuit voltage and dividing by the total mass of the cell (or battery) in kg.

- (iii) Using an air electrode together with either lithium or aluminium counter-electrodes and having a power output of 5 kW or more or an energy output of 5 kW-hours or more;
- (3) Secondary (rechargeable) cells and batteries having any of the following characteristics after more than 20 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours):
 - (i) Utilising nickel and hydrogen as the active constituents and having an energy density of 55 watt-hours per kg (25 watt-hours per lb) or more at 297 K (24°C, 75°F); *or*
 - (ii) Utilising lithium or sodium as electrodes or reactants and having an energy density of 55 watt-hours per kg (25 watt-hours per lb) or more at the rated operating temperature;

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 and dividing by the total mass of the cell (or battery) in kg;

- (4) Molten salt electrolyte cells and batteries which normally operate at temperatures of 773 K (500°C, 932°F) or below;
- (b) Photo-voltaic cells as follows, and specially designed components therefor:
 - (1) With a power output of 14 mW or more per sq.cm. under 100 mW per sq.cm. tungsten at 2,800 K (2,527°C, 4,581°F) illumination; *or*
 - (2) All gallium arsenide photo-voltaic cells excluding those having a power output of less than 4 mW measured by the above technique; *or*
 - (3) With a power output of 450 mW or more per sq.cm. under 10 watts per sq.cm. silicon carbide at 1,750 K (1,477°C, 2,691°F) illumination;
 - (4) Electromagnetic (including laser) and ionised particle radiation resistant;
- (c) Power sources based on radio-active materials systems other than nuclear reactors, *except*:
 - (i) Those having an output power of less than 0.5 W and a total weight (force) of more than 890 N (90.7 kg, 200 lbs);
 - (ii) Those specially designed and developed for medical use within the human body.

NOTES:

1. See also Item 1570.
2. This Item does not embargo the following cells and power source devices, and specially designed components therefor (nothing in this Note shall be construed as permitting the export of technology for such cells, power source devices or specially designed components):
 - (a) Fuel cells embargoed by sub-item (a) (1), provided they are not "space qualified", with a maximum output power of more than 10 kW and which use gaseous pure hydrogen and oxygen/air reactants, alkaline electrolyte and a catalyst supported by carbon either pressed on a metal mesh electrode or attached to a conducting porous plastic;

- (b) Lithium primary cells or batteries embargoed by sub-item (a) (2)(ii) which:
- (1) Are specially designed for consumer applications and used in watches, pacemakers, calculators or hearing aids; *or*
 - (2) Are specially designed for consumer or civil industrial applications and have a nominal capacity less than or equal to 35 ampere-hours and a discharge current of less than C/10 hours (C as defined in (a)(2)(ii));
- (c) Lithium secondary (rechargeable) cells and batteries embargoed by sub-item (a) (3)(ii) which:
- (1) Are specially designed for consumer applications which will have been previously determined by the government of the exporting country; *or*
 - (2) Have a nominal capacity less than or equal to 0.5 ampere-hour and an energy density of less than 40 watt-hours per kg (18 watt-hours per lb) at 273 K (0°C, 32°F) and a discharge current of less than C/10 hours (C as defined in (a)(3));
- (d) Sodium secondary (rechargeable) cells and batteries embargoed by sub-item (a) (3)(ii) which are specially designed for consumer or civil industrial applications and which are not "space qualified";

N.B.:

The term "space qualified" used in this Item refers to products which are stated by the manufacturer as designed and tested to meet the special electrical, mechanical or environmental requirements for use in rockets, satellites or high-altitude flight systems operating at altitudes of 100 km or more.

General Industrial Equipment

NOTES:

1. For computer related terms, see Item 1565 or 1566.
2. For mechanical measuring instruments, see Item 1532.

1301

Equipment and technology for the production of "superalloys", as follows:

- (a) Equipment specially designed for the production of "superalloys";

NOTES:

1. This sub-item does not include the following equipment:
 - (a) Electric arc and induction furnaces, basic oxygen furnaces and remelting equipment using other techniques for the production of carbon steels, low alloy steels and stainless steels;
 - (b) Degassing equipment used for the production of carbon steels, low alloy steels and stainless steels;
 - (c) Hot and cold rolling mills, extrusion presses, and swaging and forging machines;
 - (d) Decarburizing and annealing and pickling equipment;
 - (e) Surface finishing equipment;
 - (f) Slitting and cutting equipment.
 2. Vacuum induction furnaces used in the production of superalloy powders, however, are embargoed by this sub-item.
- (b) Technology specific to the production of "superalloys", regardless of the type of equipment with which it may be intended to use such technology.

NOTES:

1. This sub-item does not include technology for the equipment excluded by Note 1 to sub-item (a) above.

2. Melting, remelting and degassing technology specific to the production of "superalloys", however, is embargoed by this sub-item.

Technical Note:

"Superalloys" are nickel-, cobalt-, or iron-base alloys having strengths superior to the AISI 300 series (as of May 1, 1982) at temperatures over 922 K (649°C) under severe environmental and operating conditions. Excluded are carbon steels, low-alloy steels and stainless steels having strengths inferior to the AISI 300 series (as of May 1, 1982).

1312

"Isostatic presses", as follows, and specially designed dies and moulds (*except* those used in "isostatic presses" operating at ambient temperatures), components, accessories and controls and "specially designed software" therefor:

- (a) Capable of achieving a maximum working pressure of 138 MPa (20,000 p.s.i.) or more and possessing a chamber cavity with an inside diameter in excess of 406 mm (16 inches); *or*
- (b) Having a controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 127 mm (5 inches) or more.

Technical Note:

"Isostatic presses" are equipment capable of pressurising a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal pressure in all directions within the cavity upon a workpiece or material.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of "isostatic presses" embargoed by sub-items (a) or (b) above, provided they have assured themselves that the equipment will be used for specific non-strategic applications and not for any nuclear or aerospace applications and provided:
 - (a) "Isostatic presses" having a controlled thermal environment within the closed cavity are limited as follows:
 - (1) Maximum working pressure not exceeding 207 MPa (30,000 p.s.i.);
 - (2) Chamber cavity with an inside diameter (i.e. the maximum inside diameter of the working chamber) not exceeding 406 mm (16 inches), when the controlled thermal environment which can be achieved and maintained does not exceed 1,500°C; *and*
 - (3) Having no facility for hydrocarbon impregnation and removal of resultant gaseous degradation products;
 - (b) "Isostatic presses" other than those dealt with under sub paragraph (a) above are limited as follows:
 - (1) Maximum working pressure not exceeding 414 MPa (60,000 p.s.i.); *and*
 - (2) Chamber cavity with an inside diameter (i.e. the maximum inside diameter of the working chamber) not exceeding 508 mm (20 inches);

N.B.:

The inside chamber dimension referenced in sub paragraphs (a)(2) and (b)(2) above is the chamber in which both the working temperature and the working pressure are achieved. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other. For "isostatic presses" having a controlled thermal environment, the insertion of fixturing leaves a diameter of less than 406 mm (16 inches) in the chamber for the piece to be pressed. For "isostatic presses" operating at ambient temperatures, the insertion of fixturing leaves a diameter of less than 508 mm (20 inches) in the chamber for the piece to be pressed.

2. Government may permit, as administrative exceptions, the shipment to the People's Republic of China of presses having no controlled thermal environment within the closed cavity and which are used for the manufacture of industrial refractory and ceramic products.

1353

Manufacturing and testing equipment for optical fibre, optical cable and other cables, as follows, and specially designed components and "specially designed software" therefor:

- (a) Equipment specially designed to manufacture cable embargoed by Item 1526(a) or (e);
- (b) Equipment specially designed to manufacture optical fibre or optical cable embargoed by Item 1526;
- (c) Equipment specially designed to manufacture optical preforms embargoed by Item 1767;
- (d) Optical fibre and preform characterisation equipment using semiconductor lasers for the testing of optical fibres or optical preforms at operating wavelengths exceeding 850 nm;

N.B.:

The status of optical fibre and optical preform characterisation equipment which contain lasers is defined in this Item.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of equipment specially designed for the insertion of optical fibres in an optical cable embargoed by Item 1526(b).
2. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following:
 - (a) Optical fibre or preform characterisation equipment using semiconductor lasers with a wavelength of 1,370 nm or less;
 - (b) Equipment specially designed for the manufacture of silica-based optical preforms, fibre or cable.

1354

Equipment designed for the manufacture or testing of printed circuit boards, as follows, and specially designed components and accessories, and "specially designed software" therefor:

- (a) Equipment specially designed for removal of resists or printed circuit board materials by dry (e.g. plasma) methods;
- (b) Computer aided design (CAD) equipment for printed circuit boards, having any of the following functions:
 - (1) Generation of artwork design with an interactive capability;
 - (2) Generation of test string lists for multilayer boards;
 - (3) Generation of data or "programmes" for "stored programme controlled" printed circuit board drilling equipment;
 - (4) Generation of data or "programmes" for "stored programme controlled" printed circuit board shaping and profiling equipment; *or*
 - (5) Generation of data for control of the sequencing of processes of the equipment for printed circuit board manufacture embargoed by (c) below;
- (c) High speed automated continuous panel processors for plating capable of delivering more than or equal to 860 A/m² (80 A/ft²) of plate current. (This does not include processors specially designed for, and restricted to, plating tab (edge) connectors.);
- (d) "Stored programme controlled" inspection equipment for the detection of defects in printed circuit boards using optical pattern comparison or other machine scanning techniques;
- (e) "Stored programme controlled" electrical test equipment for the identification of open and short circuits on bare printed circuit boards, capable of:
 - (1) Continuity testing (less than or equal to 4 ohm) at a rate of 2,500 or more measurements per second; *or*
 - (2) High voltage testing (greater than or equal to 50 volts) at a rate of 10,000 or more measurements per minute;
- (f) "Stored programme controlled" multi-spindle drills and routers which have any of the following characteristics:
 - (1) Absolute positioning accuracy of ± 10 micrometres (0.0004 inch) or better;
 - (2) Minimum time needed for drill bit changes less than or equal to 5 seconds; *or*
 - (3) X and Y positioning speeds higher than or equal to 0.125 m/sec (300 inch/min) for drilling or for routing;

- (g) "Stored programme controlled" cyclic voltametric stripping equipment specially designed for printed circuit board plating bath monitoring and analysis.

Technical Note:

"Stored programme controlled" is defined as a control using instructions stored in an electronic storage which a processor can execute in order to direct the performance of predetermined functions.

N.B.:

Equipment may be "stored programme controlled" whether the electronic storage is internal or external to the equipment.

NOTES:

1. See also Item 1522(b) for the embargo of printed circuit board manufacturing equipment incorporating a laser.
2. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of equipment for the manufacture of printed circuit boards, as follows:
 - (a) Equipment specially designed for the removal of resists or printed circuit board materials by dry (e.g. plasma) methods;
 - (b) "Stored programme controlled" multi-spindle drills with the following characteristics:
 - (1) Absolute positioning accuracy of ± 5 micrometres or worse; *and*
 - (2) X and Y positioning speeds of 0.210 m/sec or slower for drilling or for routing.
 - (c) "Stored programme controlled" routers which are not capable of three-dimensional contouring operations;
 - (d) Work-table positioning systems for digitising and editing drilling positions from printed circuit art work for the generation of data or "programmes" for "stored programme controlled" printed circuit board drilling equipment;
 - (e) "Stored programme controlled" electrical test equipment embargoed by sub-item (e), for the identification of open and short circuits on bare printed circuit boards.

1355

Equipment for the manufacture or testing of electronic components and materials, as follows, and specially designed components, accessories and "specially designed software" therefor:

- (a) Equipment specially designed for the manufacture or testing of electron tubes, optical elements and specially designed components therefor embargoed by Items 1555, 1556 or 1558;
- (b) Equipment specially designed for the manufacture or testing of semiconductor devices, integrated circuits and "assemblies", as follows, and systems incorporating or having the characteristics of such equipment:

NOTE:

This sub-item also embargoes such equipment used or modified for use in the manufacture or testing of other devices, such as: imaging devices, electro-optical devices, acoustic-wave devices, film-memory devices.

- (1) Equipment for the processing of materials for the manufacture of devices and components as specified in the heading of this sub-item;

NOTE:

This Item does not embargo quartz crucibles specially designed for equipment embargoed by sub-item (b)(1).

- (2) Masks, mask substrates, mask-making equipment and image-transfer equipment for the manufacture of devices and components as specified in the heading of this sub-item;

NOTE:

The term "masks" refers to those used in electron beam lithography, X-ray lithography, and ultraviolet lithography, as well as the usual ultraviolet and visible photo-lithography.

- (3) "Stored programme controlled" inspection equipment for the detection of defects in processed wafers, substrates or chips using optical pattern comparison or other machine scanning techniques;

NOTE:

Conventional scanning electron microscopes, except when specially designed and instrumented for automatic pattern inspection, are not embargoed by this sub-item.

- (4) Specially designed "stored programme controlled" measuring and analysis equipment;
- (5) Equipment for the assembly of integrated circuits;
- (6) "Stored programme controlled" wafer probing equipment;
- (7) Test equipment as follows (for standard test instruments, see Item 1529):
 - (i) "Stored programme controlled" equipment specially designed for testing discrete semiconductor devices and unencapsulated dice, capable of performing any of the following functions:
 - (a) Measurement of time intervals of less than 10 ns;
 - (b) Measurement of parameters (e.g. fr, S-parameters, noise figure) at frequencies greater than 250 MHz;
 - (c) Resolution of currents of less than 100 pico-amperes; *or*
 - (d) Measurement of spectral response at wavelengths outside the range from 450 to 950 nm;

Technical Note:

Discrete semiconductor devices include, for example, diodes, transistors, thyristors, photocells and solar cells.

- (ii) "Stored programme controlled" equipment specially designed for testing integrated circuits, and "assemblies" thereof, capable of performing any of the following functions:
 - (a) Functional (truth table) testing at a pattern rate greater than 2 MHz;
 - (b) Resolution of currents of less than 1 nano-ampere;
 - (c) Testing of integrated circuits (not mounted on circuit boards) in packages having more than a total of 24 terminals; *or*

NOTE:

(b)(7)(ii)(c) does not embargo equipment specially designed for and dedicated to the testing of integrated circuits not embargoed by Item 1564.

- (d) Measurement of rise times, fall times and edge placement times with a resolution of less than 20 ns;

Technical Note:

The terms "integrated circuit" and "assembly" are defined in Item 1564.

NOTES:

1. Test equipment which is not of a general purpose nature and which is specially designed for, and dedicated to, testing "assemblies" or a class of "assemblies" for home and entertainment applications is not embargoed by (b)(7)(ii).
2. Test equipment which is not of a general purpose nature and which is specially designed for, and dedicated to, testing electronic components, "assemblies" and integrated circuits specifically excluded by Item 1564 is not embargoed by (b)(7)(ii), provided such test equipment does not incorporate computing facilities with user-accessible programming capabilities;
- (iii) Equipment specially designed for determining the performance of focal-plane arrays at wavelengths of more than 1,200 nm, using "stored programme controlled" measurements or computer aided evaluation and having any of the following characteristics:
 - (a) Using scanning light spot diameters of less than 0.12 mm (0.005 inch);
 - (b) Designed for measuring photosensitive performance parameters and for evaluating frequency response, modulation transfer function, uniformity of responsivity or noise; *or*
 - (c) Designed for evaluating arrays capable of creating images of greater than 32 × 32 line elements;
 - (iv) Specially designed for bubble memories;

- (8) Class 10 filters capable of providing an environment of 10 or less particles of 0.3 micrometre or more per 0.02832 m³ (one cubic foot) and filter materials therefor;
- (9) Electron beam test systems (capable of operating at or below 3,000 eV), for non-contactive probing of powered-up semiconductor devices having any of the following:
 - (a) Stroboscopic capability with either beam blanking or detector strobing;
 - (b) An electron spectrometer for voltage measurements with a resolution of less than 0.5 volt; *or*
 - (c) Electrical tests fixtures for performance analysis of integrated circuits.

NOTE:

This sub-item does not embargo scanning electron microscopes, except when specially designed and instrumented for non-contactive probing of a powered-up semiconductor device.

NOTES:

1. For equipment which is used in the manufacture and processing of semiconductors and semiconductor materials and which is specially designed to employ lasers or laser technology, see Item 1522.
2. For the purposes of this Item, "stored programme control" is defined as a control using instructions stored in an electronic storage which a processor can execute in order to direct the performance of predetermined functions.

N.B.:

Equipment may be "stored programme controlled" whether the electronic storage is internal or external to the equipment.

3. Equipment embargoed by sub-item (b)(1) above is defined as follows:
 - (a) Equipment for producing polycrystalline silicon embargoed by Item 1757(f) having a purity of 99.99% or more in the form of rods (ingots, boules), pellets, sheets, tubes or small particles;
 - (b) Equipment specially designed for purifying or processing III-V and II-VI semiconductor materials covered by Item 1757, except crystal pullers, for which see (c) below;
 - (c) Crystal pullers, furnaces and gas systems, as follows:
 - (1) Types with specially designed "stored programme controlled" temperature, power input or gas, liquid or vapour flow;
 - (2) Diffusion, oxidation and annealing furnaces for operation at pressures above 1 atmosphere (nominal);
 - (3) Annealing or recrystallising equipment other than constant temperature furnaces employing high rates of energy transfer capable of processing wafers at a rate greater than 50 cm² per minute;
 - (4) Plasma-enhanced or photo-enhanced chemical reactor equipment;
 - (5) Equipment for automatic control of crystal taper and diameter *except* taper and diameter control mechanisms using any of the following equipment techniques:
 - (i) Radiation pyrometers;
 - (ii) Thermocouples;
 - (iii) RF power sensors; *or*
 - (iv) Mass weighing (without digital or anomaly control permitting the growth of semiconductors);
 - (6) Crystal pullers having any of the following characteristics:
 - (i) Rechargeable without replacing the crucible container;
 - (ii) Capable of operation at pressures above 2.5 × 10⁵ pascal (2.5 atmospheres absolute) or below 1 × 10⁵ pascal (1 atmosphere absolute);
 - (iii) Capable of pulling crystals of a diameter greater than 76.2 mm (3 inches);
 - (iv) Specially designed to minimise convection currents in the melt by the use of magnetic fields or multiple crucibles; *or*
 - (v) Capable of pulling sheet or ribbon crystals;
 - (7) Vacuum induction heated zone refining equipment for operation at a pressure of 0.01 pascal or less;
 - (d) Equipment for epitaxial growth having any of the following characteristics:
 - (1) Operation at pressures below 10⁵ pascals (1 atmosphere absolute);
 - (2) "Stored programme controlled";

- (3) Rotating vertical-support, radiant-heated reactors;
- (4) Specially designed for processing bubble memories;
- (5) Metal-organic chemical vapour deposition reactors; *or*
- (6) For liquid phase epitaxy;
- (e) Molecular beam epitaxial growth equipment;
- (f) "Magnetically-enhanced" sputtering equipment;

Technical Note:

"Magnetically-enhanced" refers to equipment incorporating a cathode assembly having an integral magnetic structure for enhancing the plasma intensity.

- (g) Equipment designed for ion implantation, or for ion-enhanced or photo-enhanced diffusion;
- (h) Equipment for selective or non-selective removal by dry methods of passivation layers, dielectrics, semiconductor materials, resists or metals, *except* horizontal, cylindrical plasma etchers without "stored programme control", endpoint detection, automatic loading or rotating mechanisms and not having the capability for parallel plate etching as used in semiconductor device manufacture;

N.B.:

This sub-paragraph does not include vacuum sputtering equipment designed to operate in the sputter-etch mode.

- (i) Equipment for semiconductor device fabrication operating below 10^5 pascals (1 atmosphere absolute) for the chemical vapour deposition of oxides, nitrides, metals and polysilicon;

N.B.:

This sub-paragraph does not cover reactive sputtering equipment.

- (j) Electron beam systems (including scanning electron microscopes), capable of mask making or semiconductor device processing and having any of the following characteristics:
 - (1) Electrostatic beam deflection;
 - (2) Shaped, non-Gaussian beam profile;
 - (3) Beam blanking capability;
 - (4) Digital-to-analogue conversion rate greater than 3 MHz;
 - (5) Digital-to-analogue conversion accuracy greater than 12 bits; *or*
 - (6) Target-to-beam position feedback control precision of 1 micrometre or finer.

N.B.:

This sub-paragraph does not cover electron beam deposition systems, and (3) above does not cover scanning electron microscopes equipped for Auger analysis.

- (k) Surface finishing equipment, specially designed for the processing of semiconductor wafers and having any of the following characteristics:
 - (1) Waxless or non-adhesive mounting;
 - (2) Double-sided simultaneous polishing or lapping;
 - (3) Capable of polishing and lapping wafers exceeding 76.2 mm (3 inches) in diameter; *or*
 - (4) Lapping or polishing in two stages on the same machine;
 - (l) Interconnection equipment which may include common single or multiple vacuum chambers specially designed to permit the integration of equipment embargoed by this Item into a complete system.
4. Equipment embargoed by sub-item (b)(2) above is defined as follows:
- (a) Finished masks, reticles and designs therefor;
 - (b) Hard surface (e.g. chromium, silicon, iron oxide) coated "substrates" (e.g. glass, quartz, sapphire) of masks having dimensions exceeding 76.2 × 76.2 mm (3 × 3 inches);
 - (c) Computer-aided design (CAD) equipment for transforming schematic or logic diagrams into designs for producing semiconductor devices or integrated circuits, having any of the following functions:
 - (1) Storage of pattern cells for subdivision of integrated circuits;
 - (2) Scaling, positioning or rotation of pattern cells;
 - (3) Interactive graphic capabilities;
 - (4) Design rule and circuit checking; *or*
 - (5) Circuit layout modification of the arrangement of the elements;

N.B.:

"Software" which performs any of the functions in this sub-paragraph, or which can be used for transient analysis, for logic analysis or logic checking, for automatic routing or cell placement, for the generation of test vectors or for process simulation is "specially designed software" embargoed by the heading of this Item.

- (d) Mask fabrication machines using photo-optical methods as follows:
 - (1) Step and repeat cameras capable of producing arrays larger than 63.5 × 63.5 mm (2.5 × 2.5 inches), or capable of producing a single exposure larger than 3.75 × 3.75 mm (0.15 × 0.15 inch) in the focal plane, or capable of producing useful line widths of 3.5 micrometres or less;
 - (2) Pattern generators specially designed for the generation or manufacture of masks or the creation of patterns in photosensitive layers and with placement precision finer than 10 micrometres;
 - (3) Mask fabrication equipment containing automatic adjustment of focus or adjustment of the mask material into the focal plane;
 - (4) Equipment and holders for altering masks or reticles or adding pellicles to remove defects;
 (For electron-beam systems, see Note 3(j) above.)
- (e) Mask, reticle or pellicle inspection equipment, as follows:
 - (1) For comparison with a precision of 0.75 micrometre or finer over an area of 63.5 × 63.5 mm (2.5 × 2.5 inches) or more;
 - (2) "Stored programme controlled" equipment with a resolution of 0.25 micrometre or finer and with a precision of 0.75 micrometre or finer over a distance in one or two coordinates of 63.5 mm (2.5 inches) or more;
 - (3) "Stored programme controlled" defect inspection equipment;

N.B.:

Conventional scanning electron microscopes except when specially designed and instrumented for automatic pattern inspection are not embargoed by this sub-paragraph.

- (f) Align and expose equipment using photo-optical methods, including projection image transfer equipment, capable of performing any of the following functions:
 - (1) Production of a useful pattern size of less than 5 micrometres;
 - (2) Alignment with a precision finer than 1 micrometre;
 - (3) Field coverage exceeding 76.2 × 76.2 mm (3 × 3 inches);
 - (4) Wafer backside alignment;
 - (5) Automatic alignment by the sensing of patterns or index marks on the substrate;
 - (6) Projection image transfer for processing slices (wafers) of 50.8 mm (2 inches) or larger in diameter;

N.B.:

Non-contacting (proximity) image transfer equipment is embargoed only by (1) to (5) above.

- (g) Electron beam, ion beam, or X-ray equipment for projection image transfer;
 - (For laser equipment, see Note 1 above.)
 - (h) Photo-optical or non photo-optical step and repeat or partial field equipment for the transfer of the image onto the wafer;
 - (i) Mask contact image transfer equipment for imaging a field larger than 76.2 × 76.2 mm (3 × 3 inches).
5. Equipment embargoed by sub-item (b)(4) above is defined as follows:
- (a) Specially designed for the measurement of oxygen or carbon content in semiconductor materials;
 - (b) Equipment for concurrent etching and doping profile analysis (employing capacitance-voltage or current-voltage analysis techniques);
 - (c) Equipment for line width measurement with a resolution of 1 micrometre or finer;
 - (d) Specially designed flatness measurement instruments capable of measuring deviations from flatness of 10 micrometres or less with a resolution of 1 micrometre or finer.

6. Equipment embargoed by sub-item (b)(5) above is defined as follows:

- (a) "Stored programme controlled" die (chip) mounters and bonders with a positioning accuracy finer than 50 micrometres or incremental steps finer than 6.4 micrometres;
- (b) "Stored programme controlled" wire bonders and welders for performing consecutive bonding operations;
- (c) Equipment for producing multiple bonds in a single operation (e.g. beam lead bonders, chip carrier bonders, tape bonders).
- (d) Semi automatic or automatic hot cap sealers, in which the cap is heated locally to a higher temperature than the body of the package, specially designed for ceramic microcircuit packages embargoed by Item 1564(b) and which have a throughput equal to or greater than one package per minute.

N.B.:

1. General purpose resistance type spot welders are not covered by Item 1355(b)(5).
 2. Thermal compression bonders, also known as nailhead bonders, are embargoed under the terms of this Item.
7. Equipment embargoed by sub-item (b)(6) above is defined as that which has any of the following:
- (a) Positioning accuracy finer than 50 micrometres, or incremental steps finer than 6.4 micrometres;
 - (b) Individual die location read-out (X-Y position information) during testing;
 - (c) Capable of testing devices having more than a total of 24 terminals; *or*
 - (d) Automatic slice (wafer) alignment.
8. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of equipment, as follows, for use in silicon semiconductor manufacturing:
- (a) Equipment for the production of polycrystalline silicon;
 - (b) Crystal pullers, *except* those which:
 - (1) Are rechargeable without replacing the crucible; *or*
 - (2) Operate at pressures above 2.5×10^7 pascals (2.5 atmosphere absolute) and have any of the following features:

N.B.:

No process technology to be supplied.

- (i) Two or more temperature zones;
 - (ii) "Stored programme controlled";
 - (iii) Anomaly shape control;
 - (iv) Produce ingots of more than 50.8 mm (2 inches) in diameter; *or*
 - (v) Produce ingots of more than 1 kg in mass;
- (c) Diffusion furnaces, *except* those which use computer feedback control operated from an "associated" computer;

N.B.:

"Associated" with equipment or systems means:

- (a) Can feasibly be either:
 - (i) Removed from the equipment or systems; *or*
 - (ii) Used for other purposes; *and*
- (b) Is not essential to the operation of such equipment or systems.
- (d) Vacuum induction-heated zone refining equipment;
- (e) Epitaxial reactors, *except* those which are:
 - (1) For molecular beam epitaxy; *or*
 - (2) Specially designed for organo-metallic deposition or liquid-phase epitaxy;
- (f) Magnetically enhanced multiple wafer sputtering equipment;
- (g) Ion implantation, ion-enhanced or photo-enhanced diffusion equipment, *except* those having any of the following characteristics:
 - (1) Patterning capability;
 - (2) Accelerating voltage for more than 200 keV; *or*
 - (3) Capable of high energy oxygen implant into a heated substrate;
- (h) Dry etching equipment embargoed by sub-item (b)(1), as follows:
 - (1) Batch types not having:
 - (i) End point detection other than optical emission spectroscopy types; *or*
 - (ii) Cryogenic or turbomolecular pumps;
 - (2) Single wafer types not having:

- (i) End point detection other than optical emission spectroscopy types;
- (ii) Cryogenic or turbomolecular pumps; *or*
- (iii) load locks;

N.B.:

1. "Batch types" refers to dry etching machines which are not specially designed for production processing of single wafers. Such machines can process two or more wafers simultaneously with common process parameters, e.g., RF power, temperature, etch gas species, flow rates.
 2. "Single wafer types" refers to dry etching machines which are specially designed for production processing of single wafers. These machines may use automatic wafer handling techniques to load a single wafer into the equipment for processing. The definition includes equipment that can load and process several wafers but where the etching parameters, e.g., RF power or end point, can be independently determined for each individual wafer.
- (i) Low-pressure chemical vapour deposition equipment, *except* equipment capable of metal deposition;
 - (j) (Not used);
 - (k) Single-side lapping and polishing equipment for wafer surface finishing;
 - (l) Hard surface (e.g. chromium, silicon, iron oxide) coated substrates (e.g. glass, quartz, sapphire) for the preparation of masks having dimensions greater than 12.5 cm x 12.5 cm;
 - (m) Mask fabrication equipment using photo-optical methods which was either commercially available before the January 1, 1980, or has a performance no better than such equipment;
 - (n) Manually operated mask inspection equipment;
 - (o) (1) Photo-optical contact and proximity mask align and expose equipment defined in Note 4(f);
 - (2) Projection aligners, defined in Note 4(f), provided such equipment cannot produce pattern sizes finer than 3 micrometres;
 - (3) Wafer steppers, defined in Note 4(h), provided they have all of the following characteristics:
 - (i) Cannot produce pattern sizes finer than 3 micrometres;
 - (ii) An alignment accuracy no better than ± 0.25 micrometres (3 sigma); *and*
 - (iii) Machine-to-machine overlay no better than ± 0.3 micrometres;
 - (p) Contact image transfer equipment;
 - (q) Wafer and chip inspection equipment which was either commercially available before January 1, 1981, or has a performance no better than such equipment;
 - (r) Equipment for concurrent etching and doping profile analysis employing capacitance-voltage or current-voltage analysis techniques;
 - (s) "Stored programme controlled" wire or die bonders;
 - (t) "Stored programmed controlled" wafer probing equipment which does not include associated test equipment or drive circuitry other than those identified in (u) or (v) below;
 - (u) Test equipment for:
 - (1) Television circuit testing;
 - (2) Operational amplifier testing;
 - (3) Voltage regulator testing;
 - (4) Analogue-to-digital and digital-to-analogue converter testing; *or*
 - (5) Discrete semiconductor testing at frequencies of 18 GHz or less;
 - (v) "Stored programme controlled" equipment for the functional testing (truth table) of integrated circuits or integrated circuit assemblies capable of either:
 - (1) Generating a basic pattern rate of 10 MHz or less; *or*
 - (2) Generating a basic pattern rate of more than 10 MHz but no more than 20 MHz and limited to testing integrated circuits with 64 or fewer pins.
9. Favourable consideration will be given to the shipment to the People's Republic of China of the following equipment:

Equipment embargoed by sub-items (b)(1) or (b)(2) which can produce patterns finer than 3 micrometres but not finer than 2 micrometres.

1357

Equipment for the production of fibres embargoed by Item 1763 or their composites as follows, and specially designed components and accessories and "specially designed software" therefor:

- (a) Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, specially designed to fabricate composite structures or laminates from fibrous and filamentary materials; coordinating and programming controls therefor;
- (b) Tape-laying machines of which the motions for positioning and laying tape and sheets are coordinated and programmed in two or more axes, specially designed for the manufacture of composite airframes and missile structures;
- (c) Multidirectional, multidimensional weaving machines and interlacing machines, including adapters and modification kits, for weaving, interlacing or braiding fibres to manufacture composite structures, *except* textile machinery which has not been modified for the above end-uses;
- (d) Specially designed or adapted equipment for the production of fibrous and filamentary materials embargoed by Item 1763(a) or (b), as follows:
 - (1) Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon, or polycarbosilane) including special provisions to strain the fibre during heating;
 - (2) Equipment for the vapour deposition of elements or compounds on heated filamentary substrates; and
 - (3) Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);
- (e) Specially designed or adapted equipment for special fibre surface treatment or for producing prepregs and preforms embargoed by Item 1763(c);

NOTE:

Equipment embargoed by this sub-item includes but is not limited to rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

NOTES:

1. Specially designed or adapted components and accessories for the machines embargoed by this Item include, but are not limited to, moulds, mandrels, dies, fixtures and tooling for pressing, curing, carbonising, graphitising, casting, sintering or bonding of preforms, composite structures, laminates and manufactures thereof embargoed by Item 1763(d).
2. Not used.

1358

Equipment specially designed for the manufacture or testing of magnetic recording media described in Item 1572, as follows, and specially designed components and "specially designed software" therefor:

- (a) Equipment which incorporates specially designed modifications for the application of magnetic coating to flexible disk recording media with a "packing density" exceeding 2,460 bits per cm (6,250 bits per inch);

NOTE:

This sub-item does not embargo general purpose coating equipment.

- (b) Equipment specially designed for the application of magnetic coating to non-flexible (rigid) disk type recording media as described in Item 1572(d);
- (c) "Stored programme controlled" equipment for monitoring, grading, exercising or testing recording media, other than tape, embargoed by Item 1572(d).

NOTE:

Governments may permit, as administrative exceptions, the shipment of equipment embargoed by sub-item (a) above, provided:

- (a) The equipment is used for a legitimate civil end-use and is reasonable for that use;
- (b) Not used; *and*

- (c) The equipment cannot produce recording media for computer flexible disk cartridges exceeding a "gross capacity" of 17 million bits.

(For the definition of "stored programmed controlled", see Item 1355.)

1361

Test facilities and equipment for the design or development of aircraft or gas turbine aero-engines, as follows, and specially designed components, accessories and "specially designed software" therefor:

- (a) Supersonic (Mach 1.4 to Mach 5), hypersonic (Mach 5 to Mach 15) and hypervelocity (above Mach 15) wind tunnels, *except*:
 - (i) Supersonic (Mach 1.4 to Mach 5) wind tunnels not specially designed for, or fitted with means of, preheating the air; *or*
 - (ii) Wind tunnels specially designed for educational purposes and having a "test section size" (measured internally) of less than 25 cm (10 inches);

Technical Note:

By "test section size" is understood the diameter of the circle, or the side of the square, or the longest side of the rectangle constituting possible shapes of the test section.

- (b) Devices for simulating flow-environments of Mach 5 and above regardless of the actual Mach number at which the devices operate, including hot shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns;
- (c) Wind tunnels and devices, other than two dimensional (2-D) sections, that have unique capabilities for simulating Reynolds number flow in excess of 25×10^6 , at transonic velocities;
- (d) Automated control systems, instrumentation (including sensors) and automated data acquisition equipment, specially designed for use with wind tunnels and devices embargoed by (a), (b) or (c) above;
- (e) Models, specially designed for use with wind tunnels or with the devices embargoed by (b) or (c) above, of embargoed aircraft, helicopters, airfoils, spacecraft, spacelaunch vehicles, rockets or surface-effect vehicles;

Technical Note:

Specially designed models are those equipped with sensors and a means of transmitting data from the sensors to the data acquisition system, or equipped with features for using non-intrusive sensors (i.e. not directly connected to the model or not located in the flow adjacent to the model).

- (f) Specially designed electromagnetic interference and electromagnetic pulse (EMI/EMP) simulators;
- (g) Specially designed test facilities and equipment for the development of gas turbine aero-engines and components, as follows:
 - (1) Special test facilities capable of applying dynamic flight loads, measuring performance or simulating the design operating environments for rotating assemblies or aero-engines;
 - (2) Test facilities, test rigs and simulators for measuring combustion system and hot gas flow path performance, heat transfer and durability for static assemblies and aero-engine components;
 - (3) Specially designed test rigs, equipment or modified gas turbine engines which are utilised for the development of gas turbine aero-engine internal flow systems (gas path seals, air-oil seals and disc cavity flow fields).

1362

Vibration test equipment as follows:

- (a) Vibration test equipment using digital control techniques and specially designed ancillary equipment and "specially designed software" therefor, *except*:
 - (i) Individual exciters (thrusters) with a maximum thrust of less than 100 kN (22,500 lbs);
 - (ii) Analogue equipment;
 - (iii) Mechanical and pneumatic exciters (thrusters);
 - (iv) Vibrometers;

1362 *continued*

- (v) Ancillary equipment not embargoed by Items 1529, 1531, 1565 or 1568;
- (b) High intensity acoustic test equipment capable of producing an overall sound pressure level of 140 dB or greater (referenced to 2×10^{-5} N/m²) or with a rated output of 4 kW or greater and specially designed ancillary equipment and "specially designed software" therefor, *except*:
 - (i) Analogue equipment;
 - (ii) Ancillary equipment not embargoed by Items 1529, 1531, 1565 or 1568;
- (c) Ground vibration (including modal survey) test equipment that uses digital control techniques and specially designed ancillary equipment and "specially designed software" therefor, *except*:
 - (i) Analogue equipment;
 - (ii) Ancillary equipment not embargoed by Items 1529, 1531, 1565 or 1568.

NOTES:

1. Vibration and acoustic test systems typically consist of one or more exciters (thrusters), or acoustic noise generators, together with ancillary equipment for instrumentation, control, data acquisition and analysis. This Item covers only the vibration and acoustic test equipment itself. The ancillary equipment, e.g., digital and logic instrumentation, computers, FFTs, etc., are to be judged in their own right against the relevant Items of this List.
2. Not used.

1363

Specially designed water tunnel equipment, components, accessories and "databases" for the design and development of vessels, as follows, and "specially designed software" therefor:

- (a) Automated control systems, instrumentation (including sensors) and data acquisition equipment specially designed for water tunnels;
- (b) Automated equipment to control air pressure acting on the surface of the water in the test section during the operation of the water tunnel;
- (c) Components and accessories for water tunnels, as follows:
 - (1) Balance and support systems;
 - (2) Automated flow or noise measuring devices; *and*
 - (3) Models of hydrofoil vessels, surface-effect vehicles, SWATH vessels and specially designed equipment and components embargoed by Item 1416(a), (b), (c), (e), (f), (g) and (h) for use in water tunnels;
- (d) "Databases" generated by use of equipment embargoed by this Item.

NOTE:

The water tunnels referred to in this Item are used for the hydrodynamic testing of a fixed model, using a moving fluid.

1364

Machinery and equipment for the manufacture of hydrofoil vessel, surface-effect vehicle and SWATH vessel structures and components, as follows, and specially designed components and accessories therefor:

- (a) Specially designed equipment for manufacturing anisotropic, orthotropic or sandwich structures embargoed by Item 1416(h)(3);

Technical Notes:

1. Anisotropic construction is the use of fibre reinforcing members aligned so that the load-carrying ability of the structure can be primarily orientated in the direction of expected stress.
2. Orthotropic construction is a means of stiffening plates in which the structural members are at right angles to each other.

3. Sandwich construction is the use of structural members or plates which are fabricated and permanently affixed in layers to enhance their strength and reduce their weight.
- (b) Specially designed equipment for the production and testing of flexible materials for skirts, seals, air curtains, bags and fingers for surface-effect vehicles;
- (c) Specially designed equipment for the production of waterscrew propellers and hub assemblies and water-screw propeller systems embargoed by Item 1416(e) and (f);
- (d) Specially designed equipment for the production, dynamic balancing and automated testing and inspection of lift fans for surface-effect vehicles;
- (e) Specially designed equipment for the production of water-jet propulsion pumps rated at 3,000 hp or greater, or multiple-pump system equivalents thereof;
- (f) Specially designed equipment for the production, dynamic balancing and automatic testing of AC-AC synchronous and AC-DC systems, sector disc and concentric-drum rotors for DC homopolar machines.
(See also Item 1416.)

1370

Machine tools for generating optical quality surfaces, specially designed components and accessories therefor, as follows, and "specially designed software" therefor:

- (a) Turning machines using a single point cutting tool and having all of the following characteristics:
 - (1) Slide positioning accuracy less (finer) than 0.0005 mm per 300 mm of travel, TIR (peak-to-peak);
 - (2) Slide positioning repeatability less (finer) than 0.00025 mm per 300 mm of travel, TIR (peak-to-peak);
 - (3) Spindle runout (radial and axial) less than 0.0004 mm TIR (peak-to-peak);
 - (4) Angular deviation of the slide movement (yaw, pitch and roll) less (finer) than 2 seconds of arc (peak-to-peak) over full travel; *and*
 - (5) Slide perpendicularity less than 0.001 mm per 300 mm of travel, TIR (peak-to-peak);
- (b) Fly cutting machines having both of the following characteristics:
 - (1) Spindle run-out (radial and axial) less than 0.0004 mm TIR (peak-to-peak); *and*
 - (2) Angular deviation of slide movement (yaw, pitch and roll) less (finer) than 2 seconds of arc (peak-to-peak) over full travel;
- (c) Specially designed components, as follows:
 - (1) Spindle assemblies, consisting of spindles and bearings as a minimal assembly, *except* those assemblies with axial and radial axis motion measured along the spindle axis in one revolution of the spindle equal to or greater (coarser) than 0.0008 mm TIR (peak-to-peak);
 - (2) Linear induction motors used as drives for slides, having all of the following characteristics:
 - (i) Stroke greater than 200 mm;
 - (ii) Nominal force rating greater than 45 N; *and*
 - (iii) Minimum controlled incremental movement less than 0.001 mm;
- (d) Specially designed accessories, i.e. single point diamond cutting tool inserts having all of the following characteristics:
 - (1) Flawless and chip-free cutting edge when magnified 400 times in any direction;
 - (2) Cutting radius between 0.1 and 5 mm; *and*
 - (3) Cutting radius out-of-roundness less than 0.002 mm TIR (peak-to-peak).

Technical Note:

Machines will be evaluated under the conditions yielding the most accurate values, including but not limited to the incorporation of control systems which permit mechanical, electronic and "software" compensation.

1371

Anti-friction bearings as follows:

- (a) Ball and roller bearings having an inner bore diameter of 10 mm or less and tolerances of ABEC 5, RBEC 5 (or national equivalents) or better and either of the following characteristics:
- (1) Made of special materials, i.e. with rings, balls or rollers made from any steel alloy or other material (including but not limited to high-speed tool steels, Monel metal, beryllium, metalloids, ceramics and sintered metal composites), *except* the following: low-carbon steel, SAE-52100 high carbon chromium steel, SAE-4615 nickel molybdenum steel, AISI-440C (SAE51440C) stainless steel (or national equivalents); *or*
 - (2) Manufactured for use at normal operating temperatures over 423 K (150°C, 302°F) either by use of special materials or by special heat treatment;
- (b) Ball and roller bearings (exclusive of separable ball bearings and thrust ball bearings) having an inner bore diameter exceeding 10 mm and having tolerances of ABEC 7, RBEC 7 (or national equivalents) or better and either of the following characteristics:
- (1) Made of special materials, i.e. with rings, balls or rollers made from any steel alloy or other material (including but not limited to high-speed tool steels, Monel metal, beryllium, metalloids, ceramics and sintered metal composites), *except* the following: low-carbon steel, SAE-52100 high carbon chromium steel, SAE-4615 nickel molybdenum steel, AISI-440C (SAE51440C) stainless steel (or national equivalents); *or*
 - (2) Manufactured for use at normal operating temperatures over 423 K (150°C, 302°F) either by use of special materials or by special heat treatment;
- (c) Ball and roller bearings having tolerances better than ABEC 7 (or national equivalents);
- (d) Gas-lubricated foil bearings;
- (e) Bearing parts usable only for bearings embargoed by this Item, as follows: outer rings, inner rings, retainers, balls, rollers and sub-assemblies.

NOTE:

This Item is not intended to cover hollow bearings.

EXPLANATORY NOTE:

- A. Balls as embargoed by Item 1371(e) may be identified among balls manufactured to the tolerances in table 1 or closer.
- B. Rollers embargoed by Item 1371(e) may be identified among non-standard rollers, that is, rollers falling outside of the tolerances for graded rollers for standard bearings which shown in table 2. This above explanatory note applies to the rollers for bearings embargoed by sub-items (a)(2) and (b)(2). It does not apply to rollers for bearings embargoed by sub-items (a)(1) and (b)(1) because these are indicated by virtue of materials used. Illustrative examples of tolerances for graded rollers for non-standard bearings are shown in table 3.
- C. Separable ball bearings are not viewed as including those bearings, one part of which serves as an integral part of the equipment incorporating the bearing.
- D. Ceramic bearings embargoed by Item 1371 consist of bearing elements (e.g. balls, rollers or races) made from ceramic or hybrid (ceramic plus metal) materials and designed to operate at temperatures over 150°C and at DN values equal to or greater than 1.5×10^6 .

N.B.:

DN is defined as the product of the bearing bore diameter in millimetres and the bearing rotational velocity in revolutions per minute.

TABLE 1 (see Item 1371, Explanatory Note A)

Ball material	Sphericity or diameter variation	Diameter tolerance per unit container	Diameter tolerance per shipment
	per ball (±)	(±)	(±)
Chrome steel such as S2100, 51100 and 50100	0.00025*	0.00025*	0.0001*
Carbon steel	0.0001*	0.0001*	0.0004*
Monel metal	0.0002*	0.001*	0.005*
Stainless steel	0.00005*	0.00005*	0.0002*
Brass		0.0002*	0.001*
Bronze		0.0002*	0.001*

Sphericity or diameter variation per ball is the geometric quality which indicates the maximum permissible variation from absolute roundness in all planes through the centre of the ball.

Diameter tolerance per unit container is the maximum degree to which the average diameter of the largest ball and the average diameter of the smallest ball, within the unit container, may vary from the specific size for indicated grade.

Diameter tolerance per shipment is the maximum permissible deviation from the specific size within the shipment, for the grade indicated.

TABLE 2 (see Item 1371, Explanatory Note B)

Roller diameter		Outside diameter tolerance variation per shipment	Maximum out of round tolerance	Maximum out of round tolerance including taper of cylindrical roller (±)
Over	Including	(±)	(±)	(±)
0 mm	26 mm	0.00004*	0.00004*	0.00008*
26 mm	42 mm	0.00006*	0.00006*	0.00012*
42 mm	64 mm	0.00008*	0.00008*	0.00016*
64 mm	100 mm	0.0001*	0.0001*	0.0002*

TABLE 3 (see Item 1371, Explanatory Note B)

Roller diameter		Outside diameter tolerance variation per shipment	Maximum out of round tolerance	Maximum out of round tolerance including taper of cylindrical roller (±)
Over	Including	(±)	(±)	(±)
Example No. 1				
0 mm	6.5 mm	0.00001*	0.00001*	0.00004*
6.5 mm	18 mm	0.00001*	0.00001*	0.00004*
18 mm	26 mm	0.00002*	0.00002*	0.00006*
26 mm	42 mm	0.00003*	0.00003*	0.00008*
Example No. 2				
0 mm	6.5 mm	0.0000075*	0.000008*	0.00004*
6.5 mm	18 mm	0.0000075*	0.000008*	0.00004*
18 mm	26 mm	0.00001*	0.00001*	0.00006*
26 mm	42 mm	0.000015*	0.000015*	0.00008*

1372

Technology for industrial gas turbine engines, as follows:

- (a) Technology common to industrial gas turbine engines and gas turbine aero-engines is covered by Item 1460;
- (b) Technology common to industrial gas turbine engines and marine gas turbine engines is covered by Item 1431.

NOTES:

1. Core-section modules and specially designed components of industrial gas turbine engines derived from gas turbine aero-engines embargoed by Item 1460 or marine gas turbine engines embargoed by Item 1431 shall be treated under the provisions of those respective Items.
2. Industrial gas turbine engines adapted as marine gas turbine engines are covered by Item 1431.

1385

Specially designed production equipment for compasses, gyroscopes (gyros), accelerometers and inertial equipment embargoed by Item 1485.

Technical Note:

Production equipment embargoed by this Item includes the following:

- (a) For ring laser gyro equipment, the following equipment used to characterise mirrors, having the threshold accuracy shown or better:

- (1) Rectilinear scatterometer (10 ppm);
 - (2) Polar scatterometer (10 ppm);
 - (3) Reflectometer (50 ppm);
 - (4) Profilometer (5 angstroms).
- (b) For other inertial equipment:
- (1) Inertial Measurement Unit (IMU) module tester;
 - (2) IMU platform tester;
 - (3) IMU stable element handling fixture;
 - (4) IMU platform balance fixture;
 - (5) Gyro tuning test station;
 - (6) Gyro dynamic balance station;
 - (7) Gyro run-in/motor test station;
 - (8) Gyro evacuation and fill station;
 - (9) Centrifuge fixture for gyro bearings;
 - (10) Accelerometer axis alignment station;
 - (11) Accelerometer test station.

1388

Specially designed equipment for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications, as follows, for non-electronic substrates by processes defined in Item 1389 and specially designed automated handling, positioning, manipulation and control components, and "specially designed software" therefor:

- (A) "Stored programme controlled" "chemical vapour deposition" (CVD) production equipment with both of the following:
- (1) Process modified for one of the following:
 - (a) Pulsating CVD;
 - (b) Controlled nucleation thermal decomposition (CNTD); *or*
 - (c) Plasma enhanced or plasma assisted CVD; *and*
 - (2) Any of the following:
 - (a) Incorporating high vacuum (less than or equal to 10^{-7} atm) rotating seals;
 - (b) Operating at reduced pressure (less than 1 atm); *or*
 - (c) Incorporating *in situ* coating thickness control;
- (B) "Stored programme controlled" "ion implantation" production equipment having beam currents of 5 mA or higher;
- (C) "Stored programme controlled" "electron beam physical vapour deposition" (EB-PVD) production equipment with either of the following characteristics:
- (i) Incorporating power systems greater than 80 kW; *or*
 - (ii) (1) Incorporating power systems greater than 50 kW; *and*
 - (2) Having both of the following characteristics:
 - (a) Incorporating a liquid pool level laser control system which regulates precisely the ingots feed rate; *and*
 - (b) Incorporating a computer controlled rate monitor operating on the principle of photo-luminescence of the ionised atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;
- (D) "Stored programme controlled" "plasma spraying" production equipment having any of the following characteristics:
- (1) Operating at atmospheric pressure discharging molten or partially molten material particles into air or inert gas (shrouded torch) at nozzle exit gas velocities greater than 750 m/sec calculated at 293 K at 1 atmosphere;
 - (2) Operating at reduced pressure controlled atmosphere (less than or equal to 100 millibar (0.1 atm) measured above and within 30 cm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 10^{-4} millibar prior to the spraying process; *or*
 - (3) Incorporating *in situ* coating thickness control;
- (E) "Stored programme controlled" "sputter deposition" production equipment capable of current densities of 5 mA/cm² or higher at a deposition rate of 10 micrometres/hr or higher;
- (F) "Stored programme controlled" "cathodic arc deposition" production equipment with either of the following characteristics:
- (1) Incorporating target areas larger than 45.6 cm²; *or*

- (2) Incorporating a magnetic field steering control of the arc spot on the cathode;
- (G) Deposition process or surface modification equipment for "stored programme controlled" production processing which enables the combining of individual deposition processes embargoed by (A) to (F) above so as to enhance the capability of such individual processes.

Technical Notes:

1. For the definitions of the coating processes specified in (A) to (G) above, see Item 1389.
2. Coating processes include original coating as well as coating repair and refurbishing.
3. For coating technologies, see Item 1389. It should be noted that, while the equipment for "electrophoretic deposition", "pack cementation" and "slurry deposition" processes is not considered sensitive because of its universal use, the restrictions on the technology for use of this equipment, as identified in Item 1389, are still in effect.
4. For the definition of "stored programme controlled", see Item 1355.
5. The status of coating and surface modification equipment for non-electronic substrates using lasers is defined in this Item.

1389

Technology for application to non-electronic devices to achieve:

- inorganic overlay coatings or inorganic surface modification coatings, specified in column 3 of the Table below;
- on substrates specified in column 2 of the Table below;
- by processes as defined in Technical Note (a) to (h) and specified in column 1 of the Table below; and specially designed "software" therefor.

TABLE

1. Coating Process ⁽¹⁾	2. Substrate	3. Resultant coating
A. "Chemical Vapour Deposition" (CVD)	Superalloys	Aluminides for internal surfaces, alloyed aluminides ⁽²⁾ or noble metal modified aluminides ⁽³⁾
	Titanium or Titanium alloys	Carbides, aluminides or Alloyed aluminides ⁽²⁾
	Ceramics	Silicides or Carbides
	Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides, Mixtures thereof ⁽⁴⁾ or Dielectric layers
	Copper or Copper alloys	Tungsten or Dielectric layers
B. "Electron-Beam Physical Vapour Deposition" (EB-PVD)	Silicon carbide or Cemented tungsten carbide	Carbides, Tungsten, Mixtures thereof ⁽⁴⁾ or Dielectric layers
	Superalloys	Alloyed silicides, Alloyed aluminides ⁽²⁾ , MCrAlX (except CoCrAlY which contains less than 22 weight percent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ Modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof (including mixtures of the above with silicides or aluminides) ⁽⁴⁾

	Ceramics	Silicides or modified zirconia (except calcia-stabilized zirconia)	F. Slurry Deposition"	Refractory metals ⁽⁸⁾	Fused silicides or Fused aluminides
	Aluminium alloys ⁽⁶⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight percent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof ⁽⁴⁾		Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides or Mixtures thereof ⁽⁴⁾
	Corrosion resistant steel ⁽⁷⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ or modified zirconia (except calcia-stabilized zirconia)	G. "Sputtering" (high rate, reactive or radio frequency only)	Superalloys	Alloyed silicides, Alloyed aluminides ⁽²⁾ , Noble metal modified aluminides ⁽³⁾ , MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof (including mixtures of the above with silicides or aluminides) ⁽⁴⁾
	Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides, Mixtures thereof ⁽⁴⁾ or Dielectric layers		Ceramics	Silicides, Platinum or Mixtures thereof ⁽⁴⁾
	Copper or Copper alloys	Tungsten or Dielectric layers		Aluminium alloys ⁽⁶⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight percent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof ⁽⁴⁾
	Silicon carbide or Cemented tungsten carbide	Carbides, Tungsten, Mixtures thereof ⁽⁴⁾ or Dielectric layers		Corrosion resistant steel ⁽⁷⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof ⁽⁴⁾
C. "Electro-phoretic Deposition"	Superalloys	Alloyed aluminides ⁽²⁾ or Noble metal modified aluminides ⁽³⁾		Titanium or Titanium alloys	Borides or Nitrides
D. "Pack cementation" ⁽⁹⁾	Superalloys	Alloyed aluminides ⁽²⁾ or Noble metal modified aluminides ⁽³⁾		Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides, Mixtures thereof ⁽⁴⁾ or Dielectric layers
(see also A above)	Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides or Mixtures thereof ⁽⁴⁾		Copper or Copper alloys	Tungsten or Dielectric layers
	Aluminium alloys ⁽⁶⁾	Aluminides or Alloyed aluminides ⁽²⁾		Silicon carbide or Cemented tungsten carbide	Carbides, Tungsten or Dielectric layers
E. "Plasma spraying" (high velocity or low pressure only)	Superalloys	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof ⁽⁴⁾	H. "Ion Implantation"	High temperature bearing steels	Additions of Chromium, Tantalum or Niobium (Columbium)
	Aluminium alloys ⁽⁶⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight percent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia), Silicides or Mixtures thereof ⁽⁴⁾		Beryllium or Beryllium Alloys	Borides
	Corrosion resistant steel ⁽⁷⁾	MCrAlX (except CoCrAlY which contains less than 22 weight per cent of chromium and less than 12 weight per cent of aluminium and less than 2 weight per cent of yttrium) ⁽⁵⁾ , modified zirconia (except calcia-stabilized zirconia) or Mixtures thereof ⁽⁴⁾		Carbon-carbon, Carbon-ceramic or Metal matrix composites	Silicides, Carbides, Mixtures thereof ⁽⁴⁾ or Dielectric layers
	Titanium or Titanium alloys	Carbides or Oxides		Titanium or Titanium alloys	Borides or Nitrides
				Silicon nitride or Cemented tungsten carbide	Nitrides, Carbides or Dielectric layers

Sensor window materials transparent to electromagnetic waves, as follows: silica, alumina, silicon, germanium, zinc sulphide, zinc selenide or gallium arsenide	Dielectric layers
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NOTES (to table under Item 1389):

- (1) Coating process includes coating repair and refurbishing as well as original coating.
- (2) Multiple-stage coatings in which an element or elements are deposited prior to application of the aluminide coating, even if these elements are deposited by another coating process, are included in the term "alloyed aluminide" coating, but the multiple use of single-stage "pack cementation" processes to achieve alloyed aluminides is not included in the term 'alloyed aluminide' coating.
- (3) Multiple-stage coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating are included in the term "noble metal modified aluminide" coating.
- (4) Mixtures consist of infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in this Table.
- (5) MCrAlX refers to an alloy where M equals cobalt, iron, nickel or combinations thereof; and X equals hafnium, yttrium, silicon or other minor additions in various proportions and combinations.
- (6) Aluminium alloys as a substrate in this Table refers to alloys usable at temperatures above 500 K (227°C).
- (7) Corrosion resistant steel refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.
- (8) Refractory metals as a substrate in this Table consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.
- (9) This Item does not embargo technology for single-stage "pack cementation" of solid airfoils.

Technical Note:

The definitions of processes specified in column 1 of the Table are as follows:

- (a) "Chemical Vapour Deposition" (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, composite or ceramic is deposited upon a heated substrate. Gaseous reactants are reduced or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloyed or compounded material on the substrate. Energy for this decomposition or chemical reaction process is provided by the heat of the substrate.

N.B.:

1. CVD includes the following processes: out-of-"pack", pulsating, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted.
 2. "Pack" denotes a substrate immersed in a powder mixture.
 3. The gaseous material utilised in the out-of-"pack" process is produced using the same basic reactions and parameters as the "pack cementation" process, except that the substrate to be coated is not in contact with the powder mixture.
- (b) "Electron-Beam Physical Vapour Deposition" (EB-PVD) is an overlay coating process conducted in a vacuum chamber, wherein an electron beam is directed onto the surface of a coating material causing vaporisation of the material and resulting in condensation of the resultant vapours onto a substrate positioned appropriately.

N.B.:

The addition of gases to the chamber during the processing is an ordinary modification to the process.

- (c) "Electrophoretic Deposition" is a surface modification coating or overlay coating process in which finely divided particles of a coating material suspended in a liquid dielectric medium migrate

under the influence of an electrostatic field and are deposited on an electrically conducting substrate.

N.B.:

Heat treatment of parts after coating materials have been deposited on the substrate, in order to obtain the desired coating, is an essential step in the process.

- (d) "Pack Cementation" is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture, a so-called "pack", that consists of:
 - (1) The metallic powders that are to be deposited (usually aluminium, chromium, silicon or combinations thereof);
 - (2) An activator (normally a halide salt); *and*
 - (3) An inert powder, most frequently alumina. The substrate and powder mixture is contained within a retort which is heated to between 1,030 K to 1,375 K for sufficient time to deposit the coating.
- (e) "Plasma Spraying" is an overlay coating process wherein a gun (spray torch), which produces and controls a plasma, accepts powdered coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed.

N.B.:

1. High velocity means more than 750 metres per second.
 2. Low pressure means less than ambient atmospheric pressure.
- (f) "Slurry Deposition" is a surface modification coating or overlay coating process wherein a metallic or ceramic powder with an organic binder is suspended in a liquid and is applied to a substrate by either spraying, dipping or painting; subsequently air or oven dried; and heat treated to obtain the desired coating.
 - (g) "Sputtering" is an overlay coating process wherein positively charged ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on the substrate.

N.B.:

Triode, magnetron or radio frequency sputtering to increase adhesion of coating and rate of deposition are ordinary modifications to the process.

- (h) "Ion implantation" is a surface modification coating process in which the element to be alloyed is ionised, accelerated through a potential gradient and implanted into the surface region of the substrate. The definition includes processes in which the source of the ions is a plasma surrounding the substrate and processes in which ion implantation is performed simultaneously with "electron beam physical vapour deposition" or "sputtering."
- (i) "Cathodic arc deposition" employs a cathode which is consumable and has an arc discharge established on the surface by a momentary contact of a ground trigger. Arc spots form and begin to erode randomly but uniformly the cathode surface creating a highly ionised plasma. The anode can be either a cone attached to the periphery of the cathode through an insulator or the chamber can be used as an anode. Substrates appropriately positioned receive deposits from the ionised plasma. Substrate biasing is used for non-line-of-sight deposition. A gas can be introduced in the vicinity of the substrate surface in order to react during deposition to synthesise compound coatings.

NOTE:

It is understood that technology embargoed by Item 1389 consists of technical information, data or know-how regarding criteria or parameters as follows:

- I. Technology for pretreatments of the substrates listed in the Table, as follows:
 - (A) Chemical stripping and cleaning bath cycle parameters, as follows:
 - (i) Bath composition
 - (a) For the removal of old or defective coatings, corrosion product or foreign deposits;
 - (b) For preparation of virgin substrates;
 - (ii) Time in bath;
 - (iii) Temperature of bath;
 - (iv) Number and sequences of wash cycles;
 - (B) Visual and macroscopic criteria for acceptance of the cleaned part;
 - (C) Heat treatment cycle parameters, as follows:
 - (i) Atmosphere parameters, as follows:
 - (a) Composition of the atmosphere;
 - (b) Pressure of the atmosphere;

- (ii) Temperature for heat treatment;
 - (iii) Time of heat treatment;
 - (D) Substrate surface preparation parameters, as follows:
 - (i) Grit blasting parameters, as follows:
 - (a) Grit composition;
 - (b) Grit size and shape;
 - (c) Grit velocity;
 - (ii) Time and sequence of cleaning cycle after grit blast;
 - (iii) Surface finish parameters;
 - (E) Masking technique parameters, as follows:
 - (i) Material of mask;
 - (ii) Location of mask.
- II. Technology for *in situ* quality assurance techniques for evaluation of the coating processes listed in the Table, as follows:
- (A) Atmosphere parameters, as follows:
 - (i) Composition of the atmosphere;
 - (ii) Pressure of the atmosphere;
 - (B) Time parameters;
 - (C) Temperature parameters;
 - (D) Thickness parameters;
 - (E) Index of refraction parameters.
- III. Technology for post deposition treatments of the coated substrates listed in the Table, as follows:
- (A) Shot peening parameters, as follows:
 - (i) Shot composition;
 - (ii) Shot size;
 - (iii) Shot velocity;
 - (B) Post shot peening cleaning parameters;
 - (C) Heat treatment cycle parameters, as follows:
 - (i) Atmosphere parameters, as follows:
 - (a) Composition of the atmosphere;
 - (b) Pressure of the atmosphere;
 - (ii) Time-temperature cycles;
 - (D) Post heat treatment visual and macroscopic criteria for acceptance of the coated substrates.
- IV. Technology for quality assurance techniques for the evaluation of the coated substrates listed in the Table, as follows:
- (A) Statistical sampling criteria;
 - (B) Microscopic criteria for:
 - (i) Magnification;
 - (ii) Coating thickness and thickness uniformity;
 - (iii) Coating integrity;
 - (iv) Coating composition;
 - (v) Coating and substrates bonding;
 - (vi) Microstructural uniformity.
- V. Technology and parameters related to specific coating and surface modification processes listed in the Table, as follows:
- (A) For "Chemical Vapour Deposition":
 - (i) Coating source composition and formulation;
 - (ii) Carrier gas composition;
 - (iii) Substrate temperature;
 - (iv) Time-temperature-pressure cycles;
 - (v) Gas control and part manipulation;
 - (B) For "Electron-Beam Physical Vapour Deposition":
 - (i) Ingot composition;
 - (ii) Substrate temperature;
 - (iii) Reactive gas composition;
 - (iv) Ingot feed rate;
 - (v) Time-temperature-pressure cycles;
 - (vi) Beam and part manipulation;
 - (C) For "Electrophoretic Deposition":
 - (i) Liquid dielectric formulation, as follows:
 - (a) Composition;
 - (b) Temperature;
 - (c) Specific gravity;
 - (ii) Particle size, distribution and composition;
 - (iii) Bath composition;
 - (iv) Electric field strength;
 - (v) Time cycle;
 - (vi) Part fixturing;
 - (D) For "Pack Cementation":
 - (i) "Pack" composition and formulation;
 - (ii) Carrier gas composition;
 - (iii) Time-temperature-pressure cycles;
 - (E) For "Plasma Spraying":
 - (i) Powder composition, preparation and size distributions;
 - (ii) Feed gas composition and parameters;
 - (iii) Substrate temperature;
 - (iv) Gun power parameters;

- (v) Spray distance;
 - (vi) Spray angle;
 - (vii) Cover gas composition, pressure and flow rates;
 - (viii) Gun control and part manipulation;
- (F) For "Slurry Deposition":
- (i) Slurry composition and formulation;
 - (ii) Slurry application techniques;
 - (iii) Time-temperature cycles;
 - (iv) Part manipulation;
- (G) For "Sputtering":
- (i) Target composition and fabrication;
 - (ii) Geometrical positioning of part and target;
 - (iii) Reactive gas composition;
 - (iv) Electrical bias;
 - (v) Time-temperature-pressure cycles;
 - (vi) Triode power;
 - (vii) Part manipulation;
- (H) For "Ion Implantation":
- (i) Beam control and part manipulation;
 - (ii) Ion source design details;
 - (iii) Control techniques for ion beam and deposition rate parameters;
 - (iv) Time-temperature-pressure cycles.

1391

"Robots", "robot" controllers and "robot" "end-effectors", as follows, and specially designed components and "specially designed software" therefor:

NOTES:

1. Mechanical structures for "robots" are included in specially designed components for the above.
 2. For simulation "software" used in the evaluation, design and optimisation of robotic systems, see Item 1566.
- (a) "Robots" having any of the following characteristics:
- (1) Capable of employing feedback information in "real-time processing" from one or more "sensors" to generate or modify "programmes" or to generate or modify numerical programme data;

NOTES:

1. This sub-item does not embargo "robots" capable of using information derived only from "sensors" which can be used to measure:
 - (a) The internal state of the "robot", i.e., velocity, position (by other than inertial position measuring systems), drive motor current or voltage, fluid or gas pressure or temperature;
 - (b) Through-the-arc current (or voltage) for weld seam tracking; *or*
 - (c) Binary or scalar values for:
 - (1) Determining the position of the "robot" relative to a work piece;
 - (2) Tool drive motor voltage or current or hydraulic/pneumatic pressure for determination of force or torque; *or*
 - (3) External safety functions.
2. This sub-item does not embargo "robots" capable of using information derived only from vision systems limited as follows:
 - (a) Capable of processing no more than 100,000 pixels using an industrial television camera, or no more than 65,536 pixels using a solid-state camera;
 - (b) Using a single-scene analysis processor having neither a word size of more than 16-bit (excluding parity bits) nor parallel processing for the same task;

N.B.:

Systems with a 16-bit word length and not more than a 32-bit architecture are regarded as 16-bit systems for the purposes of this sub-paragraph.

- (c) "Software" not capable of full three-dimensional mathematical modelling or full three-dimensional scene analysis;

N.B.:

This scene analysis limitation precludes neither approximation of the third dimension by viewing at a given angle, nor limited grey scale interpretation for the perception of depth or texture for the approved tasks (2 ½ D);

- (d) Having no "user-accessible programmability" other than by input reference images through the system's camera; *or*
- (e) Capable of no more than one scene analysis every 0.1 second.
3. This sub-item does not embargo "robots" capable of using information derived only from "end-effectors" not embargoed by sub-item (c).
4. "Software" provided for "robots" released by Notes 2 or 3 above shall be in "object code" only.
5. Documentation provided for "robots" released by Notes 2 or 3 above shall not exceed that necessary to perform the operation, repair or maintenance of the "robot".
- (2) Specially designed to comply with national safety standards applicable to explosive munitions environments;
- (3) Incorporating means of protecting hydraulic lines against externally induced punctures caused by ballistic fragments (e.g. incorporating self-sealing lines) and designed to use hydraulic fluids with flash points higher than 839 K (566°C, 1,050°F);
- (4) Specially designed for underwater use (i.e., incorporating special techniques or components for sealing, pressure compensation or corrosion resistance);

NOTE:

For underwater manipulator mechanisms, see Item 1417.

- (5) Operable at altitudes exceeding 30,000 metres;
- (6) Specially designed for outdoor applications and meeting military specifications therefor;
- (7) Specially designed or rated for operating in an electro-magnetic pulse (EMP) environment;
- (8) Specially designed or rated as radiation-hardened beyond that necessary to withstand normal industrial (i.e., non-nuclear industry) ionising radiation;
- (9) Equipped with "robot" manipulator arms which contain fibrous and filamentary materials embargoed by Item 1763;
- (10) Equipped with precision measuring devices embargoed by Item 1532; *or*
- (11) Specially designed to move autonomously its entire structure through three-dimensional space in a simultaneously coordinated manner, *except* systems in which the "robot" moves along a fixed path;

NOTE:

This sub-item does not embargo "robots" specially designed for household use or those modified from household "robots" for educational purposes (pre-university) if not embargoed by the other provisions of this Item.

- (b) Electronic controllers for "robots" having any of the following characteristics:

NOTES:

1. For controllers capable of controlling numerically controlled machine-tools or dimensional-inspection machines, see Item 1091.
2. For "digital computers" not "embedded" in controllers, see Item 1565.
- (1) Controllers specially designed to be part of a "robot" embargoed by (a)(2) to (8), (a)(10) or (11) above;
- (2) Minimum programmable increment less (finer) than 0.001 mm per linear axis;
- (3) Having more than one integral interface which meets or exceeds ANSI/IEEE standard 488-1978, IEC publication 625-1 or any equivalent standard for parallel data exchange;

- (4) Capable of being programmed by means other than lead-through, key-in (i.e., without processing, on-line or off-line) or teach-pendant techniques;
- (5) Word size exceeds 16 bits (excluding parity bits);

N.B.:

Systems with a 16-bit word length and not more than a 32-bit architecture are regarded as 16-bit systems for the purposes of this sub-item.

- (6) Incorporating interpolation algorithms for an order of interpolation higher than two;
- (7) Generation or modification of the programmed path, velocity and functions other than the following, by on-line, "real-time processing":
- (i) Manual velocity override;
- (ii) Linear, rotary or Cartesian offset;
- (iii) Manual "robot" path editing (including manual path compensation) excluding "source language" used to programme automatically the "robot" path, velocity or function;
- (iv) Branching to pre-programmed modification of "robot" path, velocity or function;
- (v) Fixed cycles (e.g., macro instructions or pre-programmed sub-routines); *or*
- (vi) Key-in or teach-in modifications;

NOTE:

Sub-item (b)(7) does not embargo controllers limited to operations with "robots" described in Notes 1, 2 or 3 to sub-item (a)(1).

- (c) "End-effectors" having any of the following characteristics:
- (1) Having integrated computer-aided data processing, *except* those using "sensors" used to measure the parameters or values specified in Note 1 to sub-item (a)(1);
- (2) Equipped with an integral interface which meets or exceeds ANSI/IEEE Standard 488-1978, IEC publication 625-1, or any equivalent standard for parallel data exchange;
- (3) Having any of the characteristics in (a)(2) to (8) and (a)(10) above.

NOTES:

1. Definitions of the terms used in this Item:
- (a) For the purposes of this Item, a "robot" is a manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use "sensors", and has all the following characteristics:
- (1) Is multifunctional;
- (2) Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;
- (3) Incorporates three or more closed or open loop servo-devices which may include stepping motors; *and*
- (4) Has "user-accessible programmability" by means of teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention.

N.B.:

The above definition does not include the following devices:

- (1) Manipulation mechanisms which are only manually/teleoperator controllable;
- (2) Fixed sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed stops, such as pins or cams. The sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;
- (3) Mechanically controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is mechanically limited by fixed, but adjustable stops, such as pins or cams. The sequence of motions and the selection of paths or angles are variable within the fixed programme pattern. Variations or modifications of the programme pattern (e.g., changes of pins or exchanges of

- cams) in one or more motion axes are accomplished only through mechanical operations;)
- (4) Non-servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The programme is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;
 - (5) Stackers defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval.
- (b) "End-effectors" include grippers, "active tooling units" and any other tooling that is attached to the baseplate on the end of the "robot's" manipulator arm(s). An "active tooling unit" is a device for applying motive power, process energy or sensing to the workpiece;
 - (c) For the purposes of this Item, a "sensor" is defined as a detector of a physical phenomenon, the output of which (after conversion into a signal that can be interpreted by a controller) is able to generate "programmes" or modify programmed instructions or numerical programme data. This includes "sensors" with machine vision, infrared imaging, acoustical imaging, tactile feel, inertial position measuring, optical or acoustic ranging or force or torque measuring capabilities.

N.B.:

For computer related terms, see Item 1565 or 1566.

2. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following equipment:
 - (a) "Robots" embargoed by sub-item (a) which are for civil use and not embargoed by sub-items (a)(2) to (a)(8), (a)(10) or (a)(11);
 - (b) Electronic controllers embargoed by sub-item (b) for the control of "robots" eligible for treatment under this Note;
 - (c) "End effectors" embargoed by sub-item (c) for use with "robots" eligible for treatment under this Note;
 - (d) Vision systems, limited as follows:
 - (1) Capable of processing no more than 200,000 pixels using an industrial television camera or a solid-state camera;
 - (2) Not programmable by the user *except*:
 - (i) To input reference images through the system's camera;
 - (ii) To input values of fixed parameters, including teach-in parameters; *or*
 - (iii) To select pre-programmed sub-routines;
 - (3) Not capable of continuous reaction or continuously updating the "robot" position while the "robot" is moving;

N.B.:

This precludes the use of vision systems for weld seam tracking during the welding operation but does not preclude straight-line or single-plane weld seam tracking using a single pass.

- (4) Capable of no more than one scene analysis every 0.02 second;
- (5) The "software" provided for the vision processor shall be in "object code" only and shall not be capable of full three-dimensional mathematical modelling or full three-dimensional scene analysis;

N.B.:

This scene analysis limitation does not preclude approximation of the third dimension by viewing at a given angle, nor limited grey scale interpretation for the perception of depth or texture for the approved tasks (2½ D).

1399

"Software" and technology for "automatically controlled industrial systems", as follows, to produce assemblies or discrete parts:

- (a) "Software" with all the following characteristics:
 - (1) Specially designed for "automatically controlled industrial systems" which include at least eight pieces of the equipment enumerated in Technical Note (b)(1) to (9) below;

NOTES:

1. The "digital computers" of the "automatically controlled industrial system" do not share a common "main storage" but exchange information by transmitting messages through a "local area network".
2. This sub-item does not release "software" in source code.
- (2) Integrating, in a hierarchical manner, while having access to data which may be stored outside the supervisory "digital computer", the manufacturing processes with:
 - (i) Design functions; *or*
 - (ii) Planning and scheduling functions; *and*
- (3) (i) Automatically generating and verifying the manufacturing data and instructions, including selection of equipment and sequences of manufacturing operations, for the manufacturing processes, from design and manufacturing data; *or*
 - (ii) Automatically reconfiguring the "automatically controlled industrial system" through reselecting equipment and sequences of manufacturing operation by "real-time processing" of data pertaining to anticipated but unscheduled events; *and*

NOTE:

This sub-item does not embargo "software" which only provides rescheduling of functionally identical equipment within "flexible manufacturing units" using prestored "part" programmes and a prestored strategy for the distribution of the "part" programmes.

- (b) Technology for the design of "automatically controlled industrial systems" which will be used with the "software" embargoed by (a) above, regardless of whether or not the conditions of (a)(1) are met.

Technical Note:

For the purposes of this Item:

- (a) An "automatically controlled industrial system" is a combination of:
 - (1) One or more "flexible manufacturing units"; *and*
 - (2) A supervisory "digital computer" for coordination of the independent sequences of computer instructions to, from and within the "flexible manufacturing units";
- (b) A "flexible manufacturing unit" is an entity which comprises a combination of a "digital computer" including its own "main storage" and its own "related equipment", and at least one of the following:
 - (1) A machine tool or a dimensional inspection machine embargoed by Item 1091 or 1370;
 - (2) A "robot" embargoed by Item 1391;
 - (3) Not used;
 - (4) Digitally controlled equipment embargoed by Item 1080, 1081, 1086 or 1088;
 - (5) Not used;
 - (6) Digitally controlled equipment embargoed by Item 1354 or 1355(b);
 - (7) Digitally controlled equipment embargoed by Item 1357;
 - (8) Digitally controlled electronic equipment embargoed by Item 1529; *or*
 - (9) A digitally controlled measuring system embargoed by Item 1532;

N.B.:

For the definitions of other terms in quotation marks, see Item 1391, 1565 or 1566.

EXPLANATORY NOTE:

Sub-item (a) above does not embargo "software" (in "machine executable form" only) for industrial sectors other than nuclear,

aerospace, shipbuilding, heavy vehicles, machine building, microelectronics and electronics. It is also understood that this Note does not release design technology specified in sub-item (b) above.

NOTE:

The phrase "in a hierarchical manner" refers to the "software" relationship between a supervisory computer and at least one "FMU" as defined in Technical Notes (a) and (b). The "software" has an overall management function that subordinates the manufacturing process to the design or planning and scheduling function regardless of the physical communications link or of the equipment configurations.

Transportation Equipment

NOTE:

For computer-related terms, see Item 1565 or 1566.

1401

Reciprocating diesel engine development and production technologies, including "specially designed software", as follows:

- (a) Development and production technology, including "specially designed software", for reciprocating diesel engine ground vehicle propulsion systems having all of the following specifications:
- (1) A box volume of 1.2 m³ or less;
 - (2) An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents;
 - (3) A power density of more than 700 kW/m³ of box volume.

NOTES:

1. The box volume is defined as 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 greatest of the following:

- (a) The outside dimension from valve cover to valve cover;
- (b) The dimension of the outside edges of the cylinder heads; *or*
- (c) The diameter of the flywheel housing;

Height:

The greater of the following:

- (a) The dimension of the crankshaft centre-line to the top plane of the valve cover (or cylinder head) plus 2 times the stroke; *or*
- (b) The diameter of the flywheel housing.

2. Not used.

3. Not used.

- (b) Development and production technology for solid or dry film cylinder wall lubrication permitting operation at temperatures in excess of 723 K (450°C) measured on the cylinder wall at the top limit of travel of the top ring of the piston.

1416

Vessels, surface-effect vehicles, water-screw propellers and hub assemblies, water-screw propeller systems, moisture and particulate separator systems and specially designed components, as follows:

- (a) Hydrofoil vessels with automatically controlled foil systems which are capable of speeds of above 40 knots in rough water (Sea State Five);
- (b) Surface-effect vehicles, i.e., hovercraft, air cushion vehicles (both sidewall and skirted varieties) and all variations of vehicles using

the wing-in-ground effect for positive lift, *except* hovercraft having all of the following characteristics:

- (1) Designed to carry fewer than 5 passengers including the driver;
 - (2) Dry mass less than 500 kg;
 - (3) Maximum speed less than 50 knots (90 km/h) at Sea State 0; *and*
 - (4) Not designed for operation above Sea State 3;
- (c) Small waterplane area twin-hull (SWATH) vessels having underwater hulls whose cross-sectional area varies along the longitudinal axis between points two major diameters from the bow and two major diameters from the stern;

Technical Note:

SWATH vessels are those which maintain buoyancy by means of submerged hulls using slender struts to support the deck and superstructure of the vessel above the waterline.

- (d) Vessels incorporating:

- (1) Equipment embargoed by any Item in Group 2, or by Items 1485, 1501, 1502, 1510;
- (2) Degaussing facilities; *or*
- (3) Closed ventilation systems designed into the vessel which are designed to maintain air purity and positive pressure regardless of the conditions external to the vessel, *except* where those closed ventilation systems are specially designed for and incorporated in the vessel's medical facilities only;

NOTE:

This sub-item does not apply to vessels containing equipment embargoed by Items 1485, 1501, 1502 or 1510 whose export has been authorised.

- (e) Water-screw propellers and hub assemblies, as follows:
- (1) Supercavitating propellers rated at more than 7.46 MW (10,000 hp);
 - (2) Controllable-pitch propellers and hub assemblies rated at more than 29.83 MW (40,000 hp) capacity;
- (f) Water-screw propeller systems, as follows:
- (1) Contrarotating propeller systems rated at more than 14.92 MW (20,000 hp);
 - (2) Ventilated, base ventilated and super-ventilated propeller systems and semi-submerged propeller systems (or surface propellers) rated at more than 2.24 MW (3,000 hp);
 - (3) Systems employing pre-swirl and post-swirl techniques for smoothing the flow into a propeller so as to improve the propulsive efficiency of:
 - (A) SWATH vessels, hydrofoil vessels and surface-effect vehicles; *or*
 - (B) Other vessels with propeller rotational speeds above 220 rev/min. or with propellers rated at more than 44.74 MW (60,000 hp) per shaft;
 - (4) "Pumpjet Systems;"

Technical Note:

"Pumpjet systems" are propulsion systems which utilise divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion generated underwater radiated noise.

NOTE:

This sub-item does not embargo technology for flow conditioning vane techniques.

- (g) Moisture and particulate separator systems which are capable of removing 99.9% of particles larger than 2 micrometres in diameter with a maximum pressure loss of 1.6 kPa (16 millibar) for gas turbine engine air inlets;

NOTE:

The control of the technology for the moisture and particulate separator systems covered by this sub-item is limited to the following:

- (a) Technology for preventing water leakage around the filter stages; *and*
 - (b) Technology for integrating the components of such a system.
- (h) Specially designed components for vessels embargoed by sub-items (a), (b) and (c) above, as follows:
- (1) Advanced hull forms which incorporate any of the following:
 - (A) Stepped hulls for hydrofoil vessels;
 - (B) Hulls for air cushion vehicles with trapezoidal planforms;
 - (C) Hulls for surface-effect vehicles with catamaranlike sidewalls;

- (D) Hulls for wing-in-ground effect vehicles; *or*
- (E) Underwater hulls and struts for SWATH vessels;
- (2) Fully submerged subcavitating or supercavitating hydrofoils;
- (3) Lightweight structural components for SWATH vessels, hydrofoil vessels and surface-effect vehicles, constructed using anisotropic, orthotropic or sandwich construction methods;

Technical Notes:

1. Anisotropic construction methods relate to the use of fibre reinforcing members aligned so that the load-carrying ability of the structure can be primarily oriented in the direction of expected stress.
 2. Orthotropic construction methods relate to means of stiffening plates, in which the structural members are at right angles to each other.
 3. Sandwich construction methods relate to the use of structural members or plates which are fabricated and permanently affixed in layers to enhance their strength and reduce their weight.
- (4) Flexible skirts, seals and fingers for surface-effect vehicles;
 - (5) Active systems for automatically controlling the stability of SWATH vessels, hydrofoil vessels or surface-effect vehicles;
 - (6) Power transmission shaft systems which incorporate composite material components, for SWATH vessels, hydrofoil vessels and surface-effect vehicles;
 - (7) Lightweight, high capacity (K factor higher than 150) gearing (planetary, cross-connect and multiple input/output gears and bearings) for SWATH vessels, hydrofoil vessels and surface-effect vehicles;

Technical Note:

For the K factor, see AGMA tables of K factor values (based on tooth profile, pinion and gear materials and surface endurance limits).

- (8) Water-cooled electrical propulsion machinery (motor and generator), including AC-AC synchronous and AC-DC systems, sectored-disc and concentric-drum rotors for DC homopolar machines for SWATH vessels, hydrofoil vessels and surface-effect vehicles;
- (9) Superconducting electrical propulsion machinery for SWATH vessels, hydrofoil vessels and surface-effect vehicles;
- (10) Lift fans for surface-effect vehicles, rated at more than 300 kW (400 hp);
- (11) Waterjet propulsor systems for hydrofoil vessels and surface-effect vehicles rated at an input of 2.24 MW (3,000 hp) or more.

(See also Item 2009 of Group 2.)

(For marine gas turbine engines, see also Item 1431.)

1417

Submersible systems (including those incorporated in a submersible vehicle) and specially designed components, as follows, and "specially designed software" therefor:

- (a) Automatically-controlled atmosphere-regeneration systems specially designed or modified for submersible vehicles which, in a single chemical-reaction cycle, ensure carbon dioxide removal and oxygen renewal;
- (b) Systems specially designed or modified for the automated control of the motion of a submersible vehicle using navigation data and having closed-loop servo-control(s) to:
 - (1) Enable the vehicle to move within 10 m of a predetermined point in the water column;
 - (2) Maintain the position of the vehicle within 10 m of a predetermined point in the water column, *or*
 - (3) Maintain the position of the vehicle within 10 m while following a cable on or under the sea bed;
- (c) Underwater vision systems, as follows:
 - (1) Television systems (comprising camera, lights, monitor and signal transmission equipment) specially designed or modified for remote operation with a submersible vehicle, having a "limiting resolution", when measured in the air, of more than 500 lines, or underwater television cameras having a "limiting resolution", when measured in the air, of more

than 600 lines, using IEEE Standard 208/1960 or any equivalent standard;

Technical Note:

"Limiting resolution" in television is a measure of horizontal resolution usually expressed in terms of the maximum number of lines per picture height discriminated on a test chart.

- (2) Systems specially designed or modified for remote operation with a submersible vehicle employing techniques to minimise the effects of back-scatter, including range-gated illuminators and laser systems;

NOTE:

The embargo status of underwater vision systems using lasers is defined in this Item.

- (d) Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles and having any of the following characteristics:
 - (1) Systems which control the manipulator using information from sensors which measure force or torque applied to an external object, distance from an external object, or tactile sense between the manipulator and an external object;
 - (2) Controlled by proportional master-slave techniques or by using a dedicated stored-programme computer; *or*
 - (3) Capable of exerting a force of 250 N or more or a torque of 250 N.m or more and using titanium based alloys or fibrous and filamentary composite materials in their structural members;
- (e) Photographic cameras and associated equipment specially designed or modified for underwater use, having a film format of 35 mm or larger, incorporating any of the following:
 - (1) Film advancement of more than 5 frames per second;
 - (2) Annotating the film with data provided by a source external to the camera;
 - (3) Taking more than 400 full frame exposures without changing the film;
 - (4) Autofocussing or remote focussing specially designed or modified for underwater use;
 - (5) Automatic back focal distance correction;
 - (6) Passive or automatic compensation control specially designed to permit underwater camera housings to be useable at depths exceeding 1,000 m;
 - (7) Titanium underwater camera housings specially designed for depths exceeding 1,000 m; *or*
 - (8) Automatic exposure control by using sensing devices in or external to the camera, if the camera is capable of operating at depths of more than 300 m;
- (f) Light systems, as follows, specially designed or modified for underwater use:
 - (1) Stroboscopic lights capable of:
 - (A) Light output energy of more than 250 Joules per flash; *or*
 - (B) Flash rates of more than 5 flashes per second at a light output energy of more than 10 Joules per flash;
 - (2) Other lights and associated equipment, designed for operation with equipment embargoed by sub-items (e)(1) or (e)(8) above;
- (g) Specially designed components for the equipment embargoed by sub-items (a) to (f) above;
- (h) Air-independent power systems and specially designed components therefor, as follows, specially designed for underwater use:
 - (1) Brayton, Stirling or Rankine Cycle Engine air-independent power systems having any of the following characteristics:
 - (A) Specially designed chemical scrubber or absorber subsystems to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
 - (B) Specially designed subsystems for utilising a monoatomic gas;
 - (C) Specially designed devices for underwater noise reduction in frequencies less than 10 kHz, or special mounting devices for shock mitigation; *or*
 - (D) Specially designed systems for pressurising products of reaction or for fuel reformation, specially designed systems for the storage of products of the reaction, and specially designed systems for discharging the products of the reaction against a pressure of 100 kPa (1 bar, 15 lb/sq. in.) or more;
 - (2) Diesel Cycle Engine air-independent systems having all of the following characteristics:

1417 *continued*

- (A) Specially designed chemical scrubber or absorber subsystems to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
 - (B) Specially designed subsystems for utilising a monoatomic gas;
 - (C) Specially designed devices for underwater noise reduction in frequencies less than 10 kHz, or special mounting devices for shock mitigation; *and*
 - (D) Specially designed exhaust systems that do not continuously exhaust products of combustion;
- (3) Alkaline, phosphoric acid or ion exchange membrane fuel cell air-independent power systems with an output exceeding 2 kW and operating at a temperature of less than 523 K (250°C), having any of the following characteristics:
- (A) Specially designed enclosures for underwater noise reduction in frequencies less than 10 kHz, or special mounting devices for shock mitigation; *or*
 - (B) Specially designed systems for pressurising products of reaction or for fuel reformation, specially designed systems for the storage of products of the reaction, and specially designed systems for discharging the products of the reaction against a pressure of 100 kPa (1 bar, 15 lb/sq. in.) or more;
- (4) Specially designed components for subsystems embargoed by sub-items (h)(1)(C) or (h)(3)(A) or described in (h)(2)(C) above;

NOTE:

This sub-item embargoes only the following technology:

- (a) Technology for air-independent power systems embargoed by sub-items (h)(1), (h)(2) or (h)(3) above;
- (b) Technology for subsystems embargoed by sub-items (h)(1)(A), (h)(1)(B), (h)(1)(C), (h)(3)(A) or (h)(4) above; *and*
- (c) Technology for subsystems described in sub-items (h)(2)(A), (h)(2)(B) or (h)(2)(C) above.

(For electromechanical, semiconductor and radioactive devices, see Item 1205.)

(For underwater "robots", see Item 1391.)

NOTES:

1. This Item does not embargo specially designed components for equipment which would not have been embargoed had it not been modified.
2. Sub-item (a) above embargoes equipment using light metal peroxides such as KO₂ without embargoing the shipment of KO₂ itself.
3. Sub-item (b) above does not embargo automated control systems incorporated in underwater bulldozers or trench-cutters not capable of operating at depths of more than 100 m and possessing only negative buoyancy.
4. Sub-item (c) above does not embargo television cameras used merely through a porthole.
5. Sub-item (d)(1) above does not embargo systems where force or torque are only measured and then displayed to the operator.

1418

Deep submergence vehicles and autonomous submersible vehicles, as follows:

- (a) Deep submergence vehicles, manned or unmanned, tethered or untethered, capable of operating at depths exceeding 1,000 m, and specially designed or modified associated systems and equipment therefor, including the following:
 - (1) Pressure housings or pressure hulls;
 - (2) Propulsion motors and thrusters;
 - (3) Hull penetrators or connectors;
- (b) Other manned underwater vehicles which may "operate autonomously" for ten hours or more provided their maximum "range" underwater exceeds 15 nautical miles.

(For hull penetrators for military use, see Item 2009 of Group 2.)

Technical Note:

"Operate autonomously"—

Fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

"Range"—

Half the maximum distance the vehicle can cover.

1431

Marine gas turbine engines (marine propulsion or shipboard power generation engines), whether originally designed as such or adapted for such use, and specially designed components therefor.

NOTES:

1. Embargo of aero or industrial gas turbine engines and their specially designed components which have been adapted for marine propulsion or shipboard power generation does not re-embargo (or embargo, for industrial gas turbine engines) the unmodified version of such engines and their specially designed components (see also Item 1460).
2. Shipboard power generation does not include offshore platform
3. Governments may permit, as administrative exceptions, the shipment of engines and their specially designed components covered by this Item for non-marine propulsion or non-shipboard civil end-use, provided:
 - (a) The numbers to be exported are appropriate for the stated end-use;
 - (b) Only the minimum necessary technology for operation, maintenance and repair is transferred; *and*
 - (c) None of the following technologies is transferred:
 - (1) Technology which is common to aero-engine technology embargoed by Item 1460 and is not eligible for administrative exceptions treatment under that Item;
 - (2) Technology for liquid-cooled turbine blades or vanes and nozzles capable of operating in hot gas temperature environments greater than 1,000°C and their associated systems;

Technical Note:

"Associated systems" are closely connected to the engine and consist of the specially designed cooling fluid and fuel control systems, pumps, condensers and fluid purification systems;

- (3) Technology for fuel nozzles, combustors and gas turbine engine-mounted fuel-handling systems (fuel pumping, metering and controls) which permit marine gas turbines to burn heavy residual fuel-oils (ASTM grades 5 and 6 or equivalent);

Technical Note:

ASTM grade 5 residual fuel-oil has a maximum kinematic viscosity of 81 centistokes at 50°C (122°F), and ASTM grade 6 residual fuel-oil has a kinematic viscosity range of 92 to 638 centistokes at 50°C (122°F). Kinematic viscosity is measured by the Saybolt-furol viscosimeter (the test measures the time in seconds for 60 cc of the oil to pass through the furol orifice).

- (4) Technology for high-temperature (above 700°C gas temperature) heat exchangers for pre-heating compressor exit air;
 - (5) Technology for lightweight, compact combined gas turbine and steam (COGAS) systems having heat recovery rates of more than 40,000 BTU/hr. per cubic foot of waste heat boiler volume or more than 1,000 BTU/hr. per lb of waste heat boiler weight, designed for use with gas turbine engines for marine propulsion or shipboard power generation.
4. Core-section modules and specially designed components covered by Item 1460 shall be treated under the provisions of that Item, even if the gas turbine aero-engine has been modified for use in marine propulsion or shipboard power generation.

Aircraft and helicopters, including tilt wing and tilt rotor aircraft, aero-engines and aircraft and helicopter equipment, and technology therefor, as follows:

NOTE:

The provisions of this Item do not release technology for computer-aided design (CAD) or computer-aided design/manufacturing (CAD/CAM); or technology relating to manufacturing equipment or hardware embargoed by Items 1080, 1081, 1086, 1088, 1091, 1312, 1357, 1361, 1362, 1371, 1522, 1529 or any other Item, for the production or evaluation of aero-engines, APUs, "helicopter power transfer systems" or their specially designed components, or technology specific to production of superalloys as embargoed by Item 1301.

- (a) Aircraft and helicopters, *except* those which do not contain equipment embargoed by Group 2 or Items 1485 or 1501 (unless the export of such equipment is permitted under the administrative exceptions Notes to Items 1485 and 1501) and which are of types which are in *bona fide* normal civil use;
- (b) Technology for aircraft and helicopter, including tilt wing and tilt rotor aircraft, airframes, for aircraft propellers, and "helicopter rotor systems" components, as follows, and "specially designed software" therefor:

Technical Note:

"Helicopter rotor systems" consist of hubs, blades, blade attachments and upper controls. Upper controls are those control elements located in the rotating system, including the swashplate if used.

- (1) Design technology using computer-aided aerodynamic analyses for integration of the fuselage, propulsion system and lifting and control surfaces to optimize aerodynamic performance throughout the flight regime of an aircraft;
- (2) Technology for the design of active flight control systems, as follows:
 - (A) Technology for configuration design for inter connecting multiple microelectronic processing elements (on-board computers) to achieve high-speed data transfer and high-speed data integration for control law implementation;
 - (B) Technology for control law compensation for sensor location and dynamic airframe loads, i.e. compensation for sensor vibration environment and for variation of sensor location from centre of gravity;
 - (C) Technology for electronic management of systems redundancy and data redundancy for fault detection, fault tolerance and fault isolation;

NOTE:

This sub-item does not embargo technology for the design of physical redundancy in hydraulic or mechanical systems or in electrical wiring.

- (D) Technology for design of flight controls which permit inflight reconfiguration of force and moment controls;

Technical Note:

Active flight control systems function to prevent undesirable aircraft motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventative commands to effect automatic control.

- (3) Design technology for integration of flight control, navigation and propulsion control data into a flight management system for flight path optimization;
- (4) Design technology for protection of avionic and electrical sub-systems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards from sources external to the aircraft, as follows:
 - (A) Technology for design of shielding systems;
 - (B) Technology for the configuration design of hardened electrical circuits and sub-systems;
 - (C) Determination of hardening criteria for the above;
- (5) Technology for the design, production and reconstruction of adhesively bonded airframe structural members designed to withstand operational temperatures in excess of 393 K (120°C);

NOTE:

Airframe structural members mentioned in this sub-item do not include engine nacelles and thrust reversers.

- (6) Technology for the design and production of propeller blades constructed wholly or partly of composite materials, and specially designed hubs therefor;

NOTE:

This sub-item does not embargo technology for the production of propeller blades:

- (a) Constructed wholly of wood or glass-fibre-reinforced plastics;
 - (b) Constructed mainly of wood or glass-fibre-reinforced plastics; and using other materials only in the leading edge or tip; *or*
 - (c) Constructed mainly of glass-fibre-reinforced or carbon-fibre-reinforced plastics;
- (7) Technology for the design and production of digital electronic synchrophasers specially designed for propellers; technology for the design of digital electronic controls for propellers; and technology for the production of digital electronic controls for the propellers described in (6) above;
 - (8) Technology for the design and production of active laminar flow control lifting surfaces;

NOTE:

Design technology covered by sub-items (b)(1) to (8) above includes the data used to substantiate the design approach.

- (9) Technology for the development of helicopter multi-axis fly-by-light or fly-by-wire controllers which combine the functions of at least two of the following into one controlling element:
 - (A) Collective controls;
 - (B) Cyclic controls;
 - (C) Yaw controls;
- (10) Technology for the development of "circulation controlled" anti-torque or directional control systems for helicopters;

Technical Note:

"Circulation-controlled" anti-torque and directional control systems utilise air blown over aerodynamic surfaces to increase or control the forces generated by the surfaces. Buried fan-in-fin anti-torque designs fitted or not fitted with guide vanes such as the "fenestron" are excluded from this category.

- (11) Technology for the development of helicopter rotor blades incorporating variable geometry airfoils;

Technical Note:

Variable geometry airfoils utilise trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, which can be controlled in position in flight.

- (12) Technology for the development of active control of helicopter blades and other surfaces used to generate aerodynamic forces and moments;

Technical Note:

Active control (of helicopter blades and other surfaces used to generate aerodynamic forces and moments) functions to prevent undesirable helicopter vibrations, structural loads, or helicopter rotor dynamic behaviour by autonomously processing outputs from multiple sensors and then providing necessary preventative commands to effect automatic control.

- (13) Technology for the development and production of integrated automated propulsion and airfoil control systems for tilt wing and tilt rotor aircraft;
- (c) "Helicopter power transfer systems" and technology therefor, *except*:
 - (1) Those "helicopter power transfer systems" destined for use in "civil helicopters" only, as follows:
 - (A) Those which have been in civil use in *bona fide* "civil helicopters" for more than eight years;
 - (B) Those which government authorities have determined do not contain and were not fabricated utilising any of the technologies shown in Note 9;
 - (C) Not used;
 - (D) Those for replacement in or servicing of specific, previously exported helicopters;
 - (2) Data not in the public domain resulting from "helicopter power transfer system" performance and installation design studies; fabrication technology, or overhaul and refurbishing

technology for specific "helicopter power transfer systems" in civil use in *bona fide* "civil helicopters" for more than eight years, unless they remain listed in Note 9;

NOTE:

"Helicopter power transfer system" performance and installation design data do not include technology for: computer-aided design (CAD); computer-aided design/manufacturing (CAD/CAM); or parametric performance analysis, engine analysis and selection, or component design utilising unpublished technical data.

- (d) Gas turbine engines and auxiliary power units (APUs) for use in aircraft or helicopters and technology therefor, *except*:
- (1) Those destined for use in "civil aircraft" or "civil helicopters" only, as follows:
 - (A) Jet, turboprop and turboshaft aircraft engines in civil use in *bona fide* "civil aircraft" or "civil helicopters" for more than eight years, or which it is considered do not contain, and were not fabricated utilising, any of the technologies shown in Note 8;
 - (B) Not used;
 - (C) Gas turbine powered aircraft APUs in civil use in *bona fide* "civil aircraft" or "civil helicopters" for more than eight years, or where it is considered do not contain, and were not fabricated utilizing, any of the technologies shown in Note 8;
 - (2) Data not in the public domain resulting from aircraft performance and installation design studies; fabrication technology, or overhaul and refurbishing technology for specific gas turbine aero-engines or gas turbine powered aircraft APUs in civil use in *bona fide* "civil aircraft" or "civil helicopters" for more than 12 years, unless they remain listed in Note 8;

NOTE:

Aircraft performance and installation design data do not include technology for: computer-aided design (CAD); computer-aided design/manufacturing (CAD/CAM); or parametric engine performance analysis, engine cycle analysis and selection, or component aerodynamic design utilising unpublished technical data.

- (e) Specially designed components for gas turbine engines, APUs and "helicopter power transfer systems", embargoed by (c) and (d) above, as follows:
- (1) Embodying technologies listed under Notes 8 or 9;
 - (2) Hot-section components;
 - (3) Engine control system components;
 - (4) Gas turbine engine or APU rotor system components (including bearings);

NOTE:

(Aero-engines, APUs or "helicopter power transfer systems" which have any special feature designed for a military application are embargoed by the Group 2. See also Items 1485 and 1501. For technology relating to industrial gas turbine engines, see Item 1372. For marine gas turbine engines and related technology, see Item 1431).

NOTES:

1. "Civil aircraft" and "civil helicopters" are defined in Note 11.
2. The period of *bona fide* civil use referred to in sub-items (c) and (d) above begins with the date that the particular engine or "helicopter power transfer system" (model and specifications) or its most recent modification was certified as airworthy for commercial service or commercial navigability under the standards and requirements of the government of the country in which it was manufactured. However, it is recognized that many modifications which may require recertification may pertain to minor safety or operational changes which do not significantly enhance the performance of a particular gas turbine aero-engine or improve its reliability. It is the intent for control purposes that:
 - (a) A gas turbine aero-engine which is recertified as the result of incorporating any technology listed in Note 8 will be treated as a newly certified engine. Recertification which does not result from incorporation of such technology, or modifications which do not require recertification by national authorities, will not affect the current period of civil use of the engine;

- (b) Modification of a gas turbine APU by incorporation of any technology listed in Note 8 will cause it to be treated as a new APU. Other modifications will not affect the current period of civil use of the APU;
 - (c) Modification of a "helicopter power transfer system" by incorporation of any technology listed in Note 9 will restart the control period for the "helicopter power transfer system" as though it were newly certified in a helicopter. Other modifications will not affect the current period of civil use of the "helicopter power transfer system".
3. "Helicopter power transfer systems" referred to in sub-item (c) above are defined as all those components which transfer power from the engine to the main and tail rotor blade(s).
 4. Exports of technology, including transfer of skills and data, necessary for the design, fabrication, assembly and production testing of gas turbine engines embargoed by sub-item (d) or of the specially designed components embargoed by sub-item (e) are subject to embargo *except*, for civil use only, as provided in (a) to (g) below and in Notes 7 and 8. It is the intent that the export of any of these technologies to a military end-user or for military end-use be subject to embargo. This Note does not remove from embargo computer-aided design (CAD) or computer-aided design/manufacturing (CAD/CAM) technology. Only technology which is non-CAD, non-CAD/CAM may be shipped as provided for in the appropriate sub-paragraph(s). This Note also does not release technology relating to manufacturing equipment or hardware, covered by Items 1080, 1086, 1088, 1091, 1312, 1357, 1361, 1522, 1529 or any other Item, for the production or evaluation of gas turbine engines or their specially designed components, or technology specific to production of superalloys as embargoed by Item 1301.
 - (a) Technology, including transfer of skills and technical data, necessary for aircraft performance analyses and installation design studies of specific gas turbine aero-engines or aircraft gas turbine APUs embargoed by sub-item (d) above or of their specially designed components embargoed by sub-item (e) above shall be subject to the embargo for a period of 12 years, as defined in Note 2, after those engines have entered into *bona fide* civil use. From the end of the embargo period, the above technology may be shipped to civil end-users for civil end-uses.
 - (b) Fabrication technologies listed in Note 8 for gas turbine aero-engines or aircraft gas turbine APUs embargoed by sub-item (d) above or for their specially designed components embargoed by sub-item (e) above shall remain embargoed until those engines or APUs have been in civil use for more than 12 years, as defined in Note 2, unless they remain listed in Note 8.
Governments may permit, as administrative exceptions, the shipment of those fabrication technologies (other than CAD/CAM) to civil end-users for civil end-uses provided such engine technologies have been in engines or APUs in civil use for more than eight years, as defined in Note 2.
 - (c) Fabrication technology for gas turbine aero-engines or aircraft gas turbine APUs embargoed by sub-item (d) above, or for specially designed components embargoed by sub-item (e) above, which do not embody any technology listed in Note 8, is embargoed for eight years.
Governments may permit, as administrative exceptions, the shipment of these fabrication technologies (other than CAD/CAM) to civil end-users for civil end-uses.
 - (d) Technology for assembly and production testing of gas turbine aero-engines or aircraft gas turbine APUs embargoed by sub-item (d) above, or of their specially designed components embargoed by subitem (e) above, is embargoed for eight years.
Governments may permit, as administrative exceptions, the shipment of such technology (other than CAD/CAM) to civil end-users for civil end-uses.
 - (e) Technology for on-site installation, operation, maintenance and repair of gas turbine engines or APUs embargoed by sub-item (d) above is embargoed for eight years.
Governments may permit, as administrative exceptions, the shipment of such technology (other than CAD/CAM) to civil end-users for civil end-uses.
 - (f) Overhaul and refurbishing technologies for gas turbine engines or APUs embargoed by sub-item (d) above or for specially designed components embargoed by sub-item (e) above, which embody any technology listed in Note 8, shall

remain embargoed until those engines or APUs have been in civil use for more than 12 years, as defined in Note 2. Governments may permit, as administrative exceptions, the shipment of those overhaul and refurbishing technologies (other than CAD or CAD/CAM) to civil end-users for civil end-uses provided that such engines or APUs have been in civil use for more than eight years, as defined in Note 2.

- (g) Overhaul and refurbishing technologies for gas turbine engines or APUs embargoed by sub-item (d) above or for specially designed components embargoed by sub-item (e) above, which do not embody any technology listed in Note 8, shall remain embargoed until those engines or APUs have been in civil use for more than eight years, as defined in Note 2.

Governments may permit, as administrative exceptions, the shipment of such know-how (other than CAD or CAD/CAM) to civil end-users for civil end-uses.

N.B.:

The provisions of (a) to (g) above apply provided:

- (a) Technology as described in this Note, including unpublished data (all data other than those generally available to the public), to be provided will be the minimum necessary in content and quality for the purposes of the transaction; and
- (b) It is considered that the specially designed components to be assembled into gas turbine engines or APUs produced by the recipient with technology supplied under this Note, and all the gas turbine engines and APUs thereby assembled, will be for civil use as described in Note 11.
5. Exports of technology including transfer of skills and data, necessary for the design, fabrication, assembly and production testing of "helicopter power transfer systems" embargoed by sub-item (c) above, or of the specially designed components embargoed by sub-item (e) above, shall be subject to embargo *except*, for civil use only, as provided in (a) to (g) below and in Note 9. It is the intent that export of any of these technologies to a military end-user or for military end-use be subject to embargo. This Note does not remove from embargo, nor authorize administrative exception treatment of, computer-aided design (CAD) or computer-aided design/manufacturing (CAD/CAM) technology. Only technology which is non-CAD, non-CAD/CAM may be shipped as provided for in the appropriate sub-paragraph(s). This Note also does not release technology relating to manufacturing equipment or hardware, covered by Items 1088, 1091, 1312, 1357, 1371, 1522, 1529 or any other Item, for the production or evaluation of "helicopter power transfer systems" or their specially designed components.
- (a) Technology, including transfer of skills and technical data, necessary for "helicopter power transfer system" performance analyses and installation design studies of specific "helicopter power transfer systems" embargoed by sub-item (c) above or of their specially designed components embargoed by sub-item (e) above shall be subject to the embargo for a period of eight years, as defined in Note 2, after those systems have entered into *bona fide* civil use. From the end of the embargo period, the above technology may be shipped to civil end-users for civil end-uses.
- (b) Fabrication technologies listed in Note 9 for "helicopter power transfer systems" embargoed by sub-item (c) above or for the specially designed "helicopter power transfer system" components embargoed by sub-item (e) above shall remain embargoed until those technologies have been in *bona fide* "civil helicopters" in civil use for more than eight years, as defined in Note 2, unless the technology remains listed in Note 9.
Governments may permit, as administrative exceptions, the shipment of those fabrication technologies (other than CAD/CAM) to civil end-users for civil end-uses, provided that such "helicopter power transfer system" technologies have been in *bona fide* "civil helicopters" in civil use for more than six years, as defined in Note 2.
- (c) Fabrication technology for "helicopter power transfer systems" embargoed by sub-item (c) above or for specially designed "helicopter power transfer system" components embargoed by sub-item (e) above, which do not embody any technology listed in Note 9, is embargoed for eight years.

- (d) Technology for assembly and production testing of "helicopter power transfer systems" embargoed by sub-item (c) above or of their specially designed components embargoed by sub-item (e) above is embargoed for eight years.

Governments may permit, as administrative exceptions, the shipment of such technology (other than CAD/CAM) to civil end-users for civil end-uses.

- (e) Technology for on-site installation, operation, maintenance and repair of "helicopter power transfer systems" embargoed by sub-item (c) above is embargoed for eight years. Governments may permit, as administrative exceptions, the shipment of such technology (other than CAD/CAM) to civil end-users for civil end-uses.

- (f) Overhaul and refurbishing technologies for "helicopter power transfer systems" embargoed by sub-item (c) above, or for specially designed components embargoed by sub-item (e) above, which embody any technology listed in Note 9, shall remain embargoed until those "helicopter power transfer systems" have been in civil use for more than eight years, as defined in Note 2.

Governments may permit, as administrative exceptions, the shipment of such overhaul and refurbishing technologies (other than CAD or CAD/CAM) to civil end-users for civil end-uses, provided such "helicopter power transfer system" technologies have been in *bona fide* "civil helicopters" in civil use for more than six years, as defined in Note 2.

- (g) Overhaul and refurbishing technologies for "helicopter power transfer systems" embargoed by sub-item (c) above, or for specially designed components embargoed by sub-item (e) above, which do not embody any technology listed in Note 9, shall remain embargoed until those helicopter power transfer systems" have been in civil use for more than eight years, as defined in Note 2.

Governments may permit, as administrative exceptions, the shipment of such overhaul and refurbishing technologies (other than CAD or CAD/CAM) to civil end-users for civil end-uses.

N.B.:

The provisions of (a) to (g) above apply provided:

- (a) Technology as described in this Note, including unpublished technical data (all data other than that generally available to the public), to be provided will be the minimum necessary in content and quality for the purposes of the transaction; and
- (b) It is considered that the specially designed components to be assembled into "helicopter power transfer systems" produced by the recipient with technology supplied under this Note, and the "helicopter power transfer systems" thereby assembled, will be for civil use as described Note 11.
6. Governments may permit, as administrative exceptions, the shipment, for civil end-uses by civil end-users, of:
- (a) "Helicopter power transfer systems" embargoed by sub-item (c) above when incorporated in *bona fide* "civil helicopters" as defined in Note 11;
- (b) Gas turbine engines or APUs embargoed by sub-item (d) above for incorporation into or incorporated in *bona fide* "civil aircraft" or "civil helicopters" as defined in Note 11;
- (c) Specially designed components embargoed by sub-item (e) above, for use in engines, APUs or "helicopter power transfer systems" authorised for production in proscribed destinations or previously exported under (a) or (b) above, provided:
- (1) The specially designed components will only be incorporated in engines, APUs or "helicopter power transfer systems" produced for use in *bona fide* "civil aircraft" or "civil helicopters" as defined in Note 11; and
- (2) It is considered that the export of specially designed components for "helicopter power transfer systems" embodying technologies listed in Note 9, or for gas turbine aero-engines or aircraft gas turbine APUs embodying technologies listed in Note 8, only in quantities appropriate:
- (A) To support the assembly of that number of "helicopter power transfer systems", engines or APUs required for installation in, and as standard spares for, *bona fide* "civil aircraft" or "civil helicopters" in current production; or
- (B) To support current civil fleet operations.
7. This Item does not embargo for civil use gas turbine engines, APUs and "helicopter power transfer systems" and modifications (and

technology therefor) certified or re-certified for civil use, as described in Note 2, prior to the January 1, 1979, and not embargoed by the following definitions:

- (i) Helicopters over 4,530 kg (10,000 lb) empty weight, and power transmissions systems therefor;

NOTE:

Empty weight is understood to include normal installation and normal minimum crew, but does not include fuel or payload.

- (ii) Aero-engines, as follows:
 - (a) Jet engines of less than 2,265 kg (5,000 lbs) of thrust;
 - (b) Turboprop or turboshaft engines of less than 2,500 horsepower or with a residual thrust of less than 453 kg (1,000 lbs).

It is the intent that the export of any of these gas turbine engines, APUs and "helicopter power transfer systems" and modifications (and technology therefor) to a military end-user or for military end-use be subject to embargo.

- 8. Sub-item (d) above does not embargo for use in *bona fide* "civil aircraft" or "civil helicopters" those engines listed which it is considered contain none of the technologies listed in table 1. Gas turbine engines embodying any of these technologies shall remain under embargo until the technology has been in civil use for eight years, as defined in Note 2, after the initial certification date (shown in table 1). The technologies listed in table 1 shall remain under control for 12 years after the initial certification date of the engine (shown in table 1), unless the expiration date of the embargo period is extended.
- 9. Sub-item (c) above does not embargo for use in *bona fide* "civil helicopters" those "helicopter power transfer systems" which it is considered contain none of the technologies listed in table 2. "Helicopter power transfer systems" embodying any of these technologies, and these technologies themselves, shall remain under control for eight years after the initial certification date (shown in table 2), unless the expiration date is extended.
- 10. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of aircraft and helicopters which are considered to be of types which are in *bona fide* normal civil use, which contain equipment covered by Items 1485 or 1501, provided:
 - (a) Any embargoed components in such aircraft or helicopters are limited to those normally installed by the manufacturer;
 - (b) Repair and maintenance of embargoed inertial navigation systems and complete overhaul of embargoed engines will be performed in a non-proscribed country or by representatives of the Western suppliers; and
 - (c) Embargoed parts will be replaced on a one-for-one basis.
- 11. The terms "civil aircraft" and "civil helicopters" are understood to include only those types of civil aircraft and helicopters which are listed by designation in published airworthiness certification lists by the civil aviation authorities to fly commercial civil internal and external routes or for legitimate civil, private or business use. The total number of aircraft or helicopters (and aero-engines or "helicopter power transfer systems") by type which may be included within the terms "civil aircraft" and "civil helicopters" shall not exceed that number which appears to constitute a reasonable requirement for operation of published scheduled services or for legitimate civil, private or business use.

TABLE 1 (see Illustration 146D Note B)

I. Materials and manufacturing procedures	Initial certification date	Engine	Type certificate number
Ceramic, ceramic-composite or composite hot-section components (combustor, turbine blades and vanes, seals, discs, flow path)	—	None	—
Turbine blades on basis of directional solidification capable of operating in high gas temperature environments (in excess of 1,593 K (1,320c))	30/09/74 (*)	JT9D-7F	E20EA
Turbine blades on basis of monocrystal technology	25/11/80	JT9D-7R4	E3NE
Turbine blades consisting of several parts connected by diffusion bonding	—	None	—
Fibre technology in frames or in highly stressed discs, casings, blades and vanes	—	None	—

Application of powder metallurgy for fan, compressor and turbine blades or vanes; discs, wheels reduction gears, engine main shafts and frames

• discs	01/78	JT8D-17	E2EA
• fan, compressor and turbine blades or vanes, wheels, reduction gears, engine main shafts and frames	—	None	—

Cooled components on basis of electrostream or laser drilling methods:

• electrostream drilling	30/09/74	JT9D-7F	E20EA
• laser drilling	16/09/70 (**)	CF6-6	E23EA

Electron beam drilling for small holes in turbine blades and vanes (Item 1080 I (c) sets out the parameters for small holes)

—	—	None	—
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Titanium or superalloy casting on basis of centrifugal techniques

—	13/01/78	TFE-731	E6WE
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Ceramic core casting technology for casting holes in turbine blades and vanes

—	07/04/71 (***)	JT8D-15	E2EA
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II. Construction methods

Adjustable flow path geometry and associated control systems for:

• fans	—	None	—
• gas generator turbine(s)	—	None	—
• fan/power turbine(s)	—	None	—
• propelling nozzles	—	None	—

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

Full authority or hybrid digital electronic control and respective sensor equipment	25/11/80	JT9D-7R4	E3NE
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High temperature (capable of utilizing gases heated above 1,373 K (1,100°C) heat exchangers for preheating compressor exit air

—	—	None	—
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Combustors with combustion in several stages

—	08/11/79	CFM-56	E2GL
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Maintenance of compressor or turbine tip clearance through methods employing active compensating casing technology:

• compressor alone	—	None	—
• turbine alone	01/04/81	JT9D-7R4E1	E3NE
• compressor and turbine	—	None	—

Ceramic bearings

—	—	None	—
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Nozzles with thrust vectoring (not including reverse thrust)

—	—	None	—
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N.B.: Technology for computer-aided design/manufacturing (CAD/CAM) is not released by the deletion of any technology from the above list.

(*) Embargo period extended by three years to September 30, 1989, and by another three years to September 30, 1992.

(**) Embargo period extended by three years to September 16, 1985, then by three years to September 1988 and by another three years to September 16, 1991.

(***) Embargo period extended by three years to April 7, 1986 and by another three years to April 7, 1989.

TABLE 2 (see Illustration 1460 Note 9)

I. Materials and manufacturing procedures	Initial certification date	Helicopter	Type certificate
A. Rotor heads, containing:			
• Hot-isostatically pressed materials	—	None	—
B. Gear boxes, containing:			
• Novikov-type gears	—	None	—
• Gears or gear support structures based on materials applying directional solidification or monocrystal technology	—	None	—
• High contact-ratio double-helical (arrow-shaped) gears	—	None	—
• Fibre technology	—	None	—
• Hot-isostatically pressed components	—	None	—
• Gear tooth surfaces hardened by vacuum carburizing or ion nitriding	—	None	—
C. Drive shaft systems containing super-critical drive shafts	—	None	—
II. Construction methods			
A. Components fabricated by diffusion bonding	—	None	—
B. High-survivability loss-of-lubrication technology for high-speed bearings (DN equal to or greater than 2.4 million where D is in millimetres and N in rpm)	—	None	—

NOTE:

The intention of Note 2 to Item 1460 is to ensure an eight-year embargo on gas turbine aero-engines, gas turbine powered aircraft APUs, and "helicopter power transfer systems". A twelve-year control of technologies for aero-engines and APUs, and an eight-year control of technologies for "helicopter power transfer systems" applies. It is the intent that, even after these time periods have elapsed, the aero-engines, APUs and "helicopter power transfer systems" and technology therefor shall be exported only for use in *bona fide* "civil aircraft" or "civil helicopters". Computer-aided design (CAD) or computer-aided design/manufacturing (CAD/CAM) technology is not removed from embargo, nor authorised for administrative exception treatment, by any provision of Item 1460.

The technology which shall be administered according to Notes 4 and 5 to Item 1460 is defined as follows:

- 1) On-site maintenance, component/sub-assembly replacement, or repair:
 - On-site installation;
 - On-site assembly and related testing;
 - Operational limitations;
 - System specifications;
 - Tooling drawings for on-site maintenance and module separation;
 - Illustrated parts catalogue;
 - Operations engineering bulletins;
 - On-site maintenance manual;
- 2) Fabrication:
 - Production line assembly and test;
 - Heat treating;
 - Drilling processes;
 - Chemical processes;
 - Materials composition;
 - Foundry practices;
 - Protective coating application techniques;
 - Powder metallurgy;
 - Joining techniques;
 - Complex machining techniques;
 - Direction solidification and single-crystal blade/vane fabrication technology;
- 3) Design:
 - (a) Aircraft performance analyses and installation design studies not in the public domain including data specific to a particular engine:
 - Tabulated performance data for installation design use;
 - Structural and heat transfer analysis;
 - Vibration analysis;
 - Bearing and seal design;
 - Durability and heat analysis;
 - Engine skin temperatures, engine cycle pressures, and engine thruster nozzle coefficients;
 - Mounting system analysis;
 - Lubrication system analysis;
 - Fuel system analysis;
 - Control system analysis;
 - Exhaust system analysis;
 - Engine noise characteristics;
 - Dimensions/tolerances;
 - Airfoil shapes;
 - (b) Helicopter power transfer system performance analyses and installation design studies not in the public domain (including data specific to a particular helicopter power transfer system):
 - Dimensions/tolerances;
 - Mounting systems analysis;
 - Structural analysis;
 - Vibration analysis;
 - Bearing and seal design;
 - Durability and heat transfer analysis;
 - Lubrication systems analysis;
 - Gear-box noise characteristics;
- 4) Other design technologies, not released on the basis of age, including but not limited to:
 - (a) For engines or APUs:
 - CAD or CAD/CAM (including design and analysis computer programmes, parametric engine performance analysis);
 - Engine cycle analysis and selection;
 - Component aerodynamic design;
 - Airfoil cooling and seal design;
 - (b) For "helicopter power transfer systems":
 - CAD or CAD/CAM (including parametric helicopter

gear-box performance analysis and helicopter load-cycle analysis and selection).

1465**"Spacecraft" and launch vehicles, as follows:**

- (a) "Spacecraft", manned or unmanned (not including their payloads);

NOTE:

For controls applicable to products contained in "spacecraft" payloads, see the appropriate International List Items.

- (b) Launch vehicles;
- (c) Propulsion systems, guidance equipment, altitude control equipment; and on-board communications equipment for remote control of the equipment embargoed by (a) or (b) above;
- (d) Specially designed components for the above.

Technical Note:

"Spacecraft" are defined as active and passive satellites and space probes.

NOTE:

Scientific mission space probes which do not contain equipment either embargoed by sub-item (c) above or embargoed by any other Item on this List are not embargoed by this Item.

1485**Inertial navigation systems, inertial equipment, gyroscopes (gyros) and accelerometers, and "specially designed software" therefor, as follows, and specially designed components therefor:**

(See also Items 1385 and 1465.)

- (a) Gyro compasses with provision for determining and transmitting ship's level reference data (roll, pitch) in addition to own ship's course data;
- (b) "Integrated digital flight instrument systems" which include gyrostabilisers or automatic digital flight control systems for aircraft and "specially designed software" for the integration thereof, *except*:
 - (1) Flight instrument systems integrated solely for VOR, ILS or MLS navigation and approaches; *or*
 - (2) Integrated flight instrument systems which:
 - (A) Have been in normal civil use for more than two years; *and*
 - (B) Are standard equipment of "civil aircraft" and "civil helicopters";

Technical Note:

"Integrated digital flight instrument system"—

A primary instrument and display system using digital data processing techniques to provide manoeuvre guidance information.

N.B.:

An "integrated digital flight instrument system" is often integrated with an autopilot to the extent of embodying a common unit for setting up the required demands.

- (c) Gyro-astro compasses and other devices which derive position or orientation by means of automatically tracking celestial bodies;
- (d) Gyro-stabilisers used for purposes other than aircraft control, *except*:
 - (1) Those for stabilising an entire surface vessel; *or*
 - (2) Those which have been in normal civil use for more than two years;
- (e) Automatic pilots used for purposes other than aircraft control and "specially designed software" for the integration thereof, *except* marine types for surface vessels;

NOTE:

This sub-item does not include automatic pilots for underwater vehicles, which are dealt with in Item 1417.

- (f) Accelerometers, designed for use in inertial navigation systems or in guidance systems of all types, having either of the following characteristics:

- (1) A threshold of 0.005 g or less; *or*
- (2) A non-linearity of less than 0.25% of full scale output;
- (g) Gyros with a rated free directional drift rate (rated free precession) of less than 0.50 degree (1 sigma or root mean square value (r.m.s.)) per hour in a 1 g environment;
- (h) Continuous output accelerometers which utilise "servo" or "force balance" techniques and gyros, both specified to function at acceleration levels above 100 g;
- (i) Inertial or other equipment using accelerometers embargoed by (f) or (h) above or gyros embargoed by (g) or (h) above, and systems incorporating such equipment, and "specially designed software" for the integration thereof;
- (j) Specially designed test, calibration and alignment equipment for goods embargoed by any of the above sub-items.

Electronics and Precision Instruments

NOTES:

1. See also Item 2011.
2. For computer related terms, see Item 1565 or 1566.
3. Broadcast and television receivers of the domestic type are expressly exempt from control.

1501

Navigation, direction finding, radar and airborne communication equipment, as follows:

(See also Items 1485(b) and (i), 1573 and 1574.)

- (a) Airborne communication equipment having any of the following characteristics, and specially designed components and "specially designed software" therefor:
 - (1) Designed to operate at frequencies greater than 156 MHz;
 - (2) Incorporating facilities for:
 - (i) The rapid selection of more than 200 channels per equipment; *or*
 - (ii) Equipment using frequency synthesis techniques (see also Item 1531); *except* equipment operating in the frequency range of 108 to 137 MHz with 760 channels or fewer at not less than 25 kHz spacing, and which has been in normal civil use for at least one year;
 - (3) Rated for continuous operation over a range of ambient temperatures extending from below -55°C to above +55°C;
 - (4) Designed for modulating methods employing any form of digital modulation using time and frequency redundancy such as Quantized Frequency Modulation (QFM);

NOTE:

This sub-item does not embargo airborne communication equipment which is not embargoed by (4) above and:

- (a) Is needed to equip "civil aircraft"; *or*
- (b) Is normal standard equipment incorporated in "civil aircraft";
- (b) Navigation and direction finding equipment, as follows, specially designed components and "specially designed software" therefor, and specialised testing, calibrating and training/simulating equipment therefor:
 - (1) Airborne navigation equipment and direction finding equipment, as follows:
 - (i) Designed to make use of Doppler frequency phenomena *except* navigation equipment to be installed in "civil aircraft" or "civil helicopters", and which is normal standard equipment of a type installed in "civil aircraft" or "civil helicopters" in a Western country.

N.B.:

Technology for navigation equipment using Doppler frequency phenomena remains under embargo.

- (ii) Utilising the constant velocity or the rectilinear propagation characteristics of electromagnetic waves having a frequency less than 4×10^{14} Hz (0.75 micrometre);
- (iii) Radio altimeters, the following:
 - (a) Pulse modulated;
 - (b) Frequency modulated having a displayed electrical output accuracy better than ± 0.914 m (± 3 feet) over the range between 0 and 30.4 m (100 feet) or better than $\pm 3\%$ above 30.4 (100 feet) *except* standard commercial airborne equipment needed to equip "civil aircraft" or "civil helicopters" or as normal standard equipment incorporated in "civil aircraft" or "civil helicopters" being exported for civil commercial use, provided such equipment is equivalent in all characteristics and performance to standard equipment of aircraft not subject to embargo, and which are frequency-modulated radio altimeters which have been in normal civil use for a period of more than one year;

N.B.:

Technology of these radio altimeters remains under embargo.

- (c) Frequency modulated which have been in normal civil use for less than one year;

Technical Note:

The accuracy is related to that provided by the electrical output circuits of the altimeter at any altitude. The word accuracy also refers to the equipment's accuracy over time. This accuracy over time is defined for the instrument itself without reference either to a calibrated value or to a designated electrical value.

- (iv) Direction finding equipment operating at frequencies greater than 5 MHz;
- (v) Rated for continuous operation over a range of ambient temperatures extending from below -55°C to above +55°C;

NOTES:

1. Sub-item (b)(1)(ii) does not embargo Loran-C equipment having all of the following characteristics:
 - (a) It has been in normal civil use for a period of more than one year;
 - (b) It is standard commercial equipment:
 - (1) Needed to equip "civil aircraft"; *or*
 - (2) Incorporated in "civil aircraft";
 - (c) It is equivalent in all characteristics and performances to standard equipment of aircraft not subject to embargo;
 - (d) It is in conformity with ICAO standards;
 - (e) It is not designed to make use of hyperbolic grids at frequencies higher than 3 MHz; *and*
 - (f) It does not contain electronic equipment which:
 - (1) Can compute the position of the aircraft in one coordinate system when furnished position information in another coordinate system (i.e., "coordinate conversion equipment");
 - (2) Could not be shipped under the provisions of Item 1565; *and*
 - (3) Has been in normal civil use for a period of less than one year.
2. Direction finding equipment specially designed for search and rescue purposes and operating at a frequency of 121.5 MHz or 243 MHz is not covered by this sub-item. This exclusion also applies to personal locator beacons operating in this form and which may also have an additional channel selectable for voice mode only.
 - (2) Ground and marine equipment for use with airborne navigation equipment utilizing the constant velocity or the rectilinear propagation characteristics of electromagnetic waves having a frequency less than 4×10^{14} Hz (0.75 micrometre);
 - (3) Ground and marine direction finding equipment operating at frequencies greater than 30 MHz;

NOTE:

This sub-item does not embargo equipment, other than single side band equipment, operating at frequencies up to 157 MHz and employing a loop system or a system employing a number of spaced vertical aerials uniformly disposed around the circumference of a circle, excluding electronically commutated types.

- (4) Timing receivers whose only function is automatically providing time derived from satellite signals to within 1 ms of Universal Coordinate Time (UTC) or better;
- (5) Ground or marine navigation and geodetic positioning systems designed for use with satellite-provided timing, positioning or navigation information;
- (c) Radar equipment, as follows, and specially designed components, specialised testing, calibrating and training/simulating equipment, and "specially designed software" therefor:
(For lidar equipment, see Item 1522.)
 - (1) Airborne radar equipment;

NOTE:

This Item does not embargo airborne civil weather radar conforming to international standards for civil weather radars provided they do not include any of the following:

- (a) Phased array antennas;
- (b) "Frequency agility";
- (c) "Spread spectrum"; or
- (d) Any signal processing specially designed for tracking of vehicles.
- (2) Ground and marine radar equipment having one or more of the following features:
 - (i) Operating at a frequency not in normal civil use or at a frequency of more than 10.5 GHz;
 - (ii) Operating at a frequency of less than 1.5 GHz and having a peak output power from the transmitter greater than 2.5 MW; or operating at a frequency within the range of 1.5 to 3.5 GHz and having a peak output power from the transmitter greater than 1.5 MW; or operating at a frequency within the range of 3.5 to 6 GHz and having a peak output power from the transmitter greater than 1 MW; or operating at a frequency within the range of 6 to 10.5 GHz and having a peak output power from the transmitter greater than 500 kW;
 - (iii) Operating at a frequency of less than 3.5 GHz and having an 80% or better probability of detection for a 10 m² target at a free space range of 250 nautical miles; or operating at a frequency within the range of 3.5 to 10.5 GHz and having an 80% or better probability of detection for a 10 m² target at a free space range of 100 nautical miles;
 - (iv) Utilising other than pulse modulation with a constant or staggered pulse repetition frequency, in which the carrier frequency of the transmitted signal is not changed deliberately between groups of pulses, from pulse to pulse or within a single pulse; *except* civil commercial airport radars using a carrier frequency that may change from pulse to pulse between two fixed frequencies separated in time and in frequency by constant magnitudes;
 - (v) Utilising a Doppler technique for any purpose, other than M.T.I. systems using a conventional double or triple pulse delay line cancellation technique; *except* those utilised for surveillance and control radars for aerial navigation in civil airports;
 - (vi) Including any digital signal processing techniques used for automatic target tracking, or having a facility for electronic tracking;
 - (vii) Including signal processing techniques other than those embargoed by (vi) above, which have been in normal civil use for a period of less than two years;
 - (viii) In the case of ground radar, having been in commercial use for a period of less than one year;

Technical Note:

Probability of detection is determined according to the following parameters:

- (a) Radial closing velocity of the target: 610 metres per second (2,000 feet per second);
- (b) Probability of false alarm: 10⁻⁸;
- (c) Operator factor: 3 dB; *and*

- (d) Fluctuation of the target in accordance with Rayleigh distribution.

NOTE:

Governments may permit, as administrative exceptions, the shipment of the following:

- (a) Radar equipment embargoed only by (2)(i), (ii) or (iii) above, provided both of the following conditions are met:
 - (1) It is specially designed for the surveillance and coordination of airfield surface traffic; *and*
 - (2) It is to be installed at airports operating scheduled commercial flights;
- (b) Radar equipment embargoed only by (2)(ii) or (iii) above, or by both, provided all the following conditions are met:
 - (1) Operating at a frequency of not more than 1.5 GHz and having a peak output power from the transmitter not greater than 5 MW; or operating at a frequency within the range of 1.5 to 3.5 GHz and having a peak output power not greater than 2.5 MW;
 - (2) Having an 80% or better probability of detection for a 10m² target at a free space range of 270 nautical miles;
 - (3) Having a pulse repetition frequency exceeding 300 pulses per second;
 - (4) It is to be installed for air traffic control scheduled international commercial flights;
- (c) Radar equipment embargoed only by (2)(iv) or (v) above, provided it is to be installed for air traffic control purposes in international airports and has been in normal civil use for a period of not less than three years.
- (d) Radar equipment embargoed by (2)(vi) above, provided it is specially designed for marine, harbour or meteorological use, or has been in normal civil use for not less than three years.
- (e) Radar equipment embargoed only by (2)(vii) above, provided it is specially designed for marine (or harbour) use, or radar equipment embargoed only by (2)(vii) or (viii) above, or both, provided it is specially designed for meteorological observation.

Technical Notes:

1. The terms "civil aircraft" and "civil helicopters" are understood to include only those types of "civil aircraft" and "civil helicopters" which are listed by designation in published airworthiness certification lists by the civil aviation authorities to fly commercial civil internal and external routes or for legitimate civil, private or business use.
2. By "coordinate conversion equipment" is meant electronic equipment designed to compute the position of the aircraft in one coordinate system when furnished position information in another coordinate system.

NOTES:

1. Nothing in the following shall be construed as permitting the export of specially designed "software" or technology for navigation, direction finding, radar and airborne communication equipment, or technology for specially designed components therefor, *except* for the minimum "software" and technology for the use (i.e. the installation, operation and maintenance) of the following equipment.

This Item does not embargo the following:

- (a) Standard commercial airborne equipment embargoed by sub-item (b)(1)(ii) above needed to equip "civil aircraft" or "civil helicopters" (see Note 11 of Item 1460) or as normal standard equipment incorporated in "civil aircraft" or "civil helicopters" being exported for civil commercial use, provided such equipment is in conformity with ICAO standards and assures no function exceeding those resulting from such standards, is not designed to use satellite broadcasted navigation signals and is not designed to make use of hyperbolic grids at frequencies greater than 3 MHz. (Standard commercial airborne equipment designed to make use of hyperbolic grids at frequencies of less than 3 MHz may be exported if "coordinate conversion equipment", which has been in normal civil use for less than one year or which could not be shipped under the provisions of Item 1565, is not included or is not separately supplied.) Normal civil equipment released by this paragraph consists of: Marker beacons, ILS, VOR ("OMNI"), Omega, Loran A and B;
- (b) Ground and marine equipment embargoed by sub-item (b)(2) above, for use with airborne navigation equipment using the constant velocity or rectilinear propagation characteristics of

electromagnetic waves having a frequency less than 4×10^{14} Hz (wavelength 0.75 micrometre), provided the ground equipment is for use at civil airports or for civil use in association with civil airborne equipment, and:

- (1) Is in conformity with ICAO standards and assures no function exceeding those resulting from such standards;
 - (2) Is not designed to make use of hyperbolic grids at frequencies greater than 3 MHz;
- (c) Equipment embargoed by sub-item (b)(5) above which is restricted to use with TRANSIT satellite systems or other unembargoed systems and which is not also embargoed by sub-item (b)(4) above;
 - (d) Secondary radar equipment embargoed by sub-item (c) above specially designed for civil air traffic identification and control purposes;
 - (e) Equipment assemblies for civil marine automatic radar plotting aids or electronic relative motion analysers designed to achieve the requirements published by the International Maritime Organisation in accordance with the Safety of Life at Sea (SOLAS) conventions, provided the designed tracking speeds do not exceed relative values of greater than knots (77.1 metres/second);
 - (f) Ground radar of the hand-held or automobile-mounted type used for vehicle speed monitoring by police authorities and operating in the frequency band from 10.5 to 10.55 GHz.
 - (g) Global positioning satellite receivers listed in sub-items (b)(4) and (b)(5) above which have all of the following characteristics:
 - (1) Capable only of processing the L1 channel (also called the Standard Positioning Service (SPS) channel);
 - (2) Capable of only the Short-Term Code (Coarse Acquisition Code (C/A) code) with short term generation cycle;
 - (3) No decryption capabilities;
 - (4) Including no cesium beam standards; *and*
 - (5) Including no null steerable antennae.
2. Specialised testing or calibrating equipment shipped pursuant to the various exclusion clauses in this Item shall be limited to equipment:
 - (a) Shipped with operational equipment for which the exclusion clause is intended; *or*
 - (b) Specifically for such operational equipment which has previously been exported.

1502

Communication, detection or tracking equipment of a kind using ultra-violet radiation, infrared radiation or ultrasonic waves, specially designed components and "specially designed software" therefor.

NOTES:

1. Infrared or ultra-violet sensing devices not otherwise embargoed by Item 2015 of Group 2 and which contain image intensifiers embargoed by Item 1555 are dealt with in this Item.
2. This Item does not embargo:
 - (a) Industrial equipment employing cells not embargoed by Item 1548;
 - (b) Industrial and civilian intrusion alarm, traffic and industrial movement control and counting systems;
 - (c) Medical equipment;
 - (d) Industrial equipment used for inspection, sorting or analysis of the properties of materials;
 - (e) "Simple educational devices" which employ photocells;
 - (f) Simple devices for entertainment or for home use which employ photocells;
 - (g) Flame detectors for industrial furnaces;
 - (h) Equipment for non-contact temperature measurement for laboratory or industrial purposes using a single detector cell with no scanning of the detector;
 - (i) Instruments capable of measuring radiated power or energy having a response time constant exceeding 10 ms;
 - (j) Equipment designed for measuring radiated power or energy for laboratory, agricultural or industrial purposes using a

single detector cell with no scanning of the detector and single detector cell assemblies or probes specially designed therefor, having a response time constant exceeding 1 microsecond;

- (k) Infrared geodetic equipment, provided that equipment uses a lighting source other than a laser and is manually operated, or uses a lighting source (other than a laser or a light-emitting diode) remote from the measuring equipment;
 - (l) Infrared communication equipment with characteristics not exceeding those in Item 1519;
3. This Item does not embargo ultrasonic devices:
 - (a) Operating in contact with a controlled material to be inspected;
 - (b) Used for industrial cleaning, sorting or materials handling;
 - (c) Used for emulsification;
 - (d) Used for homogenisation;
 - (e) Used in "simple educational devices";
 - (f) Used in simple entertainment devices;
 4. This Item does not embargo underwater ultrasonic communication systems which do not have any of the following:
 - (a) Electronic beam steering;
 - (b) Encryption techniques; *or*
 - (c) A carrier frequency outside the range from 20 to 60 kHz.
 5. This Item does not embargo:
 - (a) Infrared thermal imaging equipment having all the following characteristics:
 - (1) The detector is a single element;
 - (2) The detector is neither a charge coupled device (CCD) nor an integrate-while-scan device;
 - (3) The detector is either:
 - (a) Not cooled; *or*
 - (b) Cooled by using a liquid nitrogen Dewar vessel; *and*
 - (4) The equipment is:
 - (a) Non-ruggedised, medical equipment; *or*
 - (b) Has both of the following:
 - (A) A resolution not exceeding 22,500 resolvable elements; *and*
 - (B) A Noise Equivalent Temperature Difference (NETD) (or temperature sensitivity) of no less than 1 K;

N.B.:

This paragraph does not release Joule-Thompson coolers, cooling engines or thermo-electric coolers.

- (b) Infrared viewing equipment having all the following characteristics:
 - (1) The detector is a pyroelectric vidicon without reticle;
 - (2) The equipment is designed for fire fighting and buried body detection; *and*
 - (3) The optimal sensitivity is in the wavelength range from 8 to 14 micrometres.

N.B.:

Nothing in this Note shall be construed as releasing any technology from embargo.

Technical Note:

"Simple educational devices" -

Devices designed for use in teaching basic scientific principles and demonstrating the operation of those principles in educational institutions.

1510

Marine or terrestrial acoustic or ultrasonic systems or equipment specially designed for positioning surface vessels or underwater vehicles, or for detecting or locating underwater or subterranean objects or features, and specially designed components of such systems or equipment, including hydrophones, transducers, beacons, towed hydrophone arrays, beamformers and geophones (except moving coil or

moving magnet electro-magnetic geophones) and "specially designed software" therefor, except:

(a) Marine systems or equipment, as follows:

- (1) Active (transmitting, or transmitting and receiving) systems or equipment, including depth sounders and fish-finders and their associated beamformers, as follows:
 - (A) Depth sounders used solely for measuring the depth of water or the distance of submerged or buried objects vertically below the apparatus;
 - (B) Horizontally-operated object detection or location systems having all of the following characteristics:
 - (1) Transmitting frequency of 15 kHz or more;
 - (2) Sound pressure level less than 250 dB (reference 1 micropascal at 1 m) for equipment with operating frequency between 15 and 30 kHz, with no decibel limitation for equipment operating at frequencies of 30 kHz or more;
 - (3) Transmission capability limited to $\pm 10\%$ of the design centre frequency;
 - (4) Not designed to withstand pressure during normal operation at depths exceeding 1,000 m;
 - (5) Displaying a range of 5,000 m or less;
 - (C) Electronic noise sources for vertically directional use only, or mechanical (e.g. air gun or vapour-shock gun) or chemical (e.g. explosive) noise sources;
 - (D) Acoustic systems or equipment for positioning surface vessels or underwater vehicles, provided:
 - (1) Their control capability is limited to release and basic transponder capabilities;
 - (2) They are not capable of processing responses from more than four beacons in the calculation of a single point;
 - (3) They do not use coherent signals from two or more beacons;
 - (4) They have neither devices nor "software" for the automatic correction of velocity-of-propagation errors for point calculation;
 - (5) They are capable only of:
 - (a) Operating within a range of less than 1,000 m; *or*
 - (b) Achieving positional accuracy of better (less) than 20 m when measured at a range of 1,000 m;
 - (6) Transducers, acoustic modules or hydrophones therefor are not designed to withstand pressure during normal operation at depths of more than 1,000 m; *and*
 - (7) Beacons therefor:
 - (a) Are not designed to withstand pressure during normal operation at depths of more than 1,000 m;
 - (b) Do not have oscillators with a stability of more than 10^{-5} over periods of 24 hours;
 - (c) Do not use complex codes; *and*
 - (d) Do not use beamformers which have shaded or formed beams;
- (2) Passive (receiving, whether or not related in normal application to separate active equipment) acoustic hydrophones or transducers having all of the following characteristics:
 - (A) Independently mounted or configured and not reasonably capable of assembly by the user into a towed hydrophone array;
 - (B) Incorporating sensitive elements made of piezoelectric ceramics or crystal:
 - (1) With a sensitivity no better than -180 dB (reference 1 volt per micropascal) when not designed for operation at depths of more than 100 m and not acceleration compensated;
 - (2) With a sensitivity no better than -192 dB (reference 1 volt per micropascal) when not designed for operation at depths of more than 100 m;
 - (3) With a sensitivity no better than -204 dB (reference 1 volt per micropascal) when not designed for operation at depths of more than 1,000 m;

(b) Terrestrial systems or equipment having both of the following characteristics:

- (1) Not reasonably capable of conversion by the user to underwater or marine applications embargoed by this Item; *and*
- (2) Not employing geophones or other transducers embargoed by this Item.

NOTES:

1. Signal processing and data processing parameters for related equipment are defined in Items 1529 and 1565, and parameters for related cable in Item 1526.
2. Magnetic detection and locating apparatus is embargoed by Item 1571.
3. Nothing in this Item shall permit the export of technology or technical data associated with the design, manufacture or upgrading of equipment excluded from embargo by this definition, when such technology or technical data are also relevant to equipment covered by this definition.
4. With respect to repairs and alterations to ships owned and controlled by organisations in proscribed destinations, then those systems or equipment embargoed by Item 1510 shall not be installed pursuant to such repair or alterations, unless previously approved. (See also Item 1416.)
5. Passive hydrophone sensitivities cited in this Item are based on sensitivity being defined as 20 times the logarithm to the base 10 of the ratio of rms output voltage to a 1 volt reference, when the hydrophone sensor is placed in a plane wave acoustic field having an rms pressure of 1 micropascal. For example, a hydrophone of -160 dB (reference 1 volt per micropascal) would yield an output voltage of 10^{-8} volts in such a field, while one of -180 dB sensitivity would yield only 10^{-9} volts output.
6. Nothing in this Note permits the export of technology. This Item does not embargo towed acoustic hydrophone arrays having all of the following characteristics:
 - (a) Not specially designed for operation at more than 100 m depth or at tow speeds in excess of 8 knots;
 - (b) Not incorporating temperature or heading sensors;
 - (c) Having hydrophone groups uniformly spaced at not less than 25 m and not more than 60 m;
 - (d) Having an assembled diameter of 40 mm or more and using metallic strength members only;
 - (e) Not having multiplexed hydrophone group signals;
 - (f) Not having a configuration for multiple or overlapping acoustic aperture operation;
 - (g) Not having characteristics better than those specified in sub-items (a)(2)(A) and (B); *and*
 - (h) Not having associated processing equipment which provides any of the following features:
 - (1) Electronically-steerable beamforming capabilities;
 - (2) Side-lobe suppression techniques such as shading coefficients; *or*
 - (3) On-line real-time processing or off-line batch preprocessing capabilities exceeding the limits specified in Items 1529 and 1565.
7. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following equipment:
 - (a) Acoustic systems or equipment for positioning surface vessels or underwater vehicles, provided:
 - (1) They are not capable of processing responses from more than 8 beacons in the calculation of a single point;
 - (2) They have neither devices nor "software" for the automatic correction of velocity-of-propagation errors for point calculation;
 - (3) They have no coherent signal processing means; *and*
 - (4) Transducers, acoustic modules, beacons or hydrophones therefor are not designed to withstand pressure during normal operation at depths exceeding 1,000 m;
 - (b) Side-scan sub-bottom profile systems no portion of which is specially designed for operation at depths exceeding 1,000 m.

1516

Receivers, as follows, and specially designed components, accessories and "specially designed software" therefor (For instruments using time compression of the input signal or FFT techniques associated with receivers, see Item 1529(b)(4).):

- (a) Panoramic radio receivers (which search or scan automatically a part of the electromagnetic spectrum and indicate or identify the received signals); *except* ancillary equipment for commercial receivers with which the frequency searched does not exceed a bandwidth of 20 MHz or does not incorporate a raster or storage display capability;
- (b) Digitally controlled radio receivers, whether or not computer controlled, which search or scan automatically a part of the electromagnetic spectrum, in which the switching operation takes less than 10 ms, and which indicate or identify the received signals, *except* non-ruggedised, digitally-controlled, pre-set type radio receivers designed for use in civil communications which have 200 selective channels or fewer;
(For digitally controlled radio receivers using frequency synthesisers, see also Item 1531);
- (c) Receivers for "spread spectrum" and "frequency agile" systems having a total transmitted bandwidth which is:
 - (1) 100 or more times greater than the bandwidth of any one information channel; *and*
 - (2) In excess of 50 kHz;
- (d) Receivers which incorporate digital signal processing, *except* receivers specially designed for internationally allocated civil frequency bands only and which do not permit user-accessible reprogrammability of the digital signal processing circuits.

Technical Notes:

1. "Spread spectrum" is defined as the technique whereby energy in a relatively narrow-band communication channel is spread over a much wider energy spectrum under the control of a random or pseudo-random bit stream. On receipt, the signal is correlated with the same bit stream to achieve the reverse process of reducing the bandwidth to its original form. By allocating different bit streams to different subscribers transmitting simultaneously, significantly greater use can be made of available bandwidth.
2. "Frequency agility" (or frequency hopping) is another form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by discrete steps under the control of a similar bit stream.
(See also Item 1517(c).)

NOTE:

This Item is not intended to embargo radio frequency spectrum analysers (see Item 1533) or field strength meters (see Item 1529).

1517

Radio transmitters, *except* radio relay communications equipment (for which see Item 1520), as follows, and specially designed components therefor:

- (a) Transmitters or transmitter-amplifiers designed to operate at output frequencies greater than 960 MHz;
- (b) Transmitters or transmitter-amplifiers designed to provide any of the following features:
 - (1) Any system of pulse modulation (this does not include amplitude-, frequency- or phase-modulated television or telegraphic transmitters or pulse-width modulated sound broadcasting transmitters);
 - (2) Rated for operation over a range of ambient temperatures extending from below -40 to above +60°C;
- (c) Transmitters for "spread spectrum" and "frequency agile" systems having a total transmitted bandwidth which is:
(For the definition of "spread spectrum" and "frequency agile", see Technical Notes 1 and 2 to Item 1516.)
 - (1) 100 or more times greater than the bandwidth of any one information channel; *and*
 - (2) In excess of 50 kHz;

(For quartz crystals, see Item 1587; and for radio transmitters incorporating transmitter drive units, exciters and master oscillators using frequency synthesis, see also Item 1531.)

NOTE:

This Item is not intended to cover the following transmitters or transmitter-amplifiers, or systems containing such equipment, accessories and sub-assemblies therefor:

- (a) Specially designed for medical applications and operating at industrial, scientific or medical (ISM) frequencies;
- (b) Having an output power of not more than 10 W, which are specially designed for:
 - (1) Industrial or civil intrusion detection and alarm;
 - (2) Industrial and traffic detection, counting, speed measurement, identification and movement control;
 - (3) Carrying the information from the equipment above, or the information of environmental, air or water, pollution detection or measurement systems.
- (c) Transmitters using wideband amplifiers designed for non-frequency agile civil applications, such as television and mobile service.

1518

Telemetry and telecontrol equipment suitable for use with aircraft (piloted or pilotless), space vehicles or weapons (guided or unguided), and test equipment specially designed for such equipment.

NOTE:

This Item is not intended to embargo equipment specially designed to be used for remote control of toys such as model planes and boats and having electric field strength of not more than 200 microvolts per metre at a distance of 500 metres.

1519

"Telecommunication transmission equipment", measuring and test equipment, as follows, specially designed components, accessories and "specially designed software" therefor:

- (a) "Telecommunication transmission equipment" employing digital techniques (including the digital processing of analogue signals) and having at least one of the following characteristics:
 - (1) Designed for a total digital transfer rate which, at the highest multiplex level, exceeds:
 - (A) 45 million bits/s (including when designed for underwater use); *or*
 - (B) 8.5 million bits/s for stored programme controlled digital crossconnection equipment;

NOTE:

The maximum of 45 million bits/s for the highest multiplex level does not preclude total digital transfer rates of maximally a factor two (2 times) higher for:

- (a) Line terminating equipment;
- (b) Intermediate amplifier equipment;
- (c) Repeater equipment;
- (d) Regenerator equipment; *or*
- (e) Translation encoders (transcoders);
- (2) Designed for a "data signalling rate" which exceeds:
 - (A) 1,200 bits/s when:
 - (a) Employing an automatic error detection and correction system; *and*
 - (b) Retransmission is not required for correction;
 - (B) 9,600 bits/s when using the "bandwidth of one voice channel"; *or*
 - (C) 64,000 bits/s when using baseband;

NOTE:

For statistical multiplexers which satisfy the definitions of either "data (message) switching" or "stored programme controlled circuit switching", and for the definitions of these terms, see Item 1567.

- (b) Electronic measuring or test equipment, including bit error rate test sets, specially designed for the equipment embargoed by sub-item (a)(1) above;

Technical Note:

Definition of terms used in this Item:

"bandwidth of one voice channel"—

In the case of data communication equipment designed to operate in one voice channel of 3,100 Hz, as defined in CCITT Recommendation G.151;

"data signalling rate"—

As defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, "baud" and "bit per second" are not equal. Bits for coding, checking and synchronisation functions are to be included.

N.B.:

When determining the "data signalling rate", servicing and administrative channels shall be excluded.

"Telecommunication transmission equipment"—

For the purpose of this item is:

- (a) Categorized as follows, or combinations thereof:

- (1) Line terminating equipment;
- (2) Intermediate amplifier equipment;
- (3) Repeater equipment;
- (4) Regenerator equipment;
- (5) Translation encoders (transcoders);
- (6) Multiplex equipment;
- (7) Modulators/demodulators (modems);
- (8) Transmultiplex equipment (see CCITT Rec. G701); *or*
- (9) Stored programme controlled digital crossconnection equipment; *and*

- (b) Designed for use in single or multi-channel communication via:

- (1) Wire (line);
- (2) Coaxial cable;
- (3) Optical fibre cable; *or*
- (4) Radio.

NOTES:

1. Nothing in this Item permits the export of technology for the development or production of equipment employing digital transmission techniques for operation at a total digital transfer rate at the highest multiplex level exceeding 8.5 million bits/s.
2. This Item does not embargo:
 - (a) Telemetering, telecommand and telesignalling equipment designed for industrial purposes, together with data transmission equipment not intended for the transmission of written or printed text;

N.B.:

Telemetering, telecommand and telesignalling equipment consists of:

- (a) Sensing heads for the conversion of information into electrical signals;
- (b) The systems used for the long-distance transmission of these electrical signals; *and*
- (c) The process used to translate electrical signals into coded data (telemetering), into control signals (telecommand) and into display signals (telesignalling).

- (b) Facsimile equipment which is not embargoed by Item 1527; *or*

- (c) Equipment employing exclusively the direct current transmission technique.

3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following communication, measuring or test equipment:

- (a) "Telecommunication transmission equipment" provided it is:

- (1) Intended for general commercial traffic in a civil communication system;
- (2) Designed for operation at a total digital transfer rate at the highest multiplex level of 140 million bits/s or less;
- (3) Installed under the supervision of the seller in a permanent circuit; *and*
- (4) To be operated by the civilian authorities of the importing country;

- (b) Measuring or test equipment necessary for the use (i.e., installation, operation and maintenance) of equipment exported under the conditions of this Note, provided:

- (1) It is designed for use with communication transmission equipment operating at a "data signalling rate" of 140 million bit/s or less; *and*
- (2) It will be supplied in the minimum quantity required for the transmission equipment eligible for administrative exception treatment.

N.B.:

Where possible, built-in test equipment (BITE) will be provided for installation or maintenance of transmission equipment eligible for administrative exception treatment under this Item rather than individual test equipment.

N.B.:

1. For communication equipment using optical fibre as the communication medium, the transmission wavelength must not exceed 1,370 nm.
2. A statement is provided identifying the following:
 - (i) Locations of the connection points;
 - (ii) Types of equipment being connected;
 - (iii) Transmission rates.
4. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of modems and multiplexers embargoed by sub-item (a)(2) above designed for operation at "data signalling rates" of 19,200 bits/s or less.

1520

Radio relay communication equipment, specially designed test equipment and "software", as follows, and specially designed components and accessories therefor:

- (a) Radio relay communication equipment designed for use at frequencies exceeding 960 MHz, *except* when having any of the following sets of characteristics:
- (1) Microwave radio links for fixed civil installations operating at fixed frequencies not exceeding 19.7 GHz, employing analogue transmission with a capacity of up to 2,700 voice channels of 4 kHz each or of a television channel of 6 MHz maximum nominal bandwidth and associated sound channels;
 - (2) Microwave radio links:
 - (A) Designed for operation at a total bit rate not exceeding 45 million bits/s;
 - (B) Not employing quadrature-amplitude-modulation (QAM) techniques above level 4 if the total bit rate exceeds 8.5 million bits/s; *and*
 - (C) Not exceeding an operating frequency of 19.7 GHz;
 - (3) Ground communication radio equipment for use with temporarily fixed services operated by the civilian authorities of the importing country and designed to be used at fixed frequencies not exceeding 19.7 GHz with a power output of not more than 5 W;
 - (4) TV-receive-only (TVRO) stations for satellite reception specially designed for use at fixed frequencies meeting ITU standards in civil television or sound radio systems in the following frequency ranges:
 - (A) S-band: 2.5 - 2.69 GHz
 - (B) C-band: 3.4 - 4.2 GHz
4.5 - 4.8 GHz
 - (C) Ku- and Ka-band 10.7 - 12.75 GHz;
 - (5) The equipment is specially designed for the transmission of television signals:
 - (A) Between camera and studio or between studio and television transmitter; *and*
 - (B) Not exceeding a line-of-sight distance with respect to any one installation;
 - (6) The equipment is specially designed to be installed and operated in communication satellite earth stations using:
 - (A) INTELSAT;
 - (B) MARISAT;
 - (C) EUTELSAT; *or*
 - (D) INMARSAT; *or*
 - (7) The equipment is tropospheric scatter communication equipment which:
 - (A) Is designed for civil fixed use;
 - (B) Operates at fixed frequencies of 2.7 GHz or less;
 - (C) Uses frequency modulation; *and*

(D) Has a power amplifier output of 10 kW or less;

NOTES:

1. Nothing in the above permits the export of technology for equipment employing quadrature-amplitude-modulation (QAM) techniques, *except* technology for use, i.e., installation, operation or maintenance.
 2. Nothing in the above permits the export of technology for equipment released by (6) above, *except* technology for installation, operation or maintenance.
- (b) Stand-alone radio transmission media simulators/channel estimators and "specially designed software" therefor, specially designed for testing equipment embargoed by (a) above, *except* those in which the adjustments are only made manually.

NOTES:

1. This Item does not embargo equipment permanently installed in a circuit operated by the civilian authorities of the importing country for civil television transmission or for general commercial traffic, or technology for the installation, maintenance and operation therefor, provided:
 - (a) The equipment is not designed for operation at a total bit rate exceeding 45 million bits/s;
 - (b) The equipment does not employ quadrature-amplitude-modulation (QAM) techniques; *and*
 - (c) Associated or integrated multiplex equipment is considered separately under the provisions of Item 1519.
2. This Item does not embargo equipment for civil industrial use, e.g., remote supervision, control and metering of oil and gas pipelines, civil public utility services (e.g., electricity networks) including telephone channels for the operation of such networks and the engineering service circuits required for the maintenance of telecommunication links, or technology for the installation, maintenance and operation therefor, provided:
 - (a) Microwave radio links employing analogue transmission techniques have a capacity not exceeding 2,700 voice channels of 4 kHz each;
 - (b) Microwave radio links employing digital transmission techniques operate at a frequency not exceeding 19.7 GHz and are designed to operate at a total digital bit rate not exceeding 45 million bits/s;
 - (c) The equipment does not employ quadrature-amplitude-modulation (QAM) techniques;
 - (d) Associated or integrated multiplex equipment is considered separately under the provisions of Item 1519.
3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following radio relay communication equipment:
 - (a) Digital microwave radio links for fixed civil installations operating at fixed frequencies not exceeding 19.7 GHz with a capacity of up to 1,920 voice channels of 3.1 kHz or four television channels of 6 MHz maximum nominal bandwidth and associated sound channels;
 - (b) Ground communication radio equipment for use with temporarily fixed services operated by the civilian authorities and designed to be used at fixed frequencies not exceeding 20 GHz;
 - (c) Radio transmission media simulators/channel estimators designed for the testing of equipment covered by (a) or (b) above;
 - (d) Power amplifiers not exceeding 10 W and 6/4-GHz-transmitters/receivers for communication satellites;
 - (e) Equipment specially designed to receive civil meteorological data provided:
 - (1) The equipment or systems are designed and used for fixed civil meteorological applications;
 - (2) The equipment has all the following characteristics:
 - (A) It is specially designed to receive and process Weather Facsimile (WEFAX) or receive and process meteorological data from civil weather satellites such as: GOES (Geostationary Operating Environmental Satellite); NOAA (National Oceanic and Atmospheric Administration) polar orbiting satellites; or the ARGOS meteorological satellite;
 - (B) "Frequency agility" techniques are not incorporated; *and*

(C) The weather satellite ground system frequencies do not exceed 1,750 MHz. Telecommunication Apparatus

1522**"Lasers" and "equipment containing lasers" as follows:**

- (a) "Lasers" and specially designed components therefor, including amplification stages, *except* the following when not specially designed for equipment embargoed by (b) below:
 - (i) Argon, krypton or non-"tunable" dye "lasers" having one of the following sets of characteristics:
 - (1) An output wavelength between 0.2 and 0.8 micrometre, a pulsed output energy not exceeding 0.5 joule per pulse and an average or continuous-wave maximum rated single- or multi-mode output power not exceeding 20 W; *or*
 - (2) An output wavelength between 0.8 and 1 micrometre, a pulsed output energy not exceeding 0.25 joule per pulse and an average or continuous-wave maximum rated single- or multi-mode output power not exceeding 10 W;
 - (ii) Helium-cadmium, nitrogen and multigas "lasers" not otherwise specified in this Item with both of the following characteristics:
 - (1) An output wavelength shorter than 0.8 micrometre; *and*
 - (2) A pulsed output not exceeding 0.5 joule per pulse and an average or continuous wave maximum rated single- or multi-mode output power not exceeding 120 W;
 - (iii) Helium-neon "lasers" with an output wavelength shorter than 0.8 micrometre;
 - (iv) Ruby-"lasers" with both of the following characteristics:
 - (1) An output wavelength shorter than 0.8 micrometre; *and*
 - (2) An energy output not exceeding 20 joules per pulse;
 - (v) CO₂, CO or CO/CO₂ "lasers" having either of the following characteristics:
 - (1) An output wavelength in the range of 9 to 11 micrometres and a pulsed output energy not exceeding 2 joules per pulse and a maximum rated average single- or multi-mode output power not exceeding 1.2 kW or a continuous-wave maximum rated single- or multi-mode output power not exceeding 5 kW; *or*
 - (2) An output wavelength in the range of 5 to 7 micrometres and having a continuous wave maximum rated single- or multi-mode output power not exceeding 50 W;
 - (vi) Nd:YAG "lasers" having an output wavelength of 1.064 micrometres with any of the following characteristics:
 - (1) A pulsed output not exceeding 0.5 joule per pulse and a maximum rated average single- or multi-mode output power not exceeding 10 W, or a continuous wave maximum rated single-mode output power not exceeding 50 W;
 - (2) A pulsed output not exceeding 10 joules per pulse with a pulse width not less than 50 microseconds and a maximum rated average single- or multi-mode output power not exceeding 50 W; *or*
 - (3) A continuous wave multi-mode output power not exceeding 175 W;
 - (vii) Nd:Glass "lasers" with both of the following characteristics:
 - (1) An output wavelength in the range of 1.05 to 1.06 micrometres; *and*
 - (2) A pulsed output not exceeding 2 joules per pulse;
 - (viii) "Tunable" CW dye "lasers", with both of the following characteristics:
 - (1) An output wavelength shorter than 0.8 micrometre; *and*
 - (2) An output not exceeding an average or continuous wave maximum rated single- or multi-mode output power of 1 W;
 - (ix) "Tunable" pulsed "lasers" (for argon and krypton "lasers", see (a)(i) above), including dye, having all of the following characteristics:
 - (1) An output wavelength between 0.15 and 0.8 micrometre;
 - (2) A pulse duration not exceeding 100 nanoseconds;

- (3) A pulsed output energy not exceeding 0.5 joule per pulse; *and*
- (4) An average power not exceeding 10 W;
- (x) Single-element semiconductor "lasers" with a wavelength shorter than 1 micrometre designed for, and used in, equipment as defined in (b) (xiii), (xiv), (xv) or (xvi) below;

NOTE:

This sub-item does not embargo semiconductor "lasers" having:

- (1) An output wavelength no longer than 1,000 nm; *and*
- (2) A continuous wave (CW) output power not exceeding 100 mW.

- (b) "Equipment containing lasers", and specially designed components therefor, *except* the equipment listed below which contains "lasers" excluded from embargo by sub-item (a):

- (i) Specially designed for industrial and civilian intrusion detection and alarm systems;
- (ii) Specially designed for medical applications;
- (iii) Equipment for educational and laboratory purposes;

NOTE:

The educational equipment referred to in this sub-item is defined as devices designed for use in teaching basic scientific principles and demonstrating the operation of those principles in educational institutions.

- (iv) Specially designed for traffic and industrial movement control and counting systems;
- (v) Specially designed for detection of environmental pollution;
- (vi) Optical spectrometers and densitometers;
- (vii) Equipment containing continuous wave helium-neon gas "lasers" (but see sub-item (c) below);
- (viii) Textile-cutting and textile-bonding equipment;
- (ix) Paper cutting equipment;
- (x) Equipment containing "lasers" for drilling diamond dies for the wire drawing industry;
- (xi) Electronic scanning equipment with auxiliary electronic screening unit specially designed for printing processes, including such equipment when used for the production of colour separations;
- (xii) Laser-radar (lidar) equipment specially designed for surveying or meteorological observation;
- (xiii) Consumer-type reproducers for video or audio disks, employing non-erasable media;
- (xiv) Price scanners (point of sale) ;
- (xv) Equipment designed for surveying purposes, provided there is no capability of measuring range;
- (xvi) Equipment specially designed for the marking of components;
- (xvii) Specially designed gravure (printing plate) manufacturing equipment;
- (xviii) Equipment specially designed for visual entertainment purposes (laser light shows) provided it has no holographic capability;
- (xix) Electronic printers, including those capable of being used with "digital computers", not exceeding 2,000 lines (30 pages) per minute or 300 characters per second;
- (xx) Electronic copiers, including those capable of being used with "digital computers", not exceeding 30 pages per minute and which do not include any of the following:
 - (1) Optical character recognition (OCR) equipment which is not released by Item 1565(h)(2)(iv)(k);
 - (2) Digitising equipment which is not released by Item 1565(h)(2)(iv)(h); *or*
 - (3) "Image enhancement" capability;
- (c) Measuring systems having both of the following characteristics:
 - (1) Contain a "laser"; *and*
 - (2) Maintain for at least 48 hours, over a temperature range of ± 10 K around a standard temperature and at a standard pressure:
 - (i) A resolution over their full scale of ± 0.1 micrometre or better; *and*
 - (ii) An accuracy of ± 1 part per million or better;

Technical Note:

Standard temperatures and standard pressures as indicated in IEC Publication 160.

- (d) Particle measuring systems employing helium-neon "lasers", designed for measuring particle size and concentration in gases, which have both of the following characteristics:
 - (1) Capable of measuring particle sizes of 0.3 micrometre or less; *and*

- (2) Capable of characterising Class 10 clean air or better.

Technical Notes:

1. "Tunable" refers to the ability of a laser to produce an output at any wavelength within its tuning range. A line-selectable laser which can operate only on discrete wavelengths is not considered tunable.
2. The term "specially designed components" is intended, among other things, to include active and passive components in semi-fabricated forms as well as in fabricated forms.
3. A "laser" is an assembly of components to produce coherent light which is amplified by stimulated emission of radiation.
4. "Equipment containing lasers" uses coherent light in the equipment for a certain application.

NOTES:

1. Nothing in the following shall be construed as permitting the export of technology for the following equipment, except for the minimum technology for their use (i.e., installation, operation and maintenance):
 - (a) Sub-item (a) does not embargo uncooled, unsegmented mirrors with glass or dielectric substrates for use as end reflectors for "laser" resonators. (For segmented mirrors, see Item 1556.)
 - (b) This Item does not embargo equipment listed in sub-item (b) containing "lasers" described in (a)(vi)(1) and (vii) provided the "lasers" have a maximum pulsed output not exceeding 2 joules per pulse;
 - (c) This Item does not embargo Nd:YAG "lasers" used for pumping "tunable" pulsed dye "lasers" excluded from embargo under (a)(ix), and having all of the following characteristics:
 - (1) An output wavelength of 1.064 micrometre;
 - (2) A pulsed output energy not exceeding 1.5 joule per pulse; *and*
 - (3) A maximum rated average single- or multi-mode output power not exceeding 25 W.
2. This Item is intended to embargo semiconductor "lasers" but not non-coherent light-emitting diodes and assemblies or integrated circuits containing such light-emitting diodes. (See Item 1564.)
3. For "laser" feedback systems and "laser" interferometers, see also Item 1093(c).
4. For the status of optical fibre and optical preform characterisation equipment which contains lasers, see Item 1353.
5. Not used.
6. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following:
 - (a) "Tunable" pulsed flowing-dye "lasers" having all of the following characteristics, and specially designed components therefor:
 - (1) An output wavelength shorter than 0.8 micrometre;
 - (2) A pulse duration not exceeding 100 ns; *and*
 - (3) A peak output power not exceeding 15 MW;
 - (b) CO₂, CO or CO/CO₂ "lasers" having an output wavelength in the range from 9 to 11 micrometres and a pulsed output not exceeding 2 joules per pulse and a maximum rated average single- or multimode output power not exceeding 5 kW or a continuous wave maximum rated single- or multi-mode output power not exceeding 10 kW;
 - (c) Equipment specially designed for medical applications using "lasers" not freed from embargo by sub-item (a)(vi) above;
 - (d) "Laser" systems for trimming resistors or thick/thin film electronic circuits;
 - (e) Equipment incorporating CO₂ "lasers" with average or continuous wave output power not exceeding 5 kW, not exceeding the parameters of Item 1091 and specially designed for welding, cutting, bonding or drilling metals for civil applications;
 - (f) Minimum quantities of semiconductor "laser" designed and destined for use with a civilian fibre optic communications system which would be either unembargoed or subject to Administrative Exceptions treatment for China under Items 1519 or 1526, having an output wavelength no longer than 1,370 nm and a power output not exceeding 100 mW CW.

1526

Cable and optical fibres, and components and accessories, as follows:

- (a) Unarmoured or single-armoured ocean cable having an attenuation of 1.62 dB/km (3.0 dB per nautical mile) or less, measured at a frequency of 600 kHz;
- (b) Optical-fibre communication cable or optical fibres therefor, having any of the following characteristics:
 - (1) The optical fibre is designed for single mode light propagation;
 - (2) The optical fibre:
 - (i) Is designed for multimode light propagation; *and*
 - (ii) Has an attenuation of less than 1.0 dB/km at a wavelength of 1,300 nm; *or*
 - (3) Optical fibres capable of withstanding a "proof test" tensile strength of 1.1×10^9 N/m² or more;

Technical Note:

"Proof Test" consists of on-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 15 cm in diameter. The ambient temperature is a nominal 20°C and relative humidity 40%.

N.B.:

Equivalent national standards for executing the "proof test" may be used.

- (4) Specially designed for underwater use; *or*
- (5) Specially designed to be insensitive to nuclear radiation;
- (c) Optical fibre communication cable or optical fibres therefor, *except* "pigtailed" which are not nuclear radiation hardened, having any of the following characteristics:

Technical Note:

"Pigtails" are pieces of optical fibre or cable no longer than 50 m which in some cases are attached to components or instruments.

- (1) Specially fabricated either compositionally or structurally, or modified by coating to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive;
- (2) Modified structurally or by coating to have either:
 - (i) A "beat length" of more than 50 cm (low birefringence), *except* if designed for operation at wavelengths of less than 650 nm; *or*
 - (ii) A "beat length" of less than 5 cm (high birefringence);

Technical Note:

"Beat length" is defined as the distance over which two orthogonally polarized signals, initially in phase, must pass in order to achieve 2 Pi radian(s) phase difference;

- (d) Secure communication cable, being either coaxial or multiconductor communication cable protected by mechanical or electrical means from physical damage or intrusion in such a manner that communications security is maintained between terminals without the necessity for encryption;
- (e) Components and accessories specially designed for the above optical fibres or cable, including fibre-optic bulkhead or hull penetration connectors impervious to leakage at any depth for use in ships or vessels, and multipoint fibreoptic couplers (including but not limited to T, star, bidirectional and wavelength division multiplexing and demultiplexing couplers), *except* connectors for use with optical fibres or cable with a repeatable coupling loss of 0.5 dB or more.
(See also Item 2009(g) of Group 2).

NOTES:

- 1. Sub-item (d) above does not embargo cable that is armoured by only either a tough outer sheath or an electromagnetic screen.
- 2. Associated equipment for sub-items (a), (b) and (c), and specially designed components therefor, are considered under Item 1519.
- 3. For military type cable (shear-resistant, etc.), see Item 2011 of Group 2.
- 4. Governments may permit, as administrative exceptions, the shipment of silica-based optical fibres and optical cable, other cable, connectors and couplers embargoed by sub-items (a), (b)(1) to (4) or (e) above, provided:

- (a) The cable, optical fibres, connectors or couplers are for a specific civil end-use;
- (b) The quantities of cable, optical fibres, connectors or couplers are normal for the purpose;
- (c) The optical fibres specially designed for the underwater use:
 - (i) Are not embargoed by sub-item (b)(1) above; *and*
 - (ii) Have performance characteristics inferior to those described in sub-items (b)(2) or (b)(3); *and*
- (d) Connectors and couplers embargoed by sub-item (e) are not:
 - (i) Fibre-optic bulkhead or hull penetration connectors, specially designed for use in ships or vessels; *or*
 - (ii) Wavelength division multiplex type fibre-optic couplers.

- 5. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of optical fibres embargoed by sub-item (c)(2), when exported for identifiable civil applications, having all of the following characteristics:
 - (a) Not fabricated to be nuclear radiation sensitive;
 - (b) A "beat length" of more than 50 cm (low birefringence); *and*
 - (c) Not optimised for operation at any wavelength exceeding 1,370 nm.

1527

Cryptographic equipment and specially designed components therefor, designed to ensure secrecy of communications (such as telegraphy, telephony, facsimile, video and data communications) or of stored information; and "software" controlling or computers performing the functions of such cryptographic equipment.

NOTES:

- 1. This Item also embargoes video systems which, for secrecy purposes, use digital techniques (conversion of an analogue, i.e. video or facsimile, signal into a digital signal).
- 2. This Item is not intended to embargo simple cryptographic devices or equipment only ensuring the privacy of communications, as follows:
 - (a) Equipment for voice transmission making use of fixed frequency inversions or fixed band scrambling techniques in which the transposition changes occur not more frequently than once every 10 seconds;
 - (b) Standard civil facsimile and video equipment designed to ensure the privacy of communications by an analogue transmission using non-standard practices for intended receivers only (video system equipment effecting the transposition of analogue data);
 - (c) Video systems for pay television and similar restricted audience television, including industrial and commercial television equipment using other than standard commercial sweep systems.
- 3. "Digital computers" and digital differential analysers (incremental computers) designed or modified for, or combined with, any cipher machines, cryptographic equipment, devices or techniques including "software", "microprogramme" control ("firmware") or specialized logic control (hardware), associated equipment therefor, and equipment or systems incorporating such computers or analysers are embargoed by this Item or by Item 2011 of Group 2.

1529

Electronic equipment for testing, measuring or for microprocessor/microcomputer development, as follows, and specially designed "software" therefor:

- (a) Any testing or measuring equipment:
 - (1) Not described in any other Item in this List; *and*
 - (2) Designed for use at frequencies exceeding 18 GHz;

N.B.:

This sub-item does not embargo the following equipment having a maximum specified operating frequency of 26.5 GHz or less:

- (1) Power meters;
- (2) Broadband noise sources; *or*
- (3) Noise figure meters;

- (b) Logic analysers having any of the following characteristics, and specially designed accessories and specially designed components therefor:
 - (1) More than a total of 64 channels;
 - (2) A synchronous (state) channel sampling rate of more than 50 MHz;
 - (3) An asynchronous (timing) channel sampling rate of more than 200 MHz;
 - (4) Probe interfaces and inverse assemblers, *except* those designed for use with a microprocessor or microcomputer microcircuit "family" which contains at least one microprocessor or microcomputer microcircuit not embargoed by Item 1564;
- (c) Frequency standards having both of the following characteristics:
 - (1) Designed as reference standards for laboratory use; *and*
 - (2) Either of the following:
 - (A) A long-term drift (ageing) over 24 hours or more of 1 part or less in 10^{10} ; *or*
 - (B) A short-term drift (instability) over a period from 1 to 100 seconds of 1 part or less in 10^{12} ;
- (d) Equipment containing frequency standards, having any of the following characteristics:
 - (1) Designed for mobile use and having a long-term drift (ageing) over 24 hours or more of 1 part or less in 10^9 ;
 - (2) Designed for fixed ground use and having a long-term drift (ageing) over 24 hours or more of 5 parts or less in 10^{10} ; *or*
 - (3) A short-term drift (instability) over a period from 1 to 100 seconds of 1 part or less in 10^{12} ;
- (e) "Comb frequency generators" designed for use at frequencies exceeding 12.5 GHz;
- (f) Instruments, as follows, designed for use at frequencies exceeding 1 GHz:
 - (1) Specially calibrated microwave instrumentation receivers capable of measuring amplitude and phase simultaneously;

N.B.:

This sub-item includes receivers used in equipment for the near- and far-zone measurement of phase and amplitude patterns of antennae.

- (2) Automatic "frequency (heterodyne) converters";
- (3) Automatic "transfer oscillators";
- (g) Digital counters, as follows:
 - (1) Capable of counting successive input signals with less than 5 ns time difference without prescaling (digital division) of the input signal (for counter/timers having a time interval measurement mode, see also (h) below);
 - (2) Employing prescaling of the input signal, in which the prescaler is capable of resolving successive input signals with less than 1 ns time difference;
 - (3) Capable of measuring "burst frequencies" exceeding 100 MHz for a burst duration of less than 5 ms;
- (h) Time interval measuring equipment, having both of the following characteristics:
 - (1) Employing digital techniques; *and*
 - (2) Capable of measuring time intervals of less than 5 ns on a single shot basis;
- (i) Digital voltage measuring equipment capable of more than 1,000 readings per second with a resolution of more than 4½ digits, not including changes in range or polarity;

NOTE:

This sub-item does not embargo:

- (a) Visual quantization apparatus capable of providing an average value, displayed or not, of the results of the measurement;
- (b) Multichannel analysers of all types used in nuclear experimentation; *or*
- (c) Industrial telemeasuring devices in which a pre-set storage value is used as a basis for measuring.
- (j) General purpose data communication protocol analysers, testers and simulators for X.25 level 3 and above as well as Integrated Services Digital Networks (ISDN) protocols (CCITT/ISO);
- (k) Microprocessor or microcomputer development instruments or systems, capable of developing "software" for, or capable of programming microcircuits embargoed by, Item 1564.

NOTES:

- 1. This sub-item includes accessories specially designed for these microprocessor or microcomputer development instruments or systems such as:
 - (a) "cross-hosted" assemblers, "cross-hosted" compilers;

- (b) Adapter interfaces for prototypes *and/or* emulation probes;
- (c) Debuggers;
- (d) Programmable read-only memory (PROM) programmers;
- (e) Programmable read-only memory (PROM) copiers of a capacity of more than 32 kbits and a word length of more than 8 bits;
- (f) So-called personality modules which contain more than one of the accessories enumerated under (a) to (e).
- 2. This sub-item does not embargo microprocessor or microcomputer development instruments or systems having all of the following characteristics:
 - (a) They can be used to develop "software" for, or to programme a "family" of microprocessor or microcomputer microcircuits not designed within a proscribed country;
 - (b) They can be used only for microprocessor or microcomputer microcircuits having both:
 - (1) An operand (data) word length of no more than 8 bits; *and*
 - (2) An arithmetic logic unit (ALU) not wider than 8 bits; *and*
 - (c) The "family" contains at least one microprocessor or microcomputer microcircuit which is not embargoed by Item 1564.
- 3. "Cross-hosted" compilers or "cross-hosted" assemblers, needed for use with a particular microprocessor or microcomputer development instrument or system, not embargoed by this sub-item, must contain only the minimum "software" in machine executable form to perform the functions for which they were designed. To make other, incompatible instruments or systems perform the same functions must require:
 - (a) Modification of this "software"; *or*
 - (b) Addition of "programmes".
- 4. For "cross-hosted" compilers or "cross-hosted" assemblers, which are not specially designed for use with microprocessor or microcomputer development instruments or systems described in this sub-item, see Item 1566.

Technical Notes:

- 1. "Burst frequency" measurement—
The capability of a counter to start only when the input signal is present and stop counting at the completion of the burst.
- 2. "Comb frequency generators"—
Apparatus which generate a spectrum of harmonics.
- 3. "Frequency (heterodyne) converters"—
Equipment which down-converts an unknown frequency by mixing it with an accurately known frequency. This accurately known reference frequency is derived from a crystal, by multiplication of its frequency and passing it through a harmonic generator. By mixing the appropriate harmonic and the unknown frequency, an accurate third frequency results.
- 4. "Transfer oscillators"—
Like "frequency (heterodyne) converters", are based on the principle of harmonic mixing. The known reference frequency is derived from a local oscillator instead of from a crystal. The unknown frequency is mixed with the local oscillator frequency, the two are phase-locked by tuning the local oscillator and can then be measured by a counter.
- 5. "Family"—
Consists of microprocessor or microcomputer microcircuits which have:
 - (a) The same architecture;
 - (b) The same basic instruction set; *and*
 - (c) The same basic technology (e.g., only NMOS or only CMOS).
- 6. "Pulse frequency profiling"—
The capability of measuring the changes of frequency (or phase) within a pulse as a function of time; such changes in frequency would be present in a transmitted pulse-compression radar pulse ("chirp radar"). This profiling may be achieved by internal or external gating. "Pulse frequency profiling" is not intended to include "frequency modulation tolerance" while it is being frequency modulated and is of interest to the communication field. The ability to perform measurement of the time interval of the pulse itself (pulse width) as opposed to frequency measurements within a pulse is covered under time interval instruments in sub-item (f) above.

NOTES:

1. For specially designed testing and measuring equipment embargoed by other Items on this List, see those Items.
2. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following equipment:
 - (a) Quartz or rubidium frequency standards not specially designed for military use;
 - (b) "Swept frequency network analysers" or sweep generators for use at frequencies not exceeding 40 GHz and which cannot be controlled remotely;
 - (c) Instruments in which the functions can be controlled by the injection of digitally coded electrical signals from an external source where the maximum frequency does not exceed 20 GHz;
 - (d) Microprocessor and microcomputer development instruments for microcircuits which are either unembargoed or exportable to the People's Republic of China as administrative exceptions under Item 1564;
 - (e) Digital counters not having any of the following characteristics:
 - (1) Capable of performing frequency measurements above 20 GHz;
 - (2) Capable of measuring either the frequency or the change in phase or frequency within a pulse ("pulse frequency profiling"), using either internally or externally gated sampling intervals of 100 ns or less; *or*
 - (3) Capable of measuring "burst frequencies" exceeding 250 MHz for a burst duration of less than 2 ms;
 - (f) Time interval measuring equipment employing digital techniques, not capable of measuring time intervals of less than 1 ns on a single shot basis;
 - (g) PROM programmers embargoed by sub-item (k) above.

1531**"Frequency synthesisers", and equipment containing such "frequency synthesisers", as follows:**

- (a) "Frequency synthesisers" containing frequency standards embargoed by Item 1529(c) or temperature-compensated crystal oscillators (TCXOs) embargoed by Item 1587(c);
- (b) Instrument "frequency synthesisers" and synthesised signal generators, and specially designed components and accessories therefor, designed for ground use, producing output frequencies whose accuracy and short term and long term stability are controlled by, derived from, or disciplined by the input frequency or internal master standard frequency, and having any of the following characteristics:
 - (1) A maximum synthesised output frequency of more than 550 MHz;
 - (2) Any of the following noise characteristics:
 - (A) A single sideband (SSB) phase noise better than -120 dBc/Hz when measured at a 20 kHz offset from the carrier frequency;
 - (B) A single sideband (SSB) phase noise better than -106 dBc/Hz when measured at a 100 Hz offset from the carrier frequency;
 - (C) An integrated phase noise better than -60 dBc/Hz referred to a 30 kHz band centred on the carrier and excluding the 1 Hz band centred on this carrier; *or*
 - (D) An integrated AM noise better than -70 dBc/Hz referred to a 30 kHz band centred on the carrier and excluding the 1 Hz band centred on this carrier;

NOTE:

Synthesised signal generators which are embargoed only by (b)(1) or (b)(2)(A) are excluded from embargo up to a maximum synthesised output frequency of 1,400 MHz or down to a single sideband phase noise of -136 dBc/Hz when measured at an offset of 20 kHz from a carrier frequency of 100 MHz, provided the technology supplied is only the minimum necessary for the use (i.e., installation, operation and maintenance) of such generators.

- (3) "Electrically programmable in frequency" with a "frequency switching time" of less than 10 ms;
- (4) "Electrically programmable in phase" with a switching time from one selected phase value to another of less than 10 ms

except those equipments incorporating pre-emphasis networks for frequency modulation;

- (5) Having a level of spurious components in the output, measured relative to the selected output frequency, better than:
 - (A) -60 dB harmonic; *or*
 - (B) -92 dB nonharmonic;
- (6) Having more than three different selected synthesised output frequencies available simultaneously from one or more outputs; *or*
- (7) With facilities for pulse modulation of the output frequency;
- (c) Airborne communication equipment using "frequency synthesisers", as follows, and specially designed components and accessories therefor:
 - (1) Designed to receive or transmit frequencies of more than 156 MHz;
 - (2) Incorporating facilities for the rapid selection of more than 200 channels per equipment, *except* equipment operating in the frequency range of 108 to 137 MHz incorporating facilities for the rapid selection of 760 channels or fewer at not less than 25 kHz channel spacing, which has been in normal civil use for at least one year;
 - (3) With a "frequency switching time" of less than 10 ms;
 - (4) "Frequency synthesisers", designed for the above equipment, whether supplied separately or with the said equipment, exceeding the parameters specified in (b) above;

NOTE:

(See also Item 1501(a).)

- (d) Digitally controlled radio receivers, whether or not computer controlled, which search or scan automatically a part of the electromagnetic spectrum, using "frequency synthesisers", as follows, and specially designed components and accessories therefor:
 - (1) Digitally controlled receivers in which the switching operation takes less than 10 ms, *except* non-ruggedised digitally-controlled preset type radio receivers designed for use in civil communications, which have 200 selective channels or fewer;
 - (2) "Frequency synthesisers" designed for the above equipment, whether supplied separately or with the said equipment, exceeding the parameters specified in (b) above, *except* those specially designed for receivers freed from embargo under (d)(1) above;

NOTE:

This sub-item does not embargo "frequency synthesisers" specially designed for use in tuners for entertainment type receivers. (See also Item 1516.)

- (e) Radio transmitters incorporating transmitter drive units, exciters and master oscillators using frequency synthesis, as follows, specially designed components and accessories therefor:
 - (1) Having:
 - (A) An output frequency of up to 32 MHz;
 - (B) A frequency resolution of better (less) than 10 Hz; *and*
 - (C) A "frequency switching time" of less than 10 ms;
 - (2) Having:
 - (A) An output frequency from 32 MHz to 235 MHz;
 - (B) A frequency resolution of better (less) than 250 Hz; *and*
 - (C) A "frequency switching time" of less than 10 ms;
 - (3) Having an output frequency of more than 235 MHz, *except*:
 - (A) Television broadcasting transmitters having all of the following characteristics:
 - (a) An output frequency from 470 MHz to 960 MHz;
 - (b) A frequency resolution of not better (less) than 1 kHz; *and*
 - (c) The manually-operated "frequency synthesiser" incorporated in or driving the transmitter has an output frequency not exceeding 120 MHz;
 - (B) FM and AM ground communication equipment having all of the following characteristics:
 - (a) For use in the land mobile service;
 - (b) Operating in the 403 to 470 MHz band;
 - (c) A power output of 50 W or less for mobile units, or 300 W or less for fixed units;
 - (d) A frequency resolution of not better (less) than 6.25 kHz; *and*
 - (e) A "frequency switching time" of more than 50 ms;
 - (C) Portable (personal) or mobile radiotelephones for civil use, e.g., for use with commercial civil cellular

radiocommunications systems having all of the following characteristics:

- (a) Operating in the 403 to 960 MHz range;
- (b) A power output of 25 W or less; and
- (c) A "frequency switching time" of 10 ms or more.

NOTE:

For stored programme controlled communications switching equipment used with cellular radio base stations, see Item 1567.

- (4) Having more than three different selected synthesised output frequencies available simultaneously from one or more outputs;
 - (5) With facilities for pulse modulation of the output frequency of the transmitter or of the incorporated "frequency synthesiser";
 - (6) "Frequency synthesisers" designed for equipment described in this sub-item, whether supplied separately or with the said equipment, exceeding the parameters specified in (b) above; *except* those specially designed for radio telephones freed from embargo under sub-item (e)(3)(C) above.
- (See also Item 1517.)

Technical Notes:

1. "Frequency synthesiser"—
Any kind of frequency source or signal generator, regardless of the actual technique used, providing a multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies.
2. "Frequency switching time"—
The maximum time (i.e., delay), when switched from one selected output frequency to another selected output frequency, to reach:
 - (a) A frequency within 100 Hz of the final frequency; or
 - (b) An output level within 1 dB of the final output level.
3. "Electrically programmable in frequency"—
The output frequency can be controlled or selected by the injection of digitally coded electrical signals from an external control source.
4. "Electrically programmable in phase"—
The phase of the output frequency can be varied relative to the internal or external reference standard, or selected in accordance with an externally supplied code or signal.

NOTES:

1. This Item does not embargo equipment in which the output frequency is produced by the addition or subtraction of two or more crystal oscillator frequencies which may be followed by multiplication of the result.
2. Governments may permit, as administrative exceptions, when satisfied that the end-use will be confined to legitimate civil applications, the shipment of equipment embargoed by sub-item (b)(3) above, with a "frequency switching time" not less than 5 ms.
3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following, specially designed components and accessories therefor:
 - (a) "Frequency synthesisers" embargoed only by sub-item (a) and not incorporating cesium beam standards;
 - (b) Instrument "frequency synthesisers" and synthesised signal generators embargoed only by sub-item (b)(1) and (b)(3) and having a maximum output frequency of 18 GHz, provided the "frequency switching time" is 2 ms or more;
 - (c) Instrument "frequency synthesisers" and synthesised signal generators not embargoed by sub-item (b)(4) and having a maximum output frequency of 2.6 GHz, provided the "frequency switching time" is 0.3 ms or more;
 - (d) Conventional synthesiser based, digitally controlled, civil land or marine mobile radio receivers and transmitters, provided:
 - (1) They operate at frequencies not exceeding 960 MHz;
 - (2) The power output and frequency resolution parameters specified in sub-item (e)(3)(B) above remain in force;
 - (3) The equipment has a "frequency switching time" of 5 ms or more;
 - (4) The equipment does not employ either "frequency agility" or other "spread spectrum" techniques; and
 - (5) The synthesisers must be embedded in the radio receivers or transmitters;

- (e) Radio receivers embargoed by sub-item (d)(1) which have 1,000 selective channels or fewer.

1532

Precision linear and angular measuring systems, as follows and specially designed components and "specially designed software" therefor:

- (a) Contact-type systems or linear voltage differential transformers (LVDT) therefor, as follows:
 - (1) Contact type measuring systems having all of the following characteristics:
 - (i) Range equal to or less than 5 mm;
 - (ii) "Linearity" equal to or better than $\pm 0.1\%$; and
 - (iii) Drift equal to or less than 0.1% per day at a standard ambient test room temperature ± 1 K;
 - (2) Linear voltage differential transformers with no compensation networks and having either of the following characteristics:
 - (i) Range equal to or less than 5 mm; or
 - (ii) "Linearity" equal to or better than $\pm 0.2\%$;

NOTE:

"Linearity" limits apply to measurements made in the static mode.

- (b) Linear measuring machines having all of the following characteristics:
 - (1) Two or more axes;
 - (2) Range in any axis greater than 200 mm; and
 - (3) "Accuracy" (including any compensation) better than ± 0.0008 mm per any 300 mm segment of travel;

NOTE:

This sub-item does not embargo optical comparators.

- (c) Angular measuring systems having an "accuracy" equal to or better than ± 1 second of arc;

NOTE:

This sub-item does not embargo optical instruments, such as autocollimators, using collimated light to detect angular displacements of a mirror.

- (d) Non-contact type measuring systems having, at a standard ambient test room temperature ± 1 K, either of the following pairs of characteristics:
 - (1) Effective probe measurement diameter less than 0.5 mm and drift less than 0.5% per day; or
 - (2) "Linearity" better than $\pm 0.3\%$ and drift less than 0.5% per day;
- (e) Contact-type measuring systems specially designed for combined, simultaneous linear-angular inspection of hemi-shells, having both of the following characteristics:
 - (1) Linear "accuracy" equal to or better than ± 0.005 mm in any 5 mm; and
 - (2) Angular "accuracy" equal to or better than ± 1 minute in 90 minutes of arc.

Technical Notes:

1. "Accuracy" is usually measured in terms of inaccuracy. It is defined as the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.
2. "Linearity" is usually measured in terms of non-linearity. It is defined as the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalise and minimise the maximum deviations.

NOTE:

Governments may permit, as administrative exceptions, the shipment of equipment covered by sub-items (a) or (d) above to civil end-users not engaged in aerospace activities.

1533

"Signal analysers" (including spectrum analysers) and network analysers, as follows, and specially designed components, accessories and "specially designed software" therefor:

- (a) "Signal analysers" having any of the following characteristics:
 - (1) Capable of analysing frequencies exceeding 18 GHz;
 - (2) Capable of analysing frequencies exceeding 2.3 GHz with a "frequency span" of more than 2.3 GHz; *or*
 - (3) Using time compression of the input signal;
- (b) "Dynamic signal analysers", *except* when having a "real-time bandwidth" less than 5.12 kHz;

NOTE:

Nothing in the above permits the export of technology for "dynamic signal analysers", *except* the minimum technology required for use, i.e., installation, operation and maintenance.

- (c) Swept frequency network analysers for the automatic measurement of complex equivalent circuit parameters over a range of frequencies and having a maximum operating frequency exceeding 1.0 GHz; *or*

NOTE:

This does not include equipment for continuous wave, point-to-point measurement.

- (d) Scalar network analysers having a maximum operating frequency exceeding 2.3 GHz.

Technical Notes:

1. "Signal analysers"—
Apparatus capable of measuring and displaying basic properties of the single-frequency components of multi-frequency signals.
2. "Dynamic signal analysers"—
"Signal analysers" which use digital sampling and transformation techniques to form a Fourier spectrum display of the given waveform including amplitude and phase information.
3. "Real-time bandwidth"—
For "dynamic signal analysers" is the widest frequency range which the analyser can output to display or mass storage without causing any discontinuity in the analysis of the input data. For analysers with more than one channel, the channel configuration yielding the widest "real-time bandwidth" shall be used to make the calculation.
4. "Frequency span"—
The maximum range of the frequency segment displayed.

NOTES:

1. This Item does not embargo:
 - (a) Optical spectrum analysers such as:
 - (1) Prism or grating monochrometers;
 - (2) Optical interferometers;
 - (3) Optical spectrometers;
 - (b) Equipment only using constant percentage bandwidth filters (also known as octave or fractional octave filters);
 - (c) Medical equipment containing, as an integral part, "signal analysers".
2. Not used.
3. Governments may permit, as administrative exceptions, the shipment of "dynamic signal analysers" embargoed by sub-item (b) above provided they:
 - (a) Have no zoom capability; *and*
 - (b) Cannot compute 512 real spectral lines in less than 50 ms.

1534

Flatbed microdensitometers (*except* cathode-ray types) having any of the following characteristics, and specially designed components therefor:

- (a) A recording or scanning rate exceeding 5,000 data points per second;
- (b) A figure of merit better (less) than 0.1, defined as the product of the density resolution (expressed in density units) and the spatial resolution (expressed in micrometres);

NOTE:

This sub-item does not embargo equipment with a spatial resolution not better (less) than 2 micrometres and a density resolution not better (less) than 0.01 density unit.

- (c) An optical density range greater than 0 to 4.

Technical Note:

Density resolution (expressed in density units) is measured over the optical density range of the instrument.

NOTE:

Governments may permit the shipment of equipment specially designed for medical applications, provided they are satisfied the equipment is a reasonable requirement for the stated application.

1537

Microwave, including millimetric wave, equipment, including parametric amplifiers as follows, capable of operating at frequencies over 1 GHz, other than microwave equipment embargoed by Items 1501, 1517, 1520 or 1529:

- (a) Rigid and flexible waveguides designed for use at frequencies in excess of 18 GHz;
- (b) Waveguides having a bandwidth ratio above 1.7:1;
- (c) Waveguide components, as follows:
 - (1) Directional couplers having a bandwidth ratio above 1.7:1 and directivity over the band of 20 dB or more;
 - (2) Rotary joints capable of transmitting more than one isolated channel or having a bandwidth greater than 5% of the centre mean frequency, *except* those used in air traffic control equipment carrying combinations of frequencies suitable for secondary surveillance radar antennae co-mounted on a primary radar antenna and which do not have a bandwidth exceeding 5% of the centre mean frequency;
 - (3) Magnetic, including gyromagnetic, waveguide components;
 - (4) Diode waveguide components using diodes embargoed by Item 1544;
- (d) Transverse electromagnetic mode (TEM) devices using either:
 - (1) Magnetic, including gyromagnetic, properties; *or*
 - (2) Diodes embargoed by Item 1544;
- (e) TR and anti-TR tubes and specially designed components therefor, *except* those designed for use in waveguides, having any of the following characteristics, and which are in normal civil use for ground or marine radar:
 - (1) Operating at a peak power not exceeding 3 MW and at a frequency of 1.5 GHz or less;
 - (2) Operating at a peak power not exceeding 1.2 MW and at a frequency in the range 1.5 to 6 GHz; *or*
 - (3) Operating at a peak power not exceeding 300 kW and at a frequency in the range 6 to 10.5 GHz;
- (f) Assemblies and sub-assemblies in which the isolating base material functions as a dielectric (as used in stripline, microstrip or slotline) *except* for those items specifically designed for use in civil television systems to meet ITU standards and using as an isolating material paper base phenolics, glass cloth melamine, glass cloth epoxy resin, polyethylene terephthalate or other isolating material with an operating temperature not exceeding 423 K (150°C);
- (g) Phased array antennae and sub-assemblies, designed to permit electronic control of beam shaping and pointing (see Item 2015 of Group 2), and specially designed components therefor, including duplexers, phase shifters and associated high speed diode switches;
- (h) Other antennae specially designed for operation at frequencies above 30 GHz having a diameter of less than 1 m, and specially designed components therefor;
- (i) Microwave assemblies and sub-assemblies capable of being used at frequencies above 3 GHz and having circuits fabricated by the same processes used in integrated circuit technology, which include active circuit elements. (For acoustic wave devices, see Item 1586.) (For integrated circuits and related technology, see also Item 1564);
- (j) Microwave assemblies and sub-assemblies which contain bandpass or band-stop filters and are capable of operating at 3 GHz or more;
- (k) Amplifiers, *except* parametric or paramagnetic amplifiers having any of the following characteristics:
 - (1) Specially designed for medical applications;

- (2) Specially designed for use in "simple educational devices" and operate at industrial, scientific or medical (ISM) frequencies; *or*
- (3) An output power of not more than 10 W and specially designed for:
 - (A) Industrial or civilian intrusion detection and alarm systems;
 - (B) Traffic or industrial movement control and counting systems;
 - (C) Systems for the detection of environmental pollution of air or water; *or*
 - (D) "Simple educational devices";

Technical Note:

"Simple educational devices"—

Devices designed for use in teaching basic scientific principles and demonstrating the operation of those principles in educational institutions.

- (f) Modulators using PIN (positive-intrinsic-negative) transistor technology.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of equipment embargoed by sub-item (f) above designed and intended for use in civil telecommunications systems at frequencies allocated by the ITU for that purpose.
2. Sub-item (g) above does not embargo duplexers and phase shifters specifically designed for use in civil television systems or in other civil radar or communication systems not embargoed elsewhere in this List.
3. Nothing in the following permits the export of technology, *except* the minimum technology for the use, i.e., installation, operation and maintenance, of the following equipment:
Sub-items (j) and (k) do not embargo microwave assemblies, sub-assemblies or amplifiers, or combinations thereof, having all of the following characteristics:
 - (a) Fixed tuned at the time of manufacture to operate only within the ITU satellite broadcasting band from 11.7 to 12.5 GHz;
 - (b) Not capable of being retuned to a new frequency band by the user; *and*
 - (c) Specially designed for use with, or in, civil television receivers.
4. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of:
 - (a) Microwave equipment embargoed by sub-items (a), (b) or (c) above, when designed for use at frequencies not exceeding 40 GHz and when specially designed for use with conventional commercial instruments described in Items 1529, 1531 or 1533, provided the equipment does not in any way extend the frequency range of the basic instrument;
 - (b) PIN modulators embargoed by sub-item (1) above designed for use at frequencies not exceeding 10.5 GHz.

1548

Photosensitive components, including linear and focal-plane arrays, as follows, and dice and wafers therefor:

- (a) Photosensitive components (including photodiodes, phototransistors, photothyristors, photoconductive cells and similar photosensitive components):
 - (1) Having a peak sensitivity at a wavelength longer than 1,200 nm or shorter than 190 nm; *or*
 - (2) Having a peak sensitivity at a wavelength shorter than 300 nm and having an efficiency of less than 0.1% relative to peak response at wavelengths longer than 400 nm;

NOTE:

Vacuum photodiodes specially designed for use in spectrophotometry having a peak response at a wavelength shorter than 300 nm are not embargoed by this sub-item.

(For photomultiplier tubes which contain microchannel plates, see Item 1549.)

- (b) Semiconductor photodiodes and phototransistors with a response time constant of 95 ns or less measured at the operating temperature for which the time constant reaches a minimum, *except* semiconductor photodiodes which are not "space qualified" with a

response time constant of 0.5 ns or more and with a peak sensitivity at a wavelength neither longer than 920 nm nor shorter than 300 nm;

- (c) Specially designed or rated as electromagnetic (including laser) and ionised-particle radiation resistant;
- (d) Linear and focal-plane arrays (hybrid or monolithic) having the characteristics in (a) or (b) above, and specially designed components therefor;

Technical Note:

The term "space qualified" used in this Item refers to products which are stated by the manufacturer as designed and tested to meet the special electrical, mechanical or environmental requirements for use in rockets, satellites or high-altitude flight systems operating at altitudes of 100 km or more.

NOTES:

1. The time constant is defined as the time taken from the application of a light stimulus for the current increment to reach a value of 1-1/e times the final value (i.e. 63% of the final value).
2. This Item does not embargo the following:
 - (a) Germanium photo devices with a peak sensitivity at a wavelength shorter than 1,750 nm;
 - (b) Infrared single-element encapsulated photo-conductive cells or pyroelectric detectors intended for civil applications and using any of the following:
 - (1) Evaporated lead sulphide;
 - (2) Triglycine sulphate with a surface area of 20 mm² or less;
 - (3) Lead-lanthanum-zirconium titanate ceramic;
 - (c) Single-element encapsulated mercury-cadmium-telluride (HgCdTe) uncooled (295 K ambient temperature operation) photo-electromagnetic (pem) or photoconductive (pc) mode photo detectors with a peak sensitivity at a wavelength shorter than 11,000 nm.
3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of semiconductor photodiodes for previously approved and installed Western civil communications equipment with a response time constant of 0.5 ns or more and with a peak sensitivity at a wavelength neither longer than 1,370 nm nor shorter than 300 nm.

N.B.:

The photodiodes will be supplied on a replacement basis with no enhancement of the system.

1549

Photomultiplier tubes having any of the following characteristics:

- (a) They are solar blind types for which the long wavelength cutoff is below 350 nanometres, where the long wavelength cutoff is defined as 10% of the maximum sensitivity;

NOTE:

Photomultiplier tubes specially designed for use in spectrophotometry having a peak sensitivity at a wavelength shorter than 300 nanometres are not embargoed by this sub-item.

- (b) An anode pulse rise time of less than 1 ns; *or*
- (c) Containing microchannel plate electron multipliers.

(For microchannel plate electron multipliers, see Item 1556.)
(For photosensitive components, see Item 1548.)

1553

Flash discharge type X-ray systems, including tubes, having all of the following characteristics:

- (a) Peak power greater than 500 MW;
- (b) Output voltage greater than 500 kV;
- (c) Pulse width less than 0.2 microsecond.

1555

Electron tubes, as follows, and specially designed components therefor:

- (a) Electron tubes for image conversion or intensification, including those designed for streak or framing cameras, incorporating:
 - (1) Microchannel-plate electron multipliers; *or*
 - (2) Semi-transparent photocathodes incorporating epitaxially grown layers of compound semiconductors, such as gallium arsenide;
- (b) Electron tubes for television or video cameras, having any of the following characteristics:
 - (1) Incorporating microchannel-plate electron multipliers;
 - (2) Coupled with electron tubes embargoed by (a) above; *or*
 - (3) Ruggedised and having a maximum length-to-bulb diameter ratio of 5:1 or less.

NOTES:

1. This Item does not embargo commercial standard X-ray amplifier tubes.
2. Governments may permit the shipment of reasonable quantities of non-ruggedised tubes embargoed by this Item, provided they are satisfied that the tubes will be used for *bona fide* medical applications.
3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of electron tubes, as follows:
 - (a) Image intensifier and image conversion tubes which incorporate microchannel-plates, when not specially designed for cameras embargoed by Item 1585;
 - (b) Television and video camera tubes which incorporate microchannel-plate electron multipliers not embargoed by Item 1556.

N.B.:

This Note does not apply to electron tubes incorporating a gallium arsenide (or similar semiconductor) photocathode.

1556

Optical elements and elements for optical tubes, as follows:

- (a) Non-flexible fused fibre-optic plates or bundles, having all of the following characteristics:
 - (1) A fibre pitch (centre-to-centre spacing) of less than 10 micrometres;
 - (2) A light-absorbing medium surrounding each fibre, or interstitially placed between fibres; *and*
 - (3) A diameter greater than 13 mm (1 inch);
- (b) Microchannel plates for electron image amplification having both of the following characteristics:
 - (1) 15,000 or more hollow tubes per plate; *and*
 - (2) Hole pitch (centre-to-centre spacing) of less than 25 micrometres;
- (c) Semi-transparent photocathodes incorporating epitaxially grown layers of compound semiconductors, such as gallium arsenide; (For associated starting materials, see Item 1757.)
- (d) Diffractive type optical elements specially designed for display screens, with any of the following characteristics:
 - (1) A transmission of more than 90% outside the reflection band and a reflection of more than 75% inside the reflection band, which has less than 15 nm bandwidth and is matched to the frequency of the display light source;
 - (2) A rear projection screen brightness gain of more than 10 times the gain of a Lambertian scatterer with an equivalent area, and less than 10% variation in brightness across the exit aperture;
 - (3) Specially designed for use in helmet-mounted displays.

1558

Electronic vacuum tubes and cathodes, as follows, and other components specially designed for those tubes:

- (a) Tubes in which space charge control is utilised as the primary functional parameter, including triodes and tetrodes, as follows:
 - (1) Tubes rated for continuous wave operation having either of the following characteristics:
 - (A) Above 4 GHz at maximum rated anode dissipation; *or*
 - (B) Within the frequency range 0.3 to 4 GHz and for which, under any condition of cooling, the product of the maximum rated anode dissipation (expressed in kW) and the square of the maximum frequency (expressed in GHz) at the maximum rated anode dissipation is greater than 10, *except* tubes specially designed for television transmitters operating in the frequency range of 0.47 to 0.96 GHz and rated for operation without a grid current, for which the product of the rated anode dissipation (expressed in kW) and the square of the maximum frequency (expressed in GHz) may reach 20;
 - (2) Tubes rated only for pulse operation having either of the following characteristics:
 - (A) Above 1 GHz, with maximum peak pulse output power greater than 45 kW; *or*
 - (B) Between 0.3 and 1 GHz and for which, under any condition of cooling, the product of the peak pulse output power (expressed in kW) and the square of the maximum frequency (expressed in GHz) exceeds 45;
 - (3) Tubes specially designed for use as pulse modulators for radar or similar applications, having a peak anode voltage rating of 100 kV or more, or rated for a peak pulse power of 20 MW or more;
- (b) Tubes which utilise interaction between a beam of electrons and microwave elements and in which the electrons travel in a direction perpendicular to the applied magnetic field, including magnetrons, crossed-field amplifier tubes and crossed-field oscillator tubes, *except*:
 - (1) Fixed frequency and tunable pulsed magnetrons and crossed-field amplifier tubes which are in normal civil use in equipment which may be exported under the terms of this Group as follows:
 - (A) Magnetrons designed to operate at frequencies below 3 GHz with a maximum rated peak output power of 5 MW or less, or between 3 to 12 GHz with the product of the maximum rated peak output power (expressed in kW) and the frequency (expressed in GHz) less than 4,200 and a "frequency tuning time" of more than 100 milliseconds;
 - (B) Crossed-field amplifier tubes designed to operate at frequencies below 4 GHz with a maximum rated average output power of 1.2 kW or less, a bandwidth of 200 MHz or less and a gain of less than 15 dB;
 - (2) Fixed frequency continuous wave magnetrons designed for medical use or for industrial heating or cooking purposes operating at a frequency of 2.375 GHz \pm 0.05 GHz or 2.45 GHz \pm 0.05 GHz with a maximum rated output power not exceeding 6 kW or, at a frequency lower than 1 GHz, with a maximum rated output power not exceeding 35 kW;
- (c) Tubes which utilise the interaction between a beam of electrons and microwave elements or cavities and in which the electrons travel in a direction parallel to the applied magnetic field, including klystrons or travelling wave tubes, *except*:
 - (1) Continuous wave tubes, having all of the following characteristics:
 - (A) Designed for use in civil ground communication;
 - (B) Instantaneous bandwidth tubes with any of the following sets of characteristics:
 - (a) Tubes with:
 - (1) An instantaneous bandwidth of half an octave or less (i.e., the highest operating frequency does not exceed 1.5 times the lowest operating frequency); *and*
 - (2) The product of the rated output power (expressed in kW) and the maximum operating frequency (expressed in GHz) does not exceed 0.3;

- (b) Tubes which:
 - (1) Have an instantaneous bandwidth of 10% or less (i.e., the highest operating frequency does not exceed 1.1 times the lowest operating frequency);
 - (2) The product of the rated output power (expressed in kW) and the maximum operating frequency (expressed in GHz) does not exceed 3; *and*
 - (3) Operate in standard international telecommunications bands; *or*
- (c) Tubes which:
 - (1) Have an instantaneous bandwidth of 3% or less (i.e., the highest operating frequency does not exceed 1.03 times the lowest operating frequency);
 - (2) The product of the rated output power (expressed in kW) and the maximum operating frequency (expressed in GHz) does not exceed 25; *and*
 - (3) Operate in standard international telecommunications bands;
- (C) Operating frequency no higher than 20 GHz;
- (D) No multiple grid, including shadow grid, electron guns; *and*
- (E) Collectors with no more than two depressed stages;
- (2) Pulsed tubes, as follows:
 - (A) For civil applications;
 - (B) Having an instantaneous bandwidth of half an octave or less (i.e., the highest operating frequency is not higher than 1.5 times the lowest operating frequency);
 - (C) Having collectors with no more than two depressed stages; *and*
 - (D) Having either of the following sets of characteristics:
 - (a) (1) A peak saturated output power not exceeding 1 kW;
 - (2) An average output power not exceeding 40 W; *and*
 - (3) Operating frequency not exceeding 10 GHz; *or*
 - (b) (1) A peak saturated output power not exceeding 100 W;
 - (2) An average output power not exceeding 20 W; *and*
 - (3) Operating frequency between 10 and 20 GHz;
- (3) Fixed frequency pulsed tubes, as follows:
 - (A) For civil applications;
 - (B) Operating at frequencies below 3.5 GHz;
 - (C) Having a peak output power of 1.6 MW or less; *and*
 - (D) Having an operating bandwidth of less than 1%;
- (4) Tubes, as follows:
 - (A) Used as fixed frequency or voltage tunable oscillator tubes;
 - (B) Designed to operate at frequencies below 20 GHz; *and*
 - (C) Having a maximum output power of less than 3 W;
- (d) Tubes which utilise interaction between a beam of electrons and microwave elements or cavities but do not require a magnetic field to control or focus the electron beam, *except* low power reflex oscillator klystrons designed to operate at frequencies below 20 GHz and at a maximum output power of less than 3 W;
- (e) Tubes which utilise interaction between a beam of electrons and microwave elements or cavities in which the electrons drift in a direction parallel to the applied magnetic field but also require for their operation a large component of velocity transverse to the direction of the applied magnetic field, including gyrotrons, ubitrons and peniotrons, *except* gyrotron oscillators;
- (f) Tubes designed to withstand on any axis an acceleration of short duration (shock) greater than 1,000 g;
- (g) Tubes designed for operation in ambient temperatures exceeding 473 K (200°C);
- (h) Tubes of the types described in (c), (d) or (e) above, designed to operate with no filament or cathode heating element (as indicated by the absence of heating supply connections);
- (i) Tubes which utilise a modulated beam of electrons striking one or more semiconductor diodes to provide power gain;
- (j) Cathodes for electronic vacuum tubes, as follows:
 - (1) Specially designed for tubes embargoed by (a) to (i) above;

or

- (2) Impregnated cathodes capable of producing a current density exceeding 0.5 A/cm² at rated operating conditions.

Technical Note:

"Frequency tuning time"—

The time required to change the operating frequency from a starting frequency, through the maximum frequency, through the minimum frequency, and return to the starting frequency, i.e., one complete tuning cycle.

$$\text{frequency tuning time: } T = \frac{1}{2f_0}$$

f_0 : dither rate

NOTES:

1. Nothing in this Note permits the export of technology for electronic vacuum tubes or specially designed components therefor. (For manufacturing equipment, see Item 1355(a).) Sub-items (a) and (c) above do not embargo tubes specially designed for civil telecasting according to CCIR or OIR standards, and specially designed components therefor.
2. Nothing in this Note permits the export of technology. Sub-items (b) and (c) above do not embargo magnetrons and klystrons specially designed for particle accelerators for medical radiation therapy, having all of the following characteristics:
 - (1) Capable of operation only at a frequency of 3,000 MHz \pm 15 MHz or at a frequency of 2,856 MHz \pm 15 MHz;
 - (2) Not capable of being tuned mechanically or electronically outside the above bands;
 - (3) Mechanically tuned within the above bands; *and*
 - (4) Having a peak output power not exceeding 10 MW and an average output power not exceeding 15 kW.

1561

Materials specially designed and manufactured for use as absorbers of electromagnetic waves having frequencies greater than 2×10^8 Hz and less than 3×10^{12} Hz, *except* materials as follows:

- (i) "Hair" type absorbers, whether constructed of natural or synthetic fibres, with non-magnetic loading to provide absorption;
- (ii) Absorbers whose incident surface is non-planar in shape, including pyramids, cones, wedges and convoluted surfaces, and which have no magnetic loss; *and*
- (iii) Absorbers having all of the following characteristics:
 - (1) Made of:
 - (a) Plastic foam materials (flexible or non-flexible) with carbon-loading providing absorption; *or*
 - (b) Organic binders with magnetic material loading which do not provide "broad-band absorption performance with low reflectivity";

Technical Note:

"Broad-band absorption performance with low reflectivity" is defined as less than 5% echo compared with metal over a bandwidth greater than \pm 15% of the centre frequency of the incident energy.

- (2) The incident surface is planar;
- (3) Their tensile strength is less than 7×10^6 N/m² (1,016 psi);
- (4) Their compressive strength is less than 14×10^6 N/m² (2,032 psi); *and*
- (5) They cannot withstand more than 450 K (177°C, 350°F).

NOTE:

Nothing in the above releases magnetic materials to provide absorption when contained in paint.

1564

"Assemblies" of electronic components, "modules", printed circuit boards with mounted components, "substrates" and integrated circuits, including packages therefor, as follows:

NOTE:

Integrated circuits are categorised as follows:

- "monolithic integrated circuits"
- "microcomputer microcircuits"
- "microprocessor microcircuits"
- "multichip integrated circuits"
- "film type integrated circuits"
- "hybrid integrated circuits"
- "optical integrated circuits"

For a list of definitions of terms used in this Item, see Technical Note below.

- (a) "Substrates" for printed circuit boards, including ceramic "substrates" and coated metal "substrates" (single-sided, double-sided or multilayer) and thin copper foils therefor, *except*:
- (1) Printed circuit boards manufactured from any of the following materials:
 - (A) Paper base phenolics;
 - (B) Glass cloth melamine;
 - (C) Glass epoxy resin uncoated or coated with copper foil of a thickness of 18 micrometres (0.00071 inch) or more;
 - (D) Polyethylene terephthalate; *or*
 - (E) Any other insulating material having all of the following characteristics:
 - (a) A maximum continuous rated operating temperature not exceeding 423 K (150°C);
 - (b) A dissipation factor equal to or more than 0.009 at 1 MHz;
 - (c) A relative dielectric constant equal to or less than 8 at 1 MHz; *and*
 - (d) A coefficient of expansion equal to or more than $\pm 10^{-5}/K$ over a temperature range of 273 K to 393 K (0°C to 120°C);
 - (2) Ceramic "substrates" having no more than two layers of interconnections, including the ground plane; *or*
 - (3) Copper foil having a thickness of 18 micrometres (0.00071 inch) or more;
- (b) Ceramic packages for integrated circuits which are designed for hermetically sealed pin or pad grid array, leadless carrier or surface-mounted configurations, *except* when having all of the following characteristics:
- (1) Single-in-line, dual-in-line or flat-pack configuration;
 - (2) Pin, pad or lead spacings of 2.50 mm or more, or 100 mil or more; *and*
 - (3) 40 leads or less;
- (c) "Assemblies", "modules" and printed circuit boards with mounted components, with any of the following characteristics:
- (1) They include "substrates" for printed circuit boards embargoed by sub-item (a); *or*
 - (2) They contain embargoed components, *except* when:
 - (A) The only embargoed components they contain are capacitors;
 - (B) They are power supply "assemblies";
 - (C) They are non-coherent light-emitting alphanumeric displays, which incorporate "monolithic integrated circuits" having both of the following characteristics:
 - (a) Used for decoding, controlling or driving the display; *and*
 - (b) Not integral with the actual display device; *or*
 - (D) They are simple encapsulated photo-coupler (transopter) "assemblies", having both of the following characteristics:
 - (a) Electrical input and output; *and*
 - (b) Any incorporated light-emitting diode can only emit non-coherent light;

NOTE:

Sub-item (c)(2) does not embargo "assemblies", "modules" or printed circuit boards with mounted components, having both of the following characteristics:

- (a) Designed for equipment not embargoed by any other Item of Group 1, 2 or 3; *and*
- (b) Substantially restricted to the particular application for which they have been designed by nature of either:
 - (1) Design;
 - (2) Performance;
 - (3) Lack of "user-accessible microprogrammability";
 - (4) Lack of "user-accessible programmability";
 - (5) "Software";
 - (6) "Microprogramme" control; *or*
 - (7) Specialised logic control.

NOTES:

1. For the embargo status of "assemblies", "modules" or printed circuit boards with mounted components which are designed for, or which have the same functional characteristics as, electronic computers or "related equipment", see Item 1565.
 2. "Assemblies", "modules" or printed circuit boards with mounted components which are designed for, or which have the same functional characteristics as, embargoed equipment shall be rated against the parameters of the appropriate equipment Item. In such cases, however, the relevant temperature parameters have to be changed into: below 218 K (-55°C) or above 358 K (85°C).
- (d) "Monolithic integrated circuits", "microcomputer microcircuits", "microprocessor microcircuits", "multichip integrated circuits", "film type integrated circuits", "hybrid integrated circuits" and "optical integrated circuits", *except*:
- (1) Encapsulated passive networks;

NOTE:

Technology for the manufacture of thin film passive networks is not released from embargo by this sub-item.

- (2) Encapsulated integrated circuits, having all of the following characteristics:
 - (A) Not designed or rated as radiation hardened;
 - (B) Not rated for operation at an ambient temperature below 233 K (-40°C) or above 358 K (85°C);
 - (C) Packaged in any of the following casings:
 - (a) TO-5 outline cases (diameter 7.7 to 9.4 mm, i.e., 0.305 to 0.370 inch); *or*
 - (b) Hermetically sealed dual in-line cases; *or*
 - (c) Non-hermetically sealed cases; *and*
 - (D) Being any of the following types:
 - (a) Bipolar "monolithic integrated circuits", having all of the following characteristics:
 - (1) Designed to perform a single digital logic function or a combination of digital logic functions;
 - (2) Encapsulated in packages having 24 terminals or less;
 - (3) A "basic gate propagation delay time" of no less than 3 ns;
 - (4) A "basic gate power dissipation" of no less than 2 mW; *and*
 - (5) A product of the "basic gate propagation delay time" and the "basic gate power dissipation" per gate of no less than 30 pJ for types having a "basic gate propagation delay time" of 3 ns or more and less than 5 ns;
 - (b) Bipolar "monolithic integrated circuits", having all of the following characteristics:
 - (1) Designed for operation in civil applications;
 - (2) Being either:
 - (A) Electronic switches, externally controlled by inductive, magnetic or optical means; *or*
 - (B) Threshold value switches; *and*
 - (3) With switching times of 0.5 microsecond or more;
 - (c) Complementary metal-oxide semiconductor (CMOS) "monolithic integrated circuits", having all of the following characteristics:
 - (1) Designed for operation as digital logic circuit elements but limited to gates, inverters, buffers, flip-flops, latches, multi-vibrators, bilateral switches, display drivers, fixed counters, fixed frequency dividers, storage registers, decoders, voltage trans-

- lators, encoders, Schmidt triggers, delay timers, carry generators, clock generators or any combination of the above digital logic functions;
- (2) Encapsulated in packages having 24 terminals or less; *and*
 - (3) A minimum value of the "basic gate propagation delay time" under any rated condition of no less than 10 ns;
- (d) Positive-channel type or negative-channel type metal-oxide semiconductor (PMOS or NMOS) "monolithic integrated circuits", having all of the following characteristics:
- (1) Designed for and by virtue of circuit design limited to use as serial digital shift registers;
 - (2) A maximum clock rate of 10 MHz; *and*
 - (3) A maximum of 1,024 bits per package;
- (e) Silicon "microcomputer microcircuits" having all of the following characteristics:
- (1) Mask programmed by the "manufacturer" for a civil application prior to shipment;
 - (2) A word size to "speed" ratio of less than or equal to 1.1 bit per microsecond;
 - (3) A "speed-power dissipation product" of more than or equal to 1.2 microjoule;
 - (4) Not containing on-the-chip:
 - (A) A read-only storage (ROM) of more than 8,192 byte;

NOTE:

This does not include the storage space needed for the "microprogramme".

- (B) A random access storage (RAM) of more than 256 byte;
- (C) A programmable read-only storage (PROM);
- (D) Multiplication capabilities;
- (E) General purpose operating systems (e.g. CP/M); *or*
- (F) High order languages (e.g. Tiny Basic);
- (5) An operand (data) word length of less than or equal to 8 bits;
- (6) Not capable of using storage off-the-chip for "programme" storage; *and*
- (7) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);

NOTE:

Bit-slice "microcomputer microcircuits" are not released by this sub-item.

- (f) Silicon "monolithic integrated circuits", "microcomputer microcircuits", "microprocessor microcircuits", "multichip integrated circuits", "film type integrated circuits", "hybrid integrated circuits" or "optical integrated circuits" having both of the following characteristics:
- (1) No "user-accessible microprogrammability"; *and*
 - (2) Designed or programmed by the "manufacturer" for any of the following applications only:
 - (A) Car electronics (e.g., entertainment, instrumentation, safety, comfort, operations or pollution);
 - (B) Home electronics (e.g., audio and video equipment, appliances, safety, education, comfort, remote controlled toys or amusement);
 - (C) Timekeeping applications (e.g., watches or clocks);
 - (D) Personal communications up to 150 MHz, including amateur radio communication and intercom;
 - (E) Unembargoed cameras including cine-cameras but excluding imaging microcircuits; *or*
 - (F) Medical electronic prostheses (e.g., cardiac pacemakers, hearing aids);

- (G) Civil telephone subscriber sets providing neither ISDN functions nor encryption;

NOTE:

Integrated circuits specially designed for mobile (radio) telephone which use frequency synthesizers are specially designed components covered by Item 1531.

NOTE:

The temperature limits specified in (d)(2)(B) do not apply to subsections (A) or (F).

- (g) "Monolithic integrated circuits" or "hybrid integrated circuits", having all of the following characteristics:
- (1) Not capable of addressing off-the-chip storage;
 - (2) No "user-accessible microprogrammability"; *and*
 - (3) Designed for and by virtue of circuit design limited to use in simple calculators, having both of the following characteristics:
 - (A) Performing a single function in response to a keystroke; *and*
 - (B) Capable of performing floating point additions of a maximum of 13 decimal digits (mantissa only) in no less than 20 ms;
- (h) "Monolithic integrated circuits" or "hybrid integrated circuits", having both of the following characteristics:
- (1) No "user-accessible microprogrammability"; *and*
 - (2) Designed for and by virtue of circuit design limited to use in simple key programmable calculators, having both of the following characteristics:
 - (A) Capable of executing a sequence of no more than 256 "programme" steps introduced into a "programme" storage on-the-chip by a sequence of keystrokes; *and*
 - (B) Capable of performing floating point additions of a maximum of 13 decimal digits (mantissa only) in no less than 20 ms;
- (i) Silicon "microprocessor microcircuits", having all of the following characteristics:
- (1) A word size to "speed" ratio of less than or equal to 1.25 bit per microsecond;
 - (2) A "speed power dissipation product" of more than or equal to 2 microjoule;
 - (3) Not containing on-the-chip:
 - (A) Read-only storage (ROM);
 - (B) Programmable read-only storage (PROM);
 - (C) Random-access storage (RAM) of more than 1,024 bits; *or*
 - (D) Multiplication instructions;
 - (4) Capable of addressing storage off-the-chip of no more than 65,536 byte;
 - (5) An operand (data) word length of less than or equal to 8 bits;
 - (6) An arithmetic logic unit (ALU) not wider than 8 bits; *and*
 - (7) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);

NOTE:

Bit-slice "microprocessor microcircuits" are not released by this sub-item.

- (j) Storage "monolithic integrated circuits" or "multichip integrated circuits", as follows:
- (1) Read-only (ROMs), having all of the following characteristics:

- (A) Mask programmed by the "manufacturer" for a civil application prior to shipment;
- (B) A maximum of 8,192 bits per package;
- (C) A maximum access time of no less than 450 ns; *and*
- (D) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (2) Positive-channel type or negative-channel type metal-oxide semiconductor read-only (PMOS- or NMOS-ROMs), having all of the following characteristics:
- (A) Mask programmed by the "manufacturer" for a civil application prior to shipment;
- (B) A maximum of 32,768 bits per package;
- (C) A maximum access time of no less than 450 ns; *and*
- (D) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (3) Positive-channel type or negative-channel type metal-oxide semiconductor read-only (PMOS- or NMOS-ROMs), having all of the following characteristics:
- (A) Mask programmed or designed as character generators for a standard character font;
- (B) A maximum access time of no less than 250 ns; *and*
- (C) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (4) Programmable (non-erasable) read-only (PROMs), having all of the following characteristics:
- (A) Programmed by the "manufacturer" for a civil application prior to shipment;
- (B) A maximum of 2,048 bits per package;
- (C) A maximum access time of no less than 250 ns; *and*
- (D) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (5) Programmable (non-erasable) read-only (PROMs), having all of the following characteristics:
- (A) Programmed by the "manufacturer" for a civil application prior to shipment;
- (B) A maximum of 8,192 bits per package;
- (C) A maximum access time of no less than 450 ns; *and*
- (D) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (6) Bipolar random-access (RAMs), having any of the following pairs of characteristics:
- (A) A maximum of 64 bits per package *and* a maximum access time of no less than 30 ns;
- (B) A maximum of 256 bits per package *and* a maximum access time of no less than 40 ns; *or*
- (C) A maximum of 1,024 bits per package *and* a maximum access time of no less than 45 ns;
- (7) Metal-oxide semiconductor dynamic random access (MOS-DRAMs), having all of the following characteristics:
- (A) A maximum of 4,096 bits per package;
- (B) A maximum access time of no less than 250 ns; *and*
- (C) Not rated for operation at an ambient temperature below 253 K (-20°C) or above 348 K (75°C);
- (8) Metal-oxide semiconductor static random access (MOS-SRAMs), having both of the following characteristics:
- (A) A maximum of 1,024 bits per package; *and*
- (B) A maximum access time of no less than 450 ns;
- (k) Amplifier "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", as follows:
- (1) Audio amplifiers:
- (A) Having a maximum rated continuous power output of 50 W or less at an ambient temperature of 298 K (25°C);
- (B) Encapsulated in non-hermetically sealed packages;
- NOTE:**
For audio amplifiers, the 358 K (85°C) upper temperature limit specified in (d)(2)(B) is not applicable. The lower limit of 233 K (-40°C) is applicable.
- (2) Instrumentation amplifiers, having all of the following characteristics:
- (A) A best-case rated linearity no better than $\pm 0.01\%$ at a gain of 100;
- (B) A maximum gain-bandwidth product of no more than 7.5 expressed in MHz (e.g., a maximum bandwidth of 75 kHz at -3 dB and a gain of 100); *and*
- (C) A typical slew rate at unity-gain not exceeding 3 V/microsecond;
- (3) Isolation amplifiers;
- (4) Operational amplifiers, having all of the following characteristics:
- (A) A typical unity-gain open-loop bandwidth of no more than 5 MHz;
- (B) A typical open-loop voltage gain of no more than 10^6 , i.e., 120 dB;
- (C) Either:
- (a) A maximum intrinsic rated input off-set voltage of no less than 1.0 mV; *or*
- (b) A maximum input offset voltage drift of no less than 5 microvolt/K;
- (D) A typical slew rate at unity-gain not exceeding 6 V/microsecond; *and*
- (E) A typical power dissipation of more than 10 mW per amplifier, if the typical slew rate at unity-gain exceeds 2.5 V/microsecond; *or*
- (5) Untuned alternating current (AC) amplifiers, having both of the following characteristics:
- (A) A bandwidth of less than 3 MHz; *and*
- (B) A maximum rated power dissipation of 5 W or less at an ambient temperature of 298 K (25°C);
- (l) Analogue multiplier or divider "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", having both of the following characteristics:
- (1) A best-case rated linearity of no better than $\pm 0.5\%$ of full scale; *and*
- (2) A -3 dB small signal bandwidth of no more than 1 MHz;
- (m) Converter "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", as follows:
- (1) Analogue-to-digital converters, having both of the following characteristics:
- (A) A maximum conversion rate to rated accuracy of no more than 50,000 complete conversions per second, i.e.,

- a conversion time to maximum resolution of no less than 20 microsecond; *and*
- (B) An accuracy of no better than $\pm 0.025\%$ of full scale over the specified operating temperature range;
- (2) Analogue-to-digital converters, having both of the following characteristics:
 - (A) Designed for digital voltmeter applications; *and*
 - (B) Permitting characteristics corresponding to those of instruments free from embargo under Item 1529(f);
- (3) Digital-to-analogue converters, having both of the following characteristics:
 - (A) A maximum settling time to rated linearity of no less than:
 - (a) 5 microsecond for voltage output converters; *or*
 - (b) 250 ns for current output converters; *and*
 - (B) A non-linearity (i.e., deviation from an ideal straight line) of equal to or worse than $\pm 0.025\%$ of full scale over the specified operating temperature range;
- (4) Voltage (rms-to-DC) converters; *or*
- (5) Voltage-to-frequency converters having all of the following characteristics:
 - (A) Not employing delta or delta/sigma modulation techniques;
 - (B) A rated accuracy of no better than $\pm 0.01\%$ of full scale; *and*
 - (C) A "gain drift" of no less than $\pm 50 \times 10^{-6}/K$ at rated frequency;

NOTE:

"Gain drift" specifies the maximum change in gain over a specified temperature range.

NOTE:

See Item 1527 for coders, decoders or coders/decoders (codec), all when designed for voice.

- (n) Interface "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", as follows:
 - (1) Line drivers and line receivers having a "typical propagation delay time" from data input to output of no less than 15 ns;
 - (2) Peripheral or display drivers, having all of the following characteristics:
 - (A) A maximum rated output current of 500 mA or less;
 - (B) A "typical propagation delay time" from data input to output of no less than 20 ns; *and*
 - (C) A maximum rated output voltage of 80 V or less;
 - (3) Sense amplifiers, having both of the following characteristics:
 - (A) A "typical propagation delay time" from data input to output of no less than 15 ns; *and*
 - (B) A typical input threshold voltage of no less than 10 mV; *or*
 - (4) Storage or clock drivers, having all of the following characteristics:
 - (A) A maximum rated output current of 500 mA or less;
 - (B) A maximum rated output voltage of 30 V or less; *and*
 - (C) A "typical propagation delay time" from data input to output of no less than 20 ns;

Technical Note:

When the "typical propagation delay time" is not specified, the typical turn-on or turn-off time, whichever is less, should be used.

- (o) Peripheral positive-channel type or negative-channel type metal-oxide semiconductor (PMOS or NMOS) "monolithic integrated circuits" or "multichip integrated circuits", designed only for:
 - (1) The support of "microprocessor microcircuits" which are excluded from embargo by (d)(2)(D)(i); *and*
 - (2) Any of the following functions:
 - (A) Parallel input/output controller (PIO);
 - (B) Serial input/output controller (SIO);
 - (C) Dual asynchronous receiver/transmitter (DART);
 - (D) Counter/timer circuit (CTC);
- (p) Sample and hold "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", having both of the following characteristics:
 - (1) An acquisition time of no less than 10 microsecond; *and*
 - (2) A non-linearity (i.e., a deviation from an ideal straight line) of equal to or worse than $\pm 0.01\%$ of full scale for a hold time of 1 microsecond;
- (q) Timing "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", having both of the following characteristics:
 - (1) A typical timing error of no less than $\pm 0.5\%$; *and*
 - (2) A typical rise time of no less than 100 ns;
- (r) Voltage "monolithic integrated circuits", "multichip integrated circuits", "film type integrated circuits" or "hybrid integrated circuits", as follows:
 - (1) Voltage comparators, having both of the following characteristics:
 - (A) A maximum input offset voltage of no less than 2 mV; *and*
 - (B) A "typical switching speed", i.e., typical response time of no less than 30 ns;
 - (2) Voltage references, having both of the following characteristics:
 - (A) A rated accuracy of no better than $\pm 0.1\%$; *and*
 - (B) A temperature coefficient of the voltage of no less than $15 \times 10^{-6}/K$; *or*
 - (3) Linear type voltage regulators, having both of the following characteristics:
 - (A) A rated nominal output voltage of 50 V or less; *and*
 - (B) A maximum output current of 2 A or less;
 - (4) Switching type voltage regulators, having both of the following characteristics:
 - (A) A rated nominal output voltage of 40 V or less; *and*
 - (B) A maximum output current of 150 mA or less;

NOTES:

1. For voltage regulators, the 358 K (85°C) upper temperature limit specified in (d)(B)(2) is not applicable. The lower limit of 233 K (-40°C) is applicable.
 2. See (d)(2)(D)(m)(4) for rms-to-DC voltage converters and (d)(2)(D)(m)(5) for voltage-to-frequency converters.
- (s) Non-coherent light-emitting alphanumeric displays, which do not incorporate other "monolithic integrated circuits";
 - (t) Non-coherent light-emitting alphanumeric displays, which incorporate "monolithic integrated circuits" having both of the following characteristics:

- (1) Used for decoding, controlling or driving the display; *and*
- (2) Not integral with the actual display device;
- (u) Simple encapsulated photocoupler (transopter) "optical integrated circuits", having both of the following characteristics:
 - (1) Electrical input and output; *and*
 - (2) Any incorporated light-emitting diode can only emit non-coherent light;
- (3) Unencapsulated integrated circuits, having all of the following characteristics:
 - (A) Based exclusively upon silicon;
 - (B) Not designed or rated as radiation hardened; *and*
 - (C) Being any of the following types:
 - (a) Bipolar "monolithic integrated circuits", having all of the following characteristics:
 - (1) Designed to perform a single digital logic function or a combination of digital logic functions;
 - (2) A "basic gate propagation delay time" of no less than 5 ns;
 - (3) A product of the "basic gate propagation delay time" and the "basic gate power dissipation" per gate of no less than 70 pJ; *and*
 - (4) No more than 24 input/output pads;

NOTE:

Sub-item (d)(3)(C)(a) does not permit shipment of complex custom-built bipolar digital "monolithic integrated circuits".

- (b) Bipolar "monolithic integrated circuits", having all of the following characteristics:
 - (1) Designed for operation in civil applications;
 - (2) Being either:
 - (A) Electronic switches, externally controlled by inductive, magnetic or optical means; *or*
 - (B) Threshold value switches;
 - (3) With switching times of 0.5 microsecond or more; *and*
 - (4) No more than 24 input/output pads;

NOTE:

Sub-item (d)(3)(C)(b) does not permit shipment of complex custom-built bipolar digital "monolithic integrated circuits".

- (c) "Monolithic integrated circuits" having all of the following characteristics:
 - (1) No "user-accessible microprogrammability";
 - (2) Designed for and by virtue of circuit design limited to use in civil radio or television receivers;
 - (3) Rated for operation at 11 MHz or less;
 - (4) Not designed for station scanning applications;
 - (5) Not utilising charge-coupled device (CCD) technology;
 - (6) Not intended for beam lead bonding; *and*
 - (7) If intended for video or luminance amplifiers, having both of the following characteristics:
 - (A) A maximum rated supply voltage not exceeding 30 V; *and*
 - (B) A typical bandwidth not exceeding 7.5 MHz;
- (d) "Monolithic integrated circuits" having all of the following characteristics:
 - (1) No "user-accessible microprogrammability";
 - (2) Not utilising charge-coupled device (CCD) technology;
 - (3) Not intended for beam lead bonding; *and*
 - (4) Designed or programmed by the "manufacturer" for any of the following applications only:
 - (A) Timekeeping applications (e.g. watches or clocks); *or*

- (B) Cardiac pacemakers or hearing aids;
- (e) Amplifier "monolithic integrated circuits" as follows:
 - (1) Audio amplifiers, having a maximum rated power output of 25 W or less at an ambient temperature of 298 K (25°C); *or*
 - (2) Operational amplifiers, having all of the following characteristics:
 - (A) A typical unity-gain open-loop bandwidth of no more than 5 MHz;
 - (B) A typical open-loop voltage gain of no more than 562,000, i.e. 115 dB;
 - (C) A maximum intrinsic rated input offset voltage of no less than 2.5 mV; *and*
 - (D) A typical slew rate at unity-gain not exceeding 2.5 V/microsecond;
- (f) Voltage "monolithic integrated circuits" as follows:
 - (1) Voltage comparators, having both of the following characteristics:
 - (A) A maximum input offset voltage of no less than 5 mV; *and*
 - (B) A "typical switching speed", i.e. typical response time of no less than 50 ns;
 - (2) Linear type voltage regulators, having both of the following characteristics:
 - (A) A rated nominal output voltage of 40 V or less; *and*
 - (B) A maximum output current of 1 A or less;
 - (3) Switching type voltage regulators, having both of the following characteristics:
 - (A) A rated nominal output voltage of 40 V or less; *and*
 - (B) A maximum output current of 150 mA or less;
- (4) Encapsulated integrated circuits having all of the following characteristics:
 - (A) Not designed or rated as radiation hardened;
 - (B) Not rated for operation at an ambient temperature below 233 K (-40°C) or above 358 K (85°C);
 - (C) Packaged in hermetically sealed ceramic packages excluded from embargo under sub-item (b) above; *and*
 - (D) Containing unencapsulated integrated circuits excluded from embargo under sub-item (d)(3) above.

NOTES:

1. Nothing in the above shall be construed as permitting the export of wafer or chip design or processing information inherent in the manufacture of any embargoed class of "assembly", "module", integrated circuit or "circuit element", irrespective of any release of devices in any of these classes. This restriction also applies to technology embodied both in the equipment embargoed by Item 1355 and in its use.
2. Integrated circuits having no "user-accessible microprogrammability" (e.g. mask programmed) are only eligible for release from embargo if:
 - (a) The design or "programme" are originated either by the "manufacturer" alone or in concert with the user of the integrated circuit;
 - (b) The "programme" is unalterably fixed at the time of manufacture; *and*
 - (c) The "manufacturer" has established that the design, basic functions and performance of the integrated circuit are only for the intended end-use.

N.B.:

Integrated circuits, including gate arrays and programmable logic arrays, based only or primarily on customer-supplied circuit design or "programmes" do not meet the criteria of this Note and are therefore not released under this Item.

3. Governments may permit, as administrative exceptions, the shipment of "assemblies", "modules" or printed circuit boards with mounted components, embargoed by sub-item (c)(2), which by nature of their design or performance:
 - (a) Are substantially restricted to the particular civil application for which they have been designed; *and*
 - (b) Contain only components which are either free from embargo or eligible for administrative exception treatment.

4. Governments may permit the shipment of devices (encapsulated or unencapsulated) not released by subitems (c) or (d) provided:
 - (a) They have been designed for identifiable civil applications;
 - (b) They are, by nature of design or performance, substantially restricted to the particular application for which they have been designed; *and*
5. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "assemblies", printed circuit boards and integrated circuits not specially designed to military standards for radiation hardening or temperature, as follows:
 - (a) "Substrates" for printed circuit boards, *except* those exceeding the limit of sub-item (a)(2);
 - (b) Patterned "substrates" for printed circuit boards which exceed the limits of sub-item (a)(1)(E), when specially designed for use in civil applications listed in sub-items (d)(2)(D)(f)(2), (d)(2)(D)(g)(3) or (d)(2)(D)(h)(2);
 - (c) Silicon-based devices exceeding the limits of:
 - (1) Sub-items (d)(2)(D)(a), (b) or (c), *except* those with more than 28 terminals;
 - (2) Sub-items (d)(2)(D)(g) or (h);
 - (3) Sub-items (d)(2)(D)(k), (l), (m)(4) and (5), (n), (r), (s) or (u); *or*
 - (4) Sub-items (d)(2)(D)(f) or (q);
 - (d) Silicon based 8-bit or less "microcomputer microcircuits" exceeding the limits of sub-items (d)(2)(D)(e)(1) to (4), (6) and (7);
 - (e) Silicon based "microprocessor microcircuits" with an operand length of 16 bits or less and an arithmetic logic unit (ALU) not wider than 32 bits and exceeding the limits of sub-items (d)(2)(D)(i)(1) to (6), *except*:
 - (1) Those with a total processing data rate exceeding 28 million bits per second;
 - (2) Bit-slice "microprocessor microcircuits";
 - (f) Silicon based memory devices, as follows:
 - (1) MOS DRAMs with no more than 256 Kbits;
 - (2) MOS SRAMs with no more than 64 Kbits;
 - (3) Mask PROMs with no more than 512 Kbits;
 - (4) UV-EPROMs (except keyed access EPROMs) with no more than 256 Kbits;
 - (5) EAROMS with no more than 64 Kbits;
 - (6) EEROMS with no more than 64 Kbits;

N.B.:

1 Kbit = 1,024 bits.

- (g) Operational amplifiers exceeding the limits of sub-item (d)(2)(D)(k)(4) which do not have a slew rate exceeding 100 volt per microsecond;
- (h) Analogue-to-digital and digital-to-analogue converters exceeding the limits of sub-item (d)(2)(D)(m)(1) to (3), *except*:
 - (1) Analogue-to-digital converters with less than a 500 ns conversion time *and* a maximum resolution of 12 bits;
 - (2) Digital-to-analogue converters with less than 500 ns settling time for voltage output and a maximum resolution of 12 bits;
 - (3) Digital-to-analogue converters with less than 25 ns settling time for current output and a maximum resolution of 12 bits;
- (i) Silicon based 8-bit or less user-programmable single chip "microcomputer microcircuits" embargoed by sub-item (d);
- (j) "Optical integrated circuits":
 - (1) Embargoed by sub-item (d);
 - (2) With no more than 2,048 elements; *and*
 - (3) Not exceeding the limits of Item 1548(a) and (b);
- (k) Non-reprogrammable silicon based integrated circuits specially designed or programmed by the "manufacturer" for business or office use; *and*
- (l) Sample and hold integrated circuits exceeding the limits of sub-item (d)(2)(D)(p) with an acquisition time of no less than 500 ns.

Technical Note:

Definitions of terms used in this Item:

"assembly"—

A number of electronic components (i.e. "circuit elements", "discrete components", integrated circuits, etc.) connected together to perform (a) specific function(s), replaceable as an entity and normally capable of being disassembled.

"basic gate power dissipation"—

The power dissipation value corresponding to the basic gate utilised within a family of "monolithic integrated circuits". This may be specified, for a given family, either as the power dissipation per typical gate or as the typical power dissipation per gate.

"basic gate propagation delay time"—

The propagation delay time value corresponding to the basic gate utilised within a family of "monolithic integrated circuits". This may be specified, for a given family, either as the propagation delay time per typical gate or as the typical propagation delay time per gate.

N.B.:

"Basic gate propagation delay time" is not to be confused with input/output delay time of a complex "monolithic integrated circuit".

"circuit element"—

A single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"discrete component"—

A separately packaged "circuit element" with its own external connections.

"film type integrated circuit"—

An array of "circuit elements" and metallic interconnections formed by deposition of a thick or thin film on an insulating "substrate".

"hybrid integrated circuit"—

Any combination of integrated circuits, "circuit elements" or "discrete components" connected together to perform (a) specific function(s).

"manufacturer"—

For the purposes of this Item, the individual or organisation designing an integrated circuit or a "programme" for an intended application, in contrast to an individual or organisation merely programming an integrated circuit at, or in accordance with, a user's request.

"microcomputer microcircuit"—

A "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing general purpose instructions from an internal storage, on data contained in the internal storage.

N.B.:

The internal storage may be augmented by an external storage.

"microprocessor microcircuit"—

A "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing a series of general purpose instructions from an external storage.

N.B.:

The "microprocessor microcircuit" normally does not contain integral user-accessible storage, although storage present on-the-chip may be used in performing its logic function.

"microprogramme"—

A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"module"—

A number of electronic components (i.e. "circuit elements", "discrete components", integrated circuits) connected together to perform (a) specific function(s), replaceable as an entity and not normally capable of being disassembled.

"monolithic integrated circuit"—

A combination of passive or active "circuit elements" or both which:

- (a) Are formed by means of diffusion processes, implantation processes or deposition processes in or on a single semiconducting piece of material, a so-called "chip";
- (b) Can be considered as indivisibly associated; *and*
- (c) Perform the function(s) of a circuit.

"multichip integrated circuit"—

Two or more "monolithic integrated circuits" bonded to a common "substrate".

"optical integrated circuit"—

A "monolithic integrated circuit" or a "hybrid integrated circuit", containing one or more parts designed to function as a photosensor or photoemitter or to perform (an) optical or (an) electro-optical function(s).

"programme"—

A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

1564 *continued*

"software"—

A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

"speed"—

The time to fetch an operand C and another operand D, both from an external storage outside any work register, add these operands and put the result back in storage. The addressing mode which yields the shortest execution time shall be used. The result of the add operation shall be stored in either the same location as one of the addends or in some other location. This choice shall be made to give the shortest execution time at the highest specified clock frequency.

"speed-power dissipation product"—

The product of the "speed" and the typical power dissipation, which shall be taken at the clock frequency used in the "speed" computation. The typical power dissipation may be any of the following, but must be the lowest value specified:

- (a) The specified typical internal power dissipation;
- (b) One half the maximum internal power dissipation;
- (c) The product of the nominal supply voltage and typical total supply current; *or*
- (d) One half the product of the nominal supply voltage and maximum total supply current;

"substrate"—

A sheet of base material with or without an interconnection pattern and on which or within which "discrete components" or integrated circuits or both can be located.

"user-accessible microprogrammability"—

The facility allowing a user to insert, modify or replace "microprogrammes".

"user-accessible programmability"—

The facility allowing a user to insert, modify or replace "programmes" by means other than:

- (a) A physical change in wiring or interconnections; *or*
- (b) The setting of function controls including entry of parameters.

1565

Electronic computers, "related equipment", equipment or systems containing electronic computers, and technology therefor, as follows; and specially designed components and accessories for these electronic computers and "related equipment": (For the embargo status of "software", see Item 1566.)

Technical Notes:

1. Electronic computers and "related equipment" are categorized as follows:

"analogue computer"

Equipment which can, in the form of one or more continuous variables:

- (a) Accept data;
- (b) Process data; *and*
- (c) Provide output of data.

"digital computer"

Equipment which can, in the form of one or more discrete variables:

- (a) Accept data;
- (b) Store data or instructions in fixed or alterable (writable) storage devices;
- (c) Process data by means of a stored sequence of instructions which is modifiable; *and*
- (d) Provide output of data.

NOTE:

Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"hybrid computer"

Equipment which can:

- (a) Accept data;
- (b) Process data, in both analogue and digital representations; *and*
- (c) Provide output of data.

"related equipment"

Equipment "embedded" in, "incorporated" in, or "associated" with electronic computers, as follows:

- (a) Equipment for interconnecting "analogue computers" with "digital computers";
- (b) Equipment for interconnecting "digital computers";
- (c) Equipment for interfacing electronic computers to "local area networks" or to "wide area networks";
- (d) Communication control units;
- (e) Other input/output (I/O) control units;
- (f) Recording or reproducing equipment referred to this Item by Item 1572;
- (g) Displays; *or*
- (h) Other peripheral equipment.

NOTE:

"Related equipment" which contains an "embedded" or "incorporated" electronic computer, but which lacks "user-accessible programmability", does not thereby fall within the definition of an electronic computer.

2. This Item includes:

- (a) "Assemblies", "modules", or printed circuit boards with mounted components referred to this Item by Item 1564;
- (b) Not used;
- (c) Central processing unit—"main storage" combinations;
- (d) Digital differential analysers (incremental computers);
- (e) Processors for stored programme control.

(This ends the Technical Notes. For a complete list of definitions of terms used in this Item, see Note 16 below.)

Listed as follows:

- (a) "Analogue computers" and "related equipment" therefor, which are designed or modified for use in airborne vehicles, missiles or space vehicles and rated for continuous operation at temperatures from below 228 K (-45°C) to above 328 K (55°C);
- (b) Equipment or systems containing "analogue computers" embargoed by sub-item (a);
- (c) "Analogue computers" and "related equipment" therefor, other than those embargoed by sub-item (a), *except*:
 - (i) Those which neither:
 - (a) Are capable of containing more than 20 summers, integrators, multipliers or function generators; *nor*
 - (b) Have facilities for readily varying the interconnections of such components; *or*
 - (ii) Those which are limited as follows:
 - (a) They use neither:
 - (1) Optical computation devices; *nor*
 - (2) Acoustic wave devices embargoed by Item 1586 other than those exportable as an administrative exception pursuant to Note 1 to Item 1586;
 - (b) The rated errors for summers, inverters and integrators are not less than:
 - (1) Static: 0.01%;
 - (2) Total at 1 kHz: 0.15%;
 - (c) The rated errors for multipliers are not less than:
 - (1) Static: 0.025%;
 - (2) Total at 1 kHz: 0.25%;
 - (d) The rated errors for fixed function generators (log and sine/cosine) are not less than:
Static: 0.1%;
 - (e) No more than 350 operational amplifiers; *and*
 - (f) No more than four integrator time scales switchable during one programme;

Technical Notes:

1. The percentage for (b)(1) above applies to the actual output voltage; all the other percentages apply to full scale, that is from maximum negative to maximum positive reference voltages.
 2. Total errors at 1 kHz for (b)(2) and (c)(2) above are to be measured with those resistors incorporated in the inverter, summer or integrator which provide the least error.
 3. Total error measurements include all errors of the unit resulting from, for example, tolerances of resistors and capacitors, tolerances of input and output impedances of amplifiers, the effects of loading, the effects of phase shift or the generating of functions.
- (d) "Hybrid computers" and "related equipment" therefor, with all the following characteristics:
- (1) The analogue section is embargoed by sub-item (c);

- (2) The digital section has an internal fixed or alterable storage of more than 2,048 bits; *and*
- (3) Facilities are included for processing numerical data from the analogue section in the digital section or vice versa;
- (e) "Digital computers" or embargoed "analogue computers" containing equipment for interconnecting "analogue computers" with "digital computers";
- (f) "Digital computers" and "related equipment" therefor, with any of the following characteristics:
 - (1) Designed or modified for use in airborne vehicles, missiles or space vehicles and rated for continuous operation at temperatures from below 228 K (-45°C) to above 328 K (55°C);
 - (2) Designed or modified to limit electromagnetic radiation to levels much less than those required by government civil interference specifications;
 - (3) Designed as ruggedised or radiation-hardened equipment and capable of meeting military specifications for ruggedized or radiation-hardened equipment;
 - (4) Modified for military use; *or*
 - (5) Designed or modified for certifiable multi-level security or certifiable user isolation applicable to government classified material or to applications requiring an equivalent level of security;
- (g) Equipment or systems containing "digital computers" embargoed by sub-item (f);
- (h) "Digital computers" and "related equipment" therefor, other than those embargoed by sub-items (e) or (f), even when "embedded" in, "incorporated" in, or "associated" with equipment or systems:

NOTE:

The embargo status of these "digital computers" and "related equipment" therefor is governed by the appropriate Item provided:

- (a) They are "embedded" in other equipment or systems;
- (b) The other equipment or systems are described in other Items of Group 1, 2 or 3; *and*
- (c) The technology for these "digital computers" *and* "related equipment" is governed by sub-item (f) below.

- (1) Including "digital computers" and "related equipment", as follows:
 - (i) Designed or modified for:

NOTE:

"Digital computers" and "related equipment" containing equipment, devices or logic control for the following functions are also included.

- (a) "Signal processing";
- (b) "Image enhancement";
- (c) "Local area networks";

NOTE:

For the purpose of this sub-item, data communication systems when located within a single piece of equipment (e.g. television set, car) are not considered to be designed or modified for "local area networks".

- (d) "Multi-data-stream processing";

NOTE:

For the purpose of this sub-item, "digital computers" and "related equipment" are not considered to be designed or modified for "multi-data-stream processing", if they:

- (a) Utilise staged (pipelined) instruction interpretation for conventional single instruction—single data sequence processing; *or*
- (b) Have an arithmetic unit implemented with bit-slice microprocessor microcircuits.
- (e) Combined recognition, understanding and interpretation of image, continuous (connected) speech or connected word text other than "signal processing" or "image enhancement" described in sub-item (h)(1)(i)(a) or (b);
- (f) "Real time processing" of sensor data:
 - (1) Concerning events occurring outside the "computer using facility"; *and*
 - (2) Provided by equipment embargoed by Items 1501, 1502, 1510 or 1518;

NOTE:

This does not include digital radar signal processing by equipment which is:

- (a) Embargoed by Item 1501(c)(2)(vi) only, for which the conditions of Item 1501 apply; *or*
- (b) Freed from embargo by the two-year limit in Item 1501(c)(2)(vii).
- (g) Microprocessor or microcomputer development systems;

NOTE:

For microprocessor or microcomputer development instruments or systems, see Item 1529 (b)(6);

- (h) "Fault tolerance";

NOTE:

For the purpose of this sub-item, "digital computers" and "related equipment" are not considered to be designed or modified for "fault tolerance", if they utilise:

- (a) Error detection or correction algorithms in "main storage";
- (b) The interconnection of two "digital computers" so that, if the active central processing unit fails, an idling but mirroring central processing unit can continue the system's functioning;
- (c) The interconnection of two central processing units by data channels or by use of shared storage to permit one central processing unit to perform other work until the second central processing unit fails, at which time the first central processing unit takes over in order to continue the system's functioning; *or*
- (d) The synchronisation of two central processing units by "software" so that one central processing unit recognises when the other central processing unit fails and recovers tasks from the failing unit.
- (i) Not used;
- (j) "User-accessible microprogrammability";

NOTE:

For the purpose of this sub-item, "digital computers" and "related equipment" are not considered to be designed or modified for "user-accessible microprogrammability", if this facility is limited to:

- (a) Loading, reloading or inserting of "microprogrammes" provided by the supplier; *or*
- (b) Simple loading of "micro-programmes", which may or may not be provided by the supplier, but which are neither designed to be accessible to the user nor accompanied by training or "software" for user accessibility.
- (k) "Data (message) switching";
- (l) "Stored programme controlled circuit switching"; *or*
- (m) "Wide area networks";
- (ii) Having the following characteristics:
 - (a) Size, weight, power consumption and reliability or other characteristics (e.g. bubble memory), which allow easy application in mobile tactical military systems; *and*
 - (b) Ruggedised above the level required for a normal commercial/office environment, but not necessarily up to levels specified in sub-item (f);
- (2) *Except:*
 - (i) "Digital computers" or "related equipment" therefor, provided:
 - (a) They are "embedded" in other equipment or systems;

NOTE:

This does not preclude input/output control unit-disk drive combinations having all of the following characteristics:

- (1) "Total transfer rate" not exceeding 5.5 million bits/s;
- (2) Total connected "net capacity" not exceeding 320 million bits;
- (3) No more than two independent drives; *and*
- (4) "Total access rate" not exceeding 80 accesses per second with a maximum "access rate" of 40 accesses per second per drive;
- (b) They are not the "principal element" of the other equipment or systems in which they are "embedded";
- (c) The other equipment or systems are not described by other Items of Group 1, 2 or 3;
- (d) They have been designed and used for non-strategic applications;
- (e) They are by nature of design or performance restricted to the particular application for which they have been designed;
- (f) The "total data processing rate" of any one "embedded" "digital computer" does not exceed 54 million bits/s;
- (g) The sum of the "total data processing rate" of each "embedded" "digital computer" does not exceed 100 million bits/s;
- (h) They do not include equipment or systems embargoed by Item 1519(a)(2) or by Item 1567;
- (i) Not used; *and*
- (j) They do not include equipment described in sub-item (h)(1)(i)(a) to (m), other than for:
 - (1) "Signal processing" or "image enhancement" when lacking "user-accessible programmability" and when "embedded" in medical imaging equipment; *or*
 - (2) "Local area networks" which is excluded from embargo;
- (ii) "Digital computers" or "related equipment" therefor, provided:
 - (a) They are "incorporated" in other equipment or systems;
 - (b) They are not the "principal element" of the other equipment or systems in which they are "incorporated";
 - (c) The other equipment or systems are not embargoed by other Items of Group 1, 2 or 3;
 - (d) The "total processing data rate" of any one "incorporated" "digital computer" does not exceed 28 million bits/s;
 - (e) The "total internal storage available to the user" does not exceed 9.8 million bits;
 - (f) They do not include embargoed "related equipment" other than input/output control unit-disk drive combinations having all of the following characteristics:
 - (1) "Total transfer rate" not exceeding 5.5 million bits/s;
 - (2) Total connected "net capacity" not exceeding 320 million bits;
 - (3) No more than two independent drives; *and*
 - (4) "Total access rate" not exceeding 80 accesses per second with a maximum "access rate" of 40 accesses per second per drive;
 - (g) They do not include equipment or systems embargoed by Item 1519(a)(2) or by Item 1567;
 - (h) They do not include equipment described in sub-item (h)(1)(ii);
 - (i) Not used; *and*
 - (j) They do not include equipment described in sub-item (h)(1)(i)(a) to (m), other than for:
 - (1) "Signal processing" or "image enhancement" when lacking "user-accessible programmability" and when "embedded" in medical imaging equipment; *or*
 - (2) "Local area networks" which are excluded from embargo;

NOTE:

"Digital computers" or "related equipment" "incorporated" in equipment exportable under the provisions of Items 1501, 1502, 1510 or 1518, which are for internal functions which incidentally might be considered to be described by sub-item (h)(1)(i)(f), are exportable as part of that equipment. "Digital computers" or "related equipment" for the "real-time processing" of the outputs of the equipment embargoed by Items 1501, 1502, 1510 or 1518 and for Air Traffic Control systems are covered by this Item.

- (iii) "Digital computers" other than those described in sub-item (h)(1) above, and "related equipment", having all of the following characteristics:
 - (a) Shipped as complete systems;
 - (b) Designed and announced by the manufacturer for identifiable civil use;
 - (c) Not specially designed for any equipment embargoed by any other Item of Group 1, 2 or 3;
 - (d) "Total processing data rate" not exceeding 6.5 million bits/s;
 - (e) "Total internal storage available to the user" not exceeding 6.2 million bits;
 - (f) They do not include a central processing unit implemented with more than two microprocessor or microcomputer microcircuits;

NOTE:

This limit does not include any dedicated microprocessor or microcomputer microcircuit used solely for display, keyboard or input/output control, or any bit-slice microprocessor microcircuit.

- (g) They do not include a microprocessor or microcomputer microcircuit with more than 16 bits word length or a bus architecture with more than 16 bits;
- (h) They do not include analogue-to-digital or digital-to-analogue converter microcircuits exceeding the limits of Item 1568;

NOTE:

This does not apply in the case of direct driven video monitors for normal commercial television;

- (i) Not used;
- (j) They do not include embargoed "related equipment" other than input/output control unit—disk drive combinations having all of the following characteristics:
 - (1) "Total transfer rate" not exceeding 5.5 million bits/s;
 - (2) Total connected "net capacity" not exceeding 200 million bits;
 - (3) No more than one independent drive; *and*
 - (4) "Total access rate" not exceeding 40 accesses per second; *and*
- (k) They do not include equipment embargoed by Item 1519(a)(2) or by Item 1567;
- (iv) Peripheral equipment, as follows, provided it lacks "user-accessible programmability":
 - (a) Card punches and readers;
 - (b) Paper tape punches and readers;
 - (c) Manually operated keyboards and teletype devices;
 - (d) Manually operated graphic tablets not having more than 1,024 resolvable points along any axis;
 - (e) Impact printers;
 - (f) Non-impact printers, not embargoed by Item 1572(b) or (c), which do not exceed:
 - (1) 2,000 lines (30 pages) per minute; *or*
 - (2) 600 characters/s;
 - (g) Plotting equipment, not embargoed by Item 1572(b) or (c), producing a physical record by ink, photographic, thermal or electrostatic techniques, which has:
 - (1) A linear accuracy worse than or equal to $\pm 0.004\%$; *and*

- (2) An active plotting area less than or equal to 1,700 mm (66.9 inch) by 1,300 mm (51.2 inch);
- (h) Digitising equipment, generating rectilinear coordinate data by manual or semi-automatic tracing of physical records, which has:
 - (1) A linear accuracy worse than or equal to $\pm 0.004\%$; *and*
 - (2) An active digitising area less than or equal to 1,700 mm (66.9 inch) by 1,300 mm (51.2 inch);
- (i) Not used;
- (j) Optical mark recognition (OMR) equipment;
- (k) Optical character recognition (OCR) equipment which:
 - (1) Does not contain "signal processing" or "image enhancement" equipment; *and*
 - (2) Is only for:
 - (i) Stylised OCR characters;
 - (ii) Other internationally standardised stylised character fonts; *or*
 - (iii) Other characters limited to non-stylised or hand-printed numerics and up to 10 hand-printed alphabetic or other characters;
- (l) Displays or monitors having all of the following characteristics:
 - (1) Not including equipment described in sub-item (h)(1)(ii) above;
 - (2) Not used;
 - (3) If capable of other than alphanumeric characters, graphs and symbols, in fixed formats:
 - (i) Not more than 1,024 resolvable elements along any axis;
 - (ii) Not more than 16 shades of grey or colour; *and*
 - (iii) The maximum bit transfer rate from the electronic computer to the display does not exceed 19,200 bits/s;

NOTE:

(ii) and (iii) above do not apply in the case of direct driven video monitors.

- (m) Displays or monitors having all of the following characteristics:
 - (1) They do not contain cathode ray tubes;
 - (2) They are not capable of displaying more than 3 levels (i.e. off, intermediate and full on); *and*
 - (3) They do not have as an integral part of the display device:
 - (a) Circuitry; *or*
 - (b) Non-mechanical character generation devices;
- (n) Displays having all of the following characteristics:
 - (1) Not used;
 - (2) Being part of industrial or medical equipment; *and*
 - (3) Not specially designed for use with electronic computers;
- (o) Graphic displays specially designed for signature or security checking having an active display area not exceeding 150 cm² (23.25 sq.inch);
- (p) Not used;
- (q) Light gun devices or other manual graphic input devices which are:
 - (1) Part of unembargoed displays; *and*
 - (2) Limited to 1,024 resolvable elements along any axis;
- (r) Disk drives for non-rigid magnetic media (floppy disks) which do not exceed:
 - (1) A "gross capacity" of 17 million bits;
 - (2) A "maximum bit transfer rate" of 0.52 million bits/s; *or*
 - (3) An "access rate" of 12 accesses per second; *or*
- (s) Cassette/cartridge tape drives or magnetic tape drives which do not exceed:

- (1) A "maximum bit packing density" of 131 bits/mm (3,300 bpi) per track; *or*
- (2) A "maximum bit transfer rate" of 2.66 million bits/s;
- (v) Input/output interface or control units, as follows, provided they lack "user-accessible programmability":
 - (a) Designed for use with peripheral equipment free from embargo under sub-item h)(2)(iv) above;
 - (b) Designed for use with digital recording or reproducing equipment specially designed to use magnetic card, tag, label or bank cheque recording media, free from embargo according to Item 1572(a)(ii); *or*
 - (c) Designed to meet ANSI/IEEE Standard 488-1978 or IEC Publication 625-1;
- (vi) Equipment for "local area networks" which do not exceed any of the following characteristics:
 - (a) Interfaces and protocols up to or including Layer 2 of the Open System Interconnection (OSI) reference model, that is ISO logical link control Draft International Standard (DIS) 8802/2, IEEE 802.2, 802.3, 802.4, 802.5, or equivalents;
 - (b) Implementations that contain functions of, or equivalent to those provided by, CCITT X.25, Level 3, protocols—none;
 - (c) Maximum "data signalling rate" on the common transmission medium—2 million bits/s; *or*
 - (d) "Internetwork gateways"—none;
- (vii) "Personal Computers" and "related equipment" therefor, not excluded from embargo by other sub-items of (h)(2), provided they meet all the following conditions:
 - (a) They are not described in sub-item (h)(1) above;
 - (b) They are shipped as complete systems;
 - (c) They are not stand-alone graphic workstations exceeding the limits of Note 9(a)(7);
 - (d) They are not ruggedized above the level required for a normal commercial/office environment;
 - (e) They do not include a central processing unit implemented with more than two microprocessor or microcomputer microcircuits;

NOTE:

This does not preclude any dedicated microprocessor or microcomputer microcircuit used solely for display, keyboard or input/output control, or any bit-slice microprocessor microcircuit.

- (f) Not used;
- (g) Not used;
- (h) Displays or monitors not exceeding the limits of Note 9(b)(8);
- (i) Not used;
- (j) They do not include analogue-to-digital or digital-to-analogue converter microcircuits exceeding the limits of Item 1568;

NOTE:

This does not apply in the case of direct driven video monitors for normal commercial television.

- (k) Central processing unit—the "total processing data rate" does not exceed 275 million bits/s;
- (l) Not used;
- (m) They do not include equipment embargoed by Item 1519(a)(2) or by Item 1567;
- (i) Not used;
- (j) Technology, as follows:
 - (1) Technology applicable to the:
 - (i) Development, production or use (i.e. installation, operation and maintenance) of electronic computers or "related equipment", even if these electronic computers or "related equipment" are not embargoed by this Item; *except:*
 - (a) Technology which is unique to "related equipment" free from embargo under sub-item (h)(2)(iv)(a) to (c), (e), (f), (m), (n) or (q) and which is not otherwise embargoed by any other Item in the International Lists; *or*
 - (b) The minimum technical information necessary for the use of electronic computers or "related equipment" free from embargo; *or*

- (ii) Development, production or use of equipment or systems embargoed by sub-item (b) or (g); *or*
- (2) Technology for the integration of:
- (i) Embargoed electronic computers or embargoed "related equipment" into other equipment or systems whether or not the other equipment or systems are embargoed; *or*

NOTE:

Nothing in the above should be construed as embargo technology for integration which is unique to the other equipment or systems if they are free from embargo.

- (ii) Unembargoed electronic computers or unembargoed "related equipment" into embargoed equipment or systems.

NOTE:

This does not, however, release from embargo technology for the integration of electronic computers or "related equipment" which are freed from embargo only by sub-item (h)(2)(i) or only by sub-item (h)(2)(ii).

NOTE 1:

Governments may permit the shipment of "digital computers" or "related equipment" therefor embargoed by sub-item (h), provided:

- (a) They are "incorporated" in other equipment or systems;
- (b) They are not the "principal element" of the equipment or systems in which they are "incorporated";
- (c) The other equipment or systems are embargoed by other Items of Group 1, 2 or 3, and they are permitted for export according to the provisions of the appropriate Item;
- (d) The "total processing data rate" of any one "incorporated" "digital computer" does not exceed 28 million bits/s;
- (e) All other parameters do not exceed the relevant limits of Note 9(b)(1)(ii) to (iv) and (b)(2) to (9) to this Item; *and*
- (f) The "incorporated" "digital computers" or "related equipment" therefor do not include:
- (1) Equipment embargoed by Item 1519(a)(2) or by Item 1567;
 - (2) Equipment described in sub-item (h)(1)(ii); *or*
 - (3) Equipment described in sub-item (h)(1)(i)(a) to (m), other than for:
 - (i) "Signal processing" or "image enhancement" when lacking "user-accessible programmability" and being "embedded" in medical imaging equipment; *or*
 - (ii) "Local area networks" which are excluded from embargo;

N.B.:

"Digital computers" or "related equipment" "incorporated" in equipment exportable under the provisions of Items 1501, 1502, 1510 or 1518, which are for internal functions which incidentally might be considered to be described by sub-item (h)(1)(i)(f), are exportable as part of that equipment. "Digital computers" or "related equipment" for the "real-time processing" of the outputs of the equipment embargoed by Items 1501, 1502, 1510 or 1518 and for Air Traffic Control systems are covered by this Item.

NOTE 2:

Governments may permit the shipment of the minimum technical information for the use (i.e. installation, operation and maintenance) of electronic computers or "related equipment" authorised for export, when shipped together with or solely for use with these electronic computers or "related equipment".

NOTE 3:

Not used.

NOTE 4:

Not used.

NOTE 5:

Governments may permit the shipment of "digital computers" or "related equipment" therefor, embargoed by sub-item (h), provided:

- (a) The "digital computers" or the "related equipment":
- (1) Have been designed or announced by a manufacturer for identifiable and dedicated medical applications;

- (2) Are substantially restricted to the area of medical applications by nature of design and performance;
 - (3) Are the equipment necessary for the medical application;
 - (4) Are exported as complete systems;
 - (5) Will be located within one "computer using facility"; *and*
 - (6) Do not include communication control unit—"communication channels" combinations;
- (b) Equipment for "signal processing", "image enhancement", or "multi-data-stream processing":
- (1) Is "embedded";
 - (2) Is designed or modified specially for the identifiable and dedicated medical applications;
 - (3) Does not have "user-accessible microprogrammability"; *and*
 - (4) Does not have "user-accessible programmability" other than allowing for insertion of the original or modified "programmes" supplied by the original manufacturer;
- (c) The "total processing data rate" of any one "incorporated" "digital computer" does not exceed 54 million bits per second;
- (d) The "digital computers" or "related equipment" therefor do not include:
- (1) Equipment or systems embargoed by Item 1519(a)(2) or Item 1567; *or*
 - (2) Equipment described in sub-item (h)(1)(i)(c) or (e) to (m); *and*

NOTE 6:

Governments may permit the shipment of "digital computers" or "related equipment" therefor, embargoed by sub-item (h), provided:

- (a) They have been approved by the Government of the exporting country, as eligible for export under the conditions of this Note;
- (b) They are described in sub-item (h)(1) only by an accident of definition; *and*
- (c) They fulfil any one of the following conditions:
- (1) They are shipped as complete systems and do not exceed:
 - (i) A "total processing data rate" of 43 million bits/s; *and*
 - (ii) Any of the limits for parameters in Note 9(b)(1)(ii) to (iv) and (b)(2) to (9) to this Item;
 - (2) They fail to meet the conditions of sub-items (h)(2)(iii), (iv), (v) only by an accident of definition; *or*
 - (3) They:
 - (i) Are designed for identifiable commercial/office or personal use and are substantially restricted to the particular application for which they have been designed by nature of design and performance;
 - (ii) Are of a type "generally available to the public" in non-proscribed areas; *and*

N.B.:

For the purpose of this Note "generally available to the public" means:

- (a) Also available at retail selling points, other than those specialised in selling electronic computers to the general public in model series exceeding the limits in (1) above; *and*
 - (b) Selling from stock by means of:
 - (1) Over-the-counter transactions;
 - (2) Mail order transactions;
 - (3) Telephone call transactions.
- (iii) Fulfil the conditions of (c)(1) above.

NOTE 7:

Governments may permit, as administrative exceptions, the shipment of spare parts for exported electronic computers or "related equipment", provided:

- (a) The parts are:
- (1) "Related equipment" or specially designed components embargoed by this Item; *or*
 - (2) Equipment or components embargoed by other Items of Group 1;
- (b) The parts:
- (1) Are destined for embargoed equipment authorised for export as an administrative exception or under favourable consideration or for equipment free from embargo;
 - (2) Are shipped in the minimum quantities (i.e., a reasonable quantity not exceeding a six-month supply) necessary for the types and quantities of exported equipment being serviced; *and*
 - (3) Do not upgrade the performance of the exported equipment beyond the level:

- (i) Specified in the relevant administrative exception or favourable consideration Note to this item; *or*
- (ii) Specified as free from embargo;
- (c) If the parts are "Advanced technology parts" and not eligible for export as an administrative exception to another Item, the Western supplier's organisation must:
 - (1) Guarantee that parts will be replaced on a one-for-one basis;
 - (2) Take measures to obtain custody of the defective parts; *and*
 - (3) If custody is not obtained, certify that the defective parts are destroyed; *and*

Technical Note:

For the purpose of this paragraph, "advanced technology parts" are either:

- (a) Parts embargoed by Item 1564 (c)(2);
- (b) Microprocessor, microcomputer, storage, programmed logic array or arithmetic logic unit microcircuits embargoed by Item 1564 (d);
- (c) Magnetic tape heads, magnetic disk heads, magnetic drum heads, or non-exchangeable magnetic disk or drum recording media, embargoed by Item 1572; *or*
- (d) Acoustic wave devices embargoed by Item 1586, other than those exportable as an administrative exception pursuant to Note 1 to Item 1586.

NOTE 8:

Not used.

NOTE 9:

Governments may permit, as administrative exceptions, the shipment of "digital computers" or "related equipment" therefor embargoed by sub-item (h), provided:

- (a) The "digital computers" or "related equipment" therefor:
 - (1) Are not described in sub-items (h)(1)(i)(d) to (m);
 - (2) Are not used with "digital computers" produced in proscribed areas;

N.B.:

This does not preclude the exchange of data media.

- (3) Are exported as:
 - (i) Complete systems; *or*
 - (ii) Enhancements to a previously exported system provided that the enhanced system does not exceed the limits of paragraph (b) of this Note;
- (4) Have not been designed for any equipment:
 - (i) Embargoed by any other Item of Group 1; *and*
 - (ii) Not eligible for export as an administrative exception to such an Item;
- (5) Have been primarily designed and used for non-strategic applications;
- (6) Do not have any of the following characteristics:
 - (i) They fall within the scope of both sub-items (h)(1)(ii)(a) and (b); *or*
 - (ii) They fall within the scope of sub-item (h)(1)(ii)(a) and are systems based upon "micro-processor microcircuits" having:
 - (a) A word length of more than 16 bits; *or*
 - (b) Their arithmetic logic unit (ALU) has a bus architecture of more than 32 bits; *or*
 - (iii) They are ruggedised above the level required for a normal commercial/civil environment, but not necessarily up to the levels specified in sub-item (f), *and* are systems based upon "microprocessor microcircuits" having:
 - (a) A word length of more than 16 bits; *or*
 - (b) Their arithmetic logic unit (ALU) has a bus architecture of more than 16 bits;
- (7) Do not have all of the following characteristics:

N.B.:

This sub-paragraph does not apply to work-stations designed for and limited to graphic arts (e.g. printing, publishing).

- (i) They are stand-alone graphics work stations designed or modified for the generation, transformation and display of two- or three-dimensional vectors;
- (ii) They have a "total processing data rate" of the central processing unit exceeding 28 million bits;
- (iii) They have a central processing unit, with a word length exceeding 16 bits; *and*

N.B.:

Microprocessor based systems with 16-bit word-length and not more than a 32-bit architecture are regarded as 16-bit systems for the purpose of this sub-paragraph.

- (iv) They exceed either of the following limits:
 - (a) "Block move data rate"—800,000 pixels per second; *or*
 - (b) Maximum bit transfer rate of the channel for direct access to the "main storage" (Direct Memory Access (DMA) channel)—11 million bits;
- (b) The "digital computers" or "related equipment" therefor do not exceed any of the following limits:
 - (1) Central processing unit—"main storage" combinations:
 - (i) "Total processing data rate"—54 million bits;
 - (ii) "Total connected capacity" of "main storage"—39 million bits;
 - (iii) "Non-volatile storage" with "user-accessible programmability" including bubble memory—none;

N.B.:

Magnetic core "main storage" may however be included.

- (iv) Number of microprocessor or microcomputer microcircuits implementing the central processing unit—three; *or*

N.B.:

This limit does not include any dedicated microprocessor or microcomputer micro-circuit used solely for display, keyboard or input/output control, or any bit-slice microprocessor microcircuit.

- (v) "Virtual storage" capability—512 MByte;

N.B.:

- 1. Supermini "digital computers" with a "virtual storage" capability exceeding the level in this sub-paragraph will not be eligible for consideration under this Note. It is recognised, however, that other "digital computers" (e.g. main frames) may have a "virtual storage" capability exceeding this limit and in such cases they may be considered under this Note.

- 2. If the "total processing data rate" does not exceed 28 million bits this sub-paragraph does not apply.

- (2) Input/output control unit—drum or disk drive combinations:
 - (i) "Total transfer rate"—16 million bits;
 - (ii) "Total access rate"—200 accesses per second;
 - (iii) Total connected "net capacity"—5,120 million bits;
 - (iv) "Maximum bit transfer rate" of any drum or disk drive—16 million bits;
 - (v) Number of independent drum or disk drives—six, of which five must not exceed a "maximum bit transfer rate" of 10.3 million bits;
 - (vi) Exchangeable disk packs which contain magnetic heads:
 - (a) "Access rate" of any independent seek mechanism—20 accesses per second;
 - (b) "Net capacity"—240 million bits;
- (3) Input/output control unit—bubble memory combinations:
 - (i) Total connected "net capacity" for point of sale devices used by cashiers—9.8 million bits;
 - (ii) Total connected "net capacity" for "digital computers" or "related equipment" other than those in (i) above—2.1 million bits;
- (4) Input/output control unit—magnetic tape or cartridge-type streamer tape drive combinations:
 - (i) Magnetic tape drives:
 - (a) "Maximum bit packing density"—246 bits/mm (6,250 bpi);
 - (b) Maximum read/write speed—508 cm/s (200 ips);
 - (c) Maximum bit transfer rate—10 million bits;
 - (d) Number exceeding 131 bits/mm (3,300 bpi)—four;
 - (ii) Cartridge-type streamer tape drives:
 - (a) Maximum "total transfer rate"—16 million bits/s;
 - (b) Number—two;
- (5) Communication control unit—"communication channel" combinations:

- (i) "Total data signalling rate" of all "communication channels" terminating remote from the "computer using facility"—19,200 bits/s;
- (ii) Maximum "data signalling rate" of any "communication channel"—9,600 bits/s;
- (iii) Number of "communication channels" not dedicated full time to the given application—three, provided:
 - (a) They are connected to the public switched network; *and*
 - (b) They have a "data signalling rate" not exceeding 1,200 bits/s at the interface between the "digital computer" and the public switched network; *and*
 - (c) Number of "communication channels" not limited to telex interfaces for services conforming to CCITT recommendations F60 to F79—one.
- (6) Input/output or communication control unit—directly connected data channel combinations:
 - (i) "Total transfer rate"—1.6 million bits/s;
 - (ii) "Transfer rate of any data channel"—1.6 million bits/s;
 - (iii) Terminations of such combinations or any extensions thereto outside the "computer using facility"—none;
- (7) Communication control unit—"local area network" combinations:

N.B.:

For the purpose of this sub-paragraph all "local area networks" interconnected within a "computer using facility" are considered as a single "local area network".

- (i) Maximum "data signalling rate" on the common transmission medium—10 million bits/s;
- (ii) Interfaces and protocols up to and including Layer 2 of the Open System Interconnection (OSI) reference model, that is logical link control Draft International Standard (DIS) 8802/2, IEEE 802.2, 802.3, 802.4, 802.5 or equivalents;
- (iii) Implementations that contain functions of, or equivalent to those provided by, CCITT X.25, Level 3, protocols—none;
- (iv) "Internetwork gateways"—none;
- (v) "Communications channels" from such combinations to one "digital computer" located outside the "computer using facility"—one, provided:
 - (a) The "communication channel" is dedicated full time to the given application;
 - (b) The maximum "data signalling rate" does not exceed 9,600 bits/s; *and*
 - (c) The "digital computer" is not designed or modified for "local area networks";
- (vi) The sum of the "total processing data rate" of all embargoed "digital computers" directly connected to a "local area network"—285 million bits/s;

N.B.:

If the maximum "data signalling rate" on the common transmission medium does not exceed 2 million bits/s, this sub-paragraph will not apply.

- (8) "Other peripheral devices":
 - (i) Maximum bit transfer rate of any "terminal device" located remote from the "computer using facility"—19,200 bits/s;
 - (ii) Displays or graphic input devices:
 - (a) Resolvable elements along any axis—1,024, and shades of grey or colour—64; *or*
 - (b) Resolvable elements along any axis—320, and shades of grey or colour—256;
- (9) Other limits on equipment: "equivalent multiply rate" for "signal processing" or "image enhancement" equipment—800,000 operations per second;
- (c) Exports covered by this Note are subject to the following conditions:
 - (1) The number, type and characteristics of the equipment are reasonable for the application;
 - (2) When the parameters of the equipment do not exceed:
 - (i) "Total processing data rate"—28 million bits/s; *and*
 - (ii) "Maximum bit transfer rate" of any independent drum or disk drive—10.3 million bits/s;

Then, subject to the equipment is not destined for military end-use; there are no limitations on the number of systems which may be licensed per transaction; and

- (3) When the parameters of any equipment involved in one transaction exceed any limit of (2) above, then:
 - (i) The "cumulative total processing data rate" must not exceed 285 million bits/s; *and*

N.B.:

When calculating the "cumulative total processing data rate", the "total processing data rates" of stand-alone microcomputers are not to be included.

- (ii) Governments shall:
 - (a) Be reasonably satisfied that:
 - (1) The equipment will be used primarily for the specific non-strategic application for which the export would be approved; *and*
 - (2) The equipment will not be used for the design, development or production of embargoed items, especially not in microelectronics;
 - (b) Be supplied with the full name and address of the end-user and details of the end-use of the equipment;

N.B.:

Special consideration will be given to the activities of proposed end-users of "digital computers" which have a "processing data rate" of more than 28 million bits/s.

NOTE 10:

Not used.

NOTE 11:

Not used.

NOTE 12:

Favourable consideration will be given to the export of "digital computers" or "related equipment" therefor embargoed by sub-item (h), provided:

- (a) The "digital computers" or "related equipment" therefor:
 - (1) Are not described in sub-items (h)(1)(i)(d) to (m);
 - (2) Are not used with "digital computers" produced in proscribed areas;

N.B.:

This does not preclude the exchange of data media.

- (3) Are exported as:
 - (i) Complete systems; *or*
 - (ii) Enhancements to a previously exported system provided the enhanced system does not exceed the limits of paragraph (b) of this Note;
- (4) Have not been designed for any equipment:
 - (i) Embargoed by any other Item in this Group; *and*
 - (ii) Not eligible for export as an administrative exception to such an Item;
- (5) Have been primarily designed and used for non-strategic applications;
- (6) Do not have any of the following characteristics:
 - (i) They fall within the scope of both sub-items (h)(1)(ii)(a) and (b); *or*
 - (ii) They fall within the scope of sub-item (h)(1)(ii)(a) and are microprocessor-based systems having a word length of more than 16 bits; *or*
 - (iii) They are ruggedised above the level required for a normal commercial/civil environment, but not necessarily up to the levels specified in sub-item (f) and are microprocessor-based systems having a word length of more than 16 bits; *and*

N.B.:

Microprocessor-based systems with 16-bit word-length and not more than a 32-bit architecture are regarded as 16-bit systems for the purpose of this sub-paragraph.

- (7) Do not have all of the following characteristics:

N.B.:

This sub-paragraph does not apply to work-stations designed for and limited to graphic arts (e.g. printing, publishing).

- (i) They are stand-alone graphics work stations designed or modified for the generation, transformation and display of two- or three- dimensional vectors;
- (ii) They have a "total processing data rate" of the central processing unit exceeding 48 million bits/s;
- (iii) They have a central processing unit with a word length exceeding 16 bits; *and*

N.B.:

Microprocessor based systems with 16-bit word-length and not more than a 32-bit architecture are regarded as 16-bit systems for the purpose of this sub-paragraph.

- (iv) They exceed either of the following limits:
 - (a) "Block move data rate"—1,500,000 pixels per second; *or*
 - (b) Maximum bit transfer rate of the channel for direct access to the "main storage" (Direct Memory Access (DMA) channel)—15 million bits/s;
- (b) The "digital computers" or "related equipment" therefor do not exceed any of the following limits:
- (1) Central processing unit—"main storage" combinations:
 - (i) "Total processing data rate"—78 million bits/s;
 - (ii) "Total connected capacity" of "main storage"—76.7 million bits;
 - (iii) "Non-volatile storage" with "user accessible program-mability" including bubble memory—none;

N.B.:

Magnetic core "main storage" may however be included.

- (iv) "Virtual storage" capability—512 MByte;

N.B.:

Supermini "digital computers" with a "virtual storage" capability exceeding the level in this sub-paragraph will not be eligible for consideration under this Note. It is recognised, however, that other "digital computers" (e.g., mainframes) may have a "virtual storage" capability exceeding this limit and in such cases they may be considered under this Note.

- (2) Input/output control unit—drum or disk drive combinations:
 - (i) "Total transfer rate"—22 million bits/s;
 - (ii) "Total access rate"—360 accesses per second;
 - (iii) Total connected "net capacity"—14,000 million bits;
 - (iv) "Maximum bit transfer rate" of any drum or disk drive—20.6 million bits/s;
 - (v) Number of drum or disk drives exceeding a "maximum bit transfer rate" of 10.3 million bits/s—four;
 - (vi) Exchangeable disk packs which contain magnetic heads:
 - (a) "Access rate" of any independent seek mechanism—29 accesses per second;
 - (b) "Net capacity"—640 million bits;
- (3) Input/output control unit—bubble memory combinations:
 - (i) Total connected "net capacity" for point of sale devices used by cashiers—9.8 million bits;
 - (ii) Total connected "net capacity" for "digital computers" or "related equipment" other than those in (i) above—2.1 million bits;
- (4) Input/output control unit—magnetic tape or cartridge-type streamer tape drive combinations:
 - (i) Magnetic tape drives:
 - (a) "Maximum bit packing density"—246 bits/mm (6,250 bpi);
 - (b) Maximum read/write speed—508 cm/s (200 ips);
 - (c) "Maximum bit transfer rate"—10 million bits/s;
 - (d) Number exceeding 131 bits/mm (3,300 bpi)—four;
 - (ii) Cartridge-type streamer tape drives:
 - (a) Maximum "total transfer rate"—16 million bits/s;
 - (b) Number—two;
- (5) Communication control unit—"communication channel" combinations:
 - (i) "Total data signalling rate" of all "communication channels" terminating remote from the "computer using facility"—38,400 bits/s;
 - (ii) Maximum "data signalling rate" of any "communication channel"—19,200 bits/s;
 - (iii) Number of "communication channels" not dedicated full time to the given application—six, provided:

- (a) They are connected to the public switched network;
- (b) They have a "data signalling rate" not exceeding 1,200 bits/s at the interface between the "digital computer" and the public switched network; *and*
- (c) Number of "communication channels" not limited to telex interfaces for services conforming to CCITT recommendations F60 to F79—two;

- (6) Input/output or communication control unit—directly connected data channel combinations:
 - (i) "Total transfer rate"—3.6 million bits/s;
 - (ii) "Transfer rate of any data channel"—3.6 million bits/s;
 - (iii) Terminations of such combinations or of any extensions thereto outside the "computer using facility"—none;
- (7) Communication control unit—"local area network" combinations:

N.B.:

For the purpose of this sub-paragraph all "local area networks" interconnected within a "computer using facility" are considered as a single "local area network"

- (i) Maximum "data signalling rate" on the common transmission medium—10 million bits/s;
- (ii) Interfaces and protocols up to and including Layer 2 of the Open System Interconnection (OSI) reference model, that is ISO logical link control Draft International Standard (DIS) 8802/2, IEEE 802.2, 802.3, 802.4, 802.5 or equivalents;
- (iii) Implementations that contain functions of, or equivalent to those provided by, CCITT X.25, Level 3, protocols—none;
- (iv) "Internetwork gateways"—none;
- (v) "Communications channels" from such combinations to one "digital computer" located outside the "computer using facility"—one, provided:
 - (a) The "communication channel" is dedicated full time to the given application;
 - (b) The maximum "data signalling rate" is 19,200 bits/s; *and*
 - (c) The "digital computer" is not designed or modified for "local area networks"; *and*
- (vi) The sum of the "total processing data rate" of all embargoed "digital computers" directly connected to a "local area network"—285 million bits/s.

N.B.:

- 1. Only one "digital computer" may exceed 54 million bits/s.
- 2. If the maximum "data signalling rate" on the common transmission medium does not exceed 2 million bits/s, this sub-paragraph does not apply.

- (8) "Other peripheral devices":
 - (i) "Maximum bit transfer rate" of any "terminal device" located remote from the "computer using facility"—19,200 bits/s;
 - (ii) Displays or graphic input devices:
 - (a) Resolvable elements—512 × 640, and shades of grey or colour—256; *or*

N.B.:

This paragraph does not prohibit the export under this Note of displays for systems specially designed for and limited to graphic arts (e.g. printing, publishing) which have displays not exceeding 576 × 900 resolvable elements and 256 shades of grey or colour.

- (b) Resolvable elements—1024 × 1280 and shades of grey or colour—64;

N.B.:

This paragraph does not prohibit the export under this Note of displays for systems specially designed for and limited to graphic arts (e.g. printing, publishing) which have displays not exceeding 1,560 × 1024 resolvable elements and 64 shades of grey or colour.

- (9) Other limits on equipment: "signal processing" or "image enhancement" equipment:

- (i) Other limits on equipment: "equivalent multiply rate"—1,500,000 operations per second;
- (ii) Output—10 million image elements per second;
- (c) Applications under this Note must comply with the following:
- (1) Provide information which includes:
- (i) A signed statement by a responsible representative of the end-user(s) or the importing agency describing the end-use and certifying that:
- (a) The "digital computers" or "related equipment" will:
- (1) Be used only for civil applications; *and*
 - (2) Not be reexported or otherwise disposed of without permission from the Government of the exporting country;
- (b) Responsible Western representatives of the supplier will:
- (1) Have the right of access to the "computer using facility" and all equipment, wherever located, during normal working hours and at any other time the equipment is operating; *and*
 - (2) Be furnished information demonstrating continued authorised application of the equipment; *and*
- (c) These Western representatives will be notified of any significant change of application or of other facts, on which the licence was based;
- (ii) A full description of:
- (a) The equipment; *and*
- (b) Its intended application and workload; *and*
- (iii) A complete identification of all end-users and their activities;
- (2) Not used.
- (3) When the parameters of the equipment do not exceed:
- (i) "Total processing data rate"—54 million bits/s; *and*
- (ii) "Total connected capacity" of "main storage"—39 million bits;
- Then there is no visitation requirement;
- (4) When the parameters of the equipment exceed either limit in (3) above, the supplier will:
- (i) Have a responsible Western representative visit and inspect the "computer using facility" and all equipment, wherever located, at least quarterly for three years; *and*
- (ii) Report periodically to the licensing authorities whether the "digital computers" and "related equipment" therefor are still being used for the approved purposes at the authorised location.
- N.B.:**
The visitation requirements of this sub-paragraph will be waived for remote "terminal devices" if they consist only of peripheral equipment freed from embargo by paragraph (h)(2)(iv) above.

NOTE 13:
Not used.

NOTE 14:
Not used.

NOTE 15:
Not used.

NOTE 16:
Definitions of terms used in this Item:
"access rate"—

- (a) Of an input/output control unit—drum or disk drive combination (R_{ad})—
Either the "access rate" of an input/output control unit (R_{ac}) or the sum of the individual "access rates" of all independent seek mechanisms (R_{as}), whichever is smaller.
Thus: $R_{ad} = \min(R_{ac}; \text{SUM } R_{as})$.
- (b) Of an input/output control unit (R_{ac})—
- (1) With rotational position sensing (rps), the sum of the individual "access rates" of all independent seek mechanisms (R_{as}) connected to the control unit.
Thus: $R_{ac} = \text{SUM } R_{as}$ (with rps); *or*

- (2) Without rotational position sensing (rps), the number (C) of independent read/write channels connected to the control unit divided by the least "latency time" (t_{lmin}) of any connected independent seek mechanism.

$$\text{Thus: } R_a = \frac{C}{t_{lmin}} \text{ (without rps).}$$

- (c) Of a seek mechanism (R_{as})—
The reciprocal of the "average access time" (t_{aa}) of the seek mechanism.

$$\text{Thus: } R_{as} = \frac{1}{t_{aa}}$$

"average access time" of a seek mechanism (t_{aa})—

The sum of the "average seek time" (t_{sa}) and the "latency time" (t_l).

$$\text{Thus: } t_{aa} = t_{sa} + t_l$$

"average seek time" (t_{sa})—

The sum of the "maximum seek time" (t_{smax}) and twice the "minimum seek time" (t_{smin}), divided by three.

$$\text{Thus: } t_{sa} = \frac{t_{smax} + 2t_{smin}}{3}$$

"maximum seek time" (t_{smax})—

- (1) For fixed head devices, it is zero; *or*
- (2) For moving head or moving media devices, the rated time to move between the two most widely separated tracks.

"minimum seek time" (t_{smin})—

- (1) For fixed head devices, it is zero; *or*
- (2) For moving head or moving media devices, the rated time to move from one track to an adjacent track.

"latency time" (t_l)—

The rotational period divided by twice the number of independent read/write heads per track.

"analogue computer"—

Equipment which can, in the form of one or more continuous variables:

- (a) Accept data;
- (b) Process data; *and*
- (c) Provide output of data.

"associated" with equipment or systems—

- (a) Can feasibly be either:
 - (i) Removed from such equipment or systems; *or*
 - (ii) Used for other purposes; *and*
- (b) Is not essential to the operation of such equipment or systems.

"block move data rate"—

The maximum number of pixels which can be moved per second from one location to another in the storage which functions as the frame buffer.

"communication channel"—

The transmission path or circuit including the terminating transmission and receiving equipment (modems) for transferring digital information between distant locations.

"computer operating area"—

The immediate contiguous and accessible area around the electronic computer, where the normal operating, support and service functions take place.

"computer using facility"—

The end-users contiguous and accessible facilities:

- (a) Housing the "computer operating area" and those end-user functions which are being supported by the stated application of the electronic computer and its "related equipment"; *and*
- (b) Not extending beyond 1,500 metres in any direction from the centre of the "computer operating area".

"cumulative total processing data rate"—

The sum of all "total processing data rates" in a given transaction.

"data device"—

Equipment capable of transmitting or receiving sequences of digital information.

"data (message) switching"—

The technique, including but not limited to store-and-forward or packet switching, for:

- (a) Accepting data groups (including messages, packets, or other digital or telegraphic information groups which are transmitted as a composite whole);
- (b) Storing (buffering) data groups as necessary;
- (c) Processing part or all of the data groups, as necessary, for the purpose of:
 - (1) Control (routing, priority, formatting, code conversion, error control, retransmission or journaling);
 - (2) Transmission; *or*
 - (3) Multiplexing; *and*

(d) Retransmitting (processed) data groups when transmission or receiving facilities are available.

"data signalling rate"—

The rate as defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, baud and bit per second are not equal. Binary digits for coding, checking, and synchronization functions are included.

N.B.:

It is the maximum one-way rate, i.e. the maximum rate in either transmission or reception.

"digital computer"—

Equipment which can, in the form of one or more discrete variables:

- (a) Accept data;
- (b) Store data or instructions in fixed or alterable (writable) storage devices;
- (c) Process data by means of a stored sequence of instructions which is modifiable; *and*
- (d) Provide output of data.

N.B.:

Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"embedded" in equipment or systems—

Can feasibly be neither:

- (a) Removed from such equipment or systems; *nor*
- (b) Used for other purposes.

"equivalent multiply rate"—

The maximally achievable number of multiplication operations which can be performed per second considering that, in the case of simultaneous multiplication operations, all multiplication rates have to be summed in order to arrive at the "equivalent multiply rate":

- (a) Assuming
 - (1) Optimal operand locations in the "most immediate storage"; *and*
 - (2) Operand lengths at least 16 bits, or more if this allows for faster operation; *and*
- (b) Neglecting
 - (1) Set-up operations;
 - (2) Pipeline filling operations;
 - (3) Initialization;
 - (4) Interrupts; *and*
 - (5) Data reordering times.

N.B.:

Simultaneous multiplication operations can occur because of:

- (a) Multiple arithmetic units for operations such as complex multiplication, convolution or recursive filtering;
- (b) Parallel pipelining;
- (c) More than one arithmetic unit in one data processing unit; *or*
- (d) More than one data processing unit in one system.

"fault tolerance"—

The capability to perform correctly without human intervention after failure of any "assembly", so that there is no single point in the system the failure of which could cause catastrophic failure of the system's functioning.

"assembly"—

A number of components (i.e. circuit elements, discrete components, microcircuits) connected together to perform a specific function or functions, replaceable as an entity and normally capable of being disassembled.

"firmware"—

See "microprogramme".

"gateway"—

The function, realised by any combination of equipment and "software", to carry out the conversion of conventions for representing, processing or communicating information used in one system into the corresponding but different conventions used in another system.

"gross capacity"—

The product of:

- (a) The maximum number of binary digit (bit) positions per unformatted track; *and*
- (b) The total number of tracks including spare tracks and tracks not accessible to the user.

"hybrid computer"—

Equipment which can:

- (a) Accept data;

(b) Process data, in both analogue and digital representations; *and*

(c) Provide output of data.

"image digitiser"—

A device for directly converting an analogue representation of an image into a digital representation.

"image enhancement"—

The processing of externally derived information-bearing images by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g. fast Fourier transform or Walsh transform). This does not include algorithms using only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false coloration.

"incorporated" in equipment or systems—

(a) Can feasibly be either:

- (i) Removed from such equipment or systems; *or*
- (ii) Used for other purposes; *and*

(b) Is essential to the operation of such equipment or systems.

"internetwork gateway"—

a "gateway" for two systems which are themselves "local area networks", "wide area networks" or both.

"local area network"—

A data communication system which:

- (a) Allows an arbitrary number of independent "data devices" to communicate directly with each other; *and*
- (b) Is confined to a geographical area of moderate size (e.g. office building, plant, campus, warehouse).

"main storage"—

The primary storage for data or instructions for rapid access by a central processing unit. It consists of the internal storage of a "digital computer" and any hierarchical extension thereto, such as cache storage or non-sequentially accessed extended storage.

"maximum bit packing density"—

The density of recording specified in accordance with the appropriate ANSI or ISO Standard (e.g. ANSI X3.14-1979, ISO 1863-1975; ANSI X3.22-1973, ISO 1873-1976; ANSI X3.39-1973, ISO 3788-1976; ANSI X3.48-1977, ISO 3407-1976; ANSI X3.56-1977, ISO 4057-1979; ANSI X3.54-1976).

"maximum bit transfer rate"—

(a) Of a drum or disk drive (R_{tdmax}) is the product of:

- (1) The maximum number of binary digit (bit) positions per unformatted track; *and*
- (2) The number of tracks which simultaneously can be read or written, divided by the rotational period;

(b) Of a magnetic tape drive (R_{tmax}), is the product of:

- (1) The "maximum bit packing density";
- (2) The number of data bits per character (ANSI) or per row (ISO); *and*
- (3) The maximum tape read/write speed.

"microprogramme"—

A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"most immediate storage"—

The portion of the "main storage" most directly accessible by the central processing unit:

- (a) For single level "main storage", this is the internal storage; *or*
- (b) For hierarchical "main storage", this is:
 - (1) The cache storage;
 - (2) The instruction stack; *or*
 - (3) The data stack.

"multi-data-stream processing"—

The "microprogramme" or equipment architecture technique which permits processing two or more data sequences under the control of one or more instruction sequences by means such as:

- (a) Parallel processing;
- (b) Structured arrays of processing elements;
- (c) Single Instruction Multiple Data (SIMD) operations; *or*
- (d) Multiple Instruction Multiple Data (MIMD) operations;

"net capacity"—

Of a drum, disk or cartridge-type streamer tape drive, or a bubble memory:

The total capacity designed to be accessible to the "digital computer" excluding error control bits.

"non-volatile storage"—

A storage device the contents of which are not lost when power is removed.

"other peripheral device"—

A "data device" which is:

- (a) Peripheral to a central processing unit—"main storage" combination; *and*
- (b) Not an input/output control unit—drum, disk or magnetic tape drive or bubble memory combination.

"personal computer"—

A microprocessor based "digital computer" that is:

- (1) Designed for a commercial/office environment;
- (2) Designed and announced by the manufacturer for personal, home or business use; *and*
- (3) Available for purchase over the counter at retail stores.

"principal element"—

A "digital computer" or "related equipment" which is:

- (a) Either "embedded" or "incorporated" in another equipment or system; *and*
- (b) In replacement value more than 35% of the replacement value of the total equipment or system, i.e. including the "digital computer" or "related equipment".

"programme"—

A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"real time processing"—

Processing of data by an electronic computer in response to an external event according to time requirements imposed by the external event.

"related equipment"—

Equipment "embedded" in, "incorporated" in, or "associated" with electronic computers, as follows:

- (a) Equipment for interconnecting "analogue computers" with "digital computers";
- (b) Equipment for interconnecting "digital computers";
- (c) Equipment for interfacing electronic computers to "local area networks" or to "wide area networks";
- (d) Communication control units;
- (e) Other input/output (I/O) control units;
- (f) Recording or reproducing equipment referred to Item 1565 by Item 1572;
- (g) Displays; *or*
- (h) Other peripheral equipment.

N.B.:

"Related equipment" which contains an "embedded" or "incorporated" electronic computer, but which lacks "user-accessible programmability", does not thereby fall within the definition of an electronic computer.

"signal processing"—

The processing of externally derived information-bearing signals by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g. fast Fourier transform or Walsh transform).

"software"—

A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

"stored programme controlled circuit switching"—

The technique for establishing, on demand and until released, a direct (space division switching) or logical (time division switching) connection between circuits based on switching control information derived from any source or circuit and processed according to the stored "programme" by one or more electronic computers.

"terminal device"—

A "data device" which:

- (a) Does not include process control sensing and actuating devices; *and*
- (b) Is capable of:
 - (1) Accepting or producing a physical record;
 - (2) Accepting a manual input; *or*
 - (3) Producing a visual output.

N.B.:

Normal groupings of such equipment (e.g. a combination of paper tape punch/reader and printer), connected to a single data channel or "communication channel", shall be considered as a single "terminal device".

"total access rate" ($R_{at\alpha}$)—

The sum of the individual "access rates" of all input/output control unit—drum or disk drive combinations (R_{ad}) provided with the

system which can be sustained simultaneously assuming the configuration of equipment which would maximize this "total access rate".

Thus: $R_{at\alpha} = \text{SUM } R_{ad}$

"total connected capacity"—

The storage capacity excluding error control bits, word marker bits, and flag bits.

"total data signalling rate"—

The sum of the individual "data signalling rates" of all "communication channels" which:

- (a) Have been provided with the system; *and*
- (b) Can be sustained simultaneously assuming the configuration of the equipment which would maximize this sum of rates.

"total internal storage available to the user"—

The sum of the individual capacities of all internal user-alterable or user-replaceable storage devices, which may be:

- (a) Included in the equipment at the same time; *and*
- (b) Used to store "software" instructions or data.

"total processing data rate"—

- (a) Of a single central processing unit, is its "processing data rate";
- (b) Of multiple central processing units which do not share direct access to a common "main storage", is: The individual "processing data rate" of each central processing unit, i.e., each unit is separately treated as a single central processing unit as in (a) above; *or*
- (c) Of multiple central processing units, which partially or fully share direct access to a common "main storage" at any level, is the sum of:

- (1) The highest of the individual "processing data rates" of all central processing units; *and*
 - (2) 0.75 times the "processing data rate" of each remaining central processing unit, sharing the same "main storage";
- assuming the configuration of equipment, which would maximize this sum of rates.

"processing data rate"—

The maximum of either:

- (a) The "floating point processing data rate" (R_f); *or*
- (b) The "fixed point processing data rate" (R_x).

N.B.:

The "processing data rate" of a central processing unit implemented with two or more microprocessor microcircuits, not including any dedicated microprocessor microcircuit used solely for display, keyboard or input/output control, is the sum of the individual "processing data rates" of all these microprocessor microcircuits.

"floating point processing data rate" (R_f)—

The sum of:

- (1) 0.85 times the "number of bits in a fixed point instruction" (n_{ix}) or 0.85 times the "number of bits in a floating point instruction" (n_{if}), if no fixed point instructions are implemented;
- (2) 0.15 times the "number of bits in a floating point instruction" (n_{if});
- (3) 0.40 times the "number of bits in a fixed point operand" (n_{ox}) or 0.40 times the "number of bits in a floating point operand" (n_{of}), if no fixed point instructions are implemented; *and*
- (4) 0.15 times the "number of bits in a floating point operand" (n_{of});

Divided by the sum of:

- (1) 0.85 times the "execution time" for a fixed point addition (t_{ax}) or for a floating point addition (t_{af}), if no fixed point instructions are implemented.
- (2) 0.09 times the "execution time" for a floating point addition (t_{af}); *and*
- (3) 0.06 times the "execution time" for a floating point multiplication (t_{mf}) or for the fastest available subroutine (t_{msub}) to simulate a floating point multiplication instruction, if no floating point multiplication instructions are implemented.

Thus:

$$R_f = \frac{(0.85)n_{ix} + (0.15)n_{if} + (0.40)n_{ox} + (0.15)n_{of}}{(0.85)t_{ax} + (0.09)t_{af} + (0.06)t_{mf}} \text{ or}$$

If no fixed point instructions are implemented, then:

$$R_f = \frac{(1.00)n_{if} + (0.55)n_{of}}{(0.94)t_{af} + (0.06)t_{mf}} \text{ or}$$

If no floating point multiplication instructions are implemented ($t_{mf} = t_{msub}$) then:

$$R_f = \frac{(0.85)n_{ix} + (0.15)n_{imf} + (0.40)n_{ox} + (0.15)n_{of}}{(0.85)t_{ax} + (0.09)t_{af} + (0.06)t_{msub}}$$

N.B.:

If a "digital computer" has neither floating point addition nor floating point multiplication instructions, then its "floating point processing data rate" is equal to zero.

"fixed point processing data rate" (R_x)—

The sum of:

- (1) 0.85 times the "number of bits in a fixed point addition instruction" (n_{iax});
- (2) 0.15 times the "number of bits in a fixed point multiplication instruction" (n_{imx}); and
- (3) 0.55 times the "number of bits in a fixed point operand" (n_{ox});

Divided by the sum of:

- (1) 0.85 times the "execution time" for a fixed point addition (t_{ax}); and
- (2) 0.15 times the "execution time" for a fixed point multiplication (t_{mx}) or for the fastest available subroutine (t_{msub}) to simulate a fixed point multiplication instruction if no fixed point multiplication instructions are implemented.

Thus:

$$R_x = \frac{(0.85)n_{iax} + (0.15)n_{imx} + (0.55)n_{ox}}{(0.85)t_{ax} + (0.15)t_{mx}} \text{ or}$$

If no fixed point multiplication instructions are implemented ($t_{mx} = t_{msub}$), then:

$$R_x = \frac{(0.85)n_{iax} + (0.15)n_{imx} + (0.55)n_{ox}}{(0.85)t_{ax} + (0.15)t_{msub}};$$

N.B.:

If a "digital computer" has neither fixed point addition nor fixed point multiplication instructions, then its "fixed point processing data rate" is equal to zero.

"number of bits in a:

- fixed point addition instruction" (n_{iax})—
- fixed point multiplication instruction" (n_{imx})—
- floating point addition instruction" (n_{iaf})—
- floating point multiplication instruction" (n_{imf})—

The appropriate shortest single fixed or floating point instruction length which permits full direct addressing of the "main storage".

N.B.:

1. When multiple instructions are required to simulate an appropriate single instruction, the number of bits in the above instructions is defined as 16 bits plus the number of bits (b_{iax} , b_{imx} , b_{iaf} , b_{imf}) which permits full direct addressing of the "main storage".

Thus:

$$\begin{aligned} n_{iax} &= 16 + b_{iax}; \\ n_{imx} &= 16 + b_{imx}; \\ n_{iaf} &= 16 + b_{iaf}; \\ n_{imf} &= 16 + b_{imf}. \end{aligned}$$

2. If the addressing capability of an instruction is expanded by using a base register, then the "number of bits in an instruction, fixed or floating point, addition or multiplication" is the number of bits in the instruction with the standard address length including the number of bits necessary to use the base register.

"number of bits in a fixed point operand" (n_{ox})—

- (a) The shortest fixed point operand length; or
 - (b) 16 bits;
- whichever number is higher.

"number of bits in a floating point operand" (n_{of})—

- (a) The shortest floating point operand length; or
 - (b) 30 bits;
- whichever number is higher.

"execution time"

- (a) The time certified or openly published by the manufacturer for the execution of the fastest appropriate instruction, under the following conditions:

- (1) No indexing or indirect operations are included;
- (2) The instruction is in the "most immediate storage";
- (3) One operand is in the accumulator or in a location of the "most immediate storage", which is acting as the accumulator;
- (4) The second operand is in the "most immediate storage"; and
- (5) The result is left in the accumulator or the same location in the "most immediate storage", which is acting as the accumulator;

- (b) If only the maximum and minimum execution times of the instructions are published, the sum of:

- (1) The maximum execution time of an instruction (t_{max}); and
- (2) Twice the minimum execution time of this instruction (t_{min});

Divided by three.

$$\text{Thus: } t = \frac{t_{max} + 2t_{min}}{3}$$

(t stands for any of the values t_{ax} , t_{af} , t_{mx} or t_{mf});

- (c) For central processing units which simultaneously fetch more than one instruction from one storage location: The average of the "execution times" when executing instructions fetched from all possible locations within the stored word.

- (d) If the longest fixed point operand length is smaller than 16-bit, then use the time required for the fastest available subroutine to simulate a 16-bit fixed point operation.

N.B.:

1. If the addressing capability of an instruction is expanded by using a base register, then the "execution time" shall include the time for adding the content of the base register to the address part of the instruction.
2. When calculating "processing data rate" for computers with cache sizes smaller than 64 KBytes, the "execution time" of the appropriate instructions will be calculated as follows:

(cache hit rate) × ("execution time" when both instruction and operand are in cache storage) + (1 - cache hit rate) × ("execution time" when neither instruction nor operand are in cache storage),

The cache hit rate being:

1.00	for cache size of 64 KByte or more
0.95	" 32 "
0.90	" 16 "
0.85	" 8 "
0.75	" 4 "

"total transfer rate"—

- (a) Of the input/output control unit—drum, disk or cartridge-type streamer tape drive combinations (R_{tdot}):

The sum of the individual "transfer rates" of all input/output control unit—drum, disk or cartridge-type streamer tape drive combinations (R_{td}) provided with the system which can be sustained simultaneously assuming the configuration of equipment which would maximize this sum of rates.

$$\text{Thus: } R_{tdot} = \text{SUM } R_{td}$$

"transfer rate"—

- (1) Of an input/output control unit—drum or disk drive combination (R_{td}), the smaller of either:

N.B.:

For the "transfer rate" of an input/output control unit—cartridge-type streamer tape drive combination, see (b) below.

- (i) The input/output control unit "transfer rate" (R_{tc}); or
- (ii) The sum of the individual "transfer rates" of all independent seek mechanisms (R_s).

$$\text{Thus: } R_{td} = \min(R_{tc}; \text{SUM } R_s)$$

- (2) Of an input/output control unit (R_{tc}):

- (i) With rotational position sensing (rps), is the product of:

- (a) The number of independent read/write channels (c); *and*
 (b) The highest "maximum bit transfer rate" ($R_{tsmaxmax}$) of all independent seek mechanisms; *or*
- (ii) Without rotational position sensing (rps), is two-thirds of this product.

Thus:

$$R_{ic} = C \cdot R_{tsmaxmax} \text{ (with rps); or}$$

$$R_{ic} = \frac{2C}{3} R_{tsmaxmax} \text{ (with rps).}$$

- (3) Of an independent seek mechanism (R_{ts}):

The product of:

- (i) The "maximum bit transfer rate" (R_{tsmax}); *and*
 (ii) The rotational period (t_r);
 Divided by the sum of:
 (i) The rotational period (t_r);
 (ii) The "minimum seek time" (t_{smin}); *and*
 (iii) The "latency time" (t_l).

$$\text{Thus: } R_{ts} = \frac{R_{tsmax} \times t_r}{t_r + t_{smin} + t_l}$$

"minimum seek time" (t_{smin})—

- (1) For fixed head devices, it is zero; *or*
 (2) For moving head or moving media devices, the rated time to move from one track to an adjacent track.

"latency time" (t_l)—

The rotational period divided by twice the number of independent read/write heads per track.

- (b) Of the input/output control unit—magnetic tape drive combinations (R_{mot}):

The sum of the individual "transfer rates" of all input/output control unit—magnetic tape drive combinations (R_{it}) provided with the system which can be sustained simultaneously assuming the configuration of equipment which would maximize this sum of rates.

$$\text{Thus: } R_{mot} = \text{SUM } R_{it}$$

"transfer rate"—

Of an input/output control unit—artridge-type streamer or magnetic tape drive combination (R_{it}):

The product of:

- (1) The number of independent read/write channels (C); *and*
 (2) The highest "maximum bit transfer rate" ($R_{itmaxmax}$) of all tape drives.
 Thus: $R_{it} = C \cdot R_{itmaxmax}$

- (c) Of the input/output or communication control unit—directly connected data channel combinations: The sum of the individual "transfer rates of all data channels" provided with the system which can be sustained simultaneously assuming the configuration of equipment which would maximize this sum of rates.

"transfer rate of any data channel"—

The sum of the individual bit transfer rates of all the "other peripheral devices", excluding "terminal devices", which can be sustained simultaneously on the data channel.

"user-accessible microprogrammability"—

The facility allowing a user to insert, modify or replace "microprogrammes".

"user-accessible programmability"—

The facility allowing a user to insert, modify or replace "programmes" by means other than:

- (a) A physical change in wiring or interconnections; *or*
 (b) The setting of function controls including entry of parameters.

"virtual storage"—

The storage space that may be regarded as addressable "main storage" by the user of a computer system in which virtual addresses are mapped into real addresses.

N.B.:

The size of "virtual storage" is limited by the addressing scheme of the computer system and not by the actual number of "main storage" locations.

"wide area network"—

A data communication system which:

- (a) Allows an arbitrary number of independent "data devices" to communicate with each other;
 (b) May include "local area networks"; *and*
 (c) Is designed to interconnect geographically dispersed facilities.

NOTE 17:

Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "digital computers" or "related equipment" therefor embargoed by sub-item (h) provided:

- (a) The "digital computers" or "related equipment" therefor:
 (1) Will be operated by civil end-users for civil applications;
 (2) Are exported as complete systems or enhancements to previously exported systems up to the limits of sub-paragraph (b) of this Note;
 (3) Have been primarily designed and used for non-strategic applications; *and*
 (4) Do not fall within the scope of both sub-items (h)(1)(ii)(a) and (b);
 (b) The "digital computers" or "related equipment" therefor do not exceed any of the following limits:
 (1) Central processing unit—"main storage" combinations with a "total processing data rate" of 550 million bits/s; *or*
 (2) Array transform processors:
 (i) "Equivalent multiply rate"—800,000 operations per second;
 (ii) Fast Fourier transform of 1,024 complex points—40 ms;
 (c) The "digital computers" or "related equipment" therefor do not have any of the following characteristics:
 (1) Those identified in sub-items (h)(1)(i)(d) to (h) or (m); *or*
 (2) Those identified in sub-item (h)(1)(i)(b) having an "equivalent multiply rate" of more than 2 million operations per second.

N.B.:

Equipment which exceeds this limit may qualify for export under the conditions of this Note if approved by the Government of the exporting country.

NOTE 18:

Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "digital computers" or "related equipment" therefor in accordance with Note 5 above, on the understanding that:

- (a) Note 5(b)(1) does not apply;
 (b) The "total processing data rate" under Note 5(c) does not exceed 155 million bits/s.

NOTE 19:

Governments may permit, as administrative exceptions, individual or bulk shipments to the People's Republic of China of peripheral equipment, as follows, and input/output interface or control units therefor:

- (a) Cathode ray tube graphic displays, which do not exceed:
 (1) 1,024 resolvable elements along one axis and 1,280 resolvable elements along the perpendicular axis; *or*
 (2) 256 shades of grey or colour (8 bit per pixel);
 (b) Plotting equipment and digitising equipment which has an accuracy of 0.002% or worse, and an active area of 254 cm × 254 cm or smaller;
 (c) Disk drives which do not exceed:
 (1) "Maximum bit transfer rate"—10.3 million bits/s; *or*
 (2) "Net capacity"—1,227 million bits;
 (d) Non-impact type printers and laser printers having a resolution not exceeding 120 dots per cm (300 dots per inch);
 (e) Optical character recognition (OCR) equipment;
 (f) Light gun devices or other manual graphic input devices.

NOTE 20:

Governments may permit, as administrative exceptions, bulk shipments to the People's Republic of China of personal computers and small business computer systems, embargoed by sub-item (h), which do not exceed any of the following parameters:

N.B.:

This Note may not be used for graphic workstations exceeding the limits of Note 9(a)(7);

- (a) "Total processing data rate"—136 million bits/s;
 (b) "Virtual storage" capability—512 MByte; *or*

N.B.:

Supermini "digital computers" with a "virtual storage" capability exceeding the level in this sub-paragraph will not be eligible for consideration under this Note. It is recognised, however, that other "digital computers" (e.g., main frames and microcomputers) may have a "virtual storage" capability exceeding this limit and in such cases they may be considered under this Note.

- (c) The other technical parameters of the system—the limits contained in Note 9(b) above without taking into account Note 9(b)(4)(ii)(b).

NOTE 21:

Governments may permit, as an administrative exception, the shipment to the People's Republic of China of spare parts in accordance with Note 7(a) and (b) to this Item.

EXPLANATORY NOTES

Illustrative examples of how to calculate various parameters

A. Conversion of Byte to bit in computing storage limits:

- (a) 1 MByte = (1,024)² Byte = 1,048,576 Byte
 (b) 1 KByte = 1,024 Byte
 (c) 1 Byte: usually equals 8 bits or 9 bits

B. Limits on "total connected capacity" of "main storage":

The limits in the various Notes to Item 1565 assume a 9-bit Byte and an appropriate amount of cache storage (16, 32, 48 or 64 KByte), as follows (although other combinations within these limits would be permissible):

Internal Storage (MByte)	Cache Storage (KByte)	"Total Connected Capacity" (million bits)
0.25	16	2.5
0.5	16	4.9
0.75	32	7.4
1.0	32	9.8
1.5	48	14.6
2.0	48	19.4
2.5	64	24.2
4.0	64	39.0
8.0	128	76.7

C. Fixed Point Processing Data Rate:

Two examples of applying the Note 16 definition of "fixed point processing data rate" to a microprocessor follow:

1. Z80 at 8 MHz clock frequency:**(i) Instruction lengths and cycles**

Operation	Instruction(s)	Instr. Length (Bytes)	Cycles
Add	LHD HE, MEM	3	16
	DAD	1	11
Totals		4	27
Multiply	Emulation routine	—	747

(ii) Execution Times

Add 27 cycles divided by 8 MHz = 3.37 microseconds
 Multiply 747 cycles divided by 8 MHz = 93.37 microseconds

(iii) Fixed Point PDR (XPDR)

$$XPDR = \frac{.85(32) + .15(16+16) + .55(16)}{.85(3.37) + .15(93.37)}$$

= 2.42 million bits per second

NOTE:

Direct addressing capability of the Z80 is 16 bits, which means 65,536 addresses of storage.

(iv) Floating Point PDR (FP PDR)

FP PDR = 0 million bits per second (no floating point addition nor multiplication instruction).

(v) "Total PDR"

"Total PDR" (Z80 at 8 MHz) = 2.42 million bits per second.

2. 8088/8087 at 4.77 MHz clock frequency**(i) Instruction lengths and cycles**

Operation	Instruction(s)	Instr. Length (bytes)	Cycles (OPN + EA + BUS)
Fixed point			
Add	ADD	4	9 + 5 + 4 = 18
Multiply	MUL	4	129 + 5 + 4 = 138
Floating point			
Add	FADD	4	100 + 5 + 16 = 121
Multiply	FMUL	4	115 + 5 + 16 = 136

(ii) Execution times

Fixed point:

ADD 18 cycles divided by 4.77 MHz = 3.77 microseconds

MUL 138 cycles divided by 4.77 MHz = 28.93 microseconds

Floating point:

FADD 121 cycles divided by 4.77 MHz = 25.37 microseconds

FMUL 136 cycles divided by 4.77 MHz = 28.51 microseconds

(iii) Fixed point PDR (XPDR)

$$XPDR = \frac{.85(32) + .15(32) + .55(16)}{.85(3.77) + .15(28.93)}$$

= 5.41 million bits per second

(iv) Floating point PDR (FP PDR)

$$FP PDR = \frac{.85(32) + .15(32) + .4(16) + .15(32)}{.85(3.77) + .09(25.37) + .06(28.51)}$$

= 6.01 million bits per second

(v) "Total PDR"

"Total PDR" (8088/8087 at 4.77 MHz) = 6.01 million bits per second.

1566

Software" and technology therefor, as follows:

NOTE:

The embargo status of "specially designed software" for the use of equipment described in other Items of Group 1, 2 or 3 (except Item 1565) is dealt with in the appropriate Item, and the embargo status of "software" for equipment described in Item 1565 is dealt with in the present Item.

Technical Notes:**1. "Software" is defined as follows:**

"software"—

A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

"programme"—

A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"microprogramme"—

A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

2. "Software" is categorized as follows (there is a close relationship and possible overlap among these categories):

"development system"—

Software" to develop or produce "software". This includes "software" to manage those activities. Examples of a "development system" are programming support environments, software development environments, and programmer-productivity aids.

"programming system"—

Software" to convert a convenient expression of one or more processes ("source code" or "source language") into equipment executable form ("object code" or "object language").

"diagnostic system"—

Software" to isolate or detect "software" or equipment malfunctions.

"maintenance system"—

Software" to:

- (a) Modify "software" or its associated documentation in order to correct faults, or for other updating purposes; or
 (b) Maintain equipment.

"operating system"—

Software" to control:

- (a) The operation of a "digital computer" or of "related equipment"; or
 (b) The loading or execution of "programmes".

"application software"—

Software" not falling within any of the other defined categories of "software".

3. "Specially designed software" is defined as: The minimum "operating systems", "diagnostic systems", "maintenance systems" and "application software" necessary to be executed on a particular equipment to perform the function for which it was designed. To make other, incompatible equipment perform the same function requires:

- (a) Modification of this "software"; or
 (b) Addition of "programmes".

(This ends the Technical Notes. For a complete list of definitions of terms used in this Item, see Note 12 below; see also Item 1565 for additional definitions relating to electronic computers.)

Listed as follows:

- (a) "Software" of whatever category, as follows:
- (1) "Software" designed or modified for any computer that is part of a computer series designed and produced within a proscribed area; *except* "application software" designed for and limited to:
 - (i) Accounting, general ledger, inventory control, payroll, accounts receivable, personnel records, wages calculation or invoice control;
 - (ii) Data and text manipulation such as sort/merge, text editing, data entry or word processing;
 - (iii) Data retrieval from established data files for purposes of report generation or inquiry for the functions described in (i) or (ii) above; *or*
 - (iv) The non "real time processing" of pollution sensor data at fixed sites or in civil vehicles for civil environmental monitoring purposes;
 - (2) "Software" designed or modified for the design, development or production of items embargoed in Group 1, 2 or 3;
 - (3) "Software" designed or modified for:
 - (i) Embargoed "hybrid computers";
 - (ii) One or more of the functions described in Item 1565(h)(1)(i)(a) to (j) or (m) or (h)(2)(vi) or for "digital computers" or "related equipment" designed or modified for such functions, *except* the minimum "specially designed software" in machine executable form for "digital computers" and "related equipment" thereof which are freed from embargo only by Item 1565(h)(2)(i) or (ii), and only when supplied with the equipment or systems;

NOTE:

"Software" for equipment which is freed from embargo only by Item 1565(h)(2)(vi) may contain file server or printer server functions above layer 2 of the Open System Interconnection (OSI) reference model provided the protocols do not contain level 3 of CCITT X.25 or equivalent functions.

- (4) "Software" for computer-aided design, manufacture, inspection or test of items embargoed in Group 1, 2 or 3;
 - (5) "Software" designed or modified to provide certifiable multi-level security or certifiable user-isolation applicable to government-classified material or to applications requiring an equivalent level of security, or "software" to certify such "software";
- (b) Categorized "software" as follows:
- (1) "Development systems" as follows:
 - (i) "Development systems" employing "high-level language" and designed for or containing "programmes" or "databases" special to the development or production of:
 - (a) "Specially designed software" embargoed by any other Item in Group 1, 2 or 3; *or*
 - (b) "Software" embargoed by sub-items (a)(2) or (c)(3) of this Item; including any subset designed or modified for use as part of such a "development system";
 - (ii) "Development systems" employing "high-level language" designed for or containing the "software" tools and "databases" for the development or production of "software" or any subset designed or modified for use as part of a "development system" such as, or equivalent to:
 - (a) Ada Programming Support Environment (APSE);
 - (b) Any subset of APSE, as follows:
 - (1) Kernel APSE;
 - (2) Minimal APSE;
 - (3) Ada compilers specially designed as an integrated subset of APSE; *or*
 - (4) Any other subset of APSE;
 - (c) Any superset of APSE; *or*
 - (d) Any derivative of APSE;
 - (2) "Programming systems" as follows:

- (i) "Cross-hosted" compilers and "cross-hosted" assemblers;

NOTE:

For "cross-hosted" compilers or "cross-hosted" assemblers which have to be used in conjunction with microprocessor or microcomputer development instruments or systems described in Item 1529, see that Item.

- (ii) Compilers or interpreters designed or modified for use as part of a "development system" embargoed by (1) above;
 - (iii) Disassemblers, decompilers or other "software" which convert "programmes" in object or assembly language into a higher level language, *except* simple debugging "application software", such as mapping, tracing, check-point/restart, breakpoint, dumping and the display of the storage contents or their assembly language equivalent;
- (3) "Diagnostic systems" or "maintenance systems" designed or modified for use as part of a "development system" embargoed by (1) above;
 - (4) "Operating systems" as follows:
 - (i) "Operating systems" designed or modified for "digital computers" or "related equipment" exceeding any of the following limits:
 - (a) Central processing unit—"main storage" combinations:
 - (1) "Total processing data rate"—48 million bits per second;
 - (2) "Total connected capacity" of "main storage"—25.2 million bits;
 - (3) "Virtual storage" capability—512 MByte (for MByte, Explanatory Notes of Item 1565);
 - (b) Input/output control unit—drum, disk or cartridge-type streamer tape drive combinations:
 - (1) "Total transfer rate"—15 million bits per second;
 - (2) "Total access rate"—320 accesses per second;
 - (3) Total connected "net capacity"—7,000 million bits;
 - (4) "Maximum bit transfer rate" of any drum or disk drive—10.3 million bits per second;
 - (c) Input/output control unit—bubble memory combinations:
 Total connected "net capacity"—2.1 million bits;
 - (d) Input/output control unit—magnetic tape drive combinations:
 - (1) "Total transfer rate"—5.2 million bits per second;
 - (2) Number of magnetic tape drives—twelve;
 - (3) "Maximum bit transfer rate" of any magnetic tape drive—2.6 million bits per second;
 - (4) "Maximum bit packing density"—63 bits per mm (1,600 bits per inch) per track;
 - (5) Maximum tape read/write speed—508 cm (200 inch) per second;

NOTE:

This sub-item does not embargo "operating systems" designed or modified for "digital computers" or "related equipment":

- (a) Not exceeding the above limits even when the "operating systems" can also be used on "digital computers" or "related equipment" exceeding the above limits; *or*
 - (b) Belonging to a series containing models exceeding the above limits, if the "operating systems" are used on "digital computers" or "related equipment" of the series which do not exceed the above limits.
- (ii) "Operating systems" providing on-line transaction data processing which permit integrated teleprocessing and "on-line updating" of "databases";
- (5) "Application software" as follows:
 - (i) "Software" for cryptologic or cryptanalytic applications;
 - (ii) Artificial intelligence "software", including "software" normally classified as expert systems, which enables a "digital computer" to perform functions that are

- normally associated with human perception and reasoning or learning;
- (iii) "Database management systems" which are designed to handle "distributed databases" for:
 - (a) Fault tolerance by using techniques such as maintenance of duplicated "databases"; *or*
 - (b) Integrating data at a single site from independent remote "databases";
 - (iv) "Software" designed to adapt "software" resident on one "digital computer" for use on another "digital computer", *except* "software" to adapt between two legally exported "digital computers";
- (c) Technology applicable to the development, production or use (i.e. installation, operation and maintenance) of "software", even if the "software" is unembargoed, *except*:
- (1) Technical data in the public domain; *or*
 - (2) The minimum technical information necessary for the use of "software" free from embargo.

NOTE:

For the purposes of this sub-item, technology does not include "software".

NOTES

1. This Item does not embargo "software" not exceeding 5,000 statements in "source language", excluding data, provided:
 - (a) The "software" is neither designed nor modified for use as a module of a larger "software" module or system which in total exceeds this limit; *and*
 - (b) The "software" is not embargoed by sub-item (b)(5) above.
2. This Item does not embargo "software" initially exported to a proscribed destination prior to January 1, 1984, provided:
 - (a) The "software" is identical to and in the same language form (source or object) as initially exported, allowing minor updates for the correction of errors which do not modify the initially exported functions;
 - (b) The accompanying documentation does not exceed the level of the initial export; *and*
 - (c) The "software" is exported to the same proscribed destination as the initial export.
3. Governments may permit the shipment of the minimum technical information for the use (i.e., installation, operation and maintenance) of "software" authorised for export, when shipped together with or solely for use with this "software".
4. Not used.
5. Governments may permit, as administrative exceptions, the shipment of "application software" embargoed by sub-item (a)(1) above, but not otherwise embargoed by this Item or any other Item of Group 1, 2 or 3, provided:
 - (a) The "application software" is designed for and limited to the following:
 - (1) The approved end-use of legally exported equipment or systems in conjunction with any computer that is part of a computer series produced within a proscribed area and based on a design originating in a member country; *or*
 - (2) The monitoring and control of industrial processes limited to the production of items not described in Group 1, 2 or 3; *and*
 - (b) No embargoed technology is provided.
6. The provisions of this Item may allow the export of "software" which is either:
 - (a) "Standard commercially available" "software":
 - (1) Designed for installation by the user without further support by the supplier;
 - (2) Designed for use on "digital computers" and "related equipment" thereof which do not exceed the performance limits in Item 1565 Note 9(b) with the substitution in Item 1565 Note 9(b)(1)(i) of a "total processing data rate" of 15 million bits per second; *and*
 - (3) "Generally available to the public"; *or*

N.B.:

For the purpose of this Note "generally available to the public" means:

- (a) Also available at retail selling points, other than those specialized in selling electronic computers to the general public in model series exceeding the limits in (2) above; *and*

- (b) Selling by means of over-the-counter transactions from stock.
 - (b) "Software" in the public domain.
7. Not used.
 8. Governments may permit, as administrative exceptions, the shipment of normal commercial "software" for civil Air Traffic Control (ATC) systems approved for export, provided:
 - (a) The "software" is commonly used by civil Air Traffic Control authorities outside proscribed areas, but not precluding the personalization of certain parameters for civil Air Traffic Control authorities wherever located;
 - (b) The "software" is not designed or modified for any "digital computer" which is part of a "digital computer" series designed and produced within a proscribed area;
 - (c) The "software" is the minimum necessary to accomplish the normal civil Air Traffic Control functions outside proscribed areas;
 - (d) The "software" will not contain or be capable of accomplishing any of the following functions:
 - (1) Electronic Counter Counter Measures (ECCM);
 - (2) Weapon display, allocation or operation;
 - (3) Intercept guiding capability; *or*
 - (4) Interfacing with altitude determining radars, *except* secondary search radars;
 - (e) The "software" is further limited by the amount of "source code", which is to be the minimum necessary for the use (i.e. installation, operation and maintenance) of the "software";
 - (f) In addition to the above limitations, the only other system "software" allowed is the minimum "programming system" for the maintenance of the "software";
 - (g) The information to accompany each case will include a signed statement of the end-user or importing agency, a full description of the "software" and its characteristics vis-a-vis the subparagraphs above, its intended application and workload and a complete identification of all end-users and their activities; *and*
 - (h) It is considered that:
 - (1) The "software" will not be used to provide or process data associated with military control centres or military radars, or otherwise be associated with such radars or centres; *and*
 - (2) The type and characteristics of the "software" are reasonable for the specific civil Air Traffic Control applications.
 9. Governments may permit, as administrative exceptions, the shipment of "operating systems" embargoed only by sub-item (b)(4)(ii) above when supplied with "digital computers" and "related equipment" exported under the provisions of Item 1565, Notes 9 and 12, provided these "operating systems" are:
 - (a) For use with a "digital computer" exported under the provisions of Item 1565;
 - (b) In machine-executable version;
 - (c) Limited to the minimum "standard commercially available" "software"; *and*
 - (d) Not designed or modified for "database management systems" embargoed by sub-item (b)(5)(iii) above.
 10. Governments may permit, as administrative exceptions, the shipment of "software" embargoed by sub-item (a)(3)(ii) above for "digital computers" and "related equipment" exported under the provisions of Item 1565, Notes 5 or 9 provided:
 - (a) The "software" is limited to:
 - (1) The minimum necessary for the approved application;
 - (2) Machine-executable form; *and*
 - (3) "Specially designed software" for:
 - (i) Equipment approved for export under Item 1565, Note 5, for one or more of the functions described in Item 1565(h)(1)(i)(a), (b) or (d); *or*
 - (ii) Equipment approved for export under Item 1565, Note 9, for one or more of the functions described in Item 1565(h)(1)(i)(a), (b) or (c);
 - (b) The "specially designed software" for "signal processing" and "image enhancement" does not provide for more than one of the following:
 - (1) Time compression; *or*
 - (2) Transformations between domains (e.g. Fast Fourier Transform or Walsh Transform).
 11. Favourable consideration will be given to applications for the export of "software" embargoed by sub-item (a)(3)(ii) above for "digital computers" and "related equipment" exported under the

provisions of Item 1565, Note 12, provided the "software" is limited to:

- (a) "Software" for one or more of the functions described in Item 1565(h)(1)(i)(a), (b) or (c);
- (b) The minimum necessary for the approved application; *and*
- (c) Machine-executable form.

12. Definitions of terms used in this Item:

"analogue computer"—

Equipment which can, in the form of one or more continuous variables:

- (a) Accept data;
- (b) Process data; *and*
- (c) Provide output of data.

"application software"—

"Software" not falling within any of the other defined categories of "software".

"cross-hosted"—

For "programming systems", those which produce "programmes" for a model of electronic computer different from that used to run the "programming system", i.e. they have code generators for equipment different from the host computer.

"database"—

A collection of data, defined for one or more particular applications, which is physically located and maintained in one or more electronic computers or "related equipment".

"database management system"—

"Application software" to manage and maintain a "database" in one or more prescribed logical structures for use by other "application software" independent of the specific methods used to store or retrieve the "database".

"development system"—

"Software" to develop or produce "software". This includes "software" to manage those activities. Examples of a "development system" are programming support environments, software development environments, and programmer-productivity aids.

"diagnostic system"—

"Software" to isolate or detect "software" or equipment malfunctions.

"digital computer"—

Equipment which can, in the form of one or more discrete variables:

- (a) Accept data;
- (b) Store data or instructions in fixed or alterable (writable) storage devices;
- (c) Process data by means of a stored sequence of instructions which is modifiable; *and*
- (d) Provide output of data.

N.B.:

Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"distributed database"—

A "database" which is physically located and maintained in part or as a whole in two or more interconnected electronic computers or "related equipment", such that inquiries from one location can involve "database" access in other interconnected electronic computers or "related equipment".

"firmware"—

See "microprogramme".

"high-level language"—

A programming language that does not reflect the structure of any one given electronic computer or that of any one given class of electronic computers.

"hybrid computer"—

Equipment which can:

- (a) Accept data;
- (b) Process data, in both analogue and digital representations; *and*
- (c) Provide output of data.

"maintenance system"—

"Software" to:

- (a) Modify "software" or its associated documentation in order to correct faults, or for other updating purposes; *or*
- (b) Maintain equipment.

"microprogramme"—

A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"object code" or "object language"—

See "programming system".

"on-line updating"—

Processing in which the contents of a "database" can be amended within a period of time useful to interact with an external request.

"operating system"—

"Software" to control:

- (a) The operation of a "digital computer" or of "related equipment"; *or*
- (b) The loading or execution of "programmes".

"programme"—

A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"programming system"—

"Software" to convert a convenient expression of one or more processes ("source code" or "source language") into equipment executable form ("object code" or "object language").

"related equipment"—

Equipment "embedded" in, "incorporated" in, or "associated" with electronic computers, as follows:

- (a) Equipment for interconnecting "analogue computers" with "digital computers";
- (b) Equipment for interconnecting "digital computers";
- (c) Equipment for interfacing electronic computers to "local area networks" or to "wide area networks";
- (d) Communication control units;
- (e) Other input/output (I/O) control units;
- (f) Recording or reproducing equipment referred to Item 1565 by Item 1572;
- (g) Displays; *or*
- (h) Other peripheral equipment.

N.B.:

"Related equipment" which contains an "embedded" or "incorporated" electronic computer, but which lacks "user-accessible programmability", does not thereby fall within the definition of an electronic computer.

"self-hosted"—

For "programming systems", those which produce "programmes" for the same model of electronic computer as that used to run the "programming system", i.e. they only have code generators for the host computer.

"software"—

A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

"source code" or "source language"—

See "programming system".

"specially designed software"—

The minimum "operating systems", "diagnostic systems", "maintenance systems" and "application software" necessary to be executed on a particular equipment to perform the function for which it was designed. To make other incompatible equipment perform the same function requires:

- (a) Modification of this "software"; *or*
- (b) Addition of "programmes".

"standard commercially available"—

For "software", that which is:

- (a) Commonly supplied to general purchasers or users of equipment outside proscribed areas, but not precluding the personalization of certain parameters for individual customers wherever located;
- (b) Designed and produced for civil applications;
- (c) Not designed or modified for any "digital computer" which is part of a "digital computer" series designed and produced within a proscribed area; *and*
- (d) Supplied in a commonly distributed form.

13. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "software" embargoed by this Item, as follows:

- (a) "Software" embargoed only by sub-item (a)(1) for computers designed and produced within the People's Republic of China;
- (b) "Software" embargoed by sub-item (a)(3)(ii) for equipment which is itself subject to administrative exception;
- (c) "Software" not specially designed for computer-aided design, manufacture, inspection or test of products embargoed by Group 1, 2 or 3;
- (d) "Cross-hosted" compilers or "cross-hosted" assemblers embargoed by sub-item (b)(2)(i);

- (e) "Software" embargoed by sub-items (b)(2)(ii) or (b)(3) for microprocessor or microcomputer development systems, which are themselves subject to administrative exception;
- (f) "Operating systems" embargoed by sub-item (b)(4) for computers which themselves are subject to administrative exception under Item 1565.

NOTE:

The embargo status of "software" specially designed for "data (message) switching" or "stored programme controlled circuit switching" described in Item 1567 is dealt with exclusively in Item 1567.

In the case of "software" for mainframe "digital computers" which may have a "virtual storage" capability exceeding the limit of sub-item (b)(4)(i)(a)(3) and which may be considered for export under the conditions of Item 1565 (Notes 9 and 12), the limitation of the "virtual storage" capability of 512 MByte does not apply.

1567

Stored programme controlled communication switching equipment or systems and technology therefor, as follows; and specially designed components therefor and "specially designed software" for the use of these equipment or systems:

Technical Notes:

1. Stored programme controlled communication switching equipment or systems are categorised as follows:
 - (a) Communication equipment or systems for "data (message) switching":
 - "data (message) switching"—
 - The technique, including but not limited to store-and-forward or packet switching, for:
 - (a) Accepting data groups (including messages, packets or other digital or telegraphic information groups which are transmitted as a composite whole);
 - (b) Storing (buffering) data groups as necessary;
 - (c) Processing part or all of the data groups, as necessary, for the purpose of:
 - (1) Control (routing, priority, formatting, code conversion, error control, retransmission or journaling);
 - (2) Transmission; *or*
 - (3) Multiplexing; *and*
 - (d) Retransmitting (processed) data groups when transmission or receiving facilities are available.
 - "local area network"—
 - A data communication system which:
 - (a) Allows an arbitrary number of independent "data devices" to communicate directly with each other; *and*
 - (b) Is confined to a geographical area of moderate size (e.g., office building, plant, campus, warehouse).
 - "wide area network"—
 - A data communication system which:
 - (a) Allows an arbitrary number of independent "data devices" to communicate with each other;
 - (b) May include "local area networks"; *and*
 - (c) Is designed to interconnect geographically dispersed facilities.
 - (b) Communication equipment or systems for "stored programme controlled circuit switching":
 - "Stored programme controlled circuit switching"—
 - The technique for establishing, on demand and until released, a direct (space-division switching) or logical (time-division switching) connection between circuits based on switching control information derived from any source or circuit and processed according to the stored programme by one or more electronic computers.
 - 2. "Digital computers" or "affiliated equipment" when:
 - (a) "Embedded" in stored programme controlled communication switching equipment or systems are to be regarded as specially designed components therefor;
 - (b) "Incorporated" in stored programme controlled communication switching equipment or systems are covered by this Item

- provided they are the standard models customarily supplied by Western manufacturers of the stored programme controlled communication switching equipment or systems; *or*
- (c) "Associated" with stored programme controlled communication switching equipment or systems are covered by Item 1565 or Item 1572.

3. This Item includes statistical multiplexers, with digital input and digital output, referred to this Item by Item 1519(a), if they satisfy the definitions of either "data (message) switching" or "stored programme controlled circuit switching".

N.B.:

See Item 1519(a) for statistical multiplexers which provide only fixed routing, i.e., routing which is neither:

- (a) Determined when the circuit is established; *nor*
- (b) Dynamically alterable.

(This ends the Technical Notes. For a complete list of definitions of terms used in this Item, see Note 8 below; See also Item 1565 for additional definitions relating to electronic computers and Item 1566 for additional definitions relating to "software".)

Listed as follows:

- (a) Communication equipment or systems for "data (message) switching", including those for "local area networks" or for "wide area networks", *except* "data (message) switching" equipment or systems, provided:

NOTE:

For "data (message) switching" equipment or systems for "local area networks" that can be used in conjunction with electronic computers, see Item 1565.

- (1) The equipment or systems are designed for fixed civil use according to the requirements of either:
 - (i) CCITT Recommendations F.1 to F.79 for store-and-forward systems (Volume II—Fascicle II.4, VIIIth plenary assembly, November 10-21, 1980); *or*
 - (ii) ICAO Recommendations for store-and-forward civil aviation communication networks (Annex 10 to the Convention on International Civil Aviation, including all amendments agreed up to and including December 14, 1981);
- (2) The number, type and characteristics of such equipment or systems are normal for the application;
- (3) Such equipment or systems will be limited as follows:
 - (i) The maximum "data signalling rate" of any circuit does not exceed 4,800 bits/s; *and*
 - (ii) The sum of the individual "data signalling rates" of all circuits does not exceed 27,500 bits/s;
- (4) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:
 - (i) Item 1565(f);
 - (ii) Item 1565(h)(1)(i)(a) to (j), (l) or (m); *or*
 - (iii) Item 1565(h)(1)(ii);
- (5) The "software" supplied:
 - (i) Is limited to:
 - (a) The minimum "specially designed software" necessary for the use (i.e., installation, operation and maintenance) of the equipment or systems; *and*
 - (b) Machine-executable form; *and*
 - (ii) Does not include "software":
 - (a) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (b) To permit user-modification of generic "software" or its associated documentation; *and*
- (6) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (i) Exported on a temporary basis only; *and*
 - (ii) Kept under the control of the supplier;
- (b) Communication equipment or systems for "stored programme controlled circuit switching"; *except*:
 - (1) Key telephone systems provided:
 - (i) Access to an external connection is obtained by pressing a special button (key) on a telephone, rather than by dial or key-pad as on a "PABX";
 - (ii) They are not designed to be upgraded to "private automatic branch exchanges" ("PABXs");
 - (iii) The "software" supplied:
 - (a) Is limited to:

- (1) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (2) Machine-executable form; *and*
 - (b) Does not include "software":
 - (1) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (2) To permit user-modification of generic "software" or its associated documentation; *and*
 - (iv) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (a) Exported on a temporary basis only; *and*
 - (b) Kept under the control of the supplier;
 - (2) "Stored programme controlled circuit switching" equipment or systems, provided:
 - (i) The equipment or systems are designed for fixed civil use in "stored programme controlled telegraph circuit switching" for data;
 - (ii) The number, type and characteristics of such equipment or systems are normal for the application; *and*
 - (iii) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:
 - (a) Item 1565(f);
 - (b) Item 1565(h)(1)(i)(a) to (k), or (m); *or*
 - (c) Item 1565(h)(1)(ii);
 - (iv) The equipment or systems do not have either of the following features:
 - (a) Multi-level call pre-emption including overriding or seizing of busy subscriber lines, "trunk circuits" or switches; *or*
- NOTE:**
This does not preclude single level call pre-emption (e.g. executive override).
- (b) "Common channel signalling";
 - (v) The maximum internal bit rate per channel does not exceed 9,600 bits/s;
 - (vi) The telegraph circuits, which may be telephone circuits, may carry any type of telegraph or telex signal compatible with a voice channel bandwidth of 3,100 Hz as defined in CCITT Recommendation G.151;
 - (vii) The "software" supplied:
 - (a) Is limited to:
 - (1) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (2) Machine-executable form; *and*
 - (b) Does not include "software":
 - (1) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (2) To permit user-modification of generic "software" or its associated documentation; *and*
 - (viii) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (a) Exported on a temporary basis only; *and*
 - (b) Kept under the control of the supplier;
 - (3) "Stored programme controlled telephone circuit switching" equipment or systems, provided:
 - (i) The equipment or systems are designed for fixed civil use as "space-division analogue exchanges" or "time-division analogue exchanges" which fulfil the definition of "private automatic branch exchanges" ("PABXs");
 - (ii) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:
 - (a) Item 1565(f);
 - (b) Item 1565(h)(1)(i)(a) to (k) or (m); *or*
 - (c) Item 1565(h)(1)(ii);

- (iii) "Communication channels" or "terminal devices" used for administrative and control purposes:
 - (a) Are fully dedicated to these purposes; *and*
 - (b) Do not exceed a maximum "data signalling rate" of 9,600 bits/s;
- (iv) Voice channels are limited to 3,100 Hz as defined in CCITT Recommendation G.151;
- (v) Not used;
- (vi) The "PABXs" do not have either of the following features:
 - (a) Multi-level call pre-emption, including overriding or seizing of busy subscriber lines, "trunk circuits" or switches; *or*

NOTE:

This does not preclude single level call pre-emption (e.g. executive override).

- (b) "Common channel signalling";
- (vii) The "software" supplied:
 - (a) Is limited to:
 - (1) The minimum "specially designed software" necessary for the use (i.e., installation, operation and maintenance) of the equipment or systems; *and*
 - (2) Machine-executable form; *and*
 - (b) Does not include "software":
 - (1) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (2) To permit user-modification of generic "software" or its associated documentation; *and*
- (viii) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (a) Exported on a temporary basis only; *and*
 - (b) Kept under the control of the supplier;
- (c) Technology applicable to the development, production or use (i.e., installation, operation and maintenance) of stored programme controlled communication switching equipment or systems, even if these equipment or systems are not embargoed by this Item; *except*: the minimum technical information necessary for the use of stored programme controlled communication switching equipment or systems which are free from embargo.

NOTES:

1. Governments may permit the shipment of the minimum technical information for the use (i.e. installation, operation and maintenance) of stored programme controlled communication switching equipment or systems authorized for export, when shipped together with or solely for use with these stored programme controlled communication switching equipment or systems.
2. Governments may permit, as administrative exceptions, the shipment of spare parts for exported stored programme controlled communication switching equipment or systems, provided:
 - (a) The parts are:
 - (1) Specially designed components embargoed by this Item; *or*
 - (2) Equipment or components embargoed by other Items in this Group 1;
 - (b) The parts:
 - (1) Are destined for embargoed equipment authorised for export as an administrative exception or for equipment free from embargo;
 - (2) Are shipped in the minimum quantities (i.e., a reasonable quantity not exceeding a six-month supply) necessary for the types and quantities of exported equipment being serviced; *and*
 - (3) Do not upgrade the performance of the exported equipment beyond the level:
 - (i) Specified in the relevant Note concerning administrative exception; *or*
 - (ii) Specified as free from embargo;
- (c) If the parts are "advanced technology parts" and not eligible for export as an administrative exception to another Item, the Western supplier's service organization must:
 - (1) Guarantee that parts will be replaced on a one-for-one exchange basis;
 - (2) Take measures to obtain custody of the defective parts; *and*

- (3) If custody is not obtained, certify that the defective parts are destroyed; *and*

Technical Note:

For the purpose of this subparagraph, "advanced technology parts" are either:

- (a) Parts embargoed by Item 1564(c)(2);
- (b) Microprocessor, microcomputer, memory, programmed logic array or arithmetic logic unit microcircuits embargoed by Item 1564(d);
- (c) Magnetic tape heads, magnetic disk heads, magnetic drum heads, or non-exchangeable magnetic disk or drum recording media embargoed by Item 1572; *or*
- (d) Acoustic wave devices embargoed by Item 1586, other than those exportable as administrative exceptions pursuant to Note 1 to Item 1586.
3. Not used.
4. Governments may permit, as administrative exceptions, the shipment of "stored programme controlled telephone circuit switching" equipment or systems embargoed by sub-item (b), provided:
- (a) The equipment or systems are designed for fixed civil use as "space-division digital exchanges" or "time-division digital exchanges" which fulfil the definition of "private automatic branch exchanges" ("PABXs");
- (b) It is considered that the equipment or systems:
- (1) Are designed and used for fixed civil "stored programme controlled telephone circuit switching" applications;
- (2) Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only; *and*
- (3) Do not support any form of Integrated Services Digital Network (ISDN);
- (c) The number, type and characteristics of such equipment or systems are normal for the approved application;
- (d) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:
- (1) Item 1565(f);
- (2) Item 1565 (h)(1)(i)(a) to (k) or (m); *or*
- (3) Item 1565 (h)(1)(ii);
- (e) The "PABXs" do not have any of the following features:
- (1) Multi-level call pre-emption, including overriding or seizing of busy subscriber lines, "trunk circuits" or switches;
- NOTE:**
This does not preclude single level call pre-emption (e.g., executive override).
- (2) "Common channel signalling";
- (3) Dynamic adaptive routing;
- (4) Interconnections which are specially designed for multi-RF channel radio equipment embargoed by Item 1531(d) or (e) or specially designed for multi-RF channel cellular radio equipment;
- (5) Digital subscriber line interfaces;
- (6) Digital synchronisation circuitry which uses equipment embargoed by Item 1529 (a)(2);
- (7) Not used; *or*
- (8) Centralised network control having all of the following characteristics:
- (i) Is based on a network management protocol; *and*
- (ii) Does all the following:
- (a) Receives data from the nodes; *and*
- (b) Processes these data in order to:
- (1) Control traffic; *and*
- (2) Directionalise paths;
- (f) "Communication channels" or "terminal devices" used for administrative and control purposes:
- (1) Are fully dedicated to these purposes; *and*
- (2) Do not exceed a maximum "data signalling rate" of 9,600 bits/s;
- (g) Voice channels are limited to 3,100 Hz as defined in CCITT Recommendation G.151;
- (h) Not used;
- (i) Not used;
- (j) The "software" supplied:
- (1) Is limited to:

- (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
- (ii) Machine-executable form; *and*
- (2) Does not include "software":
- (i) Embargoed by Items 1527 or 1566 (a)(5) or Item 2011 of Group 2; *or*
- (ii) To permit user-modification of generic "software" or its associated documentation;
- (k) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
- (1) Exported on a temporary basis only; *and*
- (2) Kept under the control of the supplier;
- (l) Not used; *and*
- (m) The exporter must supply a statement identifying:
- (1) The equipment or system to be provided;
- (2) The intended application, including the number of lines, number of trunks and traffic load;
- (3) The operating authority; *and*
- (4) The location of the equipment or system.
5. Not used.
6. Governments may permit, as administrative exceptions, the shipment of "stored programme controlled circuit switching" equipment or systems, embargoed by sub-item (b), provided that:
- (a) The equipment or systems are designed for fixed civil use as "stored programme controlled telephone circuit switching" exchanges which fulfil the definitions of either "terminal exchange" or "transit exchange";
- (b) The equipment or systems:
- (1) Were in service in public networks before January 1, 1984; *and*
- (2) Were approved as such by the Government of the exporting country before April 15, 1986;
- (c) The equipment or systems:
- (1) Are designed and used for fixed civil "stored programme controlled telephone circuit switching" applications; *and*
- (2) Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only; *and*
- (3) Do not support any form of Integrated Services Digital Network (ISDN);
- (d) The number, type and characteristics of such equipment or systems are normal for the approved application;
- (e) The equipment or systems cannot be adapted to mobile use or security use, as described in Item 1565 (f)(1) to (4), (g) or (h)(1)(ii)(a) and (b);
- (f) The equipment or systems do not exceed any of the following limits:
- (1) A termination capacity of either:
- (i) 50,000 subscriber lines; *or*
- (ii) 13,000 "trunk circuits";
- (2) Designed or modified for a maximum capacity of 225,000 busy hour call attempts; *or*
- (3) Designed or modified for switched traffic limited to 5,000 erlang;
- (g) The equipment or systems do not have any of the following features:
- (1) Multi-level call pre-emption including overriding or seizing of busy subscriber lines, "trunk circuits" or switches; *or*
- NOTE:**
This does not preclude single level call pre-emption (e.g., executive override).
- (2) "Common channel signalling";
- (3) Dynamic adaptive routing;
- (4) Interconnections which are specially designed for multi-RF channel radio equipment embargoed by Item 1531(d) or (e) or specially designed for multi-RF channel cellular radio equipment;
- (5) Digital subscriber line interfaces;
- (6) Digital synchronisation circuitry which uses equipment embargoed by Item 1529(a)(2); *or*
- (7) Centralised network control having all of the following characteristics:

- (i) Is based on a network management protocol; *and*
 - (ii) Does all the following:
 - (a) Receives data from the nodes; *and*
 - (b) Processes these data in order to:
 - (1) Control traffic; *and*
 - (2) Directionalise paths;
 - (h) "Communication channels" or "terminal devices" used for administrative and control purposes:
 - (1) Are fully dedicated to these purposes; *and*
 - (2) Do not exceed a maximum "data signalling rate" of 9,600 bits/s;
 - (i) Not used;
 - (j) Voice channels are limited to 3,100 Hz as defined in CCITT Recommendation G.151;
 - (k) The "software" supplied:
 - (1) Is limited to:
 - (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (ii) Machine-executable form; *and*
 - (2) Does not include "software":
 - (i) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
 - (l) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (1) Exported on a temporary basis only; *and*
 - (2) Kept under the control of the supplier; *and*
 - (m) The exporter must supply a statement identifying:
 - (1) The equipment or system to be provided;
 - (2) The intended application, including the number of lines, and number of trunks and traffic load;
 - (3) The operating authority; *and*
 - (4) The location of the equipment or system.
7. Governments may permit, as administrative exceptions, the shipment of "stored programme controlled circuit switching" equipment or systems, embargoed by sub-item (b), provided:
- (a) The equipment or systems are designed for fixed civil use as "stored programme controlled telephone circuit switching" exchanges which fulfil the definitions of either "terminal exchange" or "transit exchange";
 - (b) The equipment or systems:
 - (1) Are designed and used for fixed civil "stored programme controlled telephone circuit switching" applications;
 - (2) Will be operated in the importing country by a civil operating authority who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only; *and*
 - (3) Do not support any form of Integrated Services Digital Network (ISDN);
 - (c) The number, type and characteristics of such equipment or systems are normal for the approved application;
 - (d) The equipment or systems cannot be adapted to mobile use or security use, as described in Item 1565(f)(1) to (4), (g) or (h)(1)(ii)(a) and (b);
 - (e) The equipment or systems do not have any of the following features:
 - (1) Multi-level call pre-emption including overriding or seizing of busy subscriber lines, "trunk circuits" or switches;
- N.B.:**
This does not preclude single level call pre-emption (e.g., executive override).
- (2) "Common channel signalling";
 - (3) Dynamic adaptive routing;
 - (4) Interconnection which are specially designed for multi-RF channel radio equipment embargoed by Item 1531(d) or (e) or specially designed for multi-RF channel cellular radio equipment;
 - (5) Digital subscriber line interfaces;

- (6) Digital synchronisation circuitry which uses equipment embargoed by Item 1529(a)(2);
- (7) Not used; *or*
- (8) Centralised network control having all of the following characteristics:
 - (i) Is based on a network management protocol; *and*
 - (ii) Does all the following:
 - (a) Receives data from the nodes; *and*
 - (b) Processes these data in order to:
 - (1) Control traffic; *and*
 - (2) Directionalise paths;
- (f) "Communication channels" or "terminal devices" used for administrative and control purposes:
 - (1) Are fully dedicated to these purposes; *and*
 - (2) Do not exceed a maximum "data signalling rate" of 9,600 bits/s;
- (g) Voice channels are limited to 3,100 Hz as defined in CCITT Recommendation G.151;
- (h) The "software" supplied:
 - (1) Is limited to:
 - (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (ii) Machine-executable form; *and*
 - (2) Does not include "software":
 - (i) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
- (i) Not used;
- (j) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (1) Exported on a temporary basis only; *and*
 - (2) Kept under the control of the supplier;
- (k) Not used;
- (l) The exporter must supply a statement identifying:
 - (1) The equipment or system to be provided;
 - (2) The intended application including the number of lines, number of trunks and traffic load;
 - (3) The operating authority; *and*
 - (4) The location of the equipment or system.

8. Definitions of terms used in this Item:

"affiliated equipment"—

Equipment, as follows:

- (a) Input/output (I/O) control units;
- (b) Recording or reproducing equipment;
- (c) Displays; *or*
- (d) Other peripheral equipment.

"common channel signalling"—

A signalling method in which a single channel between exchanges conveys, by means of labelled messages, signalling information relating to a multiplicity of circuits or calls and other information such as that used for network management.

"communication channel"—

The transmission path or circuit including the terminating transmission and receiving equipment (modems) for transferring digital information between distant locations.

"data device"—

Equipment capable of transmitting or receiving sequences of digital information.

"datagram"—

Is a self-contained, independent entity of data carrying sufficient information to be routed from the source to the destination data terminal equipment without reliance on earlier exchanges between these source and destination data terminal equipments and the transporting network.

"data (message) switching"—

The technique, including but not limited to store-and-forward or packet switching, for:

- (a) Accepting data groups (including messages, packets or other digital or telegraphic information groups which are transmitted as a composite whole);
- (b) Storing (buffering) data groups as necessary;
- (c) Processing part or all of the data groups, as necessary, for the purpose of:
 - (1) Control (routing, priority, formatting, code conversion, error control, retransmission or journaling);

- (2) Transmission; *or*
- (3) Multiplexing; *and*
- (d) Retransmitting (processed) data groups when transmission or receiving facilities are available.

"data signalling rate"—

The rate as defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, baud and bit per second are not equal. Binary digits for coding, checking and synchronization functions are included.

N.B.:

It is the maximum one-way rate, i.e., the maximum rate in either transmission or reception.

"digital computer"—

Equipment which can, in the form of one or more discrete variables:

- (a) Accept data;
- (b) Store data or instructions in fixed or alterable (writable) storage devices;
- (c) Process data by means of a stored sequence of instructions which is modifiable; *and*
- (d) Provide output of data.

N.B.:

Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"embedded" in equipment or systems—

Can feasibly be neither:

- (a) Removed from such equipment or systems; *nor*
- (b) Used for other purposes.

"fast select"—

A facility applicable to virtual calls which allows a data terminal equipment to expand the possibility to transmit data in call set-up and clearing "packets" beyond the basic capabilities of a virtual call.

"local area network"—

A data communication system which:

- (a) Allows an arbitrary number of independent "data devices" to communicate directly with each other; *and*
- (b) Is confined to a geographical area of moderate size (e.g. office building, plant, campus, warehouse).

"PABX"—

See "private automatic branch exchange".

"packet"—

A group of binary digits including data and call control signals which is switched as a composite whole. The data, call control signals and possibly error control information are arranged in a specified format.

"packet-mode operation"—

The transmission of data by means of addressed "packets" whereby a transmission channel is occupied for the duration of the "packet" only. The channel is then available for use by "packets" being transferred between different data terminal equipments. In certain data communication networks the data may be formatted into a "packet" or divided and then formatted into a number of "packets" (either by the data terminal equipment or by equipment within the network) for transmission and multiplexing purposes.

"private automatic branch exchange"—

An automatic telephone exchange, typically incorporating a position for an attendant, designed to provide access to the public network and serving extensions in an institution such as a business, government, public service or similar organisation.

"software"—

A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

"space-division analogue exchange"—

A "space-division exchange", using an analogue (including sampled analogue) signal within the switching matrix. Such exchanges can route digital signals, subject to the bandwidth limitations of the equipment. Thus, such exchanges in public networks commonly pass digital data at rates of several kilobit per second per voice channel of 3,100 Hz as defined in CCITT Recommendation G.151.

N.B.:

A "space-division analogue exchange" with a wideband switching matrix can be converted to a "space-division digital exchange" by modifying some or all of the input interface circuitry.

"space-division digital exchange"—

A "space-division exchange" which accommodates the transmission through the switching matrix of digital signals requiring a bandwidth wider than a voice channel of 3,100 Hz as defined in CCITT recommendation G.151.

N.B.:

A "space-division digital exchange" can be converted to a "space-division analogue exchange" by modifying some or all of the input interface circuitry.

"space-division exchange"—

An exchange in which different streams of data or voice signals are routed through the switching matrix along physically different paths. The signal being routed through the matrix can be analogue (e.g. conventional amplitude modulation, pulse amplitude modulation) or digital (e.g. pulse code modulation, delta modulation or data).

"specially designed software"—

The minimum "operating systems", "diagnostic systems", "maintenance systems" and "application software" necessary to be executed on a particular equipment to perform the function for which it was designed. To make other, incompatible equipment perform the same function requires:

- (a) Modification of this "software"; or
- (b) Addition of "programmes".

"stored programme controlled circuit switching"—

The technique for establishing, on demand and until released, a direct (space-division switching) or logical (time-division switching) connection between circuits based on switching control information derived from any source or circuit and processed according to the stored "programme" by one or more electronic computers.

"stored programme controlled telegraph circuit switching"—

Techniques essentially identical to those for "stored programme controlled telephone circuit switching", for establishing connections between telegraph (e.g. telex) circuits based solely on a subscriber-type of signalling information.

"stored programme controlled telephone circuit switching"—

The technique for establishing within an exchange, on demand and until released, an exclusive direct (space-division switching) or logical (time-division switching) connection between calling and called telephone circuits:

- (a) Based solely on a subscriber-type of telephone signalling information, derived from the calling circuit; *and*
- (b) Processed according to the stored "programmes" by one or more electronic computers.

The telephone circuits may carry any type of signal, e.g. telephone or telex, compatible with a voice channel bandwidth of 3,100 Hz or less.

"terminal device"—

A "data device" which:

- (a) Does not include process control sensing and actuating devices; *and*
- (b) Is capable of:
 - (1) Accepting or producing a physical record;
 - (2) Accepting a manual input; *or*
 - (3) Producing a visual output.

N.B.:

Normal groupings of such equipment (e.g. a combination of paper tape punch/reader and printer), connected to a single data channel or "communication channel", shall be considered as a single "terminal device".

"terminal exchange"—

- (a) A local exchange used for terminating subscribers' lines;
- (b) A remote switching unit which performs some functions of a local exchange and operates under a measure of control from the parent exchange;
- (c) A local exchange, typically 2-wire, used as a switching point for traffic between subordinate local exchanges, which may also provide 4-wire connections to and from the national long distance network; *or*
- (d) An exchange which performs any combination of functions in (a), (b) or (c) above.

"time-division analogue exchange"—

A "time-division exchange" in which the parameter, associated with an individual segment of a stream of data or voice signals, varies continuously.

"time-division digital exchange"—

A "time-division exchange" in which the parameter, associated with an individual segment of a stream of data or voice signals, is one of a finite number of digitally coded values.

"time-division exchange"—

An exchange in which segments of different streams of data or voice signals are interleaved in time and routed through the switching matrix along a common physical path. The matrix may also include one or more stages of space-division switching. The signal being routed through the matrix can be analogue (e.g. pulse amplitude

modulation) or digital (e.g. pulse code modulation, delta modulation or data).

"total data signalling rate"—

The sum of the individual "data signalling rates" of all "communication channels" which:

- (a) Have been provided with the system; *and*
- (b) Can be sustained simultaneously assuming the configuration of the equipment which would maximize this sum of rates.

"transit exchange"—

- (a) An exchange, typically 4-wire, used as a switching point for traffic between other exchanges in the national network (historically known as a "trunk exchange");
- (b) A 4-wire exchange serving outgoing, incoming or transit international calls; *or*
- (c) An exchange which performs any combination of functions in (a) or (b) above or those of a "terminal exchange".

"trunk circuit"—

A circuit with associated equipments terminating in two exchanges.

"trunk exchange"—

See "transit exchange".

"wide area network"—

A data communication system which:

- (a) Allows an arbitrary number of independent "data devices" to communicate with each other;
- (b) May include "local area networks"; *and*
- (c) Is designed to interconnect geographically dispersed facilities.

9. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "data (message) switching" equipment or systems embargoed by sub-item (a), provided:

(a) The equipment or systems are designed to meet the requirements of either:

- (1) CCITT Recommendations F.1 to 79 for store-and-forward systems (Volume II, Fascicle II.4, VIIth plenary assembly, November 10-21, 1980); *or*
- (2) ICAO Recommendations for store-and-forward civil aviation communication networks (Annex 10 to the Convention on International Civil Aviation, including all amendments agreed up to and including December 14, 1981);

(b) The equipment or systems:

- (1) Are designed and used for fixed civil "data (message) switching" applications;
- (2) Will be used primarily for the specified civil application; *and*
- (3) Will be operated in the importing country by:

(i) The Post, Telegraph and Telephone Authority in order to provide public "data (message) switching" services for:

- (a) Domestic civil use; *or*
- (b) International civil use with Western countries;

(ii) A civil authority, which is a member of an intergovernmental organization including Western countries (e.g. ITU or ICAO), in order to provide an extension of international "data (message) switching" services in the importing country to fulfil a commitment to the intergovernmental organization; *or*

(iii) An approved civil public service organization, in order to provide "data (message) switching" services in a densely populated, commercial area for:

- (a) Private domestic civil use; *or*
- (b) Private international civil use with Western countries;

(c) The number, type and characteristics of such equipment or systems are normal for the approved application;

(d) Not used;

(e) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:

- (1) Item 1565(f);
- (2) Item 1565(h)(1)(i)(a) to (j), (l) or (m); *or*
- (3) Item 1565(h)(1)(ii);

(f) The "software" supplied:

- (1) Is limited to:

(i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*

(ii) Machine-executable form; *and*

(2) Does not include "software":

(i) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*

(ii) To permit user-modification of generic "software" or its associated documentation;

(g) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:

- (1) Exported on a temporary basis only; *and*
- (2) Kept under the control of the supplier;

(h) Not used;

(i) Not used; *and*

(j) The exporter must supply:

- (1) A statement identifying:
 - (i) The equipment or system to be provided; *and*
 - (ii) The intended application and traffic load; *and*
- (2) A complete identification of all end-users and their activities.

10. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "stored programme controlled telephone circuit switching" equipment or systems embargoed by sub-item (b), provided:

(a) The equipment or systems are designed for fixed civil use as "space-division digital exchanges" or "time-division digital exchanges" which fulfil the definition of "private automatic branch exchanges" ("PABXs");

(b) The equipment or systems:

- (1) Are designed and used for fixed civil "stored programme controlled telephone circuit switching" applications; *and*
- (2) Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only;

(c) Not used;

(d) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:

- (1) Item 1565(f);
- (2) Item 1565(h)(1)(i)(a) to (k) or (m); *or*
- (3) Item 1565(h)(1)(ii);

(e) The "PABXs" do not have any of the following features:

- (1) Multi-level call pre-emption, including overriding or seizing of busy subscriber lines, "trunk circuits" or switches;

N.B.:

This does not preclude single level call pre-emption (e.g. executive override).

(2) "Common channel signalling";

(3) Dynamic adaptive routing;

(4) Not used;

(5) Not used;

(6) Digital synchronisation circuitry which uses equipment embargoed by Item 1529(a)(2);

(7) Not used; *or*

(8) Centralised network control having all of the following characteristics:

(i) Is based on a network management protocol; *and*

(ii) Does all the following:

(a) Receives data from the nodes; *and*

(b) Processes these data in order to:

- (1) Control traffic; *and*
- (2) Directionalize paths;

(f) "Communication channels" or "terminal devices" used for administrative and control purposes:

(1) Are fully dedicated to these purposes; *and*

(2) Do not exceed a maximum "data signalling rate" of 19,200 bits per second;

(g) Not used;

(h) Not used;

(i) Not used;

(j) The "software" supplied:

- (1) Is limited to:

- (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (ii) Machine-executable form; *and*
 - (2) Does not include "software":
 - (i) Embargoed by Items 1527, 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
 - (k) Not used;
 - (l) Not used; *and*
 - (m) The exporter must supply a statement identifying:
 - (1) The equipment or system to be provided; *and*
 - (2) The intended application.
11. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "stored programme controlled circuit switching" equipment or systems, embargoed by sub-item (b), provided:
- (a) The equipment or systems are designed for fixed civil use of "stored programme controlled telegraph circuit switching" for data;
 - (b) The equipment or systems:
 - (1) Are designed and used for fixed civil "stored programme controlled telegraph circuit switching" applications; *and*
 - (2) Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only;
 - (c) The number, type and characteristics of such equipment or systems are normal for the approved application;
 - (d) The equipment or systems do not contain "digital computers" or "related equipment" embargoed by:
 - (1) Item 1565(f);
 - (2) Item 1565(h)(1)(i)(a) to (k) or (m); *or*
 - (3) Item 1565(h)(1)(ii);
 - (e) The equipment or systems do not have the following features:
 - (1) Multi-level call pre-emption including overriding or seizing of busy subscriber lines, "trunk circuits" or switches;
- N.B.:**
This does not preclude single level call pre-emption (e.g. executive override).
- (2) "Common channel signalling";
 - (f) The maximum internal bit rate per channel does not exceed 19,200 bits/s;
 - (g) Not used;
 - (h) The "software" supplied:
 - (1) Is limited to:
 - (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (ii) Machine-executable form; *and*
 - (2) Does not include "software":
 - (i) Embargoed by Items 1527 or 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
 - (i) Not used;
 - (j) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
 - (1) Exported on a temporary basis only; *and*
 - (2) Kept under the control of the supplier;
 - (k) Not used; *and*
 - (l) The exporter must supply:
 - (1) A statement identifying:
 - (i) The equipment or system to be provided; *and*
 - (ii) The intended application and traffic load; *and*
 - (2) A complete identification of all end-users and their activities.
12. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of "stored programme controlled circuit switching" equipment or systems, embargoed by sub-item (b), provided:

- (a) The equipment or systems are designed for fixed civil use as "stored programme controlled telephone circuit switching" exchanges which fulfil the definitions of either "terminal exchange" or "transit exchange";
 - (b) Not used;
 - (c) The equipment or systems:
 - (1) Are designed and used for fixed civil "stored programme controlled telephone circuit switching" applications; *and*
 - (2) Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement, certifying that the equipment or systems will be used for the specified end-use at a specified location only;
 - (d) Not used;
 - (e) The equipment or systems cannot be adapted to mobile use or security use, as described in Item 1565(f)(1) to (4), (g) or (h)(1)(ii)(a) and (b);
 - (f) Not used;
 - (g) The equipment or systems do not have any of the following features:
 - (1) Multi-level call pre-emption, including overriding or seizing of busy subscriber lines, "trunk circuits" or switches;
- N.B.:**
This does not preclude single level call pre-emption (e.g. executive override).
- (2) "Common channel signalling";
 - (3) Dynamic adaptive routing;
 - (4) Not used;
 - (5) Not used;
 - (6) Digital synchronisation circuitry which uses equipment embargoed by Item 1529(a)(2);
 - (7) Not used; *or*
 - (8) Centralised network control having all of the following characteristics:
 - (i) Is based on a network management protocol; *and*
 - (ii) Does all the following:
 - (a) Receives data from the nodes; *and*
 - (b) Processes these data in order to:
 - (1) Control traffic; *and*
 - (2) Directionalize paths;
 - (h) "Communication channels" or "terminal devices" used for administrative and control purposes:
 - (1) Are fully dedicated to these purposes; *and*
 - (2) Do not exceed a maximum "data signalling rate" of 19,200 bits per second;
 - (i) Not used;
 - (j) The "software" supplied:
 - (1) Is limited to:
 - (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*
 - (ii) Machine-executable form; *and*
 - (2) Does not include "software":
 - (i) Embargoed by Items 1527, 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
 - (k) Not used;
 - (l) Not used; *and*
 - (m) The exporter must supply a statement identifying:
 - (1) The equipment or system to be provided;
 - (2) The intended application;
 - (3) The operating authority; *and*
 - (4) The location of the equipment or system.
13. Not used;
14. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of equipment or "software" for "common channel signalling", contrary to the provisions in Notes 10 or 12, provided that:
- (a) The "common channel signalling" is restricted to "quasi-associated" or "associated mode of operation" according to CCITT Red Book, Volume X, fascicle X.1;
 - (b) No functions, other than those described in the following recommendations in the Red Book of CCITT: Q701 to Q709, Q721 to Q725, Q791 and Q795, are included;

N.B.:

Only functions described in paragraph 2 of Q795 are to be included. These Q795 functions may not provide centralized network control functions as defined in Note 10(e)(8) or Note 12(g)(8).

- (c) No form of Integrated Services Digital Network (ISDN) is provided;
 - (d) Equipment or "software" is restricted to those necessary for the operation within a city or, for "PABXs", within a radius of 100 km;
 - (e) No means are provided which will allow "common channel signalling" via analogue transmission links;
 - (f) All the applicable conditions enumerated in (a) to (e) above are accomplished by:
 - (1) Omission or physical removal of equipment or coding;
 - (2) Over-writing with non-functioning statements; *or*
 - (3) Reasonably non-reversible modifications.
15. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of technology or repair facilities embargoed by this Item for repair of stored programme controlled communication switching equipment or systems, provided that:
- (a) The technology to be transferred is strictly limited to that required for repair work;
 - (b) The repair facilities:
 - (1) Are specially designed equipment for repair;
 - (2) Are to be used to repair embargoed equipment authorised for export as an administrative exception, or equipment free from embargo;
 - (3) Are shipped in reasonable quantities necessary for the types and quantities of exported equipment being serviced;
 - (4) Do not provide local production facilities; *and*
 - (5) Do not provide for testing of individual electronic components;
 - (c) The repair does not upgrade the equipment or systems beyond the performance thresholds of Notes 10 or 12;
 - (d) All the records of repair activity are kept by a representative of the Western supplier;
 - (e) The exporter must supply a statement identifying:
 - (1) The equipment to be provided; *and*
 - (2) The users and their activities; *and*
 - (f) Technology for general purpose computers is not eligible for treatment under this Note, i.e. it remains to be treated under sub-item 1565(j).

N.B.:

Nothing in this Note shall be construed as overriding controls elsewhere in this Group.

16. Favourable consideration will be given to licence applications for the export, to the People's Republic of China only, of "data (message) switching" equipment or systems embargoed by sub-item (a), provided:
- (a) The equipment or systems are designed for fixed civil use and stored programme controlled "packet-mode operation";
 - (b) The equipment or systems do not have any of the following features:
 - (1) "Datagram" service;
 - (2) "Fast select";
 - (3) Dynamic adaptive routing;
 - (4) Precedence, priority override or multi-level call pre-emption;
 - (5) Centralised network control having all of the following characteristics:
 - (i) Is based on a network management protocol; *and*
 - (ii) Does all the following:
 - (a) Receives data from the nodes; *and*
 - (b) Processes these data in order to:
 - (1) Control traffic; *and*
 - (2) Directionalize paths;
 - (c) The "software" supplied:
 - (1) Is limited to:
 - (i) The minimum "specially designed software" necessary for the use (i.e. installation, operation and maintenance) of the equipment or systems; *and*

- (ii) Machine-executable form; *and*
- (2) Does not include "software":
- (i) Embargoed by Items 1527, 1566(a)(5) or Item 2011 of Group 2; *or*
 - (ii) To permit user-modification of generic "software" or its associated documentation;
- (d) If the equipment or systems are not designed for installation by the user without support from the supplier, then the "software" necessary for commissioning is:
- (1) Exported on a temporary basis only; *and*
 - (2) Kept under the control of the supplier;
- (e) Systems for "packet-mode operation" are limited to five nodes;
- (f) No "internetwork gateways" are provided other than for messages originating from or terminating in Western countries;

N.B.:

Connections of private networks to international destinations must be via public "internetwork gateways".

- (g) Each node in a system is limited to 64 ports;
- (h) Node throughput does not exceed 153,600 octets per second;

N.B.:

One octet in, at any port, plus one octet out, also at any port, equals a throughput of one octet. One octet is defined as eight bits residing in the user data field.

- (i) All the applicable conditions enumerated in (a) to (e) above are accomplished by:
 - (1) Omission or physical removal of equipment or coding;
 - (2) Over-writing with non-functioning statements; *or*
 - (3) Reasonably non-reversible modifications;
 - (j) Not used.
17. Favourable consideration will be given to licence applications for the export, to the People's Republic of China only, of technology embargoed by sub-item (c), and of instrumentation, test equipment, components or specially designed "software" therefor for modification, production or use of equipment or systems, provided that:
- (a) The characteristics of the equipment or systems are limited to those which make them eligible for treatment under Notes 10 or 12;
 - (b) Technology for general purpose computers is not eligible for treatment under this Note, i.e. it remains to be treated under sub-item 1565(j);
 - (c) Technology for testing of large scale integrated (LSI) circuits or those with higher component densities is limited to go/no-go tests;
 - (d) Generic "software" is exported in machine executable form only;
 - (e) No technology for the design or development of printed circuit boards or integrated circuits is supplied;
 - (f) Technology and training for "software" are limited to the creation or maintenance of customer specific data bases and site parameters;
 - (g) Modification of the equipment or systems is not permitted if any aspect of the design would result in exceeding the performance thresholds or features of Notes 10 or 12;
 - (h) The contract includes explicit conditions to ensure that:
 - (1) The technology or equipment or systems are not reexported or exported, either directly or indirectly, to another proscribed destination without the agreement of the Government of the exporting country;
 - (2) The supplier may appoint a representative in China who could verify that the manufactured equipment was serving its intended use;
 - (3) Any modification of the capabilities or functions of the equipment has been agreed by both parties;
 - (i) The Western personnel have right of access to all the facilities directly involved in the modification and production of the equipment or systems;
 - (j) Not used;
 - (k) Favourable consideration will also be given to the export of the minimally required associated materials and components embargoed by this Item or other Items in Group 1 and specially designed "software" for modification, production or testing of equipment or systems.

N.B.:

No export under the favourable consideration provisions of this sub-paragraph shall establish a precedent for export approval under other entries in this Group.

N.B.:

Sub-paragraphs (c) or (e) above do not preclude exports of technology which would be possible according to the provisions of other Items.

1568

Analogue-to-digital and digital-to analogue converters, position encoders and transducers, as follows, and specially designed components and test equipment therefor:

NOTE:

For digital voltmeters or counters, see Item 1529.

- (a) Electrical input type analogue-to-digital converters having any of the following characteristics:
- (1) A conversion rate of more than 200,000 complete conversions per second at rated accuracy;
 - (2) An accuracy in excess of 1 part in more than 10,000 of full scale over the specified operating temperature range; *or*
 - (3) A figure of merit 1×10^8 or more (derived from the number of complete conversions per second divided by the accuracy);
- (b) Electrical input type digital-to-analogue converters having any of the following characteristics:
- (1) A maximum "settling time" of less than 3 microseconds for voltage output devices and less than 250 ns for current output devices;
 - (2) An accuracy in excess of 1 part in more than 10,000 of full scale over the specified operating temperature range; *or*
 - (3) A figure of merit (defined as the reciprocal of the product of the maximum "settling time" in seconds and the accuracy) of more than 2×10^9 for voltage output converters or 1×10^{10} for current output converters;
- (c) Solid-state synchro-to-digital or digital-to-synchro converters and resolver-to-digital or digital-to-resolver converters (including multipole resolvers) having a resolution of better than ± 1 part in 5,000 per full synchro revolution for single speed synchro systems or ± 1 part in 40,000 for dual speed systems;
- (d) Mechanical input type position encoders and transducers, as follows, excluding complex servo-follower systems:
- (1) Rotary types having:
 - (i) A resolution of better than 1 part in 265,000 of full scale; *or*
 - (ii) An accuracy better than ± 2.5 arc-seconds;
 - (2) Linear displacement types having a resolution of better than 5 micrometres;

Technical Note:

Sub-item (d) includes absolute and incremental shaft position encoders, linear displacement encoders and inductosyns.

- (e) Any equipment described above which is designed to operate below 218 K (-55°C) or above 398 K (125°C);

Technical Note:

"Settling time" is defined as the time required for the output to come within one-half bit of the final value when switching between any two levels of the converter.

NOTE:

Governments may permit, as administrative exceptions, the shipment to the People's Republic of China, of analogue-to-digital or digital-to-analogue converters, as follows:

- (a) Analogue-to-digital converters with more than a 200 ns conversion time to a maximum resolution of 12 bits;
- (b) Digital-to-analogue converters with more than 200 ns "settling time" for voltage output and a maximum resolution of 12 bits; *or*
- (c) Digital-to-analogue converters with more than 25 ns "settling time" for current output and a maximum resolution of 12 bits.

1570

Thermoelectric materials and devices, as follows:

- (a) Thermoelectric materials with a maximum product of the figure of merit (Z) and the temperature (T in degrees K) in excess of 0.75;
- (b) Junctions and combinations of junctions using any of the materials in (a) above;
- (c) Heat absorbing or electrical power generating devices containing any of the junctions in (b) above, and specially designed components therefor;
- (d) Other power generating devices, and specially designed components therefor, which generate in excess of 22 W per kg (10 W per lb) or of 17.70 kW per cubic metre (500 W per cubic foot) of the device's basic thermoelectric components;

Technical Note:

The figure of merit (Z) equals Seebeck coefficient square divided by the product of electrical resistivity and thermal conductivity.

NOTES:

1. See also Item 1205(c).
2. The weight and cubic measurements in sub-item (d) above are not intended to encompass the complete device but to include only the thermoelectric elements and assembly and the components for pumping calories. Other components, such as heating or cooling sources or containers, device frames or stands and control equipment are not to be included in the calculations.

1571

Magnetometers, magnetometer systems and related equipment, as follows, and specially designed components therefor:

- (a) Magnetometers and magnetometer systems having or capable of having a sensitivity better than ± 1.0 gamma ($\pm 10^{-5}$ oersteds), *except* magnetometers having sensitivities not better than ± 0.1 gamma ($\pm 10^{-6}$ oersteds) where the reading rate capability is no faster than once per half-second;
 - (b) Magnetometer test facilities able to control magnetic field values to an accuracy of 1.0 gamma (10^{-5} oersteds) or less;
 - (c) Magnetic compensation systems utilising "digital computers", non-magnetic platforms and calibration systems;
- (For optical fibres, see Item 1526(c) and (d).)

Technical Notes:

1. Sensitivity is defined as the visually recognized minimum sinusoidal signal in the frequency range of 0.025 Hz to 1.5 Hz when signal-to-noise ratio is higher than 1.
2. The term "specially designed components therefor" is intended to include non-magnetic pumping lamps and heating coils, cryogenic magnetic componentry, enhanced resonance gases, and any form of dynamic signal-processing gradient compensation provided as part of, or designed for use with, magnetometers embargoed by this Item. Enhanced resonance gases are gases of isotopes of cesium, rubidium and other metals which exhibit very sharp bands of response to pumping frequencies in optically pumped magnetometers.
3. Magnetometer systems use magnetic sensors, including those designed to operate at cryogenic temperatures, compensation systems, displays, recorders and associated electronics for signal processing, target parameter detection, gradient compensation and dynamic range control.

1572

Recording or reproducing equipment, "recording media" and technology, as follows, and specially designed components, accessories and "software" therefor:

NOTE:

For equipment which may be used in conjunction with electronic computers, see Item 1565.

(a) Recording or reproducing equipment using magnetic techniques, *except:*

- (i) When specially designed for:
 - (1) Audio programmes on tape or disk;
 - (2) Analogue recording or reproducing of video programmes on tape or disk; *or*

NOTE:

This does not apply to magnetic heads mounted on servomechanisms which include piezoelectric transducers and have a gap width less than 0.75 micrometre (29.5 microinches); *or*

N.B.:

Gap width is the dimension of the gap parallel to the relative movement between tape and head.

- (3) Digital reproducing (i.e., play-back only) of video programmes from tape or disk;
- (ii) When specially designed to use magnetic card, tag, label or bank cheque "recording media" with a magnetic surface area not exceeding 85 cm² (13 sq. ins.);
- (iii) Analogue magnetic tape recorders having all of the following characteristics:
 - (a) Bandwidth at maximum speed not exceeding 300 kHz per track;
 - (b) "Recording density" not exceeding 2,000 magnetic flux sine waves per linear cm (5,080 magnetic flux sine waves per linear inch) per track;
 - (c) Not including recording or reproducing heads designed for use in equipment with characteristics superior to those defined in (a) or (b) above;
 - (d) Tape speed not exceeding 155 cm per second (61 inches per second);
 - (e) Number of recording tracks (excluding audio voice track) not exceeding 28;
 - (f) Start-stop time not less than 25 ms;
 - (g) Equipped with tape-derived (off-tape) servo speed control and with a time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of no less than ± 5 microsecond;
 - (h) Using only direct or FM recording;
 - (i) Not ruggedised for military use;
 - (j) Not rated for continuous operation in ambient temperatures from below 233 K (-40°C) to above 328 K (55°C); *and*
 - (k) Not specially designed for underwater use;

N.B.:

Analogue instrumentation recording equipment permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module) and having all the characteristics in sub-item (a)(iii) above are not embargoed by this Item.

- (iv) Digital recording or reproducing equipment having all of the following characteristics:
 - (a) Cassette/cartridge tape drives or magnetic tape drives which do not exceed:
 - (1) A "maximum bit packing density" of 131 bits per mm (3,300 bits per inch) per track; *or*
 - (2) A "maximum bit transfer rate" of 2.66 million bits per second;
 - (b) Not ruggedised for military use;
 - (c) Not specially designed for underwater use; *and*
 - (d) Not rated for continuous operation in ambient temperatures from below 233 K (-40°C) to above 328 K (55°C);
- (b) Recording or reproducing equipment using laser beams, which produce patterns or images directly on the recording surface or reproduce from such surfaces, *except:*
 - (i) When specially designed for the production of audio or video disk masters for the replication of entertainment- or education-type disks;
 - (ii) Facsimile equipment such as used for commercial weather imagery and commercial wire photos and text;
 - (iii) Consumer-type reproducers for audio or video disks employing non-erasable media; *or*

(iv) When specially designed for gravure (printing plate) manufacturing;

(c) Graphics instruments capable of continuous direct recording of sine waves at frequencies exceeding 20 kHz;

(d) "Recording media" used in equipment embargoed by (a) or (b) above, *except:*

- (i) Magnetic tape having all of the following characteristics:
 - (a) Specially designed for television recording and reproduction or for instrumentation;
 - (b) Being a standard commercial product;
 - (c) Not designed for use in satellite applications;
 - (d) Been in use in quantity for at least two years;
 - (e) A tape width not exceeding 25.4 mm (1 inch);
 - (f) A magnetic coating thickness not less than:
 - (1) 2.0 micrometres (0.079 mil) if the tape length does not exceed 1,450 m (4,760 feet); *or*
 - (2) 5.0 micrometres (0.1975 mil) if the tape length does not exceed 6,000 m (19,710 feet);
 - (g) A magnetic coating material consisting of doped or undoped gamma-ferric oxide or chromium dioxide;
 - (h) A base material consisting only of polyester;
 - (i) A rated intrinsic coercivity not exceeding 64 kA/m (804 oersted); *and*
 - (j) A retentivity not exceeding 0.16 T (1,600 gauss);
- (ii) Magnetic tape having all of the following characteristics:
 - (a) Specially designed for television recording and reproduction or for instrumentation;
 - (b) Being a standard commercial product; *and*
 - (c) Having either of the following sets of characteristics:
 - (1) (i) A tape width not exceeding 50.8 mm (2 inches);
 - (ii) Not designed for use in satellite applications;
 - (iii) Been in use in quantity for at least two years;
 - (iv) A magnetic coating material consisting of doped or undoped gamma-ferric oxide or chromium dioxide;
 - (v) A rated intrinsic coercivity not exceeding 64 kA/m (804 oersted); *and*
 - (vi) A tape length not exceeding 1,096 m (3,600 feet); *or*
 - (2) (i) A tape width not exceeding 25.4 mm (1 inch);
 - (ii) A magnetic coating material consisting of chromium dioxide;
 - (iii) A base material consisting only of polyester; *and*
 - (iv) A rated intrinsic coercivity not exceeding 60 kA/m (750 oersted);
- (iii) Video or audio magnetic tape in cassette having all of the following characteristics:
 - (a) Specially designed for television or audio recording and reproduction;
 - (b) Being a standard commercial product;
 - (c) A rated intrinsic coercivity not exceeding 120 kA/m (1,500 oersted);
 - (d) A retentivity not exceeding 0.30 T (3,000 gauss);
 - (e) A tape length not exceeding 550 m (1,805 feet); *and*
 - (f) A magnetic coating thickness not less than 2.0 micrometres (0.079 mil);
- (iv) Computer magnetic tape having all of the following characteristics:
 - (a) Designed for digital recording and reproduction;
 - (b) A magnetic coating certified for a maximum "packing density" of 2,460 bits per cm (6,250 bits per inch) or 3,560 flux changes per cm (9,042 flux changes per inch) along the length of the tape;
 - (c) A magnetic coating thickness not less than 3.6 micrometres (0.142 mil);
 - (d) A tape width not exceeding 25.4 mm (1 inch);
 - (e) A tape length not exceeding 1,100 m (3,609 feet);
 - (f) Been in civil use for at least two years; *and*
 - (g) The base material consists only of polyester;
- (v) Computer flexible disk cartridges having both of the following characteristics:
 - (a) Designed for digital recording and reproduction; *and*
 - (b) Not exceeding a "gross capacity" of 17 million bits;
- (vi) Rigid magnetic disk "recording media" having all of the following characteristics:
 - (a) Being a standard commercial product;
 - (b) Non servo-written;
 - (c) A "packing density" not exceeding 866 bits per cm (2,200 bits per inch);

- (d) Not exceeding 80 tracks per cm (200 tracks per inch); *and*
- (e) Conforming to any of the following specifications:
 - (1) Unrecorded single disk cartridges (front loading (2315-type)) designed to meet ANSI X3.52-1976;
 - (2) Unrecorded single disk cartridges (top loading (5440-type)) designed to meet ISO 3562-1976;
 - (3) Unrecorded six-disk packs (2311 type) designed to meet ANSI X3.46-1974 or ISO 2864-1974(E); *or*
 - (4) Unrecorded eleven-disk packs (2316 type) designed to meet ANSI X3.58-1977 or ISO 3564-1976;
- (e) Technology for the development, production or use of recording or reproducing equipment described in this Item, *except*:
 - (i) Technology which is unique to equipment released under sub-items (a)(i)(1), (a)(i)(2) or (a)(ii), (b) or (c) above;

NOTE:

This does not apply to technology for the design or production of:

- (a) Cylindrical structures used to record or reproduce video signals in a helical scan system recorder or reproducer, *and*
- (b) Recorded alignment tapes used in the production of recording or reproducing equipment.
- (ii) The minimum technology necessary for the use of equipment which may be exported under the provisions of this Item.
- (f) Technology for continuous coating of magnetic tape described in this Item as follows:
 - (1) Technology for the formulation of coating material;
 - (2) Technology for the application of coating material to the backing;
- (g) Technology for the manufacture of flexible disk "recording media" described in this Item as follows:
 - (1) Technology for the formulation of coating material;
 - (2) Technology for the application of coating material to the flexible backing;
- (h) Technology for the development or production of rigid disk "recording media" described in this Item.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of:
 - (a) Analogue magnetic tape recorders:
 - (1) Embargoed by sub-item (a)(iii)(h); *or*
 - (2) Equipped with tape-derived (off-tape) servo speed control and with a time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of no less than ± 1.0 microsecond;
 - (b) Systems having all of the following characteristics:
 - (1) Designed for use in civil aircraft or helicopters to record flight data for safety or maintenance purposes;
 - (2) Been in normal civil use for more than one year;
 - (3) No more than 100 input channels; *and*
 - (4) A sum of the individual channel recording bandwidth not exceeding 500 Hz;
 - (c) Incremental recorders or reproducers having all of the following characteristics:
 - (1) Designed for discontinuous sampling or collection of data in an incremental manner;
 - (2) The maximum tape speed, at the maximum stepping rate, does not exceed 50.8 mm (2 inches) per second;
 - (3) Not ruggedised for military use;
 - (4) Not rated for continuous operation in ambient temperatures from below 233 K (-40°C) to above 328 K (55°C);
 - (5) Not specially designed for underwater use; *and*
 - (6) Not including recording or reproducing heads designed for use in equipment with characteristics superior to those defined in (a)(1) or (a)(2) above;
 - (d) Digital magnetic recorders having both of the following characteristics:
 - (1) Specially designed for seismic or geophysical applications; *and*
 - (2) Operating in the frequency range from 5 Hz to 800 Hz.
2. Governments may permit, as administrative exceptions, the shipment of computer tape in cassettes or cartridges having all of the following characteristics:
 - (a) Designed for digital recording and reproduction;

- (b) A magnetic coating certified for a "packing density" of 3,940 bits per cm (10,008 bits per inch) along the length of the tape;
- (c) A tape width not exceeding 2.54 cm (1 inch);
- (d) A tape length not exceeding 1,100 m (3,608 feet); *and*
- (e) In civil use for at least two years.
- 3. Governments may permit, as administrative exceptions, the shipment of magnetic tape embargoed by sub-item (d) above having all of the following characteristics:
 - (a) Intended for being put into cassettes or cartridges under a commercial agreement;

N.B.:

Tape exported under this Note is used only for insertion into cassettes or cartridges specially designed for television or audio recording or reproduction.

- (b) Being a standard commercial product;
- (c) Not designed for use in satellite applications;
- (d) Been in use in quantity for at least two years;
- (e) A tape width not exceeding 25.4 mm (1 inch);
- (f) A magnetic coating thickness not less than 2 micrometres (0.079 mil);
- (g) A magnetic coating material consisting of doped or undoped gamma-ferric oxide;
- (h) A base material consisting only of polyester;
- (i) A rated intrinsic coercivity not exceeding 64 kA/m (804 oersted);
- (j) A retentivity not exceeding 0.16 T (1,600 gauss); *and*
- (k) A tape length not exceeding 6,500 m (21,320 feet).
- 4. Governments may permit, as administrative exceptions, the shipment of reasonable quantities of magnetic tape embargoed by sub-item (d) above, having all of the following characteristics:
 - (a) It is for use in civil television recording and reproducing applications;
 - (b) The magnetic coating material consists of undoped gamma-ferric oxide;
 - (c) The rated intrinsic coercivity not exceeding 28 kA/m (350 oersted);
 - (d) The tape width not exceeding 50.8 mm (2 inches); *and*
 - (e) A base material consisting only of polyester.
- 5. Governments may permit, as administrative exceptions, the shipment of reasonable quantities of analogue magnetic tape recorders embargoed by sub-item (a) above, and specially designed components and "recording media" thereof embargoed by sub-item (d) above, for use with those recorders, provided:
 - (a) The equipment is for a legitimate civil end-use and is reasonable for that use;
 - (b) Not used;
 - (c) The analogue magnetic tape recorders are limited as follows:
 - (1) Characteristics not superior to those defined in Note 1(a)(1) to (9);
 - (2) Equipped with tape derived (off-tape) servospeed control and with a time displacement (base) error of not less than ± 0.8 microsecond at a tape speed of 152.4 cm (60 inches) per second and not less than ± 1.6 microsecond at any lower tape speed measured in accordance with applicable IRIG and EIA documents.
- 6. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of recording and reproducing equipment, as follows:
 - (a) Graphic instruments capable of continuous direct recording of sine waves at frequencies exceeding 20 KHz, and not containing a cathode ray tube with a fibre optic face plate;
 - (b) Analogue magnetic tape recorders with all the following characteristics:
 - (1) Bandwidth of up to:
 - (i) 4 MHz per track and having up to 28 tracks; *or*
 - (ii) 2 MHz per track and having up to 42 tracks;
 - (2) Tape speed of 610 cm per second or less;
 - (3) Not designed for underwater use;
 - (4) Not ruggedised for military use; *and*
 - (5) Recording density not exceeding 6,532 magnetic flux sine waves per cm;
 - (c) Instrumentation digital recorders having all of the following characteristics:
 - (1) "Packing density" of 13,125 bits per cm or less;
 - (2) Maximum of 28 tracks;
 - (3) Tape speed of 305 cm per second or less;
 - (4) Not designed for underwater use; *and*
 - (5) Not ruggedised for military use;

- (d) Magnetic tape appropriate for use with magnetic tape recorders free from embargo or exportable under this Note or under any other Item providing administrative exceptions treatment for exports to the People's Republic of China, provided the tape length, "packing density" and "recording density" do not exceed the performance limits of the magnetic tape recorders;
- (e) Disks appropriate for use with disk drives free from embargo or exportable under this Note or under any other Item providing administrative exceptions treatment for exports to the People's Republic of China, provided the "packing density" and inner and outer diameters do not exceed the performance limits of the disk drives;
- (f) Video magnetic tape recorders specially designed for television recording.

7. Definition of terms used in this Item:

"Recording media"—

All types and forms of specialised media used in recording techniques, including but not limited to tapes, drums, disks and matrices.

"Recording density" for direct recorders—

The recording bandwidth divided by the tape speed.

"Recording density" for FM recorders—

The sum of the carrier frequency and the deviation divided by the tape speed.

"Packing density" for digital recorders—

The number of bits per second per track divided by the tape speed.

N.B.:

For the definition of the terms related to "digital computers" or "software", see Items 1565 or 1566.

NOTE:

Forms of removable media other than tape (e.g., removable disk packs) not released by sub-item (d)(vi) are nevertheless considered to be free from embargo when shipped in reasonable quantities in conjunction with electronic computers under the provisions of Item 1565.

1573

Superconductive electromagnets and solenoids, as follows:

- (a) Those which have a non-uniform distribution of current-carrying windings, measured along the axis of symmetry when specially designed for gyrotron applications, *except* those rated for both:
- (1) Magnetic induction of less than 1 T; *and*
 - (2) "Overall current density" in the windings of less than 10,000 A/cm²;
- (b) Those which are specially designed to be fully charged or discharged in less than one minute, provided:
- (1) The maximum energy delivered during discharge divided by the duration of the discharge is more than 500 kJ per minute;
 - (2) The inner diameter of the current-carrying windings is more than 6 cm; *and*
 - (3) They are rated for magnetic induction of more than 8 T or "overall current density" in the windings of more than 10,000 A/cm².

Technical Note:

"Overall current density" is defined as the total number of ampere-turns in the coil (i.e. the sum of the number of turns multiplied by the maximum current carried by each turn) divided by the total cross-section of the coil (comprising the superconducting filaments, the metallic matrix in which the superconducting filaments are embedded, the encapsulating material, any cooling channels, etc.).

1574

Electronic devices, circuits or systems containing components manufactured from "superconductive" materials, as follows:

- (a) Specially designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents; *and*
- (b) Performing functions such as:
- (1) Electromagnetic sensing and amplification;
 - (2) Current switching;
 - (3) Frequency selection; *or*
 - (4) Electromagnetic energy storage at resonant frequencies above 1 MHz.

NOTE:

This Item includes Josephson-effect devices and superconducting quantum interference devices (squids).

Technical Notes:

1. "Superconductive" materials (i.e., metals, alloys or compounds) which can lose all electrical resistance (i.e., which can attain infinite electrical conductivity and carry very large electrical currents without Joule heating).

N.B.:

The "superconductive" state of a material is individually characterised by a "critical temperature", a critical magnetic field, which is a function of temperature, and a critical current density, which is a function of both magnetic field and temperature.

2. "Critical temperature" (sometimes referred to as the transition temperature) of a specific "superconductive" material — the temperature at which the material loses all resistance to the flow of direct current.

1585

Cameras, components and photographic recording media therefor, as follows:

(For cameras operating at below 190 nm (ultra-violet) or above 1,200 nm (infrared), see Item 1502.)

(For cameras specially designed or modified for underwater use, see Item 1417.)

- (a) High speed cinema recording cameras and equipment as follows:
- (1) Cameras in which the film is continuously advanced throughout the recording period, and which are capable of recording at framing rates exceeding 13,150 frames per second, using any camera and film combination from the standard 8 mm to the 90 mm size inclusive;
 - (2) Special optical or electronic devices which supplement, replace or are interchangeable with standard camera components for the purpose of increasing the number of frames per second exceeds the limits in (a)(1) above;
- (b) Mechanical high speed cameras in which the film does not move, and which are capable of recording at rates exceeding 1,000,000 frames per second for the full framing height of standard 35 mm wide photographic film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;
- (c) Cameras incorporating electron tubes embargoed by Item 1555, *except* television or video cameras specially designed for television broadcasting use;
- (d) Mechanical or electronic streak cameras having writing speeds of 10 mm/microsecond and above;
- (e) Electronic framing cameras having a speed exceeding 10⁶ frames per second;
- (f) Video cameras incorporating solid state sensors, having any of the following characteristics:
- (1) More than 4 × 10⁶ "active pixels" per solid state array for monochrome (black and white) cameras;
 - (2) More than 4 × 10⁶ "active pixels" per solid state array for colour cameras incorporating three solid state arrays; *or*
 - (3) More than 12 × 10⁶ "active pixels" for solid state array colour cameras incorporating one solid state array;

NOTE:

The camera output in each case is thereby limited to 4×10^6 resolvable elements excluding colour information.

Technical Note:

"Active pixel"—A minimum element of the solid state array (sensor) which has a photoelectric transfer function and which is exposed to the light.

- (g) Electronic cameras having both of the following characteristics:
- (1) An electronic shutter speed (gating capability) of less than 10 microseconds per full frame; *and*
 - (2) A read out time allowing a framing rate of more than 125 full frames per second;
- (h) Camera shutters with speeds of 50 ns or less per operation, and specialised parts and accessories therefor;
- (i) Film, as follows:
- (1) Having a speed of ISO 10,000 (or its equivalent) or better;
 - (2) Colour film having a spectral sensitivity extending beyond 7,200 Angströms or below 2,000 Angströms;
- (j) Cameras incorporating:
- (1) Linear detector arrays exceeding a size of 4,096 elements per array; *and*
 - (2) Mechanical scanning in one direction.

NOTES:

1. Not used.
2. Not used.
3. Governments may permit, as administrative exceptions, the shipment of cameras embargoed only by sub-item (j) above provided:
 - (a) They are intended for civil end-uses and civil end-users; *and*
 - (b) They do not contain linear detector arrays exceeding a size of 8,192 elements per array.
4. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of:
 - (a) Non-ruggedised cinema recording cameras, embargoed by sub-item (a), for normal civil purposes;
 - (b) Mechanical framing cameras embargoed by sub-item (b) which are designed for civil purposes (i.e., non-nuclear use) with a framing speed of not more than 2×10^6 frames per second.

1586**Acoustic wave devices, as follows, and specially designed components therefor:**

- (a) Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e. signal-processing devices employing elastic waves in materials, including but not limited to lithium niobate, lithium tantalate, bismuth germanium oxide, silicon, quartz, zinc oxide, aluminium oxide (sapphire), gallium arsenide and alpha-aluminium phosphate (berlinite)), which permit direct processing of signals, including but not limited to convolvers, correlators (fixed, programmable and memory), oscillators, bandpass filters, delay lines (fixed and tapped) and non-linear devices, having any of the following characteristics:
- (1) A carrier frequency of greater than 400 MHz;
 - (2) A carrier frequency of 400 MHz or less, *except* those specially designed for home electronics and entertainment type applications, having any of the following characteristics:
 - (i) A side-lobe rejection of greater than 45 dB;
 - (ii) A product of the maximum delay time and the bandwidth (time in microseconds and bandwidth in MHz) greater than 100;
 - (iii) A dispersive delay of greater than 10 microseconds;
 - (iv) An insertion loss of less than 10 dB;
- (b) Bulk (volume) acoustic wave devices (i.e. signal processing devices employing elastic waves in the various materials described in (a) above) which permit direct processing of signals at frequencies over 1 GHz, including but not limited to, fixed delay lines, non-linear and pulse compression devices.
- (c) Acousto-optic signal-processing devices employing an interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including but not limited to spectral analysis, correlation or convolution.

Technical Note:

This sub-item embargoes devices made from acousto-optic materials, including but not limited to lithium niobate, bismuth germanium oxide, bismuth silicon oxide, gallium arsenide, gallium phosphide, tellurium oxide and lead molybdenate.

NOTE:

Governments may permit, as administrative exceptions, the shipment of the following devices embargoed by sub-item (a)(1) which are specially designed for civil applications and which operate at frequencies below 1 GHz:

- (a) Devices for civil television equipment;
- (b) Devices for video or AM and FM broadcasting equipment;
- (c) Non-reprogrammable devices for pagers, cellular radio communication equipment, automobile radio communication equipment or cordless telephone sets.

1587**Quartz crystals and assemblies thereof in any stage of fabrication (i.e., worked, semi-finished or mounted), as follows:**

- (a) For use as filter elements, and having either of the following characteristics:
- (1) Designed for operation over a temperature range exceeding 125°C; *or*
 - (2) Crystals or assemblies of crystals which use the trapped energy phenomenon and which have more than four series or parallel resonances on a single quartz element;
- (b) For use as oscillator elements specially designed for temperature-controlled crystal ovens or for TCXOs covered by (c) below, and having an average aging rate of $\pm 1 \times 10^{-9}$ per day or better (less);

NOTE:

Aging rate shall be measured over a longer period at a constant temperature of 333 K (+2 K) or higher.

- (c) Temperature-compensated crystal oscillators (TCXO) having any of the following characteristics:
- (1) A stability with respect to temperature of better (less) than $\pm 1.0 \times 10^{-7}$ over an operating temperature range exceeding 700°C;
 - (2) An operating temperature range exceeding 120°C;
 - (3) Rated to have an acceleration sensitivity of less than 1×10^{-9} of the operating frequency per g (where $g = 9.81 \text{ m/sec}^2$) over a vibration test frequency range from 10 to 2,000 Hz sine wave and with a maximum level of acceleration not exceeding 20 g;
 - (4) Designed to withstand a shock greater than 10,000 g over a period of 1 ms;
 - (5) Radiation hardened to better (less) than 10^{-10} of the operating frequency per gray (1 rad = 10^{-2} gray).

NOTES:

1. This Item only embargoes quartz crystals having piezoelectric qualities. This Item does not embargo optical grade quartz crystals.
2. This Item does not embargo quartz crystals for use as filter elements which have either of the following characteristics:
 - (a) Designed for operation as intermediate frequency filters operating from 10.5 to 11 MHz or from 21 to 22 MHz with 3 dB bandwidths not exceeding 40 kHz; *or*
 - (b) Designed for operation as single side-band (SSB) filters operating from 1 to 10 MHz with 3 dB bandwidths not exceeding 4 kHz.
3. Notes 1 and 2 above do not permit the export of technology for quartz crystal elements or assemblies thereof.
4. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of the following:
 - (a) Temperature-compensated crystal oscillators (TCXOs) embargoed only by sub-item (c)(1);
 - (b) Quartz crystals for use as oscillator elements specially designed for temperature-controlled crystal ovens or for TCXOs covered by sub-item (c) and having an average aging rate of $\pm 1 \times 10^{-11}$ per day or better (less), *except* stress compensated (SC) cut crystals.

1595

Gravity meters (gravimeters), gravity gradiometers and specially designed components therefor, *except*:

- (a) Gravity meters for land use having any of the following characteristics:
 - (1) Static accuracies of not less than 100 microgal; *or*
 - (2) Being of the Worden type;
- (b) Marine gravimetric systems having any of the following characteristics:
 - (1) Static accuracies of 1 milligal or more; *or*
 - (2) An in-service (operational) accuracy of 1 milligal or more with a time to steady state registration of two minutes or greater under any combination of attendant corrective compensations and motional influences.

NOTE:

Nothing in this Item shall permit the export of technology or technical data associated with the design, manufacture or upgrading of equipment excluded from embargo by this definition, when such technology or technical data is also relevant to equipment embargoed by this definition.

Metals, Minerals and their Manufactures

NOTE:

See also "Chemicals" for some metal compounds.

1601

Inert gas and vacuum atomising technology to achieve sphericity and uniform size of particles in metal powders regardless of the type of metal and the embargo status of the powder.

1602

Pyrolytic deposition technology and specially designed components therefor, as follows:

- (a) Technology for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,573 K (1,300°C) to 3,173 K (2,900°C) temperature range at pressures of 133.3 Pa to 19,995 kPa (including the composition of precursor gases, flow rates and process control schedules and parameters);
- (b) Specially designed nozzles for the above processes.

1631

Magnetic metals of all types and of whatever form, having one or more of the following characteristics:

- (a) Initial permeability: 0.15 henry/m (120,000 gauss/oersted) or more calculated at induction 0 and magnetic field strength 0 or the equivalent;

NOTE:

Measurement of initial permeability must be carried out on materials which:

- (a) Have a thickness between 0.076 mm (3 mil) and 2.54 mm (100 mil); *and*
- (b) Are fully annealed.
- (b) Remanence: 98.5% or over of maximum magnetic flux for materials having magnetic permeability;
- (c) Capable of an energy product of 200,000 J/m³ (25 × 10⁶ gauss/oersted) or more;

- (d) Grain-oriented iron alloy sheets or strips of a thickness of 0.1 mm (0.004 inch) or less;
- (e) Magnetostrictive alloys having either of the following characteristics:
 - (1) Saturation magnetostriction more than 5×10^{-4} ; *or*
 - (2) Magnetomechanical coupling factor (*k*) more than 0.8.
- (f) Amorphous alloy strips having both of the following characteristics:
 - (1) Composition having a minimum 75 weight % of one or more of the elements iron, cobalt and nickel; *and*
 - (2) Saturation magnetic induction (*B_s*) of 1.6 T or more, and either:
 - (i) Strip thickness of 0.020 mm (0.0008 inch) or less; *or*
 - (ii) Electrical resistivity of 2×10^{-4} ohm. cm or more.

1648

Cobalt-based alloys (i.e., containing a higher percentage by weight of cobalt than of any other element), as follows:

- (a) Dispersion strengthened containing more than 1% of oxides of thorium, aluminium, yttrium, zirconium or cerium; *or*
- (b) Containing 0.05% or more of scandium, yttrium, cerium, lanthanum, neodymium or praseodymium.

1661

Nickel-based alloys (i.e. containing a higher percentage by weight of nickel than of any other element), as follows:

- (a) Dispersion strengthened containing more than 1% of oxides of thorium, aluminium, yttrium, zirconium, cerium, or lanthanum;
- (b) Containing 0.05% or more of scandium, yttrium, cerium, lanthanum, neodymium or praseodymium;
- (c) Containing 10 weight % or more of aluminium in the form of nickel aluminide in crude or semi-fabricated forms and scrap thereof.

1672

Titanium-based alloys containing 12 weight % or more of aluminium in the form of titanium aluminide in crude or semi-fabricated forms and scrap thereof.

1675

"Superconductive" materials and composite conductors, as follows:

- (a) "Superconductive" materials of all types:
 - (1) Having a "critical temperature", at zero magnetic induction, of 9.85 K (-263.3°C) or higher; *and*
 - (2) In quantities of more than 25 g;
- (b) "Superconductive" niobium-titanium wire not embedded in a metallic matrix with a cross section area of less than 3.14×10^{-4} mm² (i.e., 20 micrometre diameter for circular filaments);
- (c) Composite conductors containing at least one "superconductive" constituent having a "critical temperature", at zero magnetic induction, of 9.3 K (-263.85°C) or higher, *except* those which:
 - (1) Have "superconductive" filaments embedded in a copper or copper-based mixture matrix; *and*
 - (2) Fulfil either of the two following sets of characteristics:
 - (A) The "superconductive" constituent or filament:
 - (a) Has a cross section area of more than 3.14×10^{-4} mm², i.e., 20 micrometre diameter for circular filaments;
 - (b) Is either non-coated or insulated with:
 - (1) Varnish;
 - (2) Glass fibre;
 - (3) Polyamide; *or*
 - (4) Polyimide; *and*

- (c) Does not remain in the "superconductive" state when:
- (1) Evaluated in sample lengths of less than 1 m; *and*
 - (2) Exposed to a magnetic field with an induction of more than 12 tesla at a temperature of 4.2 K (-268.95°C); *or*
- (B) The composite conductor contains:
- (a) "Superconductive" niobium-titanium wire with a cross section area of more than 9.5×10^{-5} mm², i.e., 11 micrometre diameter for circular filaments; *and*
 - (b) A total mass, i.e., including the mass of the matrix, not exceeding 10 kg.

Technical Notes:

1. "Superconductive"—

Materials (i.e. metals, alloys or compounds) which can lose all electrical resistance, i.e., which can attain infinite electrical conductivity and carry very large electrical currents without Joule heating.

N.B.:

The "superconductive" state of a material is individually characterised by a "critical temperature", a critical magnetic field, which is a function of temperature, and a critical current density which is, however, a function of both magnetic field and temperature.

2. "Critical temperature"—

"Critical temperature" (sometimes referred to as the transition temperature) of a specific "superconductive" material—the temperature at which the material loses all resistance to the flow of direct current.

Chemicals, Metalloids and Petroleum Products

NOTE:

See also "Metals, Minerals and their Manufactures" for some chemical compounds.

1702

Hydraulic fluids which contain as the principal ingredient(s), petroleum (mineral) oils, synthetic hydrocarbon oils, non-fluorinated silicones or fluorocarbons, and which have all of the following characteristics:

- (a) A flash point of greater than 477 K (204°C, 400°F);
- (b) A pour point of 239 K (-34°C, -30°F) or lower;
- (c) A viscosity index of 75 or greater; *and*
- (d) Thermally stable at 616 K (343°C, 650°F).

Technical Notes:

1. For the purpose of this Item, flash point is determined using the "Cleveland Open Cup Method" as shown in ASTM D-92, or national equivalents.
2. The following is the test procedure for determining thermal stability:
Twenty cc of the fluid under test shall be placed in a 46 cc type 317 stainless steel chamber containing one each of 0.25 cm (0.5 inch) (nominal) diameter balls of M-10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0.75% Sn). The chamber shall be purged with nitrogen, sealed at atmospheric pressure and the temperature raised to 644 ± 6 K ($371 \pm 6^\circ\text{C}$, $700 \pm 10^\circ\text{F}$) and maintained at this temperature 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 0.1 mg/sq. cm of ball surface (0.65 mg/sq. inch);
- (2) The change in original viscosity as determined at 38°C is less than 25% when measured in the centistokes system of units;
- (3) The total acid or base number is less than 0.40.

NOTE:

Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of reasonable quantities of hydraulic fluids embargoed by this Item to civil end-users, *except* hydraulic fluids containing:

- (a) Super-dewaxed refined mineral oil;
- (b) Non-fluorinated silicones (silica-hydrocarbons); *or*
- (c) Synthetic hydrocarbons (poly-alpha hydrocarbons).

1715

Boron, as follows:

- (a) Boron element (metal) in all forms;
- (b) Boron compounds, mixtures, and composites containing 5% or more of boron (*except* pharmaceutical specialities packaged for retail sale), as follows:
 - (1) Non-ceramic boron-nitrogen compounds (e.g. borazanes, borazines, and boropyrazoyls);
 - (2) Boron hydrides (e.g. boranes), *except* sodium boron hydride, potassium boron hydride, monoborane, diborane and triborane;
 - (3) Organoboron compounds, including metallo-organoboron compounds.

1733

Base materials, non-"composite" ceramic materials, ceramic-ceramic "composite" materials and precursor materials, as follows, for the manufacture of high temperature fine technical ceramic products:

- (a) Base materials having all the following characteristics:
 - (1) Any of the following compositions:
 - (A) Single or complex oxides of zirconium, and complex oxides of silicon or aluminium;
 - (B) Single or complex borides of zirconium;
 - (C) Single or complex borides of titanium;
 - (D) Single or complex carbides of silicon or boron; *or*
 - (E) Single or complex nitrides of silicon, boron, aluminium or zirconium;
 - (2) Total metallic impurities, excluding intentional additions, of less than:
 - (A) 1,000 ppm for single oxides or carbides; *or*
 - (B) 5,000 ppm for complex compounds, single borides or single nitrides; *and*
 - (3) Average particle size less than or equal to 5 micrometre and no more than 10% of the particles larger than 10 micrometre.

NOTE:

For zirconia, these limits are 1 micrometre and 5 micrometre respectively.

- (b) Non-"composite" ceramic materials in crude or semi-fabricated form composed of the materials embargoed by (a) above, *except* abrasives;
- (c) Ceramic-ceramic "composite" materials containing finely dispersed particles or phases or any non-metallic fibrous or whisker-like materials, whether externally introduced or grown in situ during processing, where the following materials form the host "matrix":
 - (1) All oxides, including glasses;
 - (2) Carbides or nitrides of silicon or boron;
 - (3) Borides or nitrides of zirconium or borides, carbides or nitrides of hafnium; *or*
 - (4) Any combination of the materials enumerated in (1) to (3) above.

NOTE:

This sub-item does not embargo manufactured products or components not embargoed by the International Lists.

1733 *continued*

- (d) Precursor materials, i.e., special purpose polymeric or metallo-organic materials, as follows, for producing any phase or phases of the materials embargoed by sub-items (b) or (c) above:
- (1) Polycarbosilanes and polydiorganosilanes (for producing silicon carbide);
 - (2) polysilazanes (for producing silicon nitride); *or*
 - (3) Polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components).

Technical Note:

"Matrix"—

A substantially continuous phase that fills the space between particles, whiskers or fibres.

"Composite"—

A "matrix" and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes.

(For carbon-carbon materials, see Item 1763.)

1746

Non-fluorinated polymeric substances, as follows, and manufactures thereof:

- (a) Polyimides (including maleimides);

NOTE:

This sub-item does not embargo fully cured polyimide or polyimide-based film, sheet, tape or ribbon having a maximum thickness of 0.254 mm (10 mils), whether or not coated or laminated with heat- or pressure-sensitive resinous substances of an adhesive nature, which contain no fibrous re-inforcing materials, and which have not been coated or laminated with carbon, graphite, metals or magnetic substances.

- (b) Polybenzimidazoles;
- (c) Aromatic polyamides, including heterocyclic aromatic polyamides characterized as aromatic owing to the presence of a benzene ring;
- (d) Polybenzothiazoles;
- (e) Polyoxadiazoles;
- (f) Polyphosphazenes (polyphosphonitriles);
- (g) Polystyrylpyridine (P.S.P.);
- (h) Thermoplastic liquid crystal copolyesters, as follows:
- (1) Ethylene copolyesters of terephthalic acid and parahydroxybenzoic acid, *except* manufactures thereof having both of the following characteristics:
 - (A) A tensile modulus of less than 15 GPa; *and*
 - (B) Specially designed for non-aerospace, non-electronic civil applications;
 - (2) Phenylene or biphenylene copolyesters of terephthalic acid and parahydroxybenzoic acid;
- (i) Polybenzoxazoles;
- (j) Aromatic polyether ether ketones (PEEK);
- (k) Butadiene polymers as follows:
- (1) Carboxyl terminated polybutadiene (CTPB);
 - (2) Hydroxyl terminated polybutadiene (HTPB);
 - (3) Thiol terminated polybutadiene (TTPB);
 - (4) Vinyl terminated polybutadiene (VTPB);
 - (5) Cyclised 1-2 polybutadiene;
 - (6) Mouldable copolymers of butadiene and acrylic acid;
 - (7) Mouldable terpolymers of butadiene, acrylonitrile and acrylic acid or any of the homologues of acrylic acid;
- (l) Carboxyl terminated polyisoprene.

NOTE:

This Item does not embargo manufactured articles where the value of the polymeric component together with materials embargoed by other Items is less than 50% of the total value of the materials used.

1754

Fluorinated compounds, materials and manufactures thereof, as follows:

- (a) Non-polymeric materials, as follows:

- (1) Dibromotetrafluoroethane, *except* when having a purity of 99.8% or less and containing at least 25 particles of 200 micrometres or larger in size per 100 ml;
 - (2) Perfluoroalkylamines;
- (b) Polymeric materials and intermediates, as follows, when unprocessed:
- (1) Polychlorotrifluoroethylene, oily and waxy modifications only;
 - (2) Fluoroelastomeric compounds composed of at least 95% of:
 - (A) A combination of two or more of the following monomers:
 - (a) Tetrafluoroethylene;
 - (b) Chlorotrifluoroethylene;
 - (c) Vinylidene fluoride;
 - (d) Hexafluoropropylene;
 - (e) Bromotrifluoroethylene;
 - (f) Iodotrifluoroethylene;
 - (g) Perfluoromethylvinylether; *and*
 - (h) Perfluoropropoxypropylvinylether;
 - (B) A copolymer of tetrafluoroethylene and propylene; *or*
 - (C) A terpolymer of tetrafluoroethylene, vinylidene fluoride and propylene;
 - (3) Polybromotrifluoroethylene;
 - (4) Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;
 - (5) Fluorinated silicone rubber, and intermediates for their production, containing 30% or more of combined fluorine;
 - (6) Fluorinated polyimides, and hexafluoroacetone and other intermediates for their production, containing 30% or more of combined fluorine;
 - (7) Fluorinated phosphazene elastomers, and intermediates for their production, containing 30% or more of combined fluorine;
- (c) Manufactures, as follows:
- (1) Greases, lubricants and dielectric fluids, damping fluids and flotation fluids made of at least 85% of any of the materials in (a) or (b) above, *except* greases and lubricants made from polyperfluoroalkylethers (See Item 1781(a));
 - (2) Electric wire and cable coated with or insulated with any of the materials in (b)(2) above, *except* oil well logging cable;
 - (3) Seals, gaskets, rods, sheets, sealants or fuel bladders made of more than 50% of any of the materials in (b)(2), (b)(5), (b)(6) or (b)(7) above, specially designed for aerospace or aircraft use;
 - (4) Piezoelectric polymers and copolymers made from vinylidene fluoride having both of the following characteristics:
 - (A) In sheet or film form; *and*
 - (B) With a thickness of more than 200 micrometres;
 - (5) Reinforced tubing (including connectors and fittings for use with such tubing) incorporating coagulated dispersion grades of polytetrafluoroethylene, copolymers of tetrafluoroethylene and hexafluoropropylene, or any of the fluorocarbon materials embargoed by (b)(2) above and designed for operating (working) pressures of 21 MPa (3,000 psi) or more, whether or not specially processed to make the flow surfaces electrically conductive.

(For hydraulic fluids using these elements, see also Item 1702.)

NOTE:

This Item does not embargo the shipment of up to 19 litres (5 US gallons) of polychlorotrifluoroethylene-based lubricating oils. Nothing in this Note permits the export of technology.

1755

Silicone fluids and greases, as follows:

- (a) Fluorinated silicone fluids, *except* those with kinematic viscosity of 5,000 centistokes or higher, measured at 25°C;
- (b) Silicone and fluorinated silicone lubricating greases capable of operating at temperatures of 478 K (205°C, 400°F) or higher and having a drop point (method of test being ASTM D 2265) of 493 K (220°C, 428°F) or higher.

(For hydraulic fluids using these elements, see also Item 1702.)

Compounds and materials, as follows:

- (a) Monocrystalline silicon, *except*:
- (i) Metallurgical-grade monocrystalline silicon having a purity not better than 99.97%; *or*
 - (ii) Monocrystalline silicon having a purity not better than 99.999% and containing at least 0.5 part in 10^6 each of iron, carbon, boron and phosphorus, plus other impurities.

NOTE:

Favourable consideration may be given to N-type 1-1-1 silicon wafers or slices with a resistivity of 50 ohm.cm or less, based on volume or frequency of shipments.

- (b) Gallium of a purity equal to or greater than 99.9999% and gallium III/V compounds of any purity level, *except*:
- (i) Gallium phosphide; *or*
 - (ii) Other gallium III/V compounds having a dislocation density (etch pit density—EPD) greater than 500,000 per cm^2 ;

NOTE:

Governments may permit, as administrative exceptions, the shipment of gallium III/V compounds intended for light-emitting diodes and having all of the following characteristics:

- (a) Dislocation density (etchpit density—EPD) greater than 10,000 per cm^2 ;
 - (b) Carrier concentration greater than 1×10^{17} per cm^3 ; *and*
 - (c) Carrier mobility less than 3,000 $\text{cm}^2/\text{V.s}$;
- (c) Indium of a purity greater than 99.9995% and III-V indium compounds containing more than 1% indium;
- (d) Hetero-epitaxial materials consisting of a monocrystalline insulating substrate epitaxially layered with silicon, compounds of gallium or compounds of indium;
- (e) Elemental Cd and Te of purity levels equal to or more than 99.9995% and CdTe compounds of a purity level equal to or more than 99.99% or single crystals of CdTe of any purity level;
- (f) Polycrystalline silicon, *except* polycrystalline silicon having a purity not better than 99.99% and containing at least 0.5 part in 10^6 each of iron, carbon, boron and phosphorus, plus other impurities;
- (g) Compounds having a purity level based upon the amount of the primary constituent of 99.5% or better and used in the synthesis of the materials embargoed by sub-item (f) above, or used as the silicon source in the deposition of epitaxial layers of silicon, silicon oxide or silicon nitride;

NOTE:

SiCl_2H_2 is embargoed by this sub-item when having a purity level of 97.0% or better.

- (h) Single crystal sapphire substrates;
- (i) B_2O_3 with a purity of 99.9% or greater, containing 1,000 parts per million of H_2O or less, in powder or cast form;
- (j) Monocrystalline germanium with a resistivity greater than 100 ohm.cm;
- (k) Resist materials as follows:
 - (1) Negative resists whose spectral response has been adjusted for use below 350 nanometres;
 - (2) All positive resists;
 - (3) All resists for use with E-beams or ion beams with a sensitivity of 100 microcoulomb/ cm^2 or better;
 - (4) All resists for use with X-rays with a sensitivity of 500 mJ/cm^2 or better; *or*
 - (5) All resists specified or optimised for dry development;
- (l) Single-crystal forms of bismuth germanium oxide having piezoelectric properties and single-crystal forms of lithium niobate, of lithium tantalate and of aluminium phosphate.
- (m) Metal-organic or hydride compounds of beryllium and magnesium (Group II A), zinc, cadmium and mercury (Group II B), aluminium, gallium and indium (Group III A), phosphorus, arsenic and antimony (Group V A) and selenium and tellurium (Group VI A) having a purity (metal basis) of 99.999% or better.

NOTE:

Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of:

- (a) Silicon, compounds and materials, as follows:
- (1) Monocrystalline silicon, N-type, crystal orientation 1-1-1 with a resistivity not exceeding 100 ohm.cm;

- (2) Monocrystalline silicon, P-type, crystal orientation 1-1-1 with a resistivity not exceeding 5 ohm.cm;
 - (3) Polycrystalline silicon;
 - (4) Compounds used in the synthesis of polycrystalline silicon;
- (b) Positive resists with a spectral response not optimised for use below 365 nm and not embargoed by sub-items (k)(3), (k)(4) or (k)(5).

1759

"Syntactic foam" for underwater use and microspheres, as follows:

- (a) "Syntactic foam" as follows:
- (1) Designed for marine depths exceeding 1,000 m; *or*
 - (2) With a density less than 0.561 g/cm^3 (35 lb/cu ft) *except* that designed for use at marine depths less than 100 m;
- (b) Hollow microspheres (microballoons), having all of the following characteristics, for use in "syntactic foam":
- (1) Made from glass or plastic;
 - (2) A true particle density of more than 0.16 g/cm^3 (10 lb/cu ft) and less than 0.41 g/cm^3 (26 lb/cu ft);
 - (3) A bulk density of more than 0.088 g/cm^3 (5.5 lb/cu ft) and less than 0.23 g/cm^3 (14.4 lb/cu ft);
 - (4) A compressive strength more than 2.8 MPa (400 psi);
 - (5) A particle size range of 20 to 200 micrometre; *and*
 - (6) A floater content of at least 94% by volume.

Technical Note:

"Syntactic foam"—

For the purposes of this Item—hollow spheres of plastic or glass embedded in a resin matrix.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of "syntactic foam" embargoed by sub-item (a) above, provided it fulfills any of the following sets of conditions:
 - (a) The "syntactic foam" is:
 - (1) Designed for use at depths not exceeding 200 m;
 - (2) To be used in unembargoed manned autonomous underwater vehicles; *and*
 - (3) To be installed by the supplier;
 - (b) The "syntactic foam" is:
 - (1) Designed for use at depths not exceeding 300 m *and*
 - (2) Shaped or pre-shaped and to be used in civil offshore drilling or production equipment; *or*
 - (c) The "syntactic foam" is:
 - (1) Designed for use at depths not exceeding 300 m;
 - (2) To be used in unembargoed underwater device other than manned autonomous underwater vehicles; *and*
 - (3) To be installed by the supplier.
2. Governments may permit, as administrative exceptions, the shipment of microspheres embargoed by sub-item (b) above, for civil uses other than underwater applications.

1763

"Fibrous and filamentary materials" which may be used in organic "matrix", metallic "matrix" or carbon "matrix" "composite" structures or laminates, and such "composite" structures and laminates and technology therefor, as follows, and "specially designed software" therefor:

- (a) "Fibrous and filamentary materials" with "specific modulus" exceeding 4×10^6 m (1.57×10^8 in) and "specific tensile strength" exceeding 7.62×10^4 m (3×10^6 in);
- (b) "Fibrous and filamentary materials" having both of the following characteristics:
- (1) "Specific modulus" exceeding 2.54×10^6 m (1×10^8 in); *and*
 - (2) Melting or sublimation point higher than 1,922 K (1,649°C) in an inert environment, *except*:
 - (A) Carbon fibres having a specific modulus less than 5.08×10^6 m (2×10^8 in) and a "specific tensile strength" less than 2.54×10^4 m (1×10^6 in);

- (B) Discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random mat form, containing 3% by weight or more silica, having a "specific modulus" less than 10×10^6 m (3.92×10^8 in);
- (C) Molybdenum and molybdenum alloy fibres;
- (c) Resin or pitch-impregnated fibres (prepregs), metal or carbon-coated fibres (preforms) or "carbon fibre preforms" made with materials embargoed by sub-items (a) or (b) above;
- (d) "Composite" structures, laminates and manufactures thereof for products and components made either with an organic "matrix", a carbon "matrix" or a metal "matrix" utilising materials embargoed by sub-items (a), (b) or (c) above;

NOTE:

This sub-item does not embargo manufactured products or components not embargoed by Group 1, 2 or 3.

- (e) Technology for "fibrous and filamentary materials" and for "composite" structures and laminates as follows:
- (1) Technology which is unique to the spinning and subsequent treatment of precursor materials into fibres specially designed for processing into carbon filamentary materials embargoed by sub-items (a) or (b) above;
 - (2) Technology for the production of "fibrous and filamentary materials" embargoed by sub-items (a) or (b) above;
 - (3) Technology for the production of prepregs embargoed by sub-item (c) above using pressure impregnation or chemical vapour deposition, and for preforms by sub-item (c) above using vacuum or pressure impregnation or chemical vapour deposition;
 - (4) Technology for the development and production of "composite" structures, laminates and manufactures embargoed by sub-item (d) above; *or*
 - (5) Technology for any of the following rigidisation and densification processes, specially designed for the manufacture of carbon-carbon "composite" materials:
 - (A) Impregnation, infiltration or deposition into "carbon fibre preforms";
 - (B) Carbonisation;
 - (C) Graphitisation; *or*
 - (D) Hot isostatic pressing.

Technical Notes:

1. The term "fibrous and filamentary materials" includes:
 - (a) Continuous monofilaments;
 - (b) Continuous yarns and rovings;
 - (c) Tapes, fabrics, random mats and braids;
 - (d) Chopped fibres, staple fibres and coherent fibre blankets;
 - (e) Whiskers, either monocrystalline or polycrystalline, of any length; *and*
 - (f) Aromatic polyamide pulp.
2. "Specific modulus"—
Young's modulus in pascals, equivalent to N/m^2 (lbs force/in²) divided by specific weight in N/m^3 (lbs force/in³), measured at a temperature of (296 ± 2) K (23 ± 2)°C and a relative humidity of $(50 \pm 5)\%$.
3. "Specific tensile strength"—
Ultimate tensile strength in pascals, equivalent to N/m^2 (lbs force/in²) divided by specific weight in N/m^3 (lbs force/in³) measured at a temperature of (296 ± 2) K (23 ± 2)°C and a relative humidity of $(50 \pm 5)\%$.
4. "Carbon fibre preform"—
An ordered arrangement of uncoated or coated fibres intended to constitute a framework of a part before the "matrix" is introduced to form a "composite".
5. "Matrix"—
A substantially continuous phase that fills the space between particles, whiskers or fibres;

6. "Composite"—

A "matrix" and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes.

NOTES:

1. For equipment used for the production of materials embargoed by this Item, see Items 1312 and 1357.
2. For coating technologies, see Items 1389 and 1602.
3. Not used.
4. Nothing in the following permits the export of technology. Sub-items (a) and (b) above do not embargo carbon fibre having both of the following characteristics:
 - (a) "Specific modulus" less than 11.43×10^6 m (4.5×10^8 in); *and*
 - (b) "Specific tensile strength" less than 10.16×10^4 m (4×10^6 in).
5. This Item does not embargo manufactured articles where the value of the aromatic polyamide content embargoed by sub-item (a) above, together with other embargoed materials, is less than 50% of the total value of the material used.
6. Governments may permit, as administrative exceptions, the shipment of polyethylene fibre embargoed by sub-item (a) above to bona fide civil end-users for non-military, non-aerospace
7. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of discontinuous ceramic fibres embargoed by sub-item (b) above, having the melting or sublimation point in an inert environment lower than 2,043 K (1,770°C).

1767

Preforms of glass or of any other material specially designed for the fabrication of optical fibres embargoed by Item 1526(b) and (c).

Technical Note:

Optical fibre preforms are defined as bars, ingots, or rods of glass, plastic or other materials which have been specially processed for use in fabricating optical fibres. The characteristics of the preform determine the basic parameters of the resultant drawn optical fibres.

NOTES:

1. Not used.
2. Governments may permit, as administrative exceptions, the shipment of preforms specially designed for multimode optical fibres only optimised to operate for communication purposes at 850 ns.
3. Governments may permit, as administrative exceptions, the shipment to the People's Republic of China of optical fibre preforms specially designed for the manufacture of silicon-based optical fibres, provided they are designed to produce non-militarised silicon-based optical fibres which are optimised to operate at a wavelength of 1,350 nm or less.

1781

Synthetic lubricating oils and greases which are or which contain, as their principal ingredient, the following:

- (a) Monomeric and polymeric forms of perfluorotriazines, perfluoroaromatic ethers and esters and perfluoroaliphatic ethers and esters;
- (b) Phenylene or alkylphenylene ethers or thio-ethers, or their mixtures, containing more than 2 ether or thio-ether functions or mixtures thereof.

MUNITIONS

- GROUP 2

2001

Small arms and machine guns, as follows, and specially designed components therefor:

- (a) Rifles, carbines, revolvers, pistols, machine pistols and machine guns, *except* antique small arms dated earlier than 1890 and their reproductions;
- (b) Smooth-bore weapons specially designed for military use;
- (c) Weapons using caseless ammunition.

Technical Note:

Smooth-bore weapons specially designed for military use as specified in sub-item (b) above are those which:

- (a) Are proof tested at pressures above 1,300 bars (19,117 psi); *and*
- (b) Operate normally and safely at pressures above 1,000 bars (14,706 psi); *and*
- (c) Are capable of accepting ammunition above 76.2 mm in length (e.g., commercial 12-gauge magnum shot gun shells).

The parameters in this Technical Note are to be measured according to the standards of the Commission Internationale Permanente.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of weapons embargoed by this Item and specially designed components therefor, provided such weapons are not of the fully automatic firing type, as follows:
 - (a) Rifled-bore weapons specially designed for sporting target shooting as defined in the Olympic Rules;
 - (b) Rifled-bore weapons specially designed for hunting having a magazine capacity not exceeding 5 rounds;
 - (c) Multiple-barrelled hunting weapons having one or more rifled-bore barrel and at least one smooth-bore barrel;
 - (d) Clips or magazines for the above weapons with a capacity not exceeding 5 rounds;

Prior to the issuance of a licence for weapons described in sub-paragraphs (a) to (d) of this Note, the exporter will obtain from a responsible representative of the end-user or importing agency a signed statement describing the end-use and certifying that the weapons will not be re-exported or otherwise disposed of without the permission of the Government of the exporting country.
2. This Item does not embargo smooth-bore weapons used for hunting or sporting purposes. These weapons must not be specially designed for military use or of the fully automatic firing type.
3. This Item does not embargo firearms specially designed for dummy ammunition and which are incapable of firing any embargoed ammunition.
4. This Item does not embargo weapons using non-centre fire cased ammunition and which are not of the fully automatic firing type.

2002

Large calibre armament or weapons and projectors, as follows, and specially designed components and "specially designed software" therefor:

- (a) Guns, howitzers, cannon, mortars, tank destroyers, projectile launchers, military flame throwers, recoilless rifles;
- (b) Military smoke, gas and pyrotechnic projectors or generators.

N.B.:

This sub-item does not include signal pistols of the Very pistol type.

2003

Ammunition, and specially designed components and "specially designed software" therefor, for the weapons embargoed by Items 2001, 2002 or 2026.

NOTES:

1. Specially designed components are understood to include:
 - (a) Metal or plastic fabrications such as primer anvils, bullet cups, cartridge links, rotating bands and munitions metal parts;
 - (b) Safing and arming devices, fuses, sensors and exploding bridge wire connectors;
 - (c) Power supplies with high one-time operational output;
 - (d) Combustible cases for charges;
 - (e) Submunitions including bomblets, minelets and terminally guided projectiles, *except* submunitions using a solely lead core.
2. This Item does not cover ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.
3. Governments may permit, as administrative exceptions, the shipment of the following ammunition or cartridges, provided they are for weapons exportable as administrative exceptions under Note 1 to Item 2001:
 - (a) Target ammunition or cartridges with an expanding bullet of the type used for hunting or sport;
 - (b) Ammunition or cartridges specifically intended for the testing of firearms.

2004

Bombs, torpedoes, rockets and missiles, as follows, and specially designed components and "specially designed software" therefor:

- (a) Bombs, torpedoes, grenades (including smoke grenades), smoke canisters, rockets, mines, missiles, depth charges, fire bombs, incendiary bombs and military demolition charges, devices and kits, pyrotechnic flare signals for military use, cartridges and simulators;
- (b) Apparatus and devices specially designed for the handling, control, activation, powering with one-time operational output, launching, laying, sweeping, discharging, detonation or detection of items enumerated in sub-item (a);
- (c) Military fuel thickeners, including: compounds (e.g., octal) or mixtures of such compounds (e.g., napalm) specifically formulated for the purpose of producing materials which, when added to petroleum products, provide a gel-type incendiary material for use in bombs, projectiles, flame throwers or other implements of war.

NOTE:

It is understood that sub-item (b) above includes:

- (1) Mobile gas liquefying equipment, specially designed for military use, and capable of producing 1,000 kg or more per day of gas in liquid form;
- (2) Buoyant electric conducting cable suitable for sweeping magnetic mines;
- (3) Tactical missile rocket nozzles and strategic re-entry vehicle nosetips and fine grain artificial graphites therefor, having all of the following characteristics:
 - (A) Bulk density of 1.79 or more (measured at 293 K);
 - (B) Tensile strain to failure of 0.7% or more (measured at 293 K);
 - (C) Coefficient of thermal expansion of 2.75×10^{-6} or less per degree K (in the range of 293 to 1,255 K).

2005

Fire control systems and sub-systems, as follows, specially designed for military use, specially designed

components and accessories and "specially designed software" therefor:

- (a) Fire control, gun laying, night sighting, missile tracking and guidance equipment and target surveillance equipment;
- (b) Range, position and height finders, spotting instruments, detection, recognition or identification equipment and sensors integration equipment;
- (c) Electronic, electro-optic, gyroscopic, acoustic and optical aiming or sighting devices;
- (d) Bomb sights, bombing computers, gun sights and periscopes.

2006

Vehicles, as follows, specially designed or modified for military use, specially designed components and "specially designed software" therefor:

Technical Note:

For the purposes of this Item, the term "specially modified for military use" means a structural, electrical or mechanical change which entails replacing a component with at least one specially designed military component, or adding at least one such component.

- (a) Tanks and self-propelled guns;
- (b) Armed, armoured vehicles or vehicles fitted with mounting for arms;
- (c) Armoured railway trains;
- (d) Half-tracks;
- (e) Recovery vehicles;
- (f) Gun-carriers and tractors specially designed for towing artillery;
- (g) Ammunition trailers;
- (h) Amphibious and deep water fording vehicles;
- (i) Mobile repair shops specially designed to service military equipment;
- (j) All other vehicles specially designed or modified for military use.

NOTES:

1. Specially designed components for the equipment embargoed by this Item include:
 - (a) Pneumatic tyre casings of a kind specially constructed to be bullet-proof or to run when deflated (excluding types for agricultural and garden tractors and farm implements);
 - (b) Engines for the propulsion of the vehicles enumerated in sub-items (a) to (j), specially designed or modified for military use including specially designed components therefor;
 - (c) Tyre inflation pressure control systems, operated from inside a moving vehicle, specially designed or modified for military use;
 - (d) Large deflection suspensions specially designed or modified for military use.
2. Vehicles embargoed by sub-item (j) include tank transporters, tracked amphibious cargo carriers, high speed tractors, heavy artillery transporters.

2007

Toxicological agents, tear gas, related equipment, components, materials and technology as follows, and "specially designed software" therefor:

- (a) Biological agents, chemical agents or radioactive materials adapted for use in war to produce casualties in men or animals, or to damage crops;
- (b) Equipment specially designed and intended for the dissemination of the materials described in (a);
- (c) Equipment specially designed and intended for defence against the materials described in (a) and for their detection and identification;
- (d) Components specially designed for the items listed in (b) or (c);
- (e) "Biopolymers" specially designed or processed for detection and identification of chemical warfare (CW) agents described in (a) and the cultures of specific cells used to produce them;

- (f) "Biocatalysts" for decontamination and degradation of CW agents, and biological systems therefor, as follows:

- (1) "Biocatalysts", specially designed for decontamination and degradation of CW agents described in (a) resulting from directed laboratory selection or genetic manipulation of biological systems;
- (2) Biological systems, as follows: "expression vectors", viruses or cultures of cells containing the genetic information specific to the production of "biocatalysts" embargoed by (f)(1);

- (g) Technology as follows:

- (1) Technology for the development, production and use of toxicological agents, related equipment and components described in (a) to (d), and tear gas;
- (2) Technology for the development, production and use of "biopolymers" and cultures of specific cells described in (e);
- (3) Technology exclusively for the incorporation of "biocatalysts", embargoed by (f)(1), into military carrier substances or military materiel.

Technical Note:

"Anti-idiotypic antibodies"—

Antibodies which bind to the specific antigen binding sites of other antibodies;

"Biocatalysts"—

"Enzymes" or other biological compounds which bind to and accelerate the degradation of CW agents;

"Biopolymers"—

Biological macromolecules as follows:

- (1) "Enzymes";
- (2) Antibodies, "monoclonal", "polyclonal" or "anti-idiotypic";
- (3) Specially designed or specially processed "receptors";

"Enzymes"—

"Biocatalysts" for specific chemical or biochemical reactions;

"Expression vectors"—

Carriers (e.g., plasmid or virus) which are used to introduce genetic material into host cells;

"Monoclonal antibodies"—

Proteins which bind to one antigenic site and are produced by a single clone of cells;

"Polyclonal antibodies"—

A mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;

"Receptors"—

Biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions.

NOTES:

1. Sub-item (a) also embargoes:
 - (a) DF (methylphosphonyldifluoride);
 - (b) QL (O-ethyl-2-di-isopropylamino ethylmethylphosphonite).
2. Sub-item (c) includes air conditioning units specially designed or modified for nuclear, biological and chemical filtration.
3. Sub-item (a) does not embargo:
 - (a) Cyanogen chloride;
 - (b) Hydrocyanic acid;
 - (c) Chlorine;
 - (d) Carbonyl chloride (phosgene);
 - (e) Diphosgene (trichloromethyl-chloroformate);
 - (f) Ethyl bromoacetate;
 - (g) Xylol bromide;
 - (h) Benzyl bromide;
 - (i) Benzyl iodide;
 - (j) Bromo acetone;
 - (k) Cyanogen bromide;
 - (l) Bromo methylethylketone;
 - (m) Chloro acetone;
 - (n) Ethyl iodoacetate;
 - (o) Iodo acetone;
 - (p) Chloropicrine.
4. Sub-item (c) does not embargo:
 - (a) Personal radiation monitoring dosimeters;
 - (b) Masks for protection against specific industrial hazards, such as fumes or powders in mining, quarrying and chemical plants; *or*
 - (c) Gas masks designed for civilian use.
5. The technology and cultures of cells for sub-item (e) are exclusive and this sub-item does not embargo technology and cells for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, and in the food industry.

6. The technology and biological systems listed in sub-items (g)(3) and (f)(2) are exclusive and these sub-items do not embargo technology and biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, and in the food industry.

2008

Military explosives and fuels, as follows: "additives", "precursors" and "stabilisers" therefor, and "specially designed software" therefor:

- (a) "Military high explosives";
 (b) "Military propellants";
 (c) "Military pyrotechnics";
 (d) Military high-energy solid or liquid fuels, including aircraft fuels specially formulated for military purposes.

NOTE:

It is understood that this sub-item embargoes finished products only and does not embargo constituents.

Technical Notes:

"Additives"—

Substances used in explosive formulations to improve their properties.

"Stabilisers"—

Substances used in explosive formulations to improve their shelf-life.

"Precursors"—

Specialty chemicals used in the manufacture of military explosives.

"Military high explosives"—

Solid, liquid or gaseous substances or mixtures of substances which, in their application as primary, booster, or main charges in warheads, demolition and other military applications, are required to detonate.

"Military propellants"—

Solid, liquid or gaseous substances or mixtures of substances used for propelling projectiles and missiles, or to generate gases for powering auxiliary devices for embargoed military equipment which, when ignited, burn or deflagrate to produce quantities of gas capable of performing work, but in their application these quantities are required not to undergo a deflagration to detonation transition.

"Military pyrotechnics"—

Mixtures of solid or liquid fuels and oxidizers which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce specific time delays, or quantities of heat, noise, smoke, visible light or infrared radiation. Pyrophorics are a subclass of pyrotechnics, which contain no oxidizers but ignite spontaneously on contact with air.

NOTES:

1. "Military high explosives", "military propellants" and "military pyrotechnics" include substances and mixtures which contain any of the following:

- (a) Spherical aluminium powder of particle size 60 micrometres or less manufactured from material with an aluminium content of 99% or more;

NOTE:

See also Item 1601 for technology to achieve sphericity and uniform particle size.

- (b) Metal fuels in particle sizes less than 60 micrometres whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of any of the following: zirconium, boron, magnesium and alloys of these; beryllium; fine iron powder with average particle size of 3 micrometres or less produced by reduction of iron oxide with hydrogen;
 (c) Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;
 (d) Nitroguanidine (NQ);
 (e) Compounds composed of fluorine and one or more of the following: other halogens, oxygen, nitrogen;
 (f) Carboranes; decaborane; pentaborane and derivatives;
 (g) Cyclotetramethylenetetranitramine (HMX); octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine; 1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane; (octogen, octogene);
 (h) Hexanitrostilbene (HNS);
 (i) Diaminotrinitrobenzene (DATB);

- (j) Triaminotrinitrobenzene (TATB);
 (k) Triaminoguanidinonitrate (TAGN);
 (l) Any explosive with a detonation velocity greater than 8,700 m/s or a detonation pressure greater than 340 kilobars;
 (m) Other organic high explosives not listed in this Note yielding detonation pressures of 250 kilobars or greater that will remain stable at temperatures of 523 K (250°C) or higher for periods of 5 minutes or longer;
 (n) Titanium subhydride of stoichiometry TiH 0.65-1.68;
 (o) Dinitroglycoluril (DNGU, DINGU); tetranitroglycoluril (TNGU, SORGUYL);
 (p) Any other UN Class 1.1 solid propellant not listed in this Note with a theoretical specific impulse (under standard conditions) greater than 250 seconds for non-metallised, or greater than 270 seconds for aluminised compositions;
 (q) Any UN Class 1.3 solid propellant with a theoretical specific impulse greater than 230 seconds with non-halogenised, 250 seconds for non-metallised and 266 seconds for metallised compositions;
 (r) Tetranitrobenzotriazolobenzotriazole (TACOT);
 (s) Diaminohexanitrophenyl (DIPAM);
 (t) Picrylamino-dinitropyridine (PYX);
 (u) 3-nitro-1,2,4-triazol-5-one (NTO or ONTA);
 (v) Hydrazine in concentrations of 70% or more; hydrazine nitrate; hydrazine perchlorates; unsymmetrical dimethyl hydrazine; monomethyl hydrazine; symmetrical dimethyl hydrazine;
 (w) Ammonium perchlorate;
 (x) Cyclotrimethylenetrinitramine (RDX); cyclonite; T4; hexahydro-1,3,5-trinitro-1,3,5-triazine; 1,3,5-trinitro-1,3,5-triaza-cyclohexane; (hexogen, hexogene);
 (y) Hydroxylammonium nitrate (HAN); hydroxylammonium perchlorate (HAP).
 (z) Any other gun propellants not listed in this Note having a force constant greater than 1,200 kJ/kg.
 (aa) Any other explosive, propellant or pyrotechnic not listed in this Note that can sustain a steady-state burning rate greater than 38 mm (1.5 inches) per second under standard conditions of 68.9 bar (1,000 psi) pressure and 294 K (21°C);
 (bb) Elastomer modified cast double based propellants (EMCDB) with extensibility at maximum stress greater than 5% at 233 K (-40°C).

2. "Additives" include the following:

- (a) Glycidylazide Polymer (GAP) and its derivatives;
 (b) Polycyanodifluoroaminoethyloxy (PCDE);
 (c) Butanetrioltrinitrate (BTTN);
 (d) Bis-2-fluoro-2, 2-dinitroethylformal (FEFO);
 (e) Butadienenitrileoxide (BNO);
 (f) Catocene, N-butyl-ferrocene, and other ferrocene derivatives;
 (g) Bis(2,2-dinitropropyl) formal and acetal;
 (h) 3-nitrazo-1,5-pentane diisocyanate;
 (i) Energetic monomers, plasticisers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups;
 (j) 1,2,3-Tris[1,2-bis-difluoroamino)ethoxy] propane; (Tris vinox propane adduct, TVOPA);
 (k) Bisazidomethyloxetane and its polymers;
 (l) Bischloromethyloxetane;
 (m) Polynitrothocarbonates;
 (n) Tetraethylenepentamineacrylonitrile (TEPAN); cyanoethylated polyamine;
 (o) Tetraethylenepentamineacrylonitrileglycidol (TEPANOL); cyanoethylated polyamine adducted with glycidol;
 (p) Polyfunctional aziridine amides: with isophthalic, trimesic BITA or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring;
 (q) Basic copper salicylate; lead salicylate;
 (r) Lead beta resorcyate;
 (s) Lead stannate, lead maleate, lead citrate;
 (t) Tris-1-(2-methyl)aziridinyl phosphine oxide (MAPO) and its derivatives;
 (u) Organo-metallic coupling agents, specifically: Neopentyl [diallyl] oxy, tri [diocetyl] phosphate titanate [titanium IV, 2,2[bis 2-propenolatemethyl, butanolate, tris [diocetyl] phosphate-O], LICA 12; Titanium IV, [(2-propenolate-1) methyl, N-propanolatomethyl] butanolate-1, tris[diocetyl] pyrophosphate, KR3538; Titanium IV, [(2-propenolate-1)methyl, N-propanolatemethyl] butanolate-1, tris(diocetyl)phosphate, KR3512.

3. "Precursors" include the following:

- (a) Guanidine nitrate;
 - (b) 1,2,4 trihydroxybutane (1,2,4-butanetriol);
 - (c) 1,3,5-trichlorobenzene;
 - (d) Polynitroorthocarbonates;
 - (e) Bischloromethyloxetane;
 - (f) Low (less than 10,000) molecular weight, alcohol-functionalised, poly(epichlorohydrin); poly(epichlorohydrindiol);
 - (g) Propylimine.
4. This Item does not embargo those "precursors" which are industrial chemicals, not embargoed elsewhere in this List widely available in international markets.
5. "Stabilisers" include the following:
N-Methyl-p-nitroaniline.
6. This Item does not embargo the following substances when not compounded or mixed with other "military high explosives" or powdered metals:
- (a) Ammonium picrate;
 - (b) Black powder;
 - (c) Hexanitrodiphenylamine;
 - (d) Difluoroamine (HNF₂);
 - (e) Nitrostarch;
 - (f) Potassium nitrate;
 - (g) Tetraniroanthalene;
 - (h) Trinitroanisol;
 - (i) Trinitronaphthalene;
 - (j) Trinitroxylene;
 - (k) Fuming nitric acid;
 - (l) Trinitrophenylmethylnitramine (tetryl);
 - (m) Acetylene;
 - (n) Propane;
 - (o) Liquid oxygen;
 - (p) Hydrogen peroxide in concentrations of less than 85%;
 - (q) Misch metal;
 - (r) N-pyrrolidinone; 1-methyl-2-pyrrolidinone;
 - (s) Dioctylmaleate;
 - (t) Ethylhexylacrylate;
 - (u) Triethylaluminium (TEA), trimethylaluminium (TMA), and other pyrophoric metal alkyls and aryls of lithium, sodium, magnesium, zinc and boron;
 - (v) Nitrocellulose;
 - (w) Nitroglycerin (or glyceroltrinitrate, trinitroglycerine) (NG);
 - (x) 2,4,6-trinitrotoluene (TNT);
 - (y) Ethylenediaminedinitrate (EDDN);
 - (z) Pentaerythritoltetranitrate (PETN);
 - (aa) Lead azide, normal and basic lead styphnate, and primary explosives or priming compositions containing azides or azide complexes;
 - (bb) Triethyleneglycoldinitrate (TEGDN);
 - (cc) 2,4,6-trinitroresorcinol (styphnic acid);
 - (dd) Diethyldiphenyl urea; dimethyldiphenyl urea; methylethyl-diphenyl urea [Centralites];
 - (ee) N, N-diphenylurea (unsymmetrical diphenylurea);
 - (ff) Methyl-N, N-diphenylurea (methyl unsymmetrical diphenylurea);
 - (gg) Ethyl-N, N-diphenylurea (ethyl unsymmetrical diphenylurea);
 - (hh) 2-Nitrodiphenylamine (2-NDPA);
 - (ii) 4-Nitrodiphenylamine (4-NDPA);
 - (jj) 2, 2-dinitropropanol.

2009

Vessels of war and special naval equipment, as follows, and specially designed components and "specially designed software" therefor:

- (a) Combatant vessels or vessels (surface or underwater) specially designed or modified for offensive or defensive action, whether or not converted to non-military use and regardless of current state of repair or operating condition, and hulls or parts of hulls for such vessels;
- (b) Engines, as follows:
 - (1) Diesel engines specially designed for submarines with both of the following characteristics:
 - (A) A power output of 1.12 MW (1,500 h.p.) or more; and

- (B) A rotary speed of 700 rev/min or more;
- (2) Electric motors specially designed for submarines having all of the following characteristics:
 - (A) A power output of more than 0.75 MW (1,000 h.p.);
 - (B) Quick reversing;
 - (C) Liquid cooled; and
 - (D) Totally enclosed;
- (3) Non-magnetic diesel engines specially designed for military purposes with a power output of 37.3 kW (50 h.p.) or more;

NOTE:

An engine shall be presumed to be specially designed for military purposes if:

- (a) It has non-magnetic parts other than crankcase, block, head, pistons, covers, end plates, valve facings, gaskets, and fuel, lubrication and other supply lines; or
- (b) Its non-magnetic content exceeds 75% of total mass;
- (c) Underwater detection devices specially designed for military purposes and controls thereof;
- (d) Submarine and torpedo nets;
- (e) Compasses and equipment therefor and ship's course indicators, specially designed for submarines;
- (f) Hull penetrators and connectors specially designed for military purposes that enable interaction with equipment external to a vessel;

NOTE:

This sub-item includes: Connectors for vessels which are of the single-conductor, multi-conductor, coaxial or waveguide type, and hull penetrators for vessels, both of which are capable of remaining impervious to leakage from without and of retaining required characteristics at marine depths exceeding 100 m; and fibre-optic connectors regardless of depth. It does not include ordinary propulsive shaft and hydrodynamic control-rod hull penetrators.

- (g) Silent bearings specially designed for military purposes and equipment containing those bearings.

2010

Aircraft and helicopters, unmanned airborne vehicles, aero-engines and aircraft or helicopter equipment, associated equipment and components, specially designed for military purposes, as follows, and "specially designed software" therefor:

- (a) Combat aircraft and helicopters and other aircraft and helicopters specially designed for military purposes, including military reconnaissance, assault, military training and logistic support, and all aircraft and helicopters having special structural features such as multiple hatches, special doors, ramps and reinforced floors, for transporting and airdropping troops, military equipment and supplies, and specially designed components therefor;
- (b) Aero-engines specially designed or adapted for use with aircraft and helicopters embargoed by sub-item (a) above, *except* aero-engines excluded from embargo under Item 1460(d), and specially designed components therefor;
- (c) Unmanned airborne vehicles, including remotely piloted air vehicles (RPVs), and autonomous, programmable vehicles specially designed or modified for military purposes and their launchers, ground support and associated equipment for command and control;
- (d) Airborne equipment, including airborne refuelling equipment, specially designed for use with the aircraft and helicopters and the aero-engines embargoed by sub-items (a) and (b) above, and specially designed components therefor;
- (e) Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for aircraft and helicopters embargoed by sub-item (a) above, or for aero-engines embargoed by sub-item (b) above;
- (f) Pressurised breathing equipment and partial pressure suits for use in aircraft and helicopters, anti-g suits, military crash helmets and protective masks, liquid oxygen converters used for aircraft, helicopters and missiles, catapults and cartridge actuated devices utilised in emergency escape of personnel from aircraft and helicopters;

- (g) Parachutes used for combat personnel, cargo dropping and aircraft deceleration, as follows:
- (1) Parachutes for:
 - (a) Pin point dropping of rangers;
 - (b) Dropping of paratroopers;
 - (2) Cargo parachutes;
 - (3) Paragliders (drag parachutes, drogue parachutes for stabilisation and attitude control of dropping bodies, e.g., recovery capsules, ejection seats, bombs);
 - (4) Drogue parachutes for use with ejection seat systems for deployment and inflation sequence regulation of emergency parachutes;
 - (5) Recovery parachutes for guided missiles, drones and space vehicles;
 - (6) Approach parachutes and landing deceleration parachutes; *and*
 - (7) Other military parachutes;
- (h) Automatic piloting systems for parachuted loads; equipment specially designed or modified for military purposes for controlled opening jumps at any height, including oxygen equipment.

2011

Electronic equipment specially designed for military use and specially designed components and "specially designed software" therefor.

NOTE:

This Item includes:

- (a) Jamming and counter-jamming equipment, including electronic counter measure (ECM) and electronic counter-counter measure (ECCM) apparatus (i.e., apparatus designed to introduce extraneous or erroneous signals into radar or radio communication receivers or otherwise hinder the reception, operation or effectiveness of adversary electronic receivers including their counter measure equipment);
- (b) Electronic systems or equipment designed either for surveillance and monitoring of the electro-magnetic spectrum for military intelligence or security purposes or for counteracting such surveillance and monitoring;
- (c) Underwater counter measure, including acoustic and magnetic jamming and decoy, equipment designed to introduce extraneous or erroneous signals into sonar receivers;
- (d) Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes;
- (e) Identification, authentication and keyloader equipment and key management, manufacturing and distribution equipment.

2012

Photographic and electro-optical imaging equipment, as follows, and specially designed components and "specially designed software" therefor:

- (a) Air reconnaissance cameras and associated equipment designed for military purposes;
- (b) Film processing and printing machines designed for military purposes;
- (c) Other cameras and electro-optical imaging devices, including infrared and imaging radar sensors, whether recording, or transmitting via data link, designed for military, including reconnaissance, purposes;
- (d) Specialised equipment for the cameras and electro-optical imaging devices embargoed by sub-item (b) above designed to make the recorded or transmitted information militarily useful.

NOTE:

Specialised equipment embargoed by sub-item (d) above which relates to electro-optical imaging devices and imaging radar sensors includes digital image processors and softcopy imagery display devices.

(See also Item 2015.)

2013

Special armoured equipment, as follows:

- (a) Armoured plate;
- (b) Combinations and constructions of metallic and non-metallic materials specially designed to provide ballistic protection for military systems;
- (c) Military helmets;
- (d) Body armour, flak suits and specially designed components therefor.

NOTES:

1. Sub-item (b) includes combinations of metallic and non-metallic materials specially designed to form explosive reactive armour.
2. Sub-item (c) does not embargo conventional steel helmets not equipped with, modified or designed to accept any type of accessory device.

2014

Specialized equipment for military training or for simulating military scenarios, specially designed components and accessories and "specially designed software" therefor.

NOTES:

1. The term "specialized military training equipment" includes military types of attack trainers, operational flight trainers, radar target trainers, radar target generators, gunnery training devices, anti-submarine warfare trainers, flight simulators (including human-rated centrifuges for pilot/astronaut training), radar trainers, instrument flight trainers, navigation trainers, target equipment, drone aircraft, armament trainers, pilotless aircraft trainers and mobile training units.
2. This Item includes synthetic image generating systems (SIG) for simulators when specially designed or modified for military purposes.

2015

Military infrared, thermal imaging and image intensifier equipment, specially designed components and "specially designed software" therefor.

(See also Items 1502, 1555 and 1556.)

NOTES:

1. This Item includes infrared jamming and counter jamming equipment (i.e., apparatus designed to introduce extraneous or erroneous signals into infrared seeking missiles, infrared surveillance systems, thermal imaging equipment and infrared communication links or otherwise hinder the operation or effectiveness of military infrared systems) including their counter measure equipment.
2. The term "specially designed components" includes the following when specially designed for military use:
 - (a) Infrared image converter tubes;
 - (b) Image intensifier tubes;
 - (c) Microchannel plates;
 - (d) Low-light-level television camera tubes;
 - (e) Infrared detector arrays;
 - (f) Pyroelectric television camera tubes;
 - (g) Cryogenic coolers used in military thermal imaging systems.

2016

Forgings, castings and semi-finished products specially designed for the products embargoed by Items 2001, 2002, 2003, 2004, 2006 or 2010.

NOTE:

This Item includes artillery material, machine guns, automatic weapons and small arms.

2017

Miscellaneous equipment and materials, as follows, specially designed components and "specially designed software" therefor:

- (a) Self-contained diving and underwater swimming apparatus, as follows:
 - (1) Closed and semi-closed circuit (rebreathing) apparatus;
 - (2) Specially designed components for use in the conversion of open-circuit apparatus to military use;
 - (3) Articles exclusively designed for military use with self-contained diving and underwater swimming apparatus;
- (b) Firearms silencers (mufflers);
- (c) Power-controlled searchlights and control units therefor, designed for military use;
- (d) Construction equipment built to military specifications, specially designed for airborne transport;
- (e) External fittings, coatings and treatments for the suppression of acoustic, radar, infrared and other emissions, specially designed for military use;
- (f) Field engineer equipment specially designed for use in a combat zone.

2018

Equipment and technology for the "production" of products referred to in Group 2, as follows, and "specially designed software" therefor:

- (a) Specially designed or modified "production" equipment for the production of products embargoed by Group 2, and specially designed components therefor;
- (b) Specially designed environmental test facilities and specially designed equipment therefor, for the certification, qualification, or testing of products embargoed by Group 2;
- (c) Specific "production" technology, even if the equipment with which such technology is to be used is unembargoed;
- (d) Technology specific to the design of, the assembly of components into, and the operation, maintenance and repair of complete "production" installations even if the components themselves are unembargoed;

Technical Note:

For the purposes of this Item, "production" includes design, examination, manufacture, testing and checking.

NOTES:

1. Sub-item (a) above includes the following equipment:
 - (a) Nitrators: continuous types;
 - (b) Centrifugal testing apparatus or equipment having any of the following characteristics:
 - (1) Driven by a motor or motors having a total rated horsepower greater than 400 h.p. (298 kW);
 - (2) Capable of carrying a payload of 113 kg (250 lb) or more;
 - (3) Capable of exerting a centrifugal acceleration of 8 g or more on a payload of 91 kg (200 lb) or more.
 - (c) Dehydration presses;
 - (d) Extrusion presses for the extrusion of small arms, cannon and rocket propellants;
 - (e) Cutting machines for the sizing of extruded propellants;
 - (f) Sweetie barrels (tumblers) 1.85 m (6 ft.) and over in diameter and having over 227 kg (500 lbs) product capacity;
 - (g) Continuous mixers for solid propellants.

2. A. The terms "products referred to in Group 2" include:
 - (1) Products not embargoed if inferior to specified concentrations as follows:
 - (a) hydrazine (see Note 1(v) to Item 2008);
 - (b) "Military high explosives" (see Item 2008);
 - (2) Products not embargoed if inferior to technical limits as follows:
 - (a) Marine boilers (see Note to Item 2009(f));
 - (b) Superconductive materials excluded from embargo under Item 1675; Superconductive electromagnets excluded from embargo under Item 1573; Superconductive electrical equipment excluded from embargo under Item 2020(b).
- B. The terms "products referred to in Group 2" exclude:
 - (1) Signal pistols of the Very type (see Item 2002(b));
 - (2) Tractor and farm implement type pneumatic tyre casings (see Note 1 to Item 2006);
 - (3) The substances excluded from embargo under Note 3 to Item 2007;
 - (4) Personal radiation monitoring dosimeters and masks for protection against specific industrial hazards (see Note 4 to Item 2007);
 - (5) Acetylene, propane, liquid oxygen, difluoramine (HNF₂), fuming nitric acid and potassium nitrate powder (see Note 6 to Item 2008);
 - (6) Aero-engines excluded from embargo under Item 2010 by reference to aero-engines excluded under Item 1460;
 - (7) Conventional steel helmets not equipped with, modified or designed to accept any type of accessory device (see Note 2 to Item 2013);
 - (8) Equipment fitted with unembargoed industrial machinery, such as coating machinery not elsewhere specified and equipment for the casting of plastics;
 - (9) Antique small arms dating back beyond the year 1890, and their reproductions.

(This listing does not allow the export of technology or production equipment for non-antique small arms, even if used to produce reproductions of antique small arms.)

3. Sub-item (d) above does not include technology for civil purposes, such as agricultural, pharmaceutical, medical, veterinary and environmental, and in the food industry (see Note 5 to Item 2007).
4. Governments may permit, as administrative exceptions, the shipment of equipment used to determine the safety data of explosives, as required by the International Convention on the Transport of Dangerous Goods (C.I.M) articles 3 and 4 in Annex I RID, provided that they are satisfied that such equipment will be used only by the railway authorities of current C.I.M. members, or by Government-accredited testing facilities in those countries, for the testing of explosives to transport safety standards, as follows:
 - (a) Equipment for determining ignition and deflagration temperatures;
 - (b) Equipment for steel-shell tests;
 - (c) Drop hammers not exceeding 20 kg in mass for determining the sensitivity of explosives to shock;
 - (d) Equipment for determining the friction sensitivity of explosives when exposed to charges not exceeding 36 kg in mass.

2020

Cryogenic and superconductive equipment, as follows, specially designed components and accessories, and "specially designed software" therefor:

- (a) Equipment specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space application and capable of operating while in motion and of producing or maintaining temperatures below 103 K (-170°C);
- (b) Superconductive electrical equipment (rotating machinery and transformers) specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications and capable of operating while in motion, *except* direct-current hybrid homopolar generators that have single-pole normal metal armatures which rotate in a magnetic field produced by superconducting windings, provided those windings are the only superconducting component in the generator.

2022

Electrically triggered shutters of photochromic or electro-optical type having a shutter speed of less than 100 microseconds, and "specially designed software" therefor, *except* shutters which are an essential part of a high-speed camera.

2023

Directed energy weapons (DEW) systems and specially designed components, as follows, and "specially designed software" therefor:

- (a) Laser systems specially designed for destruction or effecting mission-abort of a target;
- (b) Particle beam systems capable of destruction or effecting mission-abort of a target;
- (c) High power radio-frequency (RF) systems capable of destruction or effecting mission-abort of a target;
- (d) Specially designed components for systems embargoed by sub-items (a), (b) or (c) above, including:
 - (1) Prime power generation, energy storage, switching, power conditioning and fuel-handling equipment;
 - (2) Target acquisition and tracking sub-systems;
 - (3) Sub-systems capable of assessing target damage, destruction or mission-abort;
 - (4) Beam-handling, propagation and pointing equipment;
 - (5) Equipment with rapid beam slew capability for rapid multiple target operations;
 - (6) Adaptive optics;
 - (7) Current injectors for negative hydrogen ion beams which provide average injection currents over 50 mA with beam brightness (defined as current divided by the product of orthogonal transverse, normalised root mean square emittances) greater than $40 \text{ A}/(\text{cm}^2 \cdot \text{mrad}^2)$ at kinetic energies of more than 20 keV; *or*
 - (8) Specially designed components for the equipment embargoed by (1) to (7) above;
- (e) Equipment specially designed for the detection and identification of, and defence against, systems embargoed by sub-items (a), (b) or (c) above, and specially designed components therefor;
- (f) Physical test models and related documentation for the systems, equipment and components described in sub-items (a) to (e) above.

(For the embargo parameters of lasers or associated laser components, see Item 1522.)

NOTE:

Directed energy weapons embargoed by this Item include systems whose capability is derived from the controlled application of:

- (a) Lasers of sufficient continuous wave or pulsed power to effect destruction similar to the manner of conventional ammunition;
- (b) Particle accelerators which project a charged or neutral particle beam with destructive power;

- (c) High pulsed power or high average power radio frequency beam transmitters which produce fields sufficiently intense to disable electronic circuitry at a distant target.

2024

"Software", as follows:

- (a) "Software" specially designed for:
 - (1) Modelling, simulation or evaluation of military weapon systems;
 - (2) Development, monitoring, maintenance or up-dating of "software" embedded in military weapon systems;
 - (3) Modelling or simulating military operation scenarios, not embargoed by Item 2014;
 - (4) Command, Communications, Control and Intelligence (C3I) applications;
- (b) "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

2026

Kinetic energy weapon systems and associated equipment, as follows, specially designed components and "specially designed software" therefor:

- (a) Kinetic energy weapons systems specially designed for destruction or effecting mission-abort of a target;
- (b) Specially designed test and evaluation facilities and test models, including diagnostic instrumentation and targets, for dynamic testing of kinetic energy projectiles and systems;
- (c) Specially designed subsystems for systems embargoed by (a) or (b) above, including:
 - (1) Launch-propulsion-subsystems capable of accelerating masses larger than 0.1 g to velocities in excess of 1.6 km/s, in single or rapid fire modes;
 - (2) Prime power generation, energy storage, thermal management, conditioning, switching and fuel-handling equipment;
 - (3) Target acquisition, tracking, fire control and damage assessment subsystems;
 - (4) Homing seeker, guidance and divert propulsion (lateral acceleration) subsystems for projectiles.

NOTES:

1. Weapon systems using sub-calibre ammunition and employing solely chemical propulsion are embargoed by Items 2001 or 2002, or 2003 with respect to the ammunition.
2. Sub-item (c)(2) does not embargo technology for magnetic induction for continuous propulsion of civil transport devices.
3. This Item embargoes systems using any of the following methods of propulsion:
 - (a) Electromagnetic;
 - (b) Electrothermal;
 - (c) Plasma;
 - (d) Light gas; *or*
 - (e) Chemical (when used in combination with any of the above).

ATOMIC ENERGY

— GROUP 3

Atomic Energy Materials

Special and Other Fissionable Materials

3001

(1) In this item,

"previously separated", means the result of any process that is intended to increase the concentration of the controlled isotope therein; (*précédemment séparés*)

"uranium enriched in the isotopes 235 or 233" means uranium that contains the isotopes 235 or 233, or both, in an amount such that the abundance ratio of the sum of those isotopes to the isotope 238 is greater than the ratio of the isotope 235 to the isotope 238 in nature. (*uranium enrichi en isotopes 235 ou 233*)

(2) Special and other fissionable materials, as follows:

- (a) plutonium and all isotopes, alloys and compounds and any material that contains any of the foregoing, other than plutonium 238 that is contained in heart pace-makers;
- (b) uranium 233, uranium enriched in the isotopes 235 or 233 and all alloys and compounds and any material that contains any of the foregoing; and
- (c) previously separated americium 242m, curium 245 and 247 and californium 249 and 251 and any material that contains the foregoing.

Source Materials

3002

Source materials that are in any form, including ore, concentrate, compound, metal or alloy, or that are incorporated in any substance other than medicinals, and in which the concentration of source material is greater than 0.05 weight per cent, as follows:

- (a) uranium that contains the mixture of isotopes that occurs in nature;
- (b) uranium that is depleted in the isotope 235; and
- (c) thorium.

Deuterium

3003

Deuterium and compounds, mixtures and solutions that contain deuterium, including heavy water and heavy paraffins, and in which the ratio of deuterium atoms to hydrogen atoms is greater than 1 part to 5,000 parts by number.

Zirconium

3004

Zirconium metal, alloys and compounds in which the ratio of hafnium content to zirconium content is less than 1 part to 500 parts by weight, and manufactures wholly thereof.

Nickel

3005

(1) In this item,

"porous nickel metal" means porous nickel metal manufactured from nickel powder described in paragraph (2)(a) that has been compacted and sintered to form a metal material that has fine pores interconnected throughout its structure. (*nickel métal poreux*)

(2) Nickel, as follows:

- (a) powder that has a nickel purity content of 99 weight per cent or more and a mean particle size of less than 10 μm when measured using ASTM Standard B 330, *Standard Test Method for Average Particle Size of Powders of Refractory Metal and their Compounds by the Fisher Sub-sieve Sizer*; and
- (b) porous nickel metal that is produced from materials included in paragraph (a), other than single porous nickel metal sheets not greater than 0.093 m^2 in size intended for use in batteries for civil applications.

Nuclear-grade Graphite

3006

Nuclear-grade graphite, that is, graphite that has

- (a) a thermal neutron absorption cross-section equivalent to less than 5 ppm of boron; and
- (b) a density greater than 1 500 kg/m^3 .

Lithium

3007

Lithium, as follows:

- (a) metal, hydrides or alloys that contain lithium enriched in the 6 isotope to a concentration higher than what exists in nature, that is, 7.5 per cent on an atom-percentage basis; and
- (b) other materials that contain lithium enriched in the 6 isotope, including compounds, mixtures and concentrates, other than lithium enriched in the 6 isotope that is incorporated in thermoluminescent dosimeters.

Hafnium

3008

Hafnium metal, alloys and compounds that contain more than 60 weight per cent hafnium, and manufactures thereof.

Beryllium

3009

Beryllium metal, alloys that contain more than 50 weight per cent beryllium, compounds that contain beryllium, and manufactures thereof other than beryllium windows for medical X-ray machines.

Tritium

3012

Tritium and compounds and mixtures that contain tritium in which the ratio of tritium to hydrogen by atoms is greater than 1 part in 1,000, and products that contain one or more of the foregoing.

Materials for Nuclear Heat Sources

3013

(1) In this item,

"previously separated" has the same meaning as in item 3001.
(*précédemment séparé*)

(2) Materials for nuclear heat sources, that is, previously separated neptunium 237 in any form.

Specially Designed or Prepared Materials for Separation of Isotopes

3014

Specially designed or prepared materials, including specially designed chemical exchange resins, for the separation of isotopes of special and other fissionable materials and for the separation of isotopes of natural and depleted uranium.

Calcium

3020

Calcium that contains less than 0.01 weight per cent of impurities other than magnesium and less than 10 ppm of boron.

Atomic Energy Equipment

Parts for Atomic Energy Equipment

3100

Parts for specially designed equipment included in items 3101 to 3221.

Plants for the Separation of Special and Other Fissionable Materials and Source Materials

3101

Plants for the separation of isotopes of special and other fissionable materials and source materials, and specially designed or prepared equipment and components thereof, including

- (a) valves that are wholly made of or lined with aluminum, aluminum alloys, nickel or alloys that contain 60 weight per cent or more nickel, and that are 5 mm or greater in diameter and have bellows seals;
- (b) blowers and compressors, turbo, centrifugal and axial-flow types, that are wholly made of or lined with aluminum, aluminum alloys, nickel or alloys that contain 60 weight per cent or more nickel, and that have a capacity of 1.7 m³/minute or greater, including compressor seals;
- (c) gaseous diffusion barriers;
- (d) gaseous diffuser housings;
- (e) heat exchangers that are made of aluminum, copper, nickel or alloys that contain more than 60 weight per cent nickel, or combinations of those metals as clad tubes, and that are designed to operate at subatmospheric pressure with a leak rate of less than 10 Pa per hour under a pressure differential of 100 kPa;
- (f) jet-nozzle separation units;
- (g) vortex separation units;
- (h) laser-isotopic separation units;
- (i) chemical exchange separation units;
- (j) electromagnetic separation units;
- (k) plasma separation units;
- (l) gaseous diffusion separation units; and
- (m) gas centrifuges and related components, including
 - (i) complete rotor assemblies,
 - (ii) rotor tubes,
 - (iii) rings or bellows that are specially designed or prepared to give localized support to the rotor tube or to join together a number of rotor tubes,
 - (iv) baffles, in the form of disc-shaped components that are specially designed or prepared to be mounted inside a centrifuge rotor tube,
 - (v) top caps and bottom caps, in the form of disc-shaped components that are specially designed or prepared to fit the ends of rotor tubes,
 - (vi) magnetic suspension bearings that consist of an annular magnet which is suspended within a housing that contains a damping medium,
 - (vii) bearings and dampers that comprise a pivot and cup assembly which is mounted on a damper,
 - (viii) molecular pumps that comprise cylinders that have internally machined or extruded helical grooves, and internally machined bores,
 - (ix) stators for high speed multiphase AC hysteresis or reluctance motors that are designed for operation
 - (a) in a vacuum,

3101 *continued*

- (b) at frequencies within the range of 600 to 2 000 Hz, and
- (c) at an apparent power consumption within the range of 50 to 1 000 VA,
- (x) feed systems and product and tails withdrawal systems, including
 - (a) feed autoclaves or stations used for passing uranium hexafluoride to the centrifuge cascades,
 - (b) desublimers or cold traps used for removing uranium hexafluoride from the centrifuge cascades, and
 - (c) products or tails stations used for trapping uranium hexafluoride into containers, and
- (xi) machine header piping systems used for handling uranium hexafluoride within the centrifuge cascades.

Plants for Processing Irradiated Nuclear Materials

3102

Plants for the processing of irradiated nuclear materials in order to isolate or recover fissionable materials, and equipment and components specially designed or prepared therefor, including

- (a) nuclear fuel chopping or shredding machines;
- (b) chemical holding or storage vessels that
 - (i) are fabricated of low-carbon stainless steels, titanium, zirconium or any other material that is resistant to the corrosive effect of nitric acid,
 - (ii) are designed for remote operation and maintenance, and
 - (iii) incorporate features for the control of nuclear criticality such as
 - (a) walls or internal structures that have a boron equivalent of at least 2 per cent,
 - (b) a maximum diameter of 178 mm for cylindrical vessels, or
 - (c) a maximum width of 76.2 mm for a slab or annular vessel; and
- (c) solvent-extraction equipment including packed or pulsed columns, mixer settlers and centrifugal contactors.

Nuclear Reactors

3103

(1) In this item,

"control rod" means a rod specially designed or prepared for the control of the reaction rate in a nuclear reactor; (*barre de commande*)

"nuclear reactor" means a reactor that is capable of operation so as to maintain a controlled self-sustaining fission chain reaction. (*réacteur nucléaire*)

(2) Nuclear reactors and equipment that is specially designed or prepared therefor, including

- (a) metal pressure vessels, as complete units or as major shop-fabricated parts therefor, that contain the core of a nuclear reactor and that are capable of withstanding the operating pressure of the primary coolant, including the top plate for a reactor pressure vessel;
- (b) fuel-element handling equipment, including reactor fuel charging and discharging machines;
- (c) control rods, including the neutron absorbing part thereof and the support or suspension structures therefor, and control rod guide tubes;
- (d) electronic controls for controlling the power levels in nuclear reactors, including reactor control rod drive mechanisms and radiation detection and measuring instruments that determine neutron flux levels;

- (e) pressure tubes in a nuclear reactor that contain, at an operating pressure greater than 5 MPa, fuel elements and the primary coolant in a nuclear reactor;
- (f) coolant pumps that circulate the primary coolant of nuclear reactors;
- (g) internals for the operation of a nuclear reactor, including core support structures, thermal shields, baffles, core grid plates and diffuser plates; and
- (h) heat exchangers.

Plants for the Fabrication of Fuel Elements

3104

Plants for the fabrication of fuel elements, and equipment that is specially designed or prepared therefor, including equipment that

- (a) normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;
- (b) seals the nuclear material within the cladding;
- (c) checks the integrity of the cladding or the seal; and
- (d) checks the finish treatment of the solid fuel.

Plants for the Production or Concentration of Deuterium

3105

Plants for the production or concentration of deuterium or deuterium compounds and equipment that is specially designed or prepared therefor.

Plants and Systems for the Processing of Special and Other Fissionable Materials and Source Materials

3106

Plants and systems, and specially designed or prepared equipment therefor, for the processing of special and other fissionable materials and source materials, including

- (a) plants and systems for the production of uranium hexafluoride;
- (b) plants and systems for the conversion of plutonium nitrate to plutonium oxide; and
- (c) plants and systems for the production of plutonium metal.

Atomic Energy Related Equipment

Neutron Generator Systems

3201

Neutron generator systems, including tubes, that are designed for operation without an external vacuum

system and that utilize electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

Power-generating or Propulsion Equipment

3202

Power-generating or propulsion equipment that is specially designed or prepared for use with military, space, marine or mobile nuclear reactors.

Electrolytic Cells

3203

Electrolytic cells that are for the production of fluorine and that have a production capacity of greater than 0.25 kg of fluorine per hour.

Lithium-separation Equipment

3204

Equipment that is specially designed or prepared for the separation of isotopes of lithium.

Tritium Plants

3205

Plants for the production, recovery, extraction, concentration or handling of tritium and its compounds and mixtures, and specially designed or prepared equipment therefor.

TECHNOLOGY — GROUP 4

4000

(1) In this item,

"technology" means technical data, including technical drawings, photographic imagery, models, formulas, engineering designs and specifications and technical and operating manuals, whether in written form or recorded on disc, tape, read-only memory (ROM) or other medium. (*technologie*)

(2) Technology for use in the development, production, installation, operation or maintenance of equipment and materials included or specifically excluded under an item in Group 1, 2 (*All*

Frequency Changers

3206

Frequency changers, converters or inverters that are specially designed or prepared to supply motor stators for gas centrifuge enrichment, and subassemblies and specially designed components therefor, and that have

- (a) a multiphase output of 600 to 2 000 Hz;
- (b) a frequency control of better than 0.1 per cent;
- (c) a harmonic distortion of less than 2 per cent; and
- (d) an efficiency of greater than 80 per cent.

Mass Spectrometers

3220

Mass spectrometers that are specially designed or modified for measuring from on-line samples the isotopic composition of feed, product or tails from uranium hexafluoride gas streams and that have

- (a) a unit resolution for mass greater than 320;
- (b) an ion-source utilizing electron bombardment that is
 - (i) nickel-plated,
 - (ii) constructed of nichrome or monel, or
 - (iii) lined with nichrome or monel; and
- (c) a collector system that is suitable for isotopic analysis.

Process Control Instrumentation

3221

Process control instrumentation that is specially designed or modified for monitoring or controlling the processing of irradiated source materials and special and other fissionable materials.

destinations other than the United States) or 3 (All destinations) of this List, other than technology that is

- (a) described in advertising and sales literature;
- (b) available to the public in published books and periodicals;
- (c) specifically included in another item in Groups 1, 2 or 3 of this List; or
- (d) essential for the installation, operation and maintenance of any product
 - (i) for which an export permit has been issued and remains in force, or
 - (ii) that is eligible for export under an exclusion in an item of this List.

MISCELLANEOUS GOODS

— GROUP 5

Wild Fauna and Flora and Medical Products

Specimens of Endangered Wild Fauna or Flora

5000

Any specimen of species of wild fauna or flora or derivatives thereof included in

- (a) Appendix I or II to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, signed on March 3, 1973 in Washington, D.C., United States, as attached to the November 13, 1989 Notification to that Convention in accordance with item 8 of the Notification; (*All destinations*) or
- (b) Appendix III to the Convention referred to in paragraph (a), as attached to the November 13, 1989 Notification to that Convention in accordance with item 9 of the Notification. (*All destinations*)

Pancreas Glands

5001

Pancreas glands of cattle and calves. (*All destinations*)

Human Serum Albumin

5011

Human serum albumin. (*All destinations*)

Forest Products

Logs

5101

Logs of all species of wood. (*All destinations*)

Pulpwood

5102

Pulpwood of all species of wood. (*All destinations*)

Red Cedar

5103

Blocks, bolts, blanks, boards and any other material or product of red cedar that is suitable for use in the manufacture of shakes or shingles. (*All destinations*)

Softwood Lumber

5104

(1) In this item,

"dressed", in relation to softwood lumber, means dressed or surfaced by planing on at least one edge or face; (*corroyé*)

"drilled or treated", in relation to softwood lumber, softwood flooring or softwood siding, means drilled at intervals for nails, screws or bolts, sanded or otherwise surface-processed in lieu of, or in addition to, planing or working, or treated with creosote or other preservatives or with fillers, sealers, waxes, oils, stains, varnishes, paints or enamels, but not including anti-stain or other temporary applications that serve only for the purpose of maintaining a product in its rough, dressed or worked condition until installation or further manufacture; (*prépercé ou traité*)

"rough", in relation to softwood lumber, means softwood lumber just as it comes from the saw, whether in the original sawed size or edged, resawn, cross-cut or trimmed to a smaller size; (*à l'état brut*)

"softwood lumber" means a product of a sawmill or sawmill and planing mill that is derived from a log from a tree of coniferous species (order *Coniferae*) by lengthwise sawing and that, in its original sawed condition, has at least two approximately parallel flat longitudinal sawed surfaces, and may be rough, dressed or worked, including edge-glued or end-glued wood over 1.82 m in length and not over 381 mm in width that as a solid piece without glued joints would be softwood lumber; (*bois d'œuvre*)

"worked", in relation to softwood lumber, means matched, that is, provided with a tongued-and-grooved joint at the edges or ends, shiplapped, that is, provided with a rabbeted or lapped joint at the edges, or patterned, that is, shaped at the edges or on the faces to a patterned or moulded form, on a matching machine, sticker or moulder. (*façonné*)

(2) In interpreting this item, recourse may be had to the Memorandum of Understanding concerning trade in certain softwood lumber products between the Government of Canada and the Government of the United States dated December 30, 1986.

(3) Softwood lumber products, as follows:

- (a) softwood lumber, rough, dressed or worked; (*United States*)
- (b) softwood siding, not drilled or treated; (*United States*)
- (c) softwood lumber and softwood siding, drilled or treated, and edged-glued or end-glued softwood not over 1.82 m in length or over 381 mm in width, whether or not drilled or treated; (*United States*) and
- (d) softwood flooring, whether in strips, planks, blocks, assembled sections or units, or in other forms, and whether or not drilled or treated. (*United States*)

Agricultural and Food Products

Sugars, Syrups and Molasses

5201

Sugars, syrups and molasses that are derived from sugar cane or sugar beets and that are

- (a) principally of a crystalline structure or in a dry amorphous form; (*United States*) or
- (b) not principally of a crystalline structure nor in a dry amorphous form but that contain soluble non-sugar solids, excluding any foreign substance that may have been added or developed in the product, equal to 6 weight per cent or less of the total soluble solids. (*United States*)

Roe Herring

5202

(1) In this item,

"fishing zones of Canada" has the same meaning as in subsection 4(1) of the Territorial Sea and Fishing Zones Act; (*zone de pêche du Canada*)

"internal waters of Canada" has the same meaning as in subsection 3(2) of the Territorial Sea and Fishing Zones Act; (*eaux intérieures du Canada*)

"territorial sea of Canada" has the same as in subsection 3(1) of the Territorial Sea and Fishing Zones Act; (*mer territoriale du Canada*)

"unprocessed roe herring" means roe herring from which the roe has not been extracted. (*hareng rogué non traité*)

(2) Unprocessed roe herring that are caught in:

- (a) those parts of the territorial sea of Canada that are adjacent to the coast of British Columbia;
- (b) those parts of the internal waters of Canada that are adjacent to the coast of British Columbia; or
- (c) those parts of the fishing zones of Canada that are adjacent to the coast of British Columbia. (*All destinations*)

Chemical, Metal and Mineral Products

Chemicals

5301

(1) In subitem (2), the number following the chemical name in each paragraph is the Chemical Abstracts Service Registry Number for that chemical as listed in the *Chemical Abstracts Service Registry Handbook published by the American Chemical Society, Washington, D.C.*

(2) Chemicals, as follows:

- (a) dimethyl methylphosphonate, 756-79-6;
- (b) methyl phosphonyl dichloride, 676-97-1;
- (c) methyl phosphonyl difluoride, 676-99-3;

- (d) phosphorus oxychloride, 10025-87-3;
- (e) phosphorus trichloride, 7719-12-2;
- (f) potassium fluoride, 7789-23-3;
- (g) thiodiglycol, 111-48-8;
- (h) thionyl chloride, 7719-09-7;
- (i) 3-quinuclidinol, 1619-34-7;
- (j) dimethyl phosphite, 868-85-9;
- (k) trimethyl phosphite, 121-45-9;
- (l) 3-hydroxy-1-methylpiperidine, 3554-74-3;
- (m) N, N-diisopropyl- β -aminoethane thiol, 5842-07-9; and
- (n) N, N-diisopropyl- β -aminoethyl chloride, 96-79-7. (*All destinations other than the United States*)"

Foreign Origin Goods

United States Origin Goods

5400

All goods that originate in the United States, unless they are included elsewhere in this List, whether in bond or cleared by Canadian Customs, other than goods that have been further processed or manufactured outside the United States so as to result in a substantial change in value, form or use of the goods or in the production of new goods. (*All destinations other than the United States*)

Goods in Transit

5401

All goods that originate outside Canada that are included in this List, whether in bond or cleared by Canadian Customs, other than goods that are in transit in bond on a through journey on a billing that originates outside Canada where the billing

- (a) indicates that the ultimate destination of the goods is a country other than Canada; (*All destinations other than the United States*) and
- (b) in the case of goods that are shipped from the United States,
 - (i) is accompanied by a certified true copy of the United States Shipper's Export Declaration, where the export declaration does not contain terms which conflict with those of the billing and is presented to the Canadian Collector of Customs,
 - (ii) cites from a Shipper's Export Declaration, or
 - (iii) cites a summary Authorization Number or Symbol, assigned to the United States exporter by the United States Bureau of the Census. (*All destinations other than the United States*)

Manufactured Products

Pumps and Servo Valves

5500

Pumps and servo valves having all flow contact surfaces made of 90 per cent or more tantalum, titanium or zirconium, either separately or combined, other than

- (a) those having all flow contact surfaces made of materials containing more than 97 per cent and less than 99.7 per cent titanium,

5500 *continued*

- (b) pumps included under item 1131, and
- (c) servo valves having flow rates of 24 liters per minute or less at a pressure of 25 MPa. (*All destinations other than the United States*)

Equipment that Suppresses Electromagnetic Signals

5501

Communications equipment, information handling equipment and computer equipment that suppresses the unintentional escape of information-bearing electromagnetic signals, other than those included under item 2011 of Group 2. (*All destinations other than the United States*)

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Tracking equipment	1502
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Triodes	1558 a
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Note 1 - Software

Software specially designed for some equipments covered by this group are also covered under the items relating to these equipments. The following items cover software; 1001, 1081, 1086, 1091, 1312, 1353, 1354, 1357, 1358, 1361, 1363, 1370, 1388, 1389, 1301, 1399, 1401, 1416, 1417, 1485, 1502, 1510, 1516.

Note 2 - Technology

For technology not explicitly described in this group and that is relating to equipment of a type being covered under the group, refer to item 4000 of group 4.

GROUP 2 - MUNITIONS

Additives, explosives	2008
Aero-engines	2010 b
Aiming devices	2005 c
Airborne equipment	2010 d
Aircraft	2010 a
Aircraft handling equipment	2010 e
Ammunition	2003
Amphibious vehicles	2006
Antibodies for biological warfare	2007
Armament, large calibre	2002
Armoured plate	2013 a
Armoured railway trains	2006
Armoured vehicles	2006
Arms, small	2001
Artillery	2002
Automatic piloting systems	2010 h
Ballistic protection, materials for	2013 b
Bearing, silent	2009 g
Biocatalysts	2007 f
Biological agents	2007 a
Biological systems	2007 f
Biological warfare	2007
Biopolymers	2007 e
Body armour	2013 d
Bombing, computers	2005 d
Bombs	2004 a
Breathing equipment	2010 f
C3I software	2024 a
Cameras, reconnaissance	2012
Cannon	2002 a
Carbines	2001 a
Cartridges	2003 & 2004
Castings	2016
Chemical agents	2007 a
Chemical warfare	2007
Compasses	2009
Computers	2011 d
Crash helmets	2010 f
Cryogenic equipment	2020
CW	2007 e
Data processing security equipment	2011 d
Demolition charges	2004 a

Depth charges	2004 a
Detection devices, underwater	2009
Detection equipment	2005 b
Directed energy weapons	2023
Diving apparatus	2017
ECM	2011 a
Electronic counter-counter measure equipment	2011 a
Electronic counter measure equipment	2011 a & c
Electronic equipment, military	2011
Electronic monitoring systems	2011 b
Electronic surveillance systems	2011 b
Engines for vessels	2009 b
Engines for aircraft	2010 b
Engines for military vehicles	2006
Enzymes for CW	2007
Explosives	2008
Field engineer equipment	2017 f
Fire bombs	2004 a
Fire control equipment	2005
Flak suits	2013 d
Flame throwers	2002 a
Forgings	2016
Fuel thickeners	2004 c
Fuels	2008
Gas projectors	2002 b
Grenades	2004 a
Gun-carriers	2006
Gun laying equipment	2005 a
Guns	2002 a
Half-tracks	2006
Height finders	2005 b
Helicopters	2010 a
Helmets	2013 c
High power radio-frequency systems	2023 c
Howitzers	2002 a
Hull penetrators and connectors	2009 f
Identification equipment	2005 b
Image intensifiers	2015
Imaging equipment	2012 & 2015
Imaging radar sensors	2012 c
Incendiary bombs	2004 a
Infrared equipment	2012
Jamming equipment	2011 a
Kinetic energy weapons	2026
Large calibre armaments	2002
Lasers	2023
Liquid fuels	2008
Machine guns	2001 a
Machine pistols	2001 a
Microwave weapon systems	2023
Mines	2004 a
Missile guidance equipment	2005 a
Missile tracking equipment	2005 a
Missiles, guided or unguided	2004 a
Mobile repair shops	2006
Modelling software	2024 a
Mortars	2002 a
Motors, submarine	2009 b
Naval equipment	2009
Night sighting equipment	2005 a
Parachutes	2010 g
Particle beam systems	2023
Photographic equipment	2012
Pistols	2001 a
Position finders	2005 b
Precursors, explosives	2008
Pressure refuellers	2010 e
Pressure suits	2010 f
Production equipment, military	2018
Production technology, military	2018
Projectile launchers	2002 a
Propellants	2008
Pyrotechnic flare signals	2004 a
Pyrotechnic projectors	2002 b
Pyrotechnics	2008
Radioactive agents	2007 a
Range finders	2005
Recoilless rifles	2002 a
Recovery vehicles	2006

Reduced observables, materials for	2017 e
Refuelling	2010 e
Remotely piloted air vehicles	2010 c
Revolvers	2001 a
Rifles	2001 a
Rocket launchers	2002 a
Rockets	2004 a
Searchlights	2017 c
Security equipment	2011
Self-propelled guns	2006
Sensors integration equipment	2005 b
Shutters, electronically triggered	2022
Sighting devices	2005 c
Silencers, firearm	2017 b
Simulation software	2024 a
Simulators	2014
Small arms	2001
Smoke canisters	2004 a
Smoke grenades	2004 a
Smoke projectors	2002 b
Smooth bore weapons	2001
Software	2024
Software embedded in weapon systems	2024 a
Solid fuels	2008
Spotting instruments	2005 b
Stabilisers, explosives	2008
Stealth technology devices and materials	2017 e
Submarine nets	2009
Submarines	2009
Superconductive equipment	2020
Surface vessels	2009
Sweeping mines, cables for	2004 b
Tank destroyers	2002 a
Tanks	2006
Target surveillance equipment	2005 a
Tear gas	2007
Technology for production	2018
Thermal imaging equipment	2015
Torpedo nets	2009
Torpedoes	2004 a
Toxicological agents	2007
Tractors	2006
Trailers	2006
Trailings, ammunition	2006
Trainers	2014
Training equipment	2014
Trains, Armoured railway	2006
Underwater swimming apparatus	2017 a
Underwater vessels	2009
Unmanned airborne vehicles	2010 c
Vehicles	2006
Vessels	2009

GROUP 3 - ATOMIC ENERGY

Americium	3001
Beryllium	3009
Calcium	3020
Californium	3001
Curium	3001
Deuterated paraffins	3003
Deuterium	3003
Deuterium production plant	3105
Electrolytic cells, fluorine productions	3203
Fissionable materials	3001
Fluorine production	3203
Frequency changers, gas centrifuge	3206
Fuel element fabrication plant	3104
Graphite, nuclear grade	3006
Hafnium	3008
Heat exchangers	3103
Heat source materials	3013
Heavy water production plant	3105
Heavy water	3003

Isotope separation, special materials	3014
Isotope separation equipment, lithium	3204
Isotopic separation plants	3101
Lithium	3007
Lithium isotope separation	3204
Mass spectrometers	3220
Materials for isotope separation	3014
Military nuclear reactors	3202
Neptunium	3013
Neutron generator systems	3201
Nickel	3005
Nuclear reactor generator systems	3201
Nuclear reactors	3103
Parts for equipment	3100
Plants for processing of fissionable materials	3106
Plants for separation of fissionable materials	3101
Plants for processing irradiated nucl.materials	3102
Plants for deuterium	3105
Plants for fabrication of fuel elements	3104
Plants, tritium	3205
Plutonium	3001, 3013
Power generating systems, nuclear reactor	3202
Process control instrumentation	3221
Production equipment, tritium	3205
Production plant, heavy water	3105
Production plant, uranium hexafluoride	3106
Production plant, plutonium	3106
Propulsion equipment, nuclear	3202
Reaction generator systems	3201
Reactors, nuclear	3103
Reprocessing plants	3102
Thorium	3002
Tritium	3012
Tritium production equipment	3205
Uranium hexafluoride production plant	3106

Uranium hexafluoride	3002
Uranium, natural or depleted	3001, 3002
Zirconium metal and alloys	3004

GROUP 5 – MISCELLANEOUS GOODS

Cedar	5103
Chemicals	5301
Electromagnetic signals, equipment suppressing	5501
Endangered species of fauna and flora	5000
Fauna, endangered species	5000
Flora, endangered species	5000
Goods in transit	5401
Goods of United States origin	5400
Herring	5202
Human serum albumin	5011
Logs	5101
Lumber	5104
Molasses	5201
Pancreas glands	5001
Pulpwood	5102
Pumps	5500
Red cedar products	5103
Servo valves	5500
Softwood lumber	5104
Sugars	5201
Syrups	5201
Tempest equipment	5501
United States Origin goods	5400

ADDITIONAL COPIES OF THIS GUIDE AND

FORMS "APPLICATION FOR PERMIT TO EXPORT GOODS" (form Ext 1042)

CAN BE OBTAINED AT THE FOLLOWING LOCATIONS:

VANCOUVER

INTERNATIONAL TRADE CENTRE

Scotia Tower
900-650 West Georgia Street
P.O. Box 11610
Vancouver, British Columbia
V6B 5H8
Fax: (604) 666-8330
Tel: (604) 666-0434

EDMONTON

INTERNATIONAL TRADE CENTRE

Canada Place
Suite 540
9700 Jasper Avenue
Edmonton, Alberta
T5J 4C3
Fax: (403) 495-4507
Tel: (403) 420-2944

CALGARY

INTERNATIONAL TRADE CENTRE

11th Floor
510 - 5th Street S.W.
Calgary, Alberta
T5P 3S2
Fax: (403) 292-4578
Tel: (403) 292-6660

SASKATOON

INTERNATIONAL TRADE CENTRE

6th Floor
105 - 21st Street East
Saskatoon, Saskatchewan
S7K 0B3
Fax: (306) 975-5334
Tel: (306) 975-5315

WINNIPEG

INTERNATIONAL TRADE CENTRE

8th Floor
330 Portage Avenue
P.O. Box 981
Winnipeg, Manitoba
R3C 2V2
Fax: (204) 983-2187
Tel: (204) 983-8036

TORONTO

INTERNATIONAL TRADE CENTRE

Dominion Public Building
4th Floor
1 Front Street West
Toronto, Ontario
M5J 1A4
Fax: (416) 973-8161
Tel: (416) 973-4782

OTTAWA

**EXTERNAL AFFAIRS AND
INTERNATIONAL TRADE CANADA
EXPORT CONTROLS DIVISION**

P.O. Box 481 - Station A
Ottawa, Ontario
K1N 9K6
Fax: (613) 996-9933
Tel: (613) 996-2387

MONTREAL

INTERNATIONAL TRADE CENTRE

Stock Exchange Tower
800 Victoria Square
Suite 3800
P.O. Box 247
Montreal, Quebec
H4Z 1E8
Fax: (514) 283-3302
Tel: (514) 283-8185

MONCTON

INTERNATIONAL TRADE CENTRE

Assumption Place
770 Main Street
P.O. Box 1210
Moncton, New Brunswick
E1C 8P9
Fax: (506) 857-6429
Tel: (506) 857-6452

HALIFAX

INTERNATIONAL TRADE CENTRE

Central Guarantee Trust Bldg.
1801 Hollis Steet
P.O. Box 940, Station M
Halifax, Nova Scotia
B3J 2V9
Fax: (902) 426-2624

CHARLOTTETOWN

INTERNATIONAL TRADE CENTRE

Confederation Court Mall
134 Kent Street, Suite 400
Charlottetown,
Prince Edward Island
C1A 7M8
Fax: (902) 566-7450

ST. JOHN'S

INTERNATIONAL TRADE CENTRE

90 O'Leary Avenue
P.O. Box 8950
St. John's, Newfoundland
A1B 3R9
Fax: (709) 772-2373
Tel: (709) 772-5511